Prevention of Work-Related Musculoskeletal Complaints

Wilhelmina IJzelenberg

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Prevention of Work-Related Musculoskeletal Complaints

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Chapter 1

General Introduction

Musculoskeletal complaints (MSC), of which low back pain comprises the larger part, represent a considerable public health problem in Western industrialized societies. This thesis aims to contribute to the scientific knowledge on the prevention and management of MSC, and in particular of low back pain (LBP), in the workplace. The first aim is to better understand the consequences of LBP in occupational populations in terms of health care utilization, sickness absence, and productivity losses at work. The second aim of this thesis is to determine the effectiveness of a back pain prevention program. This chapter will briefly introduce and define the main concepts used in this thesis. Subsequently, the objectives are stated and an outline is provided of the chapters included in this thesis.

1. Definition and classification of LBP and other MSC

Low back pain is located below the costal margin and above the inferior gluteal folds, and can be classified in several ways.

One classification distinguishes between 'specific' and 'non-specific' LBP. Specific LBP is defined as symptoms caused by a specific pathophysiologic mechanism, such as vertebral cancer, spinal stenosis, infection, osteoporosis, rheumatoid arthritis, hernia nuclei pulposi, or fracture. LBP cannot be attributed to a specific pathology in approximately 85% to 90% of all LBP patients.[1,2] In cases where no specific cause for LBP can be found, LBP is referred to as non-specific. Non-specific LBP can be defined as pain without a specific cause localised between the lower angle of the scapulae and above the buttocks.[1] This thesis focuses on non-specific LBP.

LBP can also be classified according to the duration of the complaints. LBP is usually defined as acute when it persists for less than 6 weeks, subacute between 6 weeks and 3 months, and chronic when it lasts for longer than 3 months.

In some studies included in this thesis, other non-specific MSC located in the neck and upper extremities are also addressed. These complaints are grouped together into upper extremity complaints (UEC). At first sight it might be unclear what the symptoms of neck, shoulder, elbow, hand or wrist have in common. The reason why these symptoms have been grouped together is that their origin is often supposed to be (partly) work-related and the approach to prevent these symptoms is supposed to be similar, irrespective of their specific location. UEC can be classified in the same way as LBP.

2. Epidemiology of LBP and other MSC

Prevalence of MSC

Non-specific LBP is a very common complaint. High lifetime prevalences indicate that most people will experience one or more episodes of LBP during their life.[3] The 12-month prevalence in the general Dutch population has been estimated at 44%.[4] In that same study almost 75% of the general population in the Netherlands reported any musculoskeletal pain during the past 12 months of which 31% neck complaints, 30% shoulder complaints, 11% elbow complaints, and 18% wrist/hand complaints.[4]

Given these high prevalences of MSC, it is not surprising that subjects often report more than one musculoskeletal complaint. Reports on musculoskeletal co-morbidity vary between 37% and 66%.[4-8]

Natural course of LBP and other MSC

LBP manifests as an untidy pattern of symptomatic periods interspersed with less troublesome periods.[9,10,11] Recurrence of complaints is high. Around two-thirds of people are likely to experience relapses of pain over 12 months.[10] In most cases, LBP tends to improve spontaneously over time, even without medical intervention.[12,13] The majority of patients (90%) seem to recover from an attack of back pain within six weeks irrespective of treatment,[3,12] although a small percentage of people develop chronic pain. This episodic nature of complaints has also been reported for other MSC. [14]

3. Consequences and related costs due to LBP and other MSC

Albeit the benign and self-limiting nature of LBP, the consequences such as disability,[15,16] sickness absence and work disability, and health care costs,[17] account for high economic costs in Western societies.[18]

Direct costs

Numerous studies have reported the direct costs of LBP in different societies and it was estimated that over 300 million euro is spent each year to treat this condition in the Netherlands.[19] LBP ranks among the top five most common reasons for consultation in the Netherlands.[20]

Despite the significant disability and economic burden associated with LBP, little is known about the impact of a person's work on their healthcare-seeking behaviour. Research on back pain in the general population can describe the care-seeking behaviour among injured workers, but separate studies among workers with back pain are needed in order to identify determinants of care seeking that are related to the type of work that an individuals does. A greater understanding of factors leading sufferers to seek health care would facilitate a better choice in the supply of services and the tailoring of treatment. In this thesis, care seeking for LBP and other MSC is referred to as health care utilization.

Indirect costs: sickness absence and productivity losses at work

Indirect costs of musculoskeletal symptoms due to work absenteeism and disability are even higher.[19,21,22] LBP is probably the most commonly reported work-related illness in the Netherlands today, and is a common reason for time off work. The total costs of LBP in the Netherlands in 1991 were estimated to be 1.7% of the GNP, and 93% of these costs were related to work absenteeism and disability.[19]

Duration of sick leave is often for a short period of time, about 75% of people who are on sick leave due to LBP return to work within 1 month,[23] although a small percentage of workers are still off work after 6 months.[24] Indirect costs due to loss of productivity are traditionally measured by sickness absence from work.[25] However, even when employees are present at work, they may experience a decreased productivity caused by functional limitations due to health problems. The phenomenon that workers turn up at work, despite health problems that should prompt absence from work, is referred to as sickness presenteeism. A study across the Swedish workforce demonstrated that during a period of 12 months about 37% of all workers experienced sickness presenteeism.[26] In this thesis, loss of productivity due to sickness presenteeism is referred to as productivity losses at work.

In economic evaluations of health care interventions it is widely recommended to consider all costs and savings relative to the benefits of the intervention. Although productivity losses at work may lead to substantial economic losses, few studies have estimated the decrease in productivity of workers with health problems or productivity losses while at work. Furthermore, since objective measures of productivity at work are hardly available or are difficult to assess, studies have used self-reports to estimate the decrease in productivity that is associated with health problems at work. In the past few years several questionnaires have been developed to measure productivity losses at work. Although these questionnaires have been used in several cost-effectiveness studies, reliability and validity studies are scarce. In addition, more information is needed to analyze the influence of individual, health-related and work-related determinants on self-reported productivity at work. In this thesis a chapter is devoted to the validation of such questionnaires for workers with physically demanding jobs.

Influence of comorbidity on health care utilization and sickness absence

Most studies on musculoskeletal complaints address only complaints of a specific anatomical region, such as back pain or neck pain. Although there is a considerable co-existence between LBP and musculoskeletal pain experienced in other anatomical regions, to date the consequences of musculoskeletal co-morbidity on health care utilization and sickness absence for LBP are not well understood. A greater understanding of the impact of musculoskeletal co-morbidity on LBP characteristics and associated health care utilization and sick leave is needed. For researchers who perform intervention studies it is important to know if they have to take into account the impact of musculoskeletal co-morbidity on outcome measures of LBP such as pain characteristics, health care utilization, and sick leave.

3. Prevention

Although many episodes of acute LBP resolve rapidly, a small percentage result in persisting disabling symptoms.[27] Especially persistent LBP is a cause of great discomfort and economic loss.[28] Unfortunately, attempts to prevent the occurrence of LBP per sé have had limited success.[18,29] The high burden of disease has focused attention not only on the prevention of the onset of LBP, but also on the prevention of a back pain episode developing into a chronic complaint with associated (work) disability.[24] Persistent disabling symptoms may be prevented by early identification and modification of factors that play a role in the transition from acute to chronic and (persistent) disabling pain. In occupational populations chronic and (persistent) disabling pain can lead to considerable productivity losses due to sickness absence and LBP presenteeism. Sickness absence is therefore increasingly being used as a health parameter of interest to study the consequences of LBP in occupational groups and to evaluate the effectiveness of interventions in occupational settings.

For prevention in occupational settings the relation of sickness absence and productivity losses at work due to LBP and other MSC with work-related factors in the workplace is of particular importance. In other words, what distinguishes workers who take sick leave for their complaints or who report productivity losses at work, from those who do not? And what is the impact of work-related factors on these consequences? Although work-related and demographic risk factors for the onset of musculoskeletal symptoms are well studied,[12,30] surprisingly little is known about the influence of work-related factors on the development of chronic musculoskeletal symptoms and on associated (work) disability (sickness absence). It is often tacitly assumed that intervention focused on well-known risk factors for the occurrence of symptoms will also reduce the likelihood of the development of MSC sickness absence. However, there are indications that demographic and work-related risk factors for the onset of LBP and other MSC may differ from those for the transition from acute to chronic LBP and other MSC with associated (persistent) disabling pain (sickness absence).[31-33]

Back pain prevention program

Many prevention programs are available, but conclusive scientific evidence of their effectiveness is not yet available for most of the interventions. The need for carefully designed and conducted randomized controlled trials in this field is still urgent.[19]

Recently, the European Guidelines for the Prevention in LBP have been issued.[34,35] These guidelines give evidence-based recommendations on strategies to prevent LBP. Since measures to prevent the onset of LBP are rated as insufficient consistent evidence, these guidelines focus primarily on evidence-based measures for the prevention of aggravation of LBP into chronic and disabling LBP. Education (based on biopsychosocial principles) that promotes staying active, that emphasizes the good prognosis of LBP, and that improves coping with complaints is encouraged to be incorporated into workplace advice. Hence, the guidelines state that treatment in order to prevent the various consequences of LBP, such as aggravation of symptoms, chronicity and (work) disability, is feasible.[34] For workers, clinical interventions with a workplace component (e.g. including a workplace visit or ergonomic adjustments) and a natural involvement of the key stakeholders are recommended in the management of sub-acute LBP.[36,37] A recent study reported that for acute LBP early intervention consisting of a combination of biopsychosocial education and treatment with manual therapy and exercise was more effective on functional recovery, general health, and quality of life than just the advice on staying active that is recommended in some guidelines.[38]

Owing to the multidimensional nature of LBP, no single intervention is likely to be effective in preventing the overall problem of LBP. Therefore, it has been recommended that new studies should focus more on broad-based multi-dimensional programs rather than mono-dimensional programs.[34,39]

A multi-dimensional approach based on a biopsychosocial model combining ergonomic education and training tailored to the risk profile of the worker with an early stage intervention at the work site in the occurrence of (absenteeism due to) LBP is promising.[29,40] Early intervention consists of early identification of barriers for recovery that are related to the worker, workplace or its interface during a first visit to the in-company physical therapist. This is followed by a quick modification of factors that play a role in sustaining the complaints, to enhance functional recovery of workers with LBP.

However, to date, little is know about the effectiveness of this approach. In this thesis the effectiveness of a multi-dimensional LBP intervention program is evaluated. This intervention program is based on the principles of the biopsychosocial model, integrating three preventive measures: tailored education and training; immediate treatment of (sub)acute LBP; and advice on ergonomic adjustment of the workplace or training sessions on appropriate work techniques at the worker's worksite (on-the-job-training). The intervention has been developed for workers with physically demanding jobs and is aimed at the prevention of the first onset of LBP, recurrent LBP, and aggravation of (sub)acute LBP. The intervention can be carried out by in-company physical therapists in cooperation with workers, employers, and occupational physicians.

Objectives of this thesis

In this thesis the problem of MSC within the work situation is addressed. Since LBP is the most prevalent complaint, the emphasis of this thesis will be on workers with non-specific LBP. Sickness absence and health care utilization are influenced by a variety of factors such as individual characteristics, work environment, socio-economic aspects, the health care system, and socio-political aspects. Due to the complexity of this environment the focus in this thesis is on the specific role of individual, work-related and individual and health-related factors. An important part of this thesis is the evaluation of the effectiveness of an LBP intervention program.

The specific objectives of this thesis are:

1. To describe the consequences of MSC and to evaluate which work-related physical and psychosocial factors, individual and health-related characteristics determine health care utilization, sickness absence, and productivity losses at work due to MSC.
2. To study the effectiveness of a back pain prevention program in an occupational setting.

Outline of this thesis

The research in this thesis consists of two parts. In the **first part** of this thesis the first research question will be addressed; a description of the consequences of MSC in terms of patterns of health care utilization, sickness absence, and productivity losses at work, and investigation of the influence of individual, work-related risk and health-related factors on the occurrence of these consequences.

In a prospective study with 1-year follow-up among 529 employees of nursing homes and homes for the elderly in the Netherlands, Chapter 2 first aims to describe health care seeking for occupational LBP. The second aim is to identify individual, health-related and physical and psycho-social work factors that distinguish workers who seek care from those who do not.

In Chapter 3 data from a cross-sectional study among 373 employees of laundry-works and dry-cleaning establishments were used to investigate whether individual, work-related physical and psychosocial risk factors involved in the occurrence of musculoskeletal complaints also determine subsequent sickness absence. Chapter 4 further elaborates on the question whether work-related risk factors for the occurrence of LBP also determine its consequences in terms of both sickness absence and health care utilization. This time the 6-month follow-up measurement of the study among industrial workers of Chapter 7 was used.

In the next two chapters two methodological issues are addressed that are of particular importance for researchers who perform LBP intervention studies and researchers who perform economic evaluations of these interventions. Chapter 5 describes the presence of musculoskeletal co-morbidity of the neck and upper extremities among industrial workers with LBP and examines whether it has an impact on health care utilization and sickness absence for LBP. Baseline measurements of the intervention study were used.

The primary objective of Chapter 6 is to evaluate the feasibility and validity of two instruments for the measurement of health-related productivity loss at work in two occupational populations with an established high prevalence of health problems. The secondary objective was to analyze individual and work-related determinants of self-reported productivity at work.

In the **second part** of this thesis, Chapter 7, the effectiveness of a back pain prevention program will be assessed. The concept of the program is widely used in the Netherlands; however, its effectiveness has not yet been scientifically tested. Chapter 8, the general discussion, integrates and discusses the results from these studies.

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Part I
Chapter 2

Patterns of Care for Low Back Pain in a Working Population

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Abstract

Study Design. A prospective longitudinal study with 1-year follow-up.

Summary of Background Data. Little is known about the consequences of having back pain and the patterns underlying the decisions to use medical care.

Objectives. The aim of this study is to describe care utilization for low back pain (LBP) and to investigate which factors determine use of care for LBP.

Methods. We used a self-administered questionnaire to collect data on individual, health-related, and work-related factors and the type of medical care sought among 529 employees of nursing homes and homes for the elderly in the Netherlands. Logistic regression models were used to present associations between aforementioned factors and care utilization for LBP.

Results. A large proportion of the working population was afflicted with LBP, and only one third sought care. Individuals who use care had more intense pain, chronic pain, and functional limitations. Patients' characteristics varied among the different type of health care providers. Well-known work-related risk factors for the occurrence of LBP did not determine use of care for workers with LBP.

Conclusions. Care utilization due to LBP was associated with severity and nature of back pain. Patients' characteristics vary among the different type of health care providers, but work-relatedness of LBP seems similar across all providers.

Introduction

Low back pain (LBP) is a major health problem in the Netherlands as well as in other Western industrialized countries. Numerous studies have reported the costs of back pain in different societies, and it was estimated that more than 300 million Euro is spent each year to treat this condition in the Netherlands.[1] LBP is one of the most frequent reasons for consulting a general practitioner in the Netherlands[2] and the second major symptomatic reason for consulting office-based physicians in the United States.[3] Total costs to society, including disability cost, are much greater. LBP is probably the most commonly reported work-related illness in the Netherlands today, and is a common reason for time off work.

Understanding factors that determine health care utilization for LBP is important for public health policy, clinical, and research reasons. Describing factors that are associated with the decision to seek health care can detect inaccessibility of the health service for patients with certain characteristics or can detect groups who may deserve special attention in preventive activities. For clinicians it is important, because it informs them about the characteristics of patients who consult them.[4] Furthermore, it provides researchers with knowledge about characteristics of back pain populations in different settings. Despite its importance, up to present few studies have demonstrated the consequences of having back pain and the patterns underlying the decisions to seek medical care.[5,6]

Recent studies of health care utilization among back pain populations have identified that race, education, the belief that back pain would be a lifelong problem, and duration and nature of back pain, pain severity, number of bed days, sciatica, and non-disabling comorbidities were associated with seeking care. Age, sex, and health insurance status were not predictive of seeking health care for chronic or acute LBP.[7] To our knowledge, only a few studies tried to elucidate the association between use of medical care for LBP and work-related factors.[5,8,9] Vingård *et al*[9] reported that exposure to occupational physical and psychosocial factors seems to increase the risk of seeking care for LBP in the population. Molano *et al*[5] performed a cross-sectional study among subjects who experienced high physical workload at their jobs and found that that self-reported physical load or psychosocial aspects at work were not associated with care seeking and that the most important determinants for care seeking were sciatica, disability, and pain intensity. In order to get more insight in patterns of care for LBP, this study was performed in a population of employees of nursing homes and homes for the elderly in the Netherlands. It is investigated whether work-related physical and psychosocial factors as well as individual and health-related factors can explain the use of medical care for LBP. First, we will describe the prevalence of LBP and patterns of care for to this condition. Second, we will examine which individual and health-related factors, as well as well-known work-related physical and psychosocial risk factors for LBP determine use of medical care for LBP.

Methods

Subjects and study design

In a prospective longitudinal study with 1-year follow-up, individual, health-related and work-related physical and psychosocial factors were assessed. The study population consisted of workers who were recruited from seven nursing homes and homes for the elderly in the Netherlands. At baseline, all employees who were working 10 hours per week or more were invited to participate in the study. Baseline measurements were performed between March 1998 and March 1999. In total, 1208 subjects were invited to participate in the study, and 779 (64%) gave written informed consent. Follow-up measurements were performed 1 year after the baseline measurements with a response of 529 (68%) subjects. Thus, for the analysis, 529 workers with complete data were available. They worked in nine different professions including 197 care givers, 85 nurses, 26 kitchen workers, 23 housekeepers, 9 transportation and maintenance workers, 8 laundry workers, 24 physical therapists, 108 office workers, and 43 miscellaneous workers.

Questionnaire

Twice, with a 12-month interval, employees completed a self-administered questionnaire on individual, job-related characteristics, psychosocial and physical factors at the workplace, perceived general health status, symptoms of LBP, sickness absence, and medical care seeking due to LBP.

Explanatory variables

We collected individual data including age, height, weight, sex, level of education, involvement in sports, and information about the family situation, such as marital status, taking care of children, or whether a person was living alone. The Body Mass Index (BMI) was calculated (weight/height^2), and a subject with a BMI higher than 30 was considered as obese.

Job-related characteristics, such as years of employment, working at night, working full-time, and having supervisor duties, were obtained as well as physical load and psychosocial load at the workplace. Questions on physical work load concerned manual handling of materials such as lifting and carrying heavy loads, awkward working postures in which the back is bent or twisted, and strenuous arm positions such as working with hands above shoulder level. A 4-point scale was used with ratings “seldom or never”, “now and then”, “often”, and “always” during a normal working day. The answers “often” and “always” were classified as high exposure.[10] The subjects were also asked to recall their global perceived exertion during a normal workday on a Borg scale ranging from 6 (very light) to 20 (very heavy), with a score of 16 or higher regarded as high perceived exertion.[11]

Psychosocial work characteristics were assessed by means of a Dutch version of Karasek’s Job Content Questionnaire,[12,13] which includes dimensions on job demands and job control. According to this model, the combination of high job demands and low job control is considered to be a job-strain situation. Job demands were measured by 11 questions with a 4-point scale, yielding a sum score for high work demands. Low job control was measured by 6 questions on skills and 11 questions on authority to make decisions. Workers at risk (high demands and low control) were classified using the median score from the job demands and the job control sum scores. In addition, questions were asked on supervisor and coworker support.

In the questionnaire, a measure of general health was included. Perceived general health was measured by 12 dichotomized questions about the worker's health representing the actual health situation and was rated according to the VOEG-scale with a good internal scale reliability (Cronbach's alpha = 0.86) and test-retest reliability (Pearson's r = 0.76).[14] A sum score was calculated and subjects with a score above the median value were considered to have a moderate perceived general health relative to those subjects with a lower score on general health.

The questions on the occurrence of back complaints were derived from the standardized Nordic questionnaire, which has been proved to be a valid instrument for collecting information on the nature, duration and frequency of symptoms.[15] Furthermore, pain was rated according to the Von Korff *et al* scheme for grading the severity of chronic pain.[16] Four end points of low back pain were defined: (1) "low back pain in the past 12 months", referred to at least one episode of LBP in the past 12 months for at least a few hours, (2) "chronic low back pain in the past 12 months" referred to LBP that was present almost every day in the preceding 12 months with a minimal presence for at least 3 months and hence we defined LBP lasting no longer than 3 months as acute LBP, (3) "severe low back pain in the past 12 months" was defined as those subjects exceeding the pain intensity score of 50 according to the Von Korff *et al* scheme for grading severity of chronic pain, and (4) "low back pain and perceived disability in the past 12 months" was defined as the subjects exceeding the disability score of 50 according to the Von Korff *et al* scheme for grading disability.

Outcome variables

In the Dutch health care system, the general practitioner functions as gatekeeper to the health care system. A patient needs referral from a general practitioner to visit another health care provider. Hence, health care utilization is distinguished in care seeking to a general practitioner by self-referral and use of other health care providers by subsequent referral. Health care utilization was measured by four dichotomous variables (yes/no), which described whether a general practitioner, occupational physician, a specialist, or a physical therapist was consulted for LBP in the past 12 months.

In principle, employees are free to visit their occupational physician whenever they want. However, a visit to an occupational physician is usually initiated by the occupational physician when sick leave prolongs for more than a few weeks. The specialist category includes neurologists, neurosurgeons, and orthopedic surgeons. All medical doctors can refer to a physical therapist.

Statistical methods

A logistic regression analysis was used to present associations between individual, work-related, and health-related factors and health care utilization for LBP in the previous 12 months. Odds ratios (ORs) were estimated as a measure of association. In the analyses, age was considered to be a potential confounder and included in each model, regardless of the level of significance. For the initial selection of variables in multivariate models, a significance level of $P < 0.10$ was used. Logistic regression models were applied both for determinants of health care utilization in the baseline (cross-sectional analysis) and for prognostic factors for health care utilization during the 1-year follow-up (longitudinal analysis). All analyses were carried out with the statistical package SAS[17] version 6 (SAS Institute Inc. 1990).

Table 1: Presence of self-reported individual and work-related factors of low back pain among personnel of nursing homes and homes for the elderly (n = 529)

	n	%
Individual factors		
Age 17-35 years	145	27
35-45 years	190	36
45-65 years	194	37
BMI (> 30)	59	12
Female	444	85
Education Low	137	27
Middle	280	54
High	99	19
Living alone	121	23
Active in sports	226	43
Job-related characteristics		
Night work	123	23
Working > 35 hours/week	158	30
Supervisor	127	25
Physical load		
High manual materials handling	168	32
High awkward back postures	130	25
Strenuous arm positions	50	10
High perceived exertions	112	21
Psychosocial load		
Low job control	262	50
High job demands	279	53
Low social support supervisor	295	56

Table 2: Nature and severity of low back pain at baseline (12 month prevalence, n = 305) and at 1-year follow-up (12 month prevalence, n = 287) among subjects with LBP in a cohort of personnel of nursing homes and homes of the elderly (n = 529).

	Baseline		**At 1-year follow-up**			
	Prevalence of LBP (n = 305)		Prevalence of LBP (n = 287)*		Recurrent LBP (n = 229)	
LBP end points	**n**	**%**	**n**	**%**	**n**	**%****
Chronic LBP	57	19	97	34	40	69
Sciatica	148	49	143	50	52	35
LBP and sickness absence	48	16	76	27	19	40
Severe LBP	100	33	112	39	57	57
LBP with perceived disability	44	14	60	21	19	43

*= new cases plus recurrent cases **= percentage of cases with the same endpoint of LBP at baseline.

Results

Baseline characteristics

Table 1 shows the personal characteristics and the presence of self-reported work-related factors at baseline. The study population consisted predominantly of women, ranging in age from 17 to 63 years. At baseline, the prevalence of LBP was not related to the specific response rates per nursing home or home for the elderly. The prevalence of LBP at baseline among subjects lost to follow-up was comparable with the prevalence among subjects available for follow-up.

Prevalence of LBP and other health complaints

Table 2 displays the nature and severity of LBP at baseline and at 1-year follow-up in the cohort of 529 workers. The prevalence of low back pain at baseline was 58% (n = 305). At follow-up 54% (n = 287) of the subjects reported low back pain in the past 12 months.

The cumulative incidence of LBP at 1-year follow-up was 26% (58 new cases of LBP among a subset of 224 workers who were free of LBP at baseline). Among the 305 subjects who reported LBP at baseline, 75% (n = 229) had a recurrence of complaints in the next year. Seventy-one percent of the subjects with acute LBP and 93% of the subjects with chronic LBP at baseline had a new episode of LBP again in the following 12 months.

Musculoskeletal comorbidity among workers with back pain was high. Among 305 workers with back complaints, 127 (42%) reported shoulder complaints and 141 (46%) suffered from neck problems. Another 52 (17%) also had some knee complaints in the past year. Subjects with LBP rated their general health less good then subjects without LBP.

Table 3: Use of medical care for acute and chronic low back pain complaints among subjects with low back pain at baseline (n = 305) and at 1-year follow-up (n = 287).

	Baseline				At 1-year follow-up			
	Acute LBP (n = 2489		Chronic LBP (n = 57)		Acute LBP (n = 190)		Chronic LBP (n = 97)	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Occupational physician	11	4	14	25	11	6	20	21
General practitioner	59	24	32	56	53	28	41	42
Specialist	7	3	12	21	7	4	14	14
Physical therapist	31	13	27	47	32	17	40	41

Patterns of care

Table 3 describes health care utilization for LBP complaints at baseline and at 1-year follow-up. Among all subjects with LBP at baseline or follow-up, approximately one third sought care for their complaints through their general practitioner. Clear differences in use of care were seen between acute and chronic LBP patients, the latter using care more often. Subjects with chronic LBP were more often referred to a physical therapist or a medical specialist compared with subjects with acute LBP. They also consulted their occupational physician more often.

Sixty-six percent (n = 80) of the subjects with recurrent LBP who sought care for complaints at baseline (n = 121) did seek care again during the follow-up. When a patient consulted a specific type of health care provider for his complaints, it was likely that he returned to the same provider during the follow-up.

Factors associated with seeking health care

Table 4 shows that nature and severity of LBP and sickness absence due to LBP determined visits to all four providers, with the strongest associations for the specialist, occupational physician, and physical therapist. A high BMI was the only significant individual factor, associated with visiting the general practitioner. In our study population women used care less often than men did (general practitioner OR = 0.6), although this was not significant at the $P < 0.05$ level. Working at night was associated with general practitioner consultation. Work that required strenuous arm positions was associated with referral to a physical therapist. Perceived general health (OR = 1.4) was not significantly associated with use of care for LBP.

Age (35-44 years OR = 0.8; 45-65 years OR = 1.1) or taking care of children (OR = 0.8) did not influence the use of care. None of the work-related physical and psychosocial factors, manual materials handling (OR = 0.9), awkward back postures (OR = 1.6), high perceived exertion (OR = 1.0), low job control with high job demands (OR = 1.0), and low social support from colleagues (OR = 0.8), did seem to be of importance in health care utilization.

Table 4: Determinants of use of medical care in the past 12 months, adjusted for age, at baseline among subjects with low back pain (n = 305) working in nursing homes and homes for the elderly.

	Subjects with LBP (n = 305)		General practitioner (n = 93)		Occupational physician (n = 26)		Specialist (n = 19)		Physical therapist (n = 59)	
	n	**%**	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
BMI > 30	34	12	2.2	1.0 – 4.5**	1.4	0.5 – 4.4	0.4	0.1 – 3.1	1.5	0.7 – 3.5
Female sex	264	88	0.6	0.3 –1.2	0.5	0.2 –1.5	0.4	0.1 – 1.1*	0.6	0.3 – 1.3
Education low	81	27	1.8	0.9 – 3.9	1.4	0.4 – 5.0	4.3	0.9 – 20.3*	2.4	1.0 – 5.7*
Night work	70	23	2.1	1.2 – 3.6**	1.8	0.7 – 4.2	1.7	0.6 – 4.7	1.9	1.0 – 3.5*
Working > 35 hours/week	81	27	1.0	0.6 – 1.8	2.1	0.9 – 4.8*	1.7	0.6 – 4.5	1.4	0.8 – 2.6
Supervisor	74	25	0.9	0.5 – 1.6	0.3	0.1 – 1.2*	0.5	0.1 – 1.9	1.3	0.7 – 2.5
Strenuous arm positions	33	11	1.3	0.6 – 2.8	1.1	0.3 – 3.8	2.4	0.7 – 7.7	2.3	1.0 – 5.1**
Chronic LBP	57	19	3.9	2.1 – 7.1**	6.7	2.8 – 15.7**	10.0	3.6 – 27.7**	6.2	3.2 – 11.8**
Severe LBP	100	33	3.8	2.2 – 6.3**	4.3	1.9 – 10.2**	13.3	3.7 – 47.0**	6.0	3.2 – 11.1**
LBP and perceived disability	44	14	5.3	2.7 – 10.5**	6.7	2.8 – 15.7**	10.6	4.0 – 28.3**	8.9	4.4 – 17.9**
Sciatica	148	49	1.8	1.1 – 2.9**	2.3	1.0 – 5.3	4.3	1.4 – 13.4**	2.5	1.4 – 4.5**
Sickness absence	48	16	7.2	3.7 – 14.2**	6.9	2.9 – 16.1**	5.8	2.2 – 15.2**	5.0	2.6 – 9.8**

Odds ratios (OR) adjusted for age and their 95% confidence intervals (95% CI). ** $P < 0.05$, * $P < 0.1$

Table 5: Prognostic factors, adjusted for age, for use of medical care during follow-up of 1-year among subjects with recurrent low back pain (n = 229) working in nursing homes and homes for the elderly.

	Subjects with recurrent LBP (n = 229)		**General practitioner** (n = 74)		**Occupational physician** (n = 25)		**Specialist** (n = 18)		**Physical therapist** (n = 59)	
	n	**%**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
BMI > 30	23	11	2.5	1.1 – 6.1**	2.7	0.9 – 8.1*	1.7	0.5 – 6.6	2.1	0.8 – 5.3
Living alone	49	22	1.1	0.6 – 2.2	1.4	0.6 – 3.7	3.2	1.2 – 8.7**	1.8	0.9 – 3.7*
Education low	59	26	1.1	0.5 – 2.7	3.9	0.8 – 18.9*	2.3	0.4 – 11.8	0.4	0.2 – 1.1*
Active in sports	98	43	0.9	0.5 – 1.5	0.4	0.1 – 1.0**	0.5	0.2 – 1.5	1.0	0.5 – 1.9
Supervisor	54	24	1.6	0.8 – 3.0	0.6	0.2 – 2.0	0.6	0.2 – 2.2	2.3	1.2 – 4.7**
Strenuous arm positions	30	13	1.4	0.6 – 3.1	1.7	0.6 – 5.1	1.3	0.4 – 4.9	2.4	1.1 – 5.4**
Low social support boss	137	60	0.8	0.5 – 1.4	0.5	0.2 – 1.1*	0.7	0.3 – 1.9	1.0	0.5 – 1.9
Moderate general health	149	65	1.6	0.9 – 2.9	2.4	0.8 – 6.6*	1.0	0.4 – 2.9	1.3	0.7 – 2.5
Chronic LBP	53	23	1.2	0.6 – 2.3	2.5	1.0 – 6.2**	2.8	1.0 – 7.9**	2.6	1.3 – 5.2**
Severe LBP	86	38	2.3	1.3 – 4.1**	2.8	1.2 – 6.5**	2.9	1.1 – 7.8**	2.8	1.5 –5.1**
LBP and high perceived disability	34	15	2.8	1.3 – 6.0**	3.3	1.3 – 8.4**	5.8	2.1 – 16.0**	3.9	1.8 – 8.6**
Sciatica	117	51	1.2	0.7 – 2.2	1.1	0.5 – 2.5	1.1	0.4 – 3.0	2.0	1.1 –3.7**
Sickness absence	37	16	3.0	1.5 – 6.2**	3.5	1.4 – 8.8**	3.9	1.4 – 10.8**	2.7	1.3 – 5.7**

Odds ratios (OR) adjusted for age and their 95% confidence intervals (95% CI). ** $P < 0.05$, * $P < 0.1$

In the multivariate model the presence of chronic pain (OR = 3.3), perceived disability (OR = 3.5), and working at night (OR = 1.9) were the strongest determinants for seeking care from a general practitioner. Chronic LBP (OR = 4.7) and perceived disability (OR = 5.6) were strong determinants for consulting an occupational physician as well as working more than 35 hours/week (OR = 3.8). Supervisors consulted an occupational physician less often (OR = 0.2). Severe (OR = 4.1) and chronic LBP (OR = 2.0) and high perceived disability (OR = 3.2) were determinants for consulting a specialist. Referral to a physical therapist was associated with chronic LBP (OR = 2.9), high perceived disability (OR = 5.2), and severe pain (OR = 2.5).

Prognostic factors associated with seeking health care

Table 5 presents prognostic factors (adjusted for age) for care utilization for recurrent LBP through the four types of practitioners during the follow-up period of 1 year. The same trends were observed. Almost all of the patients who used care had severe pain, a high degree of disability, chronic pain, or a period of a sickness absence from work at baseline. Some of the individual and work-related factors were associated with consultation from a specific type of health care provider. Gender was not associated with health care utilization.

In the multivariate analysis, the strongest predictor for use of care from all types of health care providers was high perceived disability due to LBP complaints in the previous year: general practitioner (OR = 2.8), occupational physician (OR = 3.3), specialist (OR = 5.6) and physical therapist (OR = 2.8). For the specialist living alone (OR = 3.2) and for the physical therapist severe pain (OR = 2.4) and supervising duties (OR = 2.6) were also predictors for use of care in the next year.

Discussion

In a prospective longitudinal study with 1-year follow-up, we analyzed the effect of individual, health-related, and work-related factors on care utilization for LBP among personnel from nursing homes and homes of the elderly. Variables on severity and nature of LBP were the strongest determinants for use of care for LBP complaints. Most individual and work-related factors did not determine use of care from the four different health care providers.

When interpreting the data, some limitations of the study design have to be considered. First, our study relied on data generated from survey research, *i.e.*, on information provided by the respondent about health care utilization. Recall of medical events can be telescoped forward in time, which is most likely to occur with major or traumatic events.[18] In contrast, some types of care, such as physicians visits, may not be recalled by respondents, yielding an underestimate of utilization.[19]

Results might be different when data from other databases, *e.g.*, hospital records, are used. Second, the results presented here might be biased by nonresponse. The respondents for whom no follow-up information was available were younger and had fewer years of service then the respondents who remained in the study. Loss to follow-up was not related to the prevalence of LBP; however, LBP with high perceived disability was more prevalent as well as medical care seeking for this condition. It is known that in our population there is a high turnover rate in the first years of employment. This could explain the difference in age and years among those available and lost to follow-up. Hence, the presence of bias due to selective loss to follow-up cannot be ruled out, and we could have underestimated health care utilization rates.

Patterns of care

Even though a substantial proportion of the subjects suffered from back pain in the past 12 months, only approximately one third consulted a general practitioner. Comparable health utilization rates as in our study were reported by Cote *et al*[4] in Saskatchewan adults where 25% consulted a health care provider in the previous 4 weeks. Others authors reported somewhat lower health care utilization rates.[7,20]

Our results support the growing awareness that acute and chronic LBP have a different impact on the health care system. Clear differences in use of care were seen between acute and chronic LBP patients, the latter using care more often. We also found different distributions across types of providers for acute and chronic LBP patients. Chronic LBP patients more often sought care from a general practitioner than patients with acute LBP. In addition, patients with chronic LBP were more often referred to a medical specialist, physical therapist, and occupational physician. Comparable results were found by Carey *et al*[21], who reported that 73% of chronic back pain sufferers sought health care, of which 91% saw a medical physician, 29% a physical therapist, and 25% a chiropractor. However, in a second study among adults with acute severe LBP, rates of care seeking at a medical physician or chiropractor were considerably lower than in our study population.[22] The reason for differences in health care utilization among the different health care providers in this study and other studies[23,24] is most likely due to differences in the structure and contents of health care systems among countries. In the Netherlands, a patient who seeks medical care will first visit a general practitioner, because the general practitioner is the only physician involved in primary care and is, therefore, "the gate-keeper" of the medical system. The majority of health problems presented to general practitioners are treated by the general practitioners themselves and, in principle, they are responsible for referral to a medical specialist or paramedical therapist. Our results also reflect the Dutch guidelines for the management of LBP in general practice in The Netherlands, where more severe and chronic LBP cases are referred to a specialist physician or physical therapist. Referral to a physical therapist is only recommended when pain persists for longer than 6 weeks.

Determinants of care utilization

The data obtained in the current study indicate that the most important factors for use of care relate to nature and severity of LBP. Several factors such as severity, chronicity, and functionally limiting back pain or absence from work were associated with type of health care provider. The magnitudes of their effect depend on the type of care. In other words, patients' characteristics vary among the different type of health care providers. The correlation between sickness absence and LBP with high perceived disability was high; thus, in the multivariate analyses, it was somewhat arbitrary which variable was included in the model. A possible explanation for the high association between sickness absence and care seeking can be that the employee on sick leave wants to prove his right not to be at work. The Dutch approach to disability makes no distinction between a "compensable backache" and a "disabling backache". A worker does not need a physician's certification in order to receive compensation payment. Every worker receives full wages during absenteeism. Hence, use of health care in this study may be underestimated compared to societies where insurance systems make this distinction.

Our results compare well with recent studies of health care utilization among primary care patients and scaffolders in the Netherlands where the most important determinants for care seeking were sciatica, disability, pain intensity, and sickness absence.[5,25] Other authors also found that severity of the LBP condition such as duration of pain, pain severity, and sciatica-like pain were predictors of use of care.[4,7,21,22,24] Self-reported general perceived health was not related to consultation for LBP complaints, which is in agreement with findings by Cote *et al*.[4]

Few studies have reported on the association of work-related factors and use of care. Work-related variables did not have a large influence on use of care for patients with LBP. However, working at night was significantly associated with care seeking from a general practitioner. Similar findings were reported by Vingård *et al*.[9] It can be hypothesized that consulting a physician during office hours is easier when working at night because an employee will not have to take time off work. Being a supervisor was a prognostic factor for visiting a physical therapist. An explanation for this finding could be that employees with supervisor duties can be more persuading to their general practitioners to get a referral to a physical therapist. In our study health care utilization for an episode of LBP was not associated with exposures to physical and psychosocial factors, which confirms results reported by Molano *et al*.[5] Factors related to impairment and disability by LBP seem to supersede the potential impact of work-related factors. The different health care providers saw patients with LBP with similar patterns of work-relatedness of their complaints. Well-known work-related risk factors for the occurrence of LBP did not determine care seeking for workers with LBP.

In agreement with other studies[5,26] individual factors such as age, sex, education, number of children and being active in sports were not associated with the use of care LBP. This suggests that in our study sample access to health care was equal among different socio-economic groups.

Conclusions

Our study elucidates that a large proportion of subjects in a working population is afflicted with LBP; however, the majority of subjects deal with this condition themselves. Individuals who use health care services for LBP have more intense pain, chronic pain, and functional limitations then those who do not use care. Furthermore, those who use care more often had a period of sickness absence from work. Individual and work-related variables did not seem to have a large influence on health care utilization for patients with LBP. Patients' characteristics vary among the different type of health care providers, but work-relatedness of LBP seems similar across all providers. Researchers and clinicians should be aware of these selection mechanisms when interpreting data from epidemiological studies performed on patients in different populations or clinical settings.

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Chapter 3

Risk factors for musculoskeletal complaints and musculoskeletal sickness absence

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Abstract

Objectives The aim of this study was to investigate whether individual, work-related physical and psychosocial risk factors involved in the occurrence of musculoskeletal complaints also determine musculoskeletal sickness absence.

Methods This cross-sectional study used a self-administered questionnaire to collect data on individual and work-related risk factors and the occurrence of musculoskeletal complaints and musculoskeletal sickness absence among 373 employees of laundry-works and dry-cleaning establishments (response rate 87%). Logistic regression models were used to determine associations between risk factors and the occurrence of musculoskeletal complaints and sickness absence due to these complaints.

Results Both work-related physical and psychosocial factors showed strong associations with low back pain (LBP) and upper extremity complaints. Work-related physical factors did not influence sickness absence, whereas psychosocial factors showed some associations with sickness absence. Sickness absence was associated with country of birth, and female workers had less often an episode of sickness absence due to LBP (Odds ratio (OR) = 0.5), but more often due to upper extremity complaints (OR = 2.2).

Conclusions Work-related physical and psychosocial factors largely determined the occurrence of LBP and upper extremity complaints, whereas individual factors predominantly determined whether subjects with these musculoskeletal complaints took sick leave.

Introduction

Musculoskeletal complaints of the low back and upper extremities represent a considerable health problem among populations in Western industrialized countries. In the past decade many studies have been initiated, aimed at identifying the essential risk factors for work-related musculoskeletal complaints.[1,2] Well-known work-related physical risk factors for low back pain (LBP) are manual material handling, awkward back postures, and physically heavy work.[3,4] There are also indications that work-related psychosocial factors such as low job satisfaction, poor social support at work, and high job demands are determinants for the onset of LBP.[3,5] Several reviews have presented evidence that exposure to work-related physical and psychosocial exposures, such as repetitive tasks and high job demands, contribute to the occurrence of neck- and/or upper extremity musculoskeletal complaints.[6,9]

The majority of the population will face an episode of musculoskeletal complaints at some time during their life that remits spontaneously in most cases.[10-12] Since only a small minority of workers with musculoskeletal pain will become disabled or have to go on sick leave for these complaints,[11,13-16] it has been argued that prevention should focus on sickness absence resulting from disability rather than on preventing the onset of pain.[17,18] In recent years a growing number of studies have used sickness absence as outcome, but our knowledge about risk factors for sickness absence is still scarce.[19,20]

Circumstantial evidence has been presented to hypothesize that risk factors for musculoskeletal complaints may differ from those for sickness absence attributed to these complaints. It has been suggested that individual and psychosocial factors at the workplace contribute to the onset of LBP, but have even more impact on the decision to go on sick leave.[19,21] However, Hoogendoorn *et al*[22-24] and Ariëns *et al*[25-27] reported that work-related physical factors were more strongly associated with sickness absence, than the occurrence of LBP and neck pain were.

Risk factors for the occurrence of and sickness absence due to musculoskeletal complaints have seldom been assessed simultaneously. However, the results of such an assessment may provide essential insight into the nature of these concepts. The aim of our study was to investigate whether individual, work-related physical and psychosocial risk factors involved in the occurrence of musculoskeletal complaints also determine musculoskeletal sickness absence.

Materials and methods

Study population

Between October 2001 and March 2002, 431 employees of nine laundry works and three dry-cleaning establishments located throughout the Netherlands were asked to participate in the study, of which 398 (90%) responded. All employees worked in the shop and floor production process. Questionnaires were filled out during work-time. One of the researchers was present to explain the purpose of the research and to answer questions when respondents were filling out the questionnaires. All the participants completed the self-administered questionnaire pertaining questions on potential indicators for sickness absence and musculoskeletal complaints in the following domains: individual factors, work-related physical load, and psychosocial factors. Sixteen participants were excluded from the analyses because of incomplete data. Analyses were done over the remaining 373 participants, yielding a response rate of 87%. Nonresponse and incomplete data were largely due to the lack of reading and writing capabilities in Dutch of the workers in this sector.

Of the 373 workers included in the analysis, 66% were women. The mean age of the study population was 36.7 (SD 9.8) years. The mean duration of employment in the current job was 8.5 (SD 7.8) years. For 63% of the workers, the educational level was low. Altogether, 32% of the employees were born outside The Netherlands, the majority of this group being born outside Europe. Among this last group approximately one third was born in Turkey and another one third in West- and North-African countries.

Of the total population, 67% of the workers rated their physical workload as high. A total of 92% reported a high exposure to static working postures, 80% to strenuous arm movements, and 68% to awkward back postures, whereas 65% reported low job satisfaction.

Explanatory variables

Individual variables

The questionnaire contained questions on individual data including age, sex, height, weight, level of education, country of birth, involvement in sports, and information about the family situation, such as marital status, or whether a person was living alone. The Body Mass Index (BMI) was calculated (weight/height^2) and the participants with a BMI value of 30 or more were considered obese.

Work-related variables

Work-related characteristics, such as details on years of employment, and full-time work, were obtained, as well as physical load and psychosocial load at the work-site. The questions on physical workload concerned manual materials handling, such as lifting and carrying heavy loads, static working postures, awkward back postures, and strenuous arm movements (*e.g.* working with hands above shoulder level and repetitive movements of arms and hands). A 4-point scale was used with the ratings "seldom or never", "now and then", "often", and "always" during a normal workday. The answers "often" and "always" were classified as high exposure.[28] The subjects also rated their perceived physical load on a numerical scale ranging from 0 (very light) to 10 (very heavy), with a score of 5 or higher regarded as high perceived physical load.[29]

Psychosocial work characteristics were assessed by means of a Dutch version of Karasek's job content questionnaire,[30] which includes dimensions on quantitative job demands, decision authority, and skill discretion. According to the model, the combination of high job demands and low job control is considered to be a job-strain situation and a potential risk factor. Job demands were measured by 11 questions with a 4-point scale, yielding a sum score for high work demands. The questions on work demands were related to working fast, working hard, excessive work, insufficient time to complete work, and conflicting demands. Low job control was measured by 6 questions on skills and 11 questions on authority to make decisions. These questions pertained to aspects such as required skills, task variety, learning new things, and amount of repetitive work. Workers at risk (high demands and low control) were classified using the median score from the job demands and the job control sum scores. In order to obtain insight into the effect of social support at the worksite on the occurrence and on sickness absence of musculoskeletal complaints, we also included dimensions on supervisory support and coworker support. The participants were asked to rank perceived support at work both from coworkers and supervisors on a numerical rating scale ranging from 0 (no support at all) to 10 (full support), with a score of 5 or lower regarded as low support at work. Finally, a question was added that addressed job satisfaction.

Musculoskeletal complaints and sickness absence

The questions on musculoskeletal complaints were derived from the standardized Nordic questionnaire that has proved to be a valid instrument for collecting information on the nature, duration and frequency of symptoms.[31] Musculoskeletal pain was defined as "pain in the past 12 months" (yes/no), which referred to at least one episode of pain in the past 12 months for at least 1 day. Since the neck, shoulders, and arms operate as a functional unit, we considered risk factors of these regions together. Hence, we grouped musculoskeletal pain in the neck, shoulder, elbow, wrist, and hand into the category "upper extremity complaints".

The question used to measure the occurrence of sickness absence was a modified question derived from a study in which the reliability of questions on the prevalence, frequency, and duration of sickness absence due to back pain was studied.[32] The questionnaire on sickness absence from back pain showed a high specificity (97%) and sensitivity (88%) and a good agreement for back pain absence (Cohen's κ 0.65). The question used to measure the occurrence of sickness absence due to

LBP was phrased "Have you been absent from work during the past 12 months due to back pain?" (yes/no). Similar questions were included for the occurrence of sickness absence in the neck region, shoulder region and elbow, wrist and hand region. We grouped absenteeism for musculoskeletal pain in the neck, shoulder, elbow, wrist, and hand into the category "sickness absence due to upper extremity complaints".

Statistical methods

Logistic regression models were used to determine associations between individual factors and work-related physical and psychosocial factors and the occurrence of musculoskeletal complaints and sickness absence attributed to these complaints. The regression analysis was executed using Proc Logist. All analyses were carried out with the statistical package SAS[33] version 8.2. Odds ratios (OR) were estimated as a measure of association. In the analyses, age was considered to be a potential confounder or effect modifier. Age strongly influences the probability of back pain; therefore, it was categorized into three groups and included in each logistic regression model, regardless of the level of significance. All other factors were dichotomized before being entered into the logistic models. The combination of low job control and high job demands was entered into the model as an interaction term.

For the initial selection of variables into the multivariate models, a significance level of $P < 0.10$ was used. Variables were retained in the final model when reaching the level of significance of $P < 0.05$. The variables influencing the outcome variable by more than 10% or variables strongly interacting with significant variables in the model were also retained.

Results

Musculoskeletal complaints and sickness absence

The 12-month prevalence of musculoskeletal complaints in the back or upper extremities, and sickness absence due to these complaints are shown in Table 1. A total of 185 (50%) workers reported LBP in the past 12 months and approximately one third went on sick leave at least once for their back complaints. A total of 216 workers reported upper extremity pain. One third of the workers with upper extremity complaints went on sick leave at least once for these complaints. All those on sick leave because of a particular musculoskeletal complaint also reported pain in this body region. Absenteeism for a particular complaint was associated with duration of pain for more than 3 months in the previous year in this body region. For the association of sickness absence the odds ratio was 4.64 (95% CI 2.34 – 9.22) for chronic LBP, 10.49 (95% CI 4.19 – 26.30) for chronic neck pain, 7.88 (95% CI 3.68 – 16.86) for chronic shoulder pain, and 15.86 (95% CI 6.23 – 40.36) for chronic elbow-hand-wrist complaints. The participants with chronic complaints also reported longer episodes of sickness absence.

Table 1: The 12-month prevalence of musculoskeletal complaints and sickness absence due to these complaints of the personnel of laundry works and dry-cleaning establishments (n = 373).

	n	**%**
Low back pain	185	50
Sickness absence due to low back pain	53	14
Upper extremity complaints	216	58
Neck complaints	115	31
Shoulder complaints	166	45
Elbow, wrist, hand complaints	86	24
Sickness absence due to upper extremity complaints	54	14

Musculoskeletal comorbidity was high. The majority of workers reported symptoms in more than one body region. Among the workers with back pain in the past 12 months, 72 (39%) reported neck complaints in the same period, 106 (58%) reported shoulder complaints, and 51 (28%) had suffered from elbow, wrist, or hand pain. Female workers with LBP reported musculoskeletal comorbidities in upper extremities more often than the male workers, 94 (87%) and 34 (54%), respectively.

Determinants of upper extremity complaints and musculoskeletal sickness absence

Table 2 presents the effects of individual and work-related physical and psychosocial variables on the occurrence of upper extremity complaints and on sickness absence due to these complaints. The individual factors gender, The Netherlands as the country of birth, and involvement in sports showed associations with both the occurrence of upper extremity complaints and musculoskeletal sickness absence. Female workers reported pain in the upper limbs and musculoskeletal sickness absence twice as often as compared with their male coworkers (OR = 2.2). Workers who reported to be actively involved in sports had a statistically significantly decreased risk for developing symptoms in the upper extremities (OR = 0.6) and there was a trend that they also went less often on sick leave due to these complaints (OR = 0.6).

Several work-related physical factors were associated with the occurrence of upper extremity complaints, but no association was found for sickness absence due to these complaints. Low job satisfaction (OR = 1.5) was associated with symptoms in the upper extremities, whereas there was no effect on sickness absence. Low social support of co-workers (OR=2.2) was statistically significantly related to sickness absence due to upper extremity complaints, but not to the occurrence of these complaints.

The results of the multivariate analyses for upper extremity complaints and musculoskeletal sickness absence are shown in table 3. The most important determinants for the occurrence of upper extremity complaints and musculoskeletal sickness absence were gender and The Netherlands as country of birth, and for the occurrence of complaints also involvement in sports. Low job satisfaction (OR = 1.6) showed an association with the occurrence of upper extremity complaints, but not with sickness absence attributed to these complaints. Low social support of coworkers (OR = 1.7) and sports participation (OR = 0.6) were not statistically significantly associated with sickness absence for upper extremity complaints. Strenuous arm positions strongly interacted with gender, and hence remained in both models.

Table 2: Age adjusted odds ratios (OR) of the association between individual, work-related physical and psychosocial factors and the occurrence of pain in the upper extremities and sickness absence due to these complaints in the past 12 months among personnel from laundry works and dry-cleaning establishments (n = 373).

		Workers		**Pain in upper extremities** (n = 216)		**Sickness absence due to pain in upper extremities** (n = 54)	
		n	**%**	**OR**	**95% CI**	**OR**	**95% CI**
Individual factors							
BMI > 30		34	9	0.9	0.4 – 1.8	1.3	0.5 – 3.3
Age	17-34 years	173	47	1.0	–	1.0	–
	35-44 years	120	32	1.2	0.8 – 2.0	1.5	0.8 – 2.8
	45-65 years	80	21	1.3	0.8 – 2.2	0.8	0.4 – 1.9
Gender female		245	66	2.1	1.4 – 3.3	2.2	1.1 – 4.5
Living alone		80	22	1.0	0.6 – 1.7	0.9	0.4 – 1.8
The Netherlands as the country of birth		253	68	0.6	0.4 – 0.9	0.3	0.2 – 0.6
Lower level education		228	63	0.8	0.5 – 1.3	0.6	0.3 – 1.1
Active in sports		145	39	0.6	0.4 – 0.9	0.6	0.3 – 1.0
Work related factors							
Working > 36 hours		257	69	0.7	0.4 – 1.1	1.1	0.6 – 2.0
Physical workload							
Manual materials handling		100	27	1.0	0.6 – 1.6	0.6	0.3 – 1.2
Awkward back posture		256	68	1.6	1.0 – 2.4	1.0	0.5 – 1.8
Static back posture		342	92	1.0	0.5 – 2.2	0.7	0.3 – 1.7
Strenuous arm movements		298	80	1.9	1.1 – 3.1	1.5	0.7 – 3.4
Perceived physical load		250	67	1.5	0.9 – 2.2	1.1	0.6 – 2.0
Psychosocial workload							
Low job control		177	47	1.2	0.8 – 1.8	0.8	0.4 – 1.4
High job demands		201	54	1.4	0.9 – 2.1	1.4	0.8 – 2.6
Job strain		109	29	1.3	0.8 – 2.0	0.8	0.4 – 1.6
Low social support coworkers		48	13	1.2	0.7 – 2.3	2.2	1.1 – 4.7
Low social support supervisor		68	18	1.0	0.6 – 1.7	1.2	0.6 – 2.4
Low job satisfaction		244	65	1.5	1.0 – 2.3	1.1	0.6 – 2.0

Table 3. Results of multivariate analyses on the associations between risk factors and the occurrence of pain in the neck or upper extremities and sickness absence due to these complaints in the past 12 months among personnel from laundry works and dry-cleaning establishments (n = 373).

				Pain in upper extremities (n = 216)		**Sickness absence due to pain in upper extremities** (n = 54)	
		n	**%**	**OR**	**95% CI**	**OR**	**95% CI**
Age	17-34 years	173	47	1.0	–	1.0	–
	35-44 years	120	32	1.2	0.7 – 2.0	1.5	0.8 – 3.0
	45-65 years	80	21	1.4	0.8 – 2.4	0.9	0.4 – 2.2
Female gender		245	66	2.0	1.3 – 3.2	2.2	1.1 – 4.5
The Netherlands as country of birth		253	68	0.5	0.3 – 0.9	0.3	0.2 – 0.6
Active in sports		145	39	0.6	0.4 – 0.9	•	•
Strenuous arm movements		298	80	1.6	0.9 – 2.8	1.6	0.7 – 3.6
Low job satisfaction		244	65	1.6	1.0 – 2.6	•	•

• = not applicable

Determinants of LBP and musculoskeletal sickness absence

Table 4 presents the effects of individual and work-related physical and psychosocial variables on LBP and on sickness absence due to LBP. None of the individual factors were associated with LBP, whereas age, gender, and The Netherlands as country of birth were strongly associated with sickness absence due to LBP. The male workers reported an episode of sick leave due to LBP twice as often as female workers. Sickness absence was associated with The Netherlands as country of birth (OR = 0.3), those born in The Netherlands being on sick leave less often due to LBP.

Work-related physical factors, (i.e. awkward back postures, strenuous arm movements and high perceived physical load), were strongly associated with the occurrence of LBP. When sickness absence was used as an outcome measure, there was no effect of any of the physical factors. All the work-related psychosocial factors were associated with the occurrence of LBP, whereas these factors were not statistically significantly associated with sickness absence attributed to LBP. The odds ratios for low job control (OR = 1.6), high job demands (OR = 1.5), low social support of coworkers (OR = 1.8), and low job satisfaction (OR = 1.7) were clearly increased.

The results of the multivariate analyses for LBP are shown in table 5. The most important determinants for the occurrence of LBP were awkward back postures (OR = 1.8) and high job demands (OR = 1.6). For sickness absence due to LBP gender female (OR = 0.5) and country of birth The Netherlands (OR = 0.3) were the most important determinants.

Table 4: Age-adjusted odds ratios (OR) of the association between individual, work-related physical and psychosocial factors and the occurrence of low back pain and sickness absence due to low back pain in the past 12 months among personnel from laundry works and dry-cleaning establishments (n = 373).

				Low back pain (n = 185)		**Sickness absence due to low back pain** (n = 53)	
		n	**%**	**OR**	**95% CI**	**OR**	**95% CI**
Individual factors							
BMI > 30		34	9	1.1	0.6 – 2.3	1.2	0.4 – 3.2
Age	17-34 years	173	47	1.0	–	1.0	–
	35-44 years	120	32	0.9	0.5 – 1.4	1.1	0.6 – 2.0
	45-65 years	80	21	0.7	0.4 – 1.1	0.4	0.2 – 1.1
Gender female		245	66	1.0	0.6 – 1.5	0.5	0.3 – 0.9
Living alone		80	22	0.8	0.5 – 1.3	1.4	0.7 – 2.8
Country of birth	The Netherlands	253	68	0.8	0.5 – 1.3	0.3	0.2 – 0.6
Education	Lower level	228	63	1.3	0.8 – 2.0	1.1	0.6 – 2.0
Active in sports		145	39	0.8	0.5 – 1.1	0.7	0.4 – 1.4
Work related factors							
Working > 36 hours		257	69	1.2	0.8 – 1.9	1.8	0.9 – 3.6
Physical workload							
Manual materials handling		100	27	1.3	0.8 – 2.1	1.1	0.6 – 2.1
Awkward back posture		256	68	2.0	1.3 – 3.1	0.9	0.5 – 1.8
Static back posture		342	92	1.6	0.7 – 3.4	0.8	0.3 – 2.2
Strenuous arm movements		298	80	1.6	0.9 – 2.7	0.7	0.3 – 1.3
Perceived physical load		250	67	1.6	1.0 – 2.5	1.3	0.7 – 2.4
Psychosocial workload							
Low job control		177	47	1.6	1.0 – 2.4	1.6	0.9 – 2.9
High job demands		201	54	1.7	1.1 – 2.6	1.5	0.8 – 2.7
Job strain		109	29	1.6	1.0 – 2.5	1.3	0.7 – 2.4
Low social support co-workers		48	13	1.7	0.9 – 3.3	1.8	0.8 – 3.8
Low social support supervisor		68	18	1.6	0.9 – 2.7	1.2	0.6 – 2.5
Low job satisfaction		244	65	1.5	0.9 – 2.3	1.7	0.9 – 3.3

Table 5: Results of the multivariate analyses on the associations between the risk factors and the occurrence of low back pain and sickness absence due to low back pain in the past 12 months among personnel from laundry works and dry-cleaning establishments (n = 373).

				Low back pain (n = 185)		**Sickness absence due to Low back pain** (n = 53)	
		n	**%**	**OR**	**95% CI**	**OR**	**95% CI**
Age	17-34 years	173	47	1.0	–	1.0	–
	35-44 years	120	32	0.9	0.6 – 1.4	1.0	0.5 – 1.9
	45-65 years	80	21	0.7	0.4 – 1.2	0.5	0.2 – 1.3
Gender female		245	66	0.9	0.6 – 1.4	0.5	0.3 – 0.9
Country of birth The Netherlands		253	68	•	•	0.3	0.2 – 0.6
Awkward back postures		256	69	1.8	1.2 – 2.9	•	•
High job demands		201	54	1.6	1.0 – 2.4	•	•

• = not applicable

Discussion

Data on simultaneously assessed individual and work-related determinants of musculoskeletal complaints and musculoskeletal sickness absence in one study population is scarce. The work-related physical and psychosocial factors largely determined the occurrence of LBP and upper extremity complaints, whereas individual factors predominantly determined whether those with these musculoskeletal complaints took sick leave.

Methodology

Some limitations of the study need to be considered in the interpretation of the results. First, sickness absence was self-reported and may have been underreported to make the responses socially desirable.[32,34] Using sick leave data collected in a standardized way from the employers' registration system may have yielded different sickness absence data, but, in this branch of industry absence registers are often incomplete, especially for short-term absence.

Second, since our data on workload relied on self-reports the results presented might be biased on account of "reversed causality". However, based on two arguments, we assume that this does not substantially affect our results. Toomingas and his colleagues[35] found no support for the idea of such bias in rating behavior in studies in which the participants rated both exposure and outcome variables, such as physical exposure and pain. Furthermore, observations at the workplace on workload in the four different departments complied well with the self-reported data on workload at the group level.

A third point of discussion is whether the physical and psychosocial factors have equal accuracy. Both the physical and psychosocial factors were self-reports based on a 4-point scale, and in the univariate analyses comparable confidence intervals were observed for associations between physical and psychosocial factors and sickness absence. Since no repeated measurements were taken we have no means with which to establish the differences in accuracy among the risk factors and with which to estimate the potential effects of a lack of accuracy on the observed risk estimates.

Fourth, the correlation among work-related physical variables was high, thus, in the multivariate analyses it was somewhat arbitrary which variable was included in the model. The same applies for the work-related psychosocial variables. In the final multivariate model only the most important factor of each domain was included. This process should be kept in mind when the multivariate models are interpreted.

Finally, it must be taken into account that, due to the small sample size for sickness absence not all elevated odds ratios reached conventional levels of significance ($P < 0.05$). Hence, some risk factors could have been relevant had a larger sample size been used.

Musculoskeletal complaints and sickness absence

The prevalence of musculoskeletal complaints was within the range of prevalences reported for occupational groups of blue-collar workers.[36] In accordance with previous findings; we observed that a substantial proportion of workers continued their regular work while experiencing an episode of pain.[11,14-16]

Individual factors

In the present study we found that the odds ratios for the occurrence of LBP were similar for the different age groups; however, there was a decreased risk for sickness absence in the older age group that could not be explained by individual and work-related variables. This finding may suggest that older workers who remain in their jobs cope better with their complaints in relation to the tasks imposed by their work. However, this effect was not observed for sickness absence due to upper extremity complaints.

Male workers went on sick leave because of LBP twice as often as their female coworkers did, even though odds ratios for the occurrence of LBP were similar for both genders. Even when individual or work-related factors were corrected for in the multivariate analyses, this effect of gender on sickness absence due to LBP remained. A possible explanation for this finding is the higher report of musculoskeletal comorbidities in upper extremities by female workers with LBP. It could be hypothesized that upper extremity complaints were harder to deal with in relation to the tasks women had to perform and hence made them go on sick leave for these complaints instead of their back trouble. Female workers indeed reported both upper extremity complaints and sickness absence twice as often as their male coworkers. These results comply well with findings in previous studies, which reported that female workers are more susceptible to overload of upper extremities.[37] The Netherlands as the country of birth showed strong associations with sickness absence due to muscoloskeletal complaints. A relationship between Swedish immigrants and sickness absence due to musculoskeletal pain has been reported by other authors, who also found that immigrants experienced a deeper impact of pain.[38] Our study does not permit a further explanation of the social and cultural factors underlying these observations. It has been suggested that language and intercultural communication problems may cause disparity in use and accessibility of health care for ethnic minorities.[39] Ensuring adequate care at the right moment is a necessary requirement for recovery and the avoidance of sick leave due to musculoskeletal complaints.

We found a decreased risk for upper extremity complaints, as well as musculoskeletal sickness absence in relation to involvement in sports; this finding is in agreement with the results reported in former longitudinal studies on the relation between physical activities in leisure time and musculoskeletal complaints.[20,40,41]

Work-related factors

Recently, two authors[22-27] reported on work-related psychosocial and physical risk factors for the occurrence of LBP and neck pain, as well as sickness absence due to these complaints. In accordance with these studies, we found that work-related psychosocial factors play a role in sickness absence due to musculoskeletal complaints. However, due to the small sample size in our study, not all the associations were significant. The results in these studies also showed that physical factors were more strongly associated with sickness absence than with the occurrence of LBP or neck complaints. Contrary to these reports, we found an opposite effect, work-related physical factors being associated with musculoskeletal complaints and not with sickness absence due to these complaints. The subjects included in the aforementioned studies worked in various occupations and were exposed to a much broader range of physical load compared with the workers in our study. Therefore, a possible explanation for this contradictory result might be the lack of sufficient contrast in exposure to physical load among the participants of our study, who were all highly exposed to physical load.

Concluding remarks

In this study among personnel of laundry works and dry-cleaning establishments with high levels of physical and psychosocial workload, these work-related factors were associated with musculoskeletal complaints, but did not seem to influence sickness absence due to these complaints. The results of our study imply that primary prevention strategies, aimed at minimizing the risks of the occurrence of symptoms of work-related musculoskeletal complaints, and secondary prevention strategies, aimed at reducing the impact of existing musculoskeletal complaints, may need to address different sets of risk factors. A better understanding of the differences in musculoskeletal complaints and musculoskeletal sickness absence is imperative and will contribute to the effectiveness of intervention programs.

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Chapter 4

Risk factors for musculoskeletal complaints and ensuing health care use and sick leave

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Abstract

Summary of background data. Preventing the socio-economic consequences of disability from musculoskeletal complaints may be a goal separate from that of eliminating the complaints themselves; thus, other factors may need to be addressed in intervention.

Objective. To investigate whether individual, work-related physical and psychosocial risk factors involved in the occurrence of musculoskeletal complaints also determine subsequent health care use and sickness absence.

Study design. A longitudinal study with 6-month follow-up.

Methods A questionnaire provided data on individuals and work-related factors, musculoskeletal complaints, and ensuing health care utilization and sickness absence among 407 industrial workers.

Results. The 12-month prevalence of low back pain (LBP) and neck/upper extremity complaints was 52% and 56%, respectively. Of those individuals with complaints at baseline, 68% had a recurrence of LBP, and 62% a recurrence of neck/upper extremity complaints during a 6-month follow-up. The recurrence of sickness absence for a particular musculoskeletal complaint was approximately 30%, while recurrence of health care use was more than 40%. Recurrence of complaints, health care utilization, and sickness absence were strongly associated with a history of severe symptoms.

Physical load, high job strain, and low social support at work determined the occurrence of LBP, related health care use and sickness absence. Older age and living alone were also important risk factors, especially for sickness absence. High job strain determined the occurrence of neck/ upper extremity complaints, related health care utilization, and sickness absence. Being female and living alone increased the probability of the occurrence of all three endpoints, especially the occurrence of sickness absence.

Conclusions. Work-related factors that were associated with the occurrence of musculoskeletal complaints were quite similar to those associated with health care utilization and sickness absence. However, for LBP, older age, and living alone, and, for neck/upper extremity complaints, living alone and being female more strongly determined whether subjects with these complaints took sick leave. These results imply that prevention strategies aimed at minimizing the risks of the occurrence of work-related musculoskeletal complaints, and prevention programs aimed at reducing sickness absence may need to emphasize different sets of risk factors.

Introduction

Health care utilization and sickness absence as a result of musculoskeletal complaints induce substantial cost for industrialized countries. In the United States, low back pain (LBP) is the leading cause of visits to orthopedic surgeons, neurosurgeons, occupational medicine physicians, and osteopathic physicians, and is second only to upper respiratory infections as the reason to consult a primary care physician.[1] Indirect costs of musculoskeletal complaints because of work absenteeism and disability are even higher.[2-4]

Musculoskeletal complaints, of which LBP comprises the larger part, are a common health condition in working populations. Considering the lifetime prevalence of 60% to 85%, LBP will eventually affect almost everyone.[5,6] In most patients, LBP is a self-limiting condition, even without necessary medical intervention.[5,7] Therefore, it has been suggested that prevention should focus on preventing the socioeconomic consequences of disability resulting from such pain rather than on preventing the onset of LBP.[8-10] Although work-related and individual risk factors for the onset of musculoskeletal complaints are well studied,[11,12] surprisingly little is known about the influence of work-related factors on the occurrence of health care use and sickness absence attributable to musculoskeletal complaints. It is often tacitly assumed that intervention focused on well-known risk factors for the occurrence of complaints will also reduce its consequences (*i.e.*, the occurrence of sickness absence and health care use). However, there are indications that individual and work-related risk factors for musculoskeletal complaints may differ from those for sickness absence and health care utilization attributed to these complaints.[13,14] For example, a cross-sectional study among workers in the laundry industry showed that sickness absence for musculoskeletal complaints was predominantly determined by individual factors and, to a lesser extent, by work-related psychosocial factors, while well-known work-related physical factors for the onset of musculoskeletal complaints played a minor role in the decision to take sick leave.[15] Two other studies reported that work-related physical factors were more strongly associated with sickness absence caused by LBP and caused by neck pain than with the occurrence of these complaints.[16,17] In a longitudinal study, Vingård *et al*[18] reported that exposure to occupational physical and psychosocial factors had a moderate impact on health care utilization for LBP in a general working population. In a case-referent study among female nursing personnel, physical load was more significant than work-related psychosocial factors in the decision to seek medical care for LBP.[19] In a Swedish study moderately increased risks of health care use for neck/shoulder pain were found for manual material handling, night work/shift work, hindrances at work and solitary work, while, among women health care use was not influenced by work.[20]

The aim of this study is to investigate whether individual, work-related physical and psychosocial risk factors involved in the occurrence of musculoskeletal complaints also determine subsequent health care use and sickness absence.

Methods

Study population

Industrial workers were recruited from 9 companies in the Netherlands. All subjects performed physically demanding work and comprised order pickers and operators in warehouses, maintenance workers in a stevedoring company and a petrochemical plant, railway workers, and 4 groups of operators in chemical plants. Subjects were invited to participate in the study if they worked 3 days per week or more. Those willing to participate gave written informed consent and completed a self-administered questionnaire during working hours, assisted, if necessary, by a member of the research team. Selected workers who were on vacation or sick leave were asked to fill out the questionnaire as soon as possible after return to work.

At baseline, 590 workers were eligible, of which 505 (86%) gave consent and returned the completed questionnaire. At 6-month follow-up 407 (81%) subjects filled out another similar questionnaire. At both baseline and follow-up, nonrespondents were sent a reminder to their home address after 2 weeks and again (with a questionnaire) after 3 weeks. At baseline the prevalence of risk factors, musculoskeletal complaints, health care utilization, or sickness absence was not associated with the subjects lost to follow-up.

Data collection

Individual factors and work-related factors

Twice, within a 6-month interval, workers completed a questionnaire on individual factors, work-related psychosocial and physical factors at the workplace, musculoskeletal complaints and subsequent health care utilization and sickness absence. Individual factors included age, gender, height, weight, level of education (primary school or lower vocational level were classified as lower educational level), involvement in sports, and family situation such as marital status and living arrangement.[21] Subjects with a Body Mass Index (BMI) of 30 kg/m^2 or higher were considered obese.

Questions on job-related characteristics, such as physical load and psychosocial load at the workplace, were obtained from a standardized questionnaire on work and musculoskeletal health.[22] Physical workload concerned manual material handling, awkward back postures, and strenuous arm positions such as working with hands above shoulder level or repetitive movements of the arms. A 4-point scale was used with the ratings “seldom or never”, “now and then”, “often”, and “always” during a regular workday. The answers “often” and “always” were classified as high exposure.[23] Subjects were asked to rank perceived physical load at work on a numerical rating scale ranging from 0 (very light) to 10 (very heavy), with a score higher than the median score regarded as a high perceived physical load.[24] The questions on psychosocial job characteristics were measured by means of a Dutch version of the Job Content Questionnaire.[25, 26] Job demands were measured by 11 questions on working fast, working hard, excessive work, insufficient time to complete the work, and conflicting demands. Job control was measured by 17 questions on skill discretion and decision latitude. These questions addressed, for example, task variety, learning new things, amount of repetitive work, and autonomy in executing tasks and solving problems. In this model, the combination of high job demands and low job control is considered to be a high job strain situation. All questions had a 4-point categorical scale and a total sum score was calculated for each dimension. Workers at risk (high job strain) were identified using the higher than median sum scores on job demands and job control. Subjects were asked to rank experienced support at work both from coworkers and supervisors on a numerical rating scale ranging from 0 (no support at all) to 10 (full support). The medium scores were used as cutoff point.

Musculoskeletal complaints

The presence of musculoskeletal complaints was determined with the standardized Nordic questionnaire on the nature, duration, and frequency of complaints.[27] Musculoskeletal pain was defined as "pain in the past 12 months" (yes/no), which referred to at least one episode of pain or discomfort in the past 12 months for at least one day. Because the neck, shoulders, and arms operate as a functional unit, we grouped musculoskeletal pain in the neck, shoulder, elbow, wrist, and hand into the category 'neck/upper extremity complaints'. The same questions were asked in the follow-up questionnaire using a recall period of 6 months.

Health care utilization

Health care utilization was determined by questions about medical care sought for musculoskeletal complaints. In the Dutch health care system the general practitioner functions as gatekeeper to the health care system and provides a referral to other health care providers. Therefore, health care utilization comprised both care seeking from a general practitioner by self-referral and from other health care providers by subsequent referral. In the Netherlands, all physicians may refer to a physical therapist. Health care utilization for neck/upper extremity complaints was defined as at least one visit to a general practitioner, a medical specialist, or a physical therapist for complaints in the neck, or shoulder or hand/wrist region. A similar definition was used for health care utilization for LBP.

Sickness absence

The question to measure sickness absence was derived from a study on the reliability of a questionnaire on the prevalence, frequency, and duration of sickness absence as a result of LBP, showing a high specificity (97%), sensitivity (88%), and a good agreement (Cohen's κ 0.65).[28] The question regarding sickness absence as a result of LBP was phrased "Have you been absent from work during the past 12 months due to back pain?". With a positive reply, subsequent questions were asked about frequency and duration of sickness absence. During the follow-up, the recall period was limited to 6 months. Similar questions were included for the occurrence of sickness absence in the neck region, shoulder region and elbow, wrist and hand region, which were grouped into the category 'sickness absence due to neck/upper extremity complaints'.

Statistical analysis

Logistic regression analysis was used to identify risk factors for the occurrence of musculoskeletal complaints, subsequent health care utilization, and sickness absence during the 6-month follow-up. A distinction was made between LBP and neck/upper extremity complaints. Self-reported individual and work-related factors were investigated as potential risk factors. Before being entered into the logistic models, all explanatory variables were dichotomized. The protocol for the analysis consisted of three steps. First, all independent variables were analyzed in a univariate model. Second, the variables with a *P*-value equal or less than 0.10 were included in a multivariate model by the step forward procedure. The variable with the lowest *P*-value was put in the model first, followed by the next lowest and so on. Variables with a *P*-value lower than 0.05 remained in the model and the other variables were excluded. Third, we determined whether all nonsignificant variables were excluded correctly by including them in the multivariate model of step two. When one of the odds ratios (OR) changed more than 10%, the variable was included in the multivariate model. In the results the final multivariate model is presented, as well as the OR for other variables when included separately in this multivariate model. An OR of more than 1 indicates that the likelihood of complaints, sickness absence, or health care utilization is higher when exposed to the specified factor. Because age may strongly influence the probability of musculoskeletal complaints, it was included in each regression model, regardless of the level of significance. Analyses were conducted with SAS software (Version 8.2).[29]

Results

Study population

Table 1 presents the individual factors and self-reported work-related factors at baseline. The study population was largely male (94%). Mean age was 42 (SD 9) years, the average number of years at the workplace was 11 (SD 9) years, 42% had a low level of education, approximately 50% of the workers had a high level of psychosocial workload, 22% rated their physical workload at the median value of 7, and thus about 27% experienced a high physical workload.

Table 2 gives the prevalence of musculoskeletal complaints, health care utilization and sickness absence. At baseline the 12-month prevalence of LBP was 52% (n = 210), and 56% (n = 227) of individuals had complaints in one or more anatomic regions of the upper extremities. Concurrence of LBP and neck/upper extremity complaints was high, with 34% (n = 140) of all subjects reporting both complaints. The occurrence of musculoskeletal comorbidity of the neck/upper extremities among LBP subjects was not associated with health care utilization or sickness absence for LBP, nor was the occurrence of LBP comorbidity among subjects with neck/upper extremity complaints associated with health care utilization or sickness absence for neck/upper extremity complaints.

Table 1: Presence of self-reported individual and work-related factors among industrial workers (n = 407) at baseline.

	n	%
Individual characteristics		
Age 16-34 years	91	22.4
35-44 years	136	33.4
45-65 years	180	44.2
Gender female	23	5.7
Body Mass Index ≥ 30 kg/m^2	51	12.5
Living alone	36	8.9
Education		
Lower level	171	42.0
Intermediate-higher level	236	58.0
Active in sports	176	43.2
Work-related physical load		
High manual materials handling	88	21.6
High awkward back postures	247	60.7
High strenuous arm positions	212	52.1
High perceived exertion	108	26.5
Work-related psychosocial load		
Low job control	193	47.4
High job demands	188	46.2
High job strain	106	26.0
Less social support colleagues	190	46.7
Less social support supervisor	159	39.1

At baseline, 32% (n = 68) of the subjects with LBP and 22% (n = 50) of those with neck/upper extremity complaints took sick leave. Approximately 45% (n = 94) of the subjects with LBP and 31% (n = 71) with neck/upper extremity complaints sought medical care for their complaint, of which 72% and 76% consulted a general practitioner, 65% and 58% a physical therapist, and 11% and 18% a medical specialist, respectively.

The incidence of LBP at 6-month follow-up among those subjects initially free of LBP at baseline was 20% (n = 40); there was a similar incidence (24%) of neck/upper extremity complaints. At follow-up, 37% (n = 14) of those individuals with sickness absence due to LBP and 48% (n = 12) of those with sickness absence due to neck/upper extremity complaints were absent for more than two weeks.

A total of 68% (n = 143) of the subjects with LBP (OR = 8.14) and 62% (n = 141) of those with neck/upper extremity complaints (OR = 5.13) at baseline had a recurrence of complaints during the 6-month follow-up. Approximately one third of those who had an episode of sickness absence had another episode of sickness absence for the same complaint within 6 months (LBP OR=7.64, neck/upper extremity complaints OR=18.07). Of those workers who consulted a health care provider at baseline, 41% (n=39) with LBP (OR=9.97) and 46% (n=33) with neck/upper extremity complaints (OR=10.97) sought care again during the 6-month follow-up. Recurrence of complaints, health care utilization and sickness absence were strongly associated with a history of severe symptoms.

Table 2: Presence of musculoskeletal complaints, sickness absence, and health care utilization among industrial workers (n = 407) at baseline and at 6-month follow-up.

	Baseline (past 12 months) n (%)	Follow-up (6 months) n (%)
Low back pain	210 (51.6)	183 (45.0)
Chronic low back pain	41 (10.1)	27 (6.6)
High pain intensity	55 (13.5)	49 (12.0)
Sciatica	43 (10.6)	33 (8.1)
Musculoskeletal comorbidity	140 (34.4)	98 (24.1)
Neck/upper extremity complaints	227 (55.8)	185 (45.5)
Chronic neck/upper extremity complaints	44 (10.8)	56 (13.8)
Neck pain	108 (26.5)	100 (24.6)
Shoulder pain	131 (32.2)	108 (26.5)
Elbow, and/or wrist, hand pain	93 (22.9)	81 (19.9)
Sickness absence due to		
Low back pain	68 (16.7)	38 (9.3)
Neck/upper extremity complaints	50 (12.3)	25 (6.1)
Health care utilization for		
Low back pain	94 (23.1)	60 (14.7)
Neck/upper extremity complaints	71 (17.4)	58 (14.3)

Risk factors for low back pain and ensuing health care utilization and sickness absence

The risk factors for LBP, and subsequent sickness absence and health care utilization are summarized in Table 3. Both work-related physical and work-related psychosocial factors influenced the occurrence of LBP, related health care utilization, and sickness absence. Older age (> 35 years) and living alone increased the probability of the occurrence of all three endpoints, and specifically determined whether subjects with LBP took sick leave.

Table 3: Risk factors for the occurrence of low back pain, sickness absence, and health care utilization due to low back pain during 6-month follow-up among industrial workers (n = 407).

	Complaints (n = 183)		**Sickness absence** (n = 38)		**Health care utilization** (n = 60)	
Individual factors	**OR[1]**	**95% CI**	**OR[1]**	**95% CI**	**OR[1]**	**95% CI**
Age 16-34 years	1.00	–	1.00	–	1.00	–
35-44 years	1.65	0.93 – 2.91	4.13*	1.16 – 14.71	1.77	0.77 – 4.05
45-65 years	1.68	0.98 – 2.89	3.33	0.96 – 11.62	1.44	0.64 – 3.25
Gender female	1.10	0.45 – 2.68	1.59	0.43 – 5.85	0.81	0.22 – 2.95
Body Mass Index ≥ 30 kg/m^2	1.02	0.55 – 1.88	0.74	0.25 – 2.20	0.65	0.26 – 1.63
Living alone	1.57	0.76 – 3.25	2.19	0.83 – 5.80	1.66	0.70 – 3.93
Low level of education	0.67	0.44 – 1.04	1.53	0.76 – 3.05	0.82	0.46 – 1.47
Active in sports	1.48	0.98 – 2.24	0.76	0.38 – 1.54	1.11	0.63 – 1.96
Work-related physical load						
High manual materials handling	0.73	0.43 – 1.25	0.64	0.26 – 1.59	0.81	0.40 – 1.65
High awkward back postures	1.14	0.73 – 1.80	1.68	0.78 – 3.59	1.74	0.91 – 3.34
Strenuous arm movements	0.80	0.52 – 1.23	0.74	0.36 – 1.51	0.96	0.54 – 1.71
High perceived physical load	1.67*	1.05 – 2.68	1.47	0.71 – 3.06	1.85*	1.02 – 3.34
Work-related psychosocial load						
Low job control	0.94	0.55 – 1.60	1.47	0.60 – 3.64	1.12	0.63 – 1.98
High job demands	1.00	0.58 – 1.70	1.05	0.41 – 2.66	1.12	0.62 – 2.03
High job strain	1.75*	1.08 – 2.84	2.05*	1.02 – 4.16	1.28	0.68 – 2.41
Less social support coworkers	1.52	0.97 – 2.38	1.24	0.62 – 2.49	1.33	0.72 – 2.49
Less social support supervisor	2.06*	1.35 – 3.14	1.33	0.67 – 2.67	2.29*	1.30 – 4.02

OR=Odds Ratio, CI=confidence interval.

[1] Significant risk factors constituting the multivariate model are indicated by *($P < 0.05$),
for other risk factors the OR is presented when including this risk factor in the multivariate model.

Table 4: Risk factors for the occurrence of neck/upper extremity complaints, sickness absence and health care utilization due to neck/upper extremity complaints during 6-month follow-up among industrial workers (n = 407).

	Complaints (n = 185)		Sickness absence (n = 25)		Health care utilization (n = 58)	
Individual factors	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Age 16-34 years	1.00	–	1.00	–	1.00	–
35-44 years	1.03	0.60 – 1.79	1.77	0.51 – 6.17	1.11	0.49 – 2.51
45-65 years	1.51	0.90 – 2.54	1.39	0.41 – 4.68	1.25	0.59 – 2.68
Gender female	1.90	0.79 – 4.60	5.29*	1.50 – 18.77	3.73*	1.45 – 9.57
Body Mass Index ≥ 30 kg/m^2	0.80	0.43 – 1.46	0.24	0.03 – 1.90	0.57	0.21 – 1.52
Living alone	1.81	0.89 – 3.68	5.28*	1.95 – 14.32	1.96	0.83 – 4.63
Low level of education	0.66	0.43 – 1.01	1.50	0.62 – 3.62	0.91	0.50 – 1.64
Active in sports	0.79	0.53 – 1.18	1.05	0.44 – 2.47	1.17	0.66 – 2.08
Work-related physical load						
High manual materials handling	1.09	0.66 – 1.79	1.29	0.49 – 3.42	1.08	0.54 – 2.16
High awkward back postures	1.14	0.75 – 1.74	1.84	0.66 – 5.15	1.22	0.65 – 2.29
Strenuous arm movements	1.02	0.67 – 1.55	1.44	0.57 – 3.68	1.21	0.65 – 2.23
High perceived physical load	1.09	0.69 – 1.72	1.45	0.60 – 3.51	1.57	0.85 – 2.87
Work-related psychosocial load						
Low job control	0.93	0.56 – 1.56	1.43	0.41 – 4.97	1.23	0.57 – 2.64
High job demands	1.02	0.60 – 1.71	0.50	0.10 – 2.38	1.33	0.61 – 2.89
High job strain	2.07*	1.31 – 3.26	3.15*	1.33 – 7.49	2.02*	1.11 – 3.69
Less social support coworkers	1.09	0.72 – 1.64	1.32	0.54 – 3.21	1.19	0.66 – 2.12
Less social support supervisor	0.93	0.61 – 1.42	0.73	0.29 – 1.79	1.08	0.60 – 1.95

OR = Odds Ratio, CI = confidence interval.

[1] Significant risk factors constituting the multivariate model are indicated by *(P < 0.05), for other risk factors the OR is presented when including this risk factor in the multivariate model.

In particular, in LBP, the occurrence of complaints was significantly associated with high perceived physical load, high job strain, and reduced social support from the supervisor. Related health care utilization was significantly associated with a high perceived physical workload and reduced social support from the supervisor. Sickness absence attributed to LBP was significantly correlated with older age and high job strain. All variables in the final three logistic regression models were significant when adjusted for each other, but were also significant on their own. Some work-related physical factors showed an increased risk of the occurrence of sickness absence and health care utilization; however, because of the small sample size, not all elevated OR reached the conventional level of significance ($P < 0.05$).

Risk factors for neck/upper extremity complaints and ensuing health care utilization and sickness absence

Table 4 presents the risk factors for neck/upper extremity complaints, related health care utilization, and sickness absence. Work-related psychosocial workload influenced the occurrence of these complaints, and subsequent health care utilization and sickness absence. Being female and living alone increased the probability of the occurrence of all three endpoints, but especially the occurrence of sickness absence.

Specifically, the occurrence of complaints was significantly associated with high job strain. A combination of being female and high job strain was significantly associated with the use of health care. Sickness absence for neck/upper extremity complaints was significantly associated with being female, living alone and high job strain. All risk factors in the final three logistic regression models were significant when adjusted for each other but were also significant on their own. Some of the work-related physical factors showed some association with sickness absence and health care use; however, none of these associations were significant.

Discussion

The results of this study show that the influence of well-known work-related factors that were associated with the occurrence of musculoskeletal complaints were quite similar to those associated with health care utilization and sickness absence. However, for LBP, older age and living alone, and, for neck/upper extremity complaints, living alone and being female, more strongly determined whether subjects with these complaints took sick leave.

A few methodological issues need to be discussed. First, because our response rates were high (86% at baseline; 81% at follow-up) and the prevalence of risk factors, musculoskeletal complaints, health care utilization, or sickness absence was not associated with loss to follow-up, the results are probably not importantly biased by nonresponse. Second, because the study relied on data generated from survey research, respondents may not have recalled some types of care (*e.g.*, physician's visits), and health care utilization may therefore be underestimated.[30] However, a previous study indicated that patient questionnaires are a reasonable source of health care utilization data in subjects with LBP up to one year after occupational injury.[31] Furthermore, in our study the prevalence of health care utilization at baseline for LBP (23%) and neck/upper extremity complaints (17%), was comparable with health care utilization in previous studies.[32,33] However, because health care utilization during the 6-month follow-up may be attributable to both new episodes of musculoskeletal complaints during the follow-up and the result of musculoskeletal complaints reported in the baseline survey, some inaccuracy may have occurred. The latter occurs when the same illness episode is counted twice when this episode straddles the time when the baseline questionnaire was completed, which is more likely to happen when the duration of the complaints is long. Since at baseline only about 20% of LBP or neck/upper extremity complaints in our workers were chronic, we do not think this will substantially affect our results. Third, sickness absence might be underreported because of socially desirable answers;[28,34] however, the questionnaire used had a good validity, especially for sickness absence of two weeks or more.[28] Alternatively, we could have used sickness absence data collected from company absence registers, but these are often incomplete as a result of inadequate recording, and often lack specific information about the nature and location of complaints. Fourth, relevant confounding factors (*e.g.*, workplace policies[35], job satisfaction[17], and job security[36]) may not have been measured. At baseline the prevalence of sickness absence for musculoskeletal complaints among our companies ranged from 3-34%, a range that could not entirely be explained by the observed variation in risk factors. However, since only 9 companies were included, it was not possible to evaluate the impact of organizational and cultural factors on sickness absence patterns. Fifth, due to the small number of workers reporting health care utilization and sickness absence, not all elevated OR reached conventional levels for significance ($P < 0.05$). Finally, because the correlation among work-related physical and among work-related psychosocial variables was high, in the multivariate analyses, it was somewhat arbitrary as to which variable was included in the final model.

Musculoskeletal complaints at baseline were highly prevalent, and the recurrence for low back and neck/upper extremity complaints in our study was more than 60% during 6-month follow-up, which is very similar to the 1-year recurrence rates in other studies.[37-40] This result indicates that for most subjects, musculoskeletal pain is not typified by a single episode in time, and this supports the notion that musculoskeletal pain can be characterized as an episodic disease, as is also described for LBP.[41-44] According to this concept, pain may subside and disappear for a while but then recur a few months later. The pain may also linger for some time and flare up periodically. If the flare-ups are bothersome, this may prompt the subject to seek medical care or take sick leave.

The frequent recurrence of sickness absence and health care utilization in our study reflects the same episodic pattern. Of the workers with an episode of sickness absence for musculoskeletal complaints at baseline, approximately 30% had an episode of sickness absence again for the same complaint within 6 months, which is comparable to previous reports.[45] The fact that more than 40% of our subjects who sought care for their complaints at baseline visited a health care provider again for the same complaints within 6 months may be explained by the fact that subjects with more severe complaints had a higher probability of recurrence of complaints.[46] These results confirm that continuing musculoskeletal complaints are a major health care problem and that most patients will present with complaints again within several months.

We found no influence of the occurrence of musculoskeletal comorbidity on health care utilization or sickness absence, which is in agreement with previous research.[47] We have no data on non-musculoskeletal comorbidity to corroborate the finding of Hurwitz and Morgenstern[48] that the decision to seek care for a back problem depends on the presence of disabling comorbidities or conditions that may be perceived to be more amenable to care.

Work-related factors that were associated with musculoskeletal complaints were quite similar to those associated with its consequences in terms of health care utilization and sickness absence, but these findings need to be corroborated in other study populations. Similar findings have been reported by others; however, those studies also showed that physical factors were more strongly associated with sickness absence than with the occurrence of LBP or neck complaints.[16,17,19,49] These contradictory results may be explained by the lack of contrast in the magnitude of physical load among subjects in our study population[16,17] or by the moderate level of physical load compared with some other occupations.[19,49] In our study individual factors were risk factors for sickness absence because of musculoskeletal complaints, which supports data from our previous study.[15] Both work-related and individual factors influenced health care utilization for musculoskeletal complaints, which also has been described for general health care utilization.[50] Female workers were more likely to seek care or have an episode of sickness absence for complaints of the upper extremities than men, which has also been reported by others.[20,47,51]

Conclusions

This study among industrial workers shows that well-known risk factors for musculoskeletal complaints also determine the consequences in terms of health care utilization and sickness absence. However, for LBP, older age and living alone, and, for neck/upper extremity complaints, living alone and being female, more strongly determined whether subjects with these complaints took sick leave. These results imply that prevention strategies aimed at minimizing the risks of the occurrence of work-related musculoskeletal complaints, and prevention strategies aimed at reducing sickness absence, may have to emphasize different sets of risk factors.

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Chapter 5

Impact of musculoskeletal comorbidity of neck and upper extremities on health care utilization and sickness absence for low back pain

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Abstract

Objectives. The aim of this study was to describe the presence of musculoskeletal comorbidity of the neck and upper extremities among industrial workers with low back pain (LBP) and to examine whether it has an impact on health care utilization and sickness absence for LBP.

Methods. We used a self-administered questionnaire to collect data among 505 industrial workers (response 86%). We gathered information on individual characteristics, musculoskeletal complaints, general health status, sickness absence, and health care utilization due to LBP.

Results. The 12-month prevalence of LBP was 50%. Among subjects with LBP the 12-month prevalence of musculoskeletal comorbidity of the neck and upper extremities was 68%. Among workers with LBP, subjects with high pain intensity (odds ratio (OR) 1.91, 95% CI 1.00 – 3.66) or disabling low back pain (OR 1.73, 95% CI 1.00 – 3.00) were more likely to have musculoskeletal comorbidity. In comparison to the subjects who report back pain only, subjects with comorbidity demonstrated worse general health and health related quality of life. No impact of upper extremity comorbidity was found on health care utilization, and sickness absence due to LBP.

Conclusions. This study provides no evidence that musculoskeletal comorbidity of the neck and upper extremities influences the choice to seek care or take sick leave due to LBP among industrial manual workers. For occupational health practitioners the finding of a high comorbidity is important to consider when implementing workplace interventions aimed at the reduction of specific musculoskeletal complaints, since the controls for one musculoskeletal complaint may impact adversely on another musculoskeletal complaint. Researchers who perform LBP intervention studies using generic health measures, should take into account the impact of musculoskeletal comorbidity on these measures.

Introduction

Musculoskeletal complaints are an important cause of morbidity and disability in Western industrialized societies. Low back pain (LBP) is the most common musculoskeletal complaint in the general population, with, in the Netherlands, a 1-year prevalence rate of 44%.[1] The same national study showed a 1-year prevalence of 31% for neck complaints, 30% for shoulder complaints, 11% for elbow complaints, and 18% for complaints of the wrist. Given these high prevalence rates, it is not surprisingly that a subject with LBP often has experienced other musculoskeletal complaints as well. Several studies have shown that subjects often report more than one musculoskeletal complaint, and musculoskeletal comorbidity varied between 37% and 66%.[1-5] However, almost all studies on musculoskeletal complaints address only complaints of a specific anatomical region, such as back pain or shoulder pain.

There is circumstantial evidence that among subjects with LBP musculoskeletal comorbidity may have a considerable impact on health care utilization and sick leave. Nordin *et al*[6] found that workers with LBP and concurrent musculoskeletal complaints were more likely to remain work disabled than those with LBP alone. Another study showed that LBP subjects with a non-disabling comorbidity were more likely to have sought care for their back pain, whereas those with musculoskeletal (disabling) comorbidity less often sought care for their back pain.[7] However, Molano and colleagues[4] reported that musculoskeletal comorbidity did not influence care seeking behavior among construction workers with LBP in the past 12 months. Although there seems to be a considerable co-existence between back pain and pain experienced in other anatomical regions, the consequences of musculoskeletal comorbidity on health care utilization and sickness absence for LBP are not well understood. A greater understanding is essential; for instance, for clinical practice it is important to know whether musculoskeletal comorbidity influences the decision to seek treatment for LBP. For researchers performing LBP intervention studies it is relevant to know whether musculoskeletal comorbidity may influence their results. Furthermore, for research on the aetiology of back pain it is significant to understand whether back pain complaints are a separate and distinctive entity or just a reflection of a more general musculoskeletal pain syndrome.[1,8]

The aim of this cross-sectional study was to describe the presence of musculo-skeletal comorbidity of the neck and upper extremities among industrial workers with LBP and to examine whether it has an impact on health care utilization and sickness absence for LBP.

Methods

Study population and data collection

In this cross-sectional study, the study population consisted of industrial workers who were recruited from nine companies located throughout the Netherlands. The workers participated in a trial on the effects of ergonomic training in combination with in-company physical therapy. A total of 590 employees were invited to participate in the study. All subjects performed physically demanding work and comprised assembly workers, order pickers in warehouses, and maintenance workers at a stevedoring company and a petrochemical plant. If the worker was willing to participate, an informed consent was signed and a self-administered questionnaire was filled out during work time. One of the members of the research team was present to help respondents fill out the questionnaire when needed. Selected workers on vacation or sick leave were asked to fill out the questionnaire as soon as possible after return to work. Non-responders were sent a reminder after two weeks and a second reminder with questionnaire after three weeks to the home address. A total of 505 workers completed the self-administered questionnaire, yielding a response of 86%. Prior to the commencement of the study we received approval for its conduct from the Medical Ethics Committee.

Questionnaire

The questionnaire contained questions on individual characteristics, LBP, and other musculoskeletal complaints, general health status, sickness absence, and health care utilization. The questions on individual data included age, gender, weight, height, involvement in sports, marital status, and education.[9] Education of 10 years or less of primary school and lower vocational level was classified as lower educational level, and education at lower general secondary or intermediate vocational level as medium level of education. The Body Mass Index (BMI) was calculated as weight (kg) divided by the square of the height (m); a BMI of 26 or more was considered as overweight.

Low back pain

We used the standardized Nordic Questionnaire for the nature and severity of musculoskeletal complaints.[10] Subjects were presented a drawing with a pre-shaded area indicating the area below the lower ribs and above the gluteal folds, and asked whether they had experienced pain or discomfort for at least a day during the past 12 months. Subjects with LBP were asked to rate their mean pain intensity in the past 12 months from 0 to 10 on a Numerical Rating Scale (NRS). On the NRS, 0 represented no pain at all, and 10 pain as bad as it could be.[11] The 75% percentile was taken as cut-off point. Chronic complaints were defined as pain, which was present almost every day in the preceding 12 months with a minimal presence for at least 3 months.[12]

The Roland Disability Questionnaire (RDQ) was used as a condition specific health status measure for LBP, designed to measure the presence of 24 activity limitations on a dichotomous scale. A sum score was calculated by adding up the number of negative items, which may range from 0 (no disability) to 24 (maximum disability).[13] The median score was taken as cut-off point.

General health status

We measured general health with the SF-12[14] and the EuroQol (EQ5d).[15] The SF-12 is a generic measure of health, which is derived from the SF-36. The SF-12 has a good test-retest reliability (r > 0.76) and a good validity (median r = 0.67).[14] It yields two summary scores, the physical component summery scale (PCS12) and the mental component summary scale (MCS12). Both scores may range from 0 to 100, with higher scores representing better health.

In the EQ5d[15], 5 dimensions are used as a measurement for preference based health-related quality of life. The preference scores for each worker were calculated using weights for different health states as obtained from a general population in the UK.[16] Respondents also recorded their health on a visual analogue scale (EuroQol-VAS), somewhere between 0 (worst imaginable health state) and 100 (best imaginable health state). The EQ5d-instrument has a good test-retest reliability and a good validity.[17,18] The EQ5D summary measure has shown significant positive correlations with the PCS-12 score (r = 0.55) and the MCS-12 score (r = 0.41), and appeared to be slightly less sensitive than the SF-12 to differences associated with less severe morbidity.[19]

Sickness absence and health care utilization

The question on the occurrence of sickness absence was a modified question derived from a study on the reliability of questions on prevalence, frequency, and duration of sickness absence due to back pain.[20] The questionnaire showed a good agreement for back pain absence (Cohen's κ 0.65).

Health care utilization was measured by a dichotomous variable (yes/no), which described whether a general practitioner, a specialist, or a physical therapist was consulted for LBP in the past 12 months.[4] The specialist category includes neurologists, neurosurgeons, and orthopaedic surgeons.

Musculoskeletal comorbidity

The occurrence of upper extremity complaints was assessed using the Nordic Questionnaire.[10] Subjects were asked if they had experienced pain or discomfort in the neck region for at least a day during the past 12 months, again using a pre-shaded area to define the particular area. Similar questions with pre-shaded areas were asked for complaints in the shoulder region and in the elbow-wrist-hand region.

Musculoskeletal comorbidity was defined as the presence of complaints in the neck, or shoulder, or elbow-wrist-hand region in the previous 12 months among subjects with LBP. Since the neck, shoulders, and arms operate as a functional unit, we grouped complaints in these regions together into the category "upper extremity complaints". Chronic neck complaints referred to pain, which was present almost every day in the neck region in the preceding 12 months with a minimal presence for at least 3 months. Similar definitions were used for chronic pain in the shoulder, and elbow-wrist-hand region.

Statistical methods

In the statistical analysis differences between continuous variables were tested with the unpaired Student's *t*-test, since all continuous variables were distributed normally. The differences between frequencies of categorical variables were tested with the chi-square test (χ^2). Logistic regression analysis was performed to study associations between LBP characteristics and comorbidity, as well as health care utilization and comorbidity. All variables were dichotomized before being entered into the logistic models. The protocol for the analysis consisted of three steps. Firstly, all independent variables were analyzed in a univariate model. Secondly, the variables with a *P*-value equal or less than 0.10 were included in a multivariate model by the step forward procedure. The variable with the lowest *P*-value was put in the model first, followed by the next lowest and so on. Variables with a *P*-value lower than 0.05 remained in the model and the other variables were excluded. Thirdly, we determined whether all non-significant variables were excluded correctly by including them in the multivariate model of step two. When the one of the odds ratios (ORs) changed more than 10%, the variable was included in the multivariate model of step two. The analyses were carried out with the statistical package SAS 8.2.[21]

Results

Subjects and musculoskeletal complaints

The majority of the study population was male (94.2%), married (83.7%), had a mean age of 41.5 (SD 9.8) years, and a BMI of 26.2 (SD 4.4). Most of the workers had a low (42.9%) or medium level of education (46.7%).

Table 1 shows the 12-month prevalence of LBP and upper extremity comorbidity. The prevalence for LBP in the previous 12 months was 49.9% (n=252). A total of 277 (54.9%) of the 505 employees reported complaints in one or more anatomical regions of the upper extremities. The larger part of upper extremity complaints was located in the shoulder (31.2%) and neck (27.1%).

Musculoskeletal comorbidity was high. Among workers with back pain in the past 12 months, 170 (67.5%) subjects reported concurrent complaints in the upper extremities. The coexistence of LBP and musculoskeletal complaints in the upper extremities was higher than expected on basis of independence. LBP was associated with pain in the neck (OR 2.66, 95% CI 1.76 – 4.01), shoulder (OR 2.21, 95% CI 1.50 – 3.26), elbow-wrist-hand (OR 1.76, 95% CI 1.14 – 2.69), and any upper extremity complaints (OR 2.83, 95% CI 1.97 – 4.07). Among subjects with chronic LBP (n = 36) other chronic complaints were common. Chronic LBP was associated with chronic neck pain (OR 4.81, 95% CI 1.48 – 15.57), chronic shoulder pain (OR 2.62, 95% CI 0.89-7.73), and chronic complaints of elbow-wrist-hand (OR 7.12, 95% CI 1.48 – 34.39). Chronic LBP was significantly associated with the occurrence of chronic upper extremity complaints (OR 3.59, 95% CI 1.47 – 8.80).

Table 1: The 12-month prevalence of low back pain and upper extremity comorbidity among blue-collar workers.

	n	%
All workers (n = 505)		
Low back pain	252	49.9
Upper extremity complaints	277	54.9
Neck pain	137	27.1
Shoulder pain	158	31.3
Elbow, and/or wrist, hand pain	112	22.2
Workers with low back complaints (n = 252)	**n**	**%**
Low back pain and upper extremity complaints**	170	67.5
Low back pain and neck pain**	92	36.5
Low back pain and shoulder pain**	100	39.7
Low back pain and elbow and/or wrist, hand pain**	68	27.0

** $P < 0.05$ $\chi 2$ test for the presence of low back pain and presence of upper extremity complaints in all subjects.

Determinants of low back pain and concurrent upper extremity complaints

Table 2 summarizes associations of LBP characteristics and upper extremity musculoskeletal comorbidity (LBP with UE). Subjects with high pain intensity or disabling LBP were more likely to have musculoskeletal comorbidity; however, sciatica was not associated with comorbidity. Chronic back pain in the past 12 months showed an increased risk on concurrent upper extremity complaints, but this association did not reach the conventional level of significance. The score on the RDQ for the LBP subjects with upper extremity comorbidity was 21% higher (mean 4.80, SD 4.98) compared with subjects with LBP only (mean 3.97, SD 5.05).

Table 2: Odds ratios (OR) of the association between low back pain characteristics and the occurrence of upper extremity musculoskeletal comorbidity (LBP with UE) in the past 12 months among industrial workers with low back pain (n = 252).

		LBP with UE (n = 170)	
	n	**OR**	**95% CI**
Low back pain characteristics			
High pain intensity	66	1.91**	1.00 – 3.66
Sciatica	51	0.81	0.42 – 1.55
Back pain lasting more than 3 months	36	2.22*	0.93 – 5.32
High perceived disability	106	1.73**	1.00 – 3.00

* $P < 0.1$, **$P < 0.05$ χ^2 test

None of the individual characteristics age, BMI (OR 1.51, 95% CI 0.88-2.59), marital status (living alone OR 0.90, 95% CI 0.38 – 2.11), gender (male OR 0.42, 95% CI = 0.12 – 1.52), educational level (lowest level OR 1.73, 95% CI 0.69 – 4.36) or participation in sports (OR 0.74, 95% CI 0.44 – 1.26) did determine the occurrence of upper extremity comorbidity.

General health status

Table 3 summarizes the impact of upper extremity comorbidity on general health and health-related quality of life. Subjects who reported only low back pain (LBP-only) or only upper extremity complaints (UE-only) had lower scores on the PCS12 and EQ5d compared with subjects without complaints. Subjects with back pain and musculoskeletal upper extremity comorbidity (LBP with UE) showed scores very similar to an additive effect of back pain and of upper extremities complaints.

Health care utilization and sickness absence

A total of 112 workers (44.4%) with LBP consulted a health care provider in the past 12 months and approximately one third (32.9%) went on sick leave at least once for their back complaints. Table 4 demonstrates that upper extremity comorbidity had no impact on health care utilization or on sickness absence due to LBP. Use of care from a health care provider was determined by disabling LBP (OR 3.27, 95% CI 1.89 – 5.67) and high pain intensity (OR 2.51, 95% CI.1.34 – 4.70). None of the individual characteristics was associated with health care utilization. LBP subjects with chronic musculoskeletal comorbidity sought less often care for their back pain and more often for these other musculoskeletal complaints.

Table 3: Impact of only low back pain (LBP-only), only upper extremity complaints (UED-only), and low back

pain with musculoskeletal upper extremity comorbidity (LBP with UE) on general health (PCS12, MCS12) and health related quality of life (EQ5d and EuroQol-Vas) compared to those without low back pain or upper extremity complaints (no MSD) among industrial workers (n = 505).

	n	PCS12 Mean (SD)	MCS12 Mean (SD)	EQ5d Mean (SD)	EuroQol-VAS Mean (SD)
LBP-only					
No MSD	146	53.36 (5.26)	54.30 (6.91)	0.96 (0.08)	83.40 (15.01)
Yes	82	49.05 (8.20)	55.81 (6.34)	0.83 (0.19)	80.12 (16.26)
Δ		4.31 (6.47)**	– 1.51 (6.71)	0.13 (0.13)**	3.27 (15.49)
UE-only					
No MSD	146	53.36 (5.26)	54.30 (6.91)	0.96 (0.08)	83.40 (15.01)
Yes	107	50.76 (6.66)	53.30 (6.27)	0.89 (0.14)	80.55 (11.92)
Δ		2.60 (5.90)**	1.02 (6.64)	0.07 (0.11)**	2.84 (13.74)
LBP with UE					
No MSD	146	53.36 (5.26)	54.30 (6.91)	0.96 (0.08)	83.40 (15.01)
Yes	170	46.67 (8.50)	51.89 (7.71)	0.79 (0.19)	75.16 (14.83)
Δ		6.69 (7.30)**[a]	2.41 (7.38)**[a]	0.18 (0.15)**	8.23 (14.91)**[a]

** $P < 0.05$ Student-t test. [a] Significant difference ($P < 0.05$) between subjects with LBP-only and subjects with LBP and upper extremity comorbidity.

PCS12 = Physical component summary scale of SF-12; MCS12 = Mental component summary scale of SF-12; EQ5d = preference based health-related quality of life on 5 dimensions of EuroQol, using weights for different health states of each individual worker as obtained from a general population in the UK. EuroQol-VAS = EuroQol-Visual Analogue Scale

Table 4: Musculoskeletal upper extremity comorbidity and health care utilization and sickness absence due to low back pain among industrial workers (n = 252).

	LBP only (n = 82)		**LBP with UE** (n = 170)	
	n	**%**	**n**	**%**
Medical care seeking for LBP	31	37.8	81	47.7
General practitioner	23	28.1	60	35.3
Medical specialist	6	7.3	6	3.5
Physical therapist	19	23.2	52	30.6
Sickness absence due to LBP	26	31.7	57	33.5

LBP-only = only low back pain

LPB with UE = low back pain with musculoskeletal upper extremity comorbidity

Discussion

The findings of this study indicate that a substantial part of subjects with low back pain experienced musculoskeletal comorbidity in the past 12 months. Subjects with high pain intensity, or disabling LBP were more likely to have musculoskeletal comorbidity. In comparison with subjects who reported back pain only, subjects with comorbidity demonstrated worse general health and health related quality of life. No impact of upper extremity comorbidity was found on health care utilization and sickness absence due to LBP.

Some methodological issues have to be considered when interpreting the results of this study. First, the findings in this study are not importantly biased by nonresponse since all subjects were from the same occupational populations and our response rate was high (86%). Second, the results presented might be biased by the fact that both LBP and comorbidity were assessed over a one year recall period. This does not necessarily imply the simultaneous occurrence of LBP and comorbidity, but could also indicate an episode of LBP followed by a separate episode of upper extremity complaints within one year. However, since we found a strong association between chronic complaints and comorbidity, we assume that this does not substantially affect our results. Third, our results relied on cross-sectional data and on data generated from survey research, *i.e.*, on information provided by the respondent about health care utilization and sickness absence. Recall of medical events can be telescoped forward in time, which is most likely to occur with major or traumatic events.[22] In contrast, some types of care, such as physicians visits, may not be recalled by respondents, yielding an underestimation of utilization.[23] Results might be different when data from other databases, for example, medical records or company records, are used. Sickness absence might be underreported because of socially desirable answers.[20,24] Using sick leave data collected in a standardized way from the employers' registration system may have yielded different sickness absence data, but in this branch of industry absence registers are often incomplete, especially for specific musculoskeletal complaints. Finally, since we used cross-sectional data the healthy worker effect could be present, hence underestimating health care utilization and sickness absence.

The 12-month prevalence of particular musculoskeletal complaints were within the range of reported prevalences in other occupational populations with physically demanding jobs.[3,4] The coexistence of LBP and musculoskeletal complaints in the upper extremities was significantly higher than expected on basis of independence. We found a 12-month prevalence of comorbidity of 68% among subjects with LBP. Previous studies reported prevalences of comorbidity varying between 37%-66%.[1-5] Comparison is hampered, because various definitions of comorbidity were used. Musculoskeletal comorbidity was associated with more serious LBP complaints; however, we did not find a relationship between comorbidity and sciatica. Even though the symptom sciatica in itself is not particularly accurate in diagnosing prolapsed disc, this supports the suggestion that non-specific

LBP is more influenced by perceptions of pain and reporting behavior than LBP associated with a well-defined pathology. Among subjects with chronic LBP other chronic upper extremity complaints were common (OR 3.59, 95% CI 1.47 – 8.80). The tendency of clustering of chronic complaints in certain subjects has been reported before and also reflects a more general musculoskeletal pain syndrome.[1,8]

However, health care utilization was determined by the nature and severity of LBP and not influenced by musculoskeletal comorbidity. This is in agreement with a previous study among construction workers[4], in which no impact of upper extremity comorbidity was found on health care utilization due to LBP.

We found that LBP subjects with severe musculoskeletal comorbidity sought care less often for their back pain and more often for these other musculoskeletal complaints. Similar results have been reported before by Hurwitz *et al*[7] in a population based survey among the adult population of the Unites States.

No significance differences were found for frequency and duration of sickness absence between subjects reporting LBP and those reporting also concurrent complaints in the upper extremities. In a previous study Nordin and colleagues[6] found that workers with LBP and concurrent musculoskeletal complaints were more likely to remain work disabled than those with LBP alone. An explanation for the difference between results could be a larger sample size and the fact that their database included the exact start and end dates of sickness absence for LBP subjects, whereas we applied a categorical classification for sickness absence, which is less precise.

The results of our study have clear implications. The majority of medical research on LBP is limited to the lower back region, and does not take into the account the coexistence of pain in other anatomical regions. For these researchers, it is important to know whether their results are influenced by musculoskeletal comorbidity. Our results imply that researchers, who perform LBP intervention studies using generic health measures, should take into account the impact of musculoskeletal comorbidity on these measures. Our data suggest that there is at most a limited contribution of upper extremity comorbidity on care seeking for LBP to a general practitioner or for subsequent referral to other health care providers. This study also showed that there is no influence of musculoskeletal comorbidity on sickness absence for LBP complaints.

Clinicians and occupational health practitioners, who are involved in the management of LBP, should be aware that musculoskeletal comorbidity is very common in LBP patients. For occupational health practitioners the finding of a high comorbidity is important to consider in workplace interventions, since an intervention aimed at the reducing physical load on the back may impact adversely on the risk factors for another musculoskeletal complaint. Furthermore, our results indicate that subjects with LBP and co-occurrence of upper extremity complaints have worse general health status and lower health related quality of life, than with those with complaints of the back only. Consequently, musculoskeletal comorbidity may slow or interfere with normal recovery from back pain and may affect response to treatment. Indeed, in clinical care guidelines for the management of LBP a poor physical and mental health status or well being is categorized as a "yellow flag".[25,26] Hence, a LBP subject presenting himself with musculoskeletal comorbidity merits extra attention.

We conclude that this study provides no evidence that musculoskeletal upper extremity comorbidity influences the decision to seek care or take sick leave due to LBP among industrial manual workers. For occupational health practitioners the finding of a high comorbidity is important to consider when implementing workplace interventions aimed at the reduction of specific musculoskeletal complaints, since the controls for one musculoskeletal complaint may impact adversely on another musculoskeletal complaint. Researchers, who perform LBP intervention studies using generic health measures, should take into account the impact of musculoskeletal comorbidity on these measures.

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Chapter 6

Health problems lead to considerable productivity loss at work among workers with high physical load jobs

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Abstract

Objective. To assess the feasibility and validity of two instruments for the measurement of health-related productivity loss at work.

Study Design and setting. A cross-sectional study was conducted in two occupational populations with a high prevalence of health problems: industrial workers (*n* = 388) and construction workers (*n* = 182). We collected information on self-reported productivity during the previous 2 weeks and during the last work day with the Health and Labor Questionnaire (HLQ) and the Quantity and Quality instrument (QQ), with added data on job characteristics, general health, presence of musculoskeletal complaints, sick leave, and health-care consumption. For construction workers, we validated self-reported productivity with objective information on daily work output from 19 work site observations.

Results. About half the workers with health problems on the last working day reported reduced work productivity (QQ), or 10.7% of all industrial workers and 11.8% of all construction workers, resulting in a mean loss of 2.0 hr/day per worker with reduced work productivity. The proportion of workers with reduced productivity was significantly lower on the HLQ: 5.3% of industrial workers and 6.5% of construction workers. Reduced work productivity on the HLQ and the QQ was significantly associated with musculoskeletal complaints, worse physical, mental and general health, and recent absenteeism. The QQ and HLQ questionnaires demonstrated poor agreement on the reporting of reduced productivity. Self-reported productivity on the QQ correlated significantly with objective work output (*r* = .48).

Conclusion. Health problems may lead to considerable sickness presenteeism. The QQ measurement instrument is better understandable, and more feasible for jobs with low opportunities for catching up on backlogs.

Introduction

In economic evaluations of health care interventions, it is widely recommended to consider all costs and savings relative to the benefits of the intervention. From a societal perspective, this also includes productivity costs, that is, the costs of production loss due to illness and associated disability.[1] Loss of productivity is traditionally measured by illness-related absence from work.[2] Even when employees are present at work, however, they may experience a decreased productivity caused by functional limitations due to health problems. The phenomenon that workers turn up at work, despite health problems that should prompt absence from work, is referred to as *sickness presenteeism*. A study across the Swedish workforce demonstrated that during a period of 12 months about 37% of all workers experienced sickness presenteeism.[3] In economic evaluations of health care interventions, the additional impact of primary effect measures (usually clinical and health outcomes) on associated indirect costs are seldom included.

Although sickness presenteeism may lead to substantial economic losses, few studies have estimated the decrease in productivity of workers with health problems. Among health insurance claim processors, it was shown that workers who used sedating antihistamines experienced on average 8% reduction in daily work output in the three days after receipt of the prescription, relative to the regular number of claims per day handled by these workers.[4] At a credit card company, sickness presenteeism accounted for higher productivity losses than sickness absence among telephone customer service operators with migraine, whereby job productivity was measured by handle time per call and time unavailable for calls.[5] Because objective measures of productivity at work are rarely available or are difficult to access, other studies have used self-reports to estimate the decrease in productivity that is associated with health problems at work. About 50% of migraine patients reported at least two work days lost per month.[6] Osteoarthritis patients with health complaints during work time reported about 9% mean loss in productivity.[7] In two studies, the prevalence of sickness presenteeism and the impact on worker productivity were estimated. Brouwer *et al*[8] reported that, on an average day, 7% of the workers in a trade company experienced health problems while being at work, with an estimated productivity loss of 13% per worker with health problems. Among computer users, about 8% reported reduced productivity due to musculoskeletal symptoms; the mean productivity loss was about 15% for women and 13% for men.[9]

Several questionnaires have been developed to measure sickness presenteeism. The Work Limitations Questionnaire measures time, physical, mental-interpersonal, and output demands of the job;[10] it has been validated with objective work productivity data.[11] Other questionnaires have focused directly on output performance by asking about work efficiency in the past 1 or 2 weeks on a 10-point numerical rating scale,[6] or the average level of functioning during a period with health problems.[12] The Health and Labor Questionnaire (HLQ) asks for the number of hours needed to compensate for lost work due to health problems during the previous 2 weeks,[13] whereas in the Quality and Quantity questionnaire (QQ) the quantity and quality of the work performed on the last working day can be reported on a 10-point numerical rating scale.[8]

Our primary objective was to evaluate the HLQ and QQ for the measurement of productivity loss at work in occupational populations with an established high prevalence of health problems. Although these questionnaires have been used in several cost-effectiveness studies, reliability and validity studies are scarce. Our secondary objective was to analyze the influence of individual characteristics, work-related risk factors, and general health on self-reported productivity at work.

Data and methods

Study population

We studied two occupational populations with an expected high level of sickness presenteeism due to musculoskeletal complaints. The first population consisted of construction workers who participated in an evaluation study of ergonomic improvements at the workplace. A total of 265 workers were invited to enroll in the study, and 93 floor layers and 89 road pavers returned a self-administered questionnaire (response 69%). Both occupations are well-known for their high physical load at work due to manual materials handling and strenuous postures. The construction workers were all male, their average age was 35 years, and they averaged 13 years of experience in the current job.

The second population consisted of industrial workers who participated in a randomized controlled trial on the impact of education and training, workplace adjustments, and in-company physiotherapy on the occurrence of musculoskeletal complaints. In nine companies, 388 industrial workers filled out a questionnaire on work and health (response 85%), comprising maintenance workers in a stevedoring company, order pickers in a warehouse, and four groups of operators in chemical plants. The industrial workers were largely male (94%), their average age was 42 years, and they averaged 11 years of experience in the current job. Almost all workers had full-time jobs and had less than higher education (higher vocational training or university degree).

Data collection

A self-administered questionnaire was used to collect data on productivity at work, sociodemographic indicators, general health, musculoskeletal complaints, sick leave, health-care consumption, and job characteristics.

Productivity at work was measured with both the HLQ and QQ instruments. The HLQ item asked whether the respondent was limited by health problems during work time in the previous 2 weeks. A respondent with an affirmative answer was subsequently asked to estimate the number of hours needed to compensate for the work loss due to sickness presenteeism in the past 2 weeks. The productivity loss was calculated as the number of hours per work day needed to compensate for work loss.[13] With the QQ instrument, the presence of health complaints during the most recent work day was evaluated, the work productivity on this day, and the reason for any self-reported loss in productivity. Reasons were classified as health problems or work-related events such as equipment failure. The respondent was asked how much work he actually performed during regular hours and what the quality of this work was as compared with a normal work day. The amount and quality of productivity were measured on a 10-point numerical rating scale, with 0 representing "nothing" and "very poor quality," respectively, and 10 representing "normal quantity" and "normal quality," respectively.[8] The productivity loss was normalized for a regular 8 hour work day and calculated by the formula [(10 – quantity score)/10] × 8 hours.

Questions on job characteristics were derived from a standardized questionnaire on work and musculoskeletal health.[14,15] Questions on physical work load concerned manual materials handling, awkward working postures with a bent or twisted back, and strenuous arm positions such as working with hands above shoulder level. A four-point scale was used with ratings "seldom or never," "now and then," "often," and "always" during a regular workday. The answers "often" and "always" were classified as high exposure.[14] The respondents also rated their perceived exertion on a Borg scale, ranging from 6 (very light) to 20 (very heavy), with a score of 16 or higher regarded as high perceived exertion.[16] The questions on psychosocial job characteristics were derived from the Karasek model.[17] Job demands were measured by 11 questions on psychosocial aspects of work, relating to working fast, working hard, excessive work, insufficient time to complete the work, and conflicting demands. Job control was measured by 17 questions on skill discretion and decision latitude. These questions pertained to aspects such as task variety, learning new things, amount of repetitive work, and autonomy in executing tasks and solving problems. In this model, subjects are supposedly at risk of ill health when experiencing high job demands and low job control. All questions had a 4-point categorical scale and a total sum score was calculated for each dimension. Workers at risk (high demands and low control) were identified using the higher than median scores on the job demands and job control sum scores.

The presence of musculoskeletal disorders was determined with the standard Nordic questionnaire, which has been proven to be a valid instrument to collect information on the nature, duration (days), and frequency (occurrences per month) of symptoms.[18] Musculoskeletal pain was defined as pain that had continued for at least a few hours during the past 6 months, specified by body region. Chronic pain referred to pain present almost every day in the preceding 6 months, with a minimal presence for at least 3 months. No attempt was made to further classify musculoskeletal complaints into specific diagnostic entities.[19] Health care utilization due to musculoskeletal complaints in the past 6 months combined care seeking to a general practitioner and subsequent referral to other health care professionals. The occurrence of sickness absence was derived from the question "Have you been absent from work during the past 6 months due to musculoskeletal complaints" and a nested question on number of days of sickness absence.[20] Sickness absence in the past 2 weeks was evaluated with the item from the HLQ.

The measurement of general health aspects was limited to the population of industrial workers. General health was measured with two generic instruments: the Short-Form 12 (SF-12) and the EuroQol. The SF-12 is a selection of 12 items from the SF-36 and has eight dimensions which were aggregated into two scores; the physical component summary scale (PCS-12) and the mental component summary scale (MCS-12), describing physical and mental health. The PCS-12 and MCS-12 scores range from 0 to 100, with greater scores representing better health. The SF-12 has a good test–retest reliability ($r > .76$) and a good validity.[21] In the EuroQol (EQ5D) instrument, general health is defined along five dimensions: mobility, self care, usual activities, pain and discomfort, and anxiety and depression.[22] The item scores were combined into a summary measure ranging from 0 for death to 1 for full health, using a scoring algorithm based on valuations from the United Kingdom general population and subsequent statistical modelling.[23] In the second part of the EuroQol instrument, respondents recorded their health on a visual analogue scale (EQ5D VAS), somewhere between 0 (worst imaginable health state) and 100 (best imaginable health state). The EuroQol instrument has a good test-retest reliability[24] and a good validity.[25] The EQ5D summary measure has shown significant positive correlations with the PCS-12 score ($r = .55$) and the MCS-12 score ($r = .41$), and appeared to be slightly less sensitive than the SF-12 to differences associated with less severe morbidity.[26]

Among a sample of the construction workers, it was possible to measure objective work productivity by means of worksite observations. QQ questionnaires were administered at the same day as the worksite observations, enabling comparison of actual and self-reported productivity at work and an assessment of the external validity of the QQ. For 36 floor layers (19 teams of two to three workers) and 24 road pavers (12 teams of two to four workers), the daily work output was measured by the size of street or floor surface made that day (square meters). The productivity among floor layers was normalized for differences in floor thickness and type of floor constructed, because these factors partly determine the number of square meters that can be achieved. Among road pavers, the team productivity was adjusted for level of mechanization at work.

Data analyses

For the main variables we generated descriptive statistics such as means and percentages. We determined the construct validity of the HLQ and QQ questionnaires on self-reported productivity by testing the relationship between the productivity scores and general health (EQ5D summary measure), physical health (PCS-12), mental health (MCS-12), the presence and severity of musculoskeletal symptoms, and job characteristics. We used the unpaired Student's *t*-test and ANOVA techniques for testing mean differences in continuous variables among groups, such as for differences in general health among workers with or without productivity loss or differences in self-reported work productivity between workers with and without musculoskeletal symptoms. Chi-square testing was used to determine associations among categorical variables, such as sickness presenteeism and the presence of musculoskeletal symptoms.

We expected that the proportion of workers reporting reduced work output would be higher in those reporting high job demands and low job control, because these job characteristics give less latitude to compensate for productivity loss in case of health problems. This hypothesis was tested with the chi-square test.

The Pearson correlation coefficient was used as a measure of association between quantity and quality of the work performance on the most recent workday (QQ instrument).

The agreement on self-reported productivity loss due to health problems between the HLQ and QQ questionnaires was evaluated by the percentage agreement over all categories and by Cohen's kappa. We considered $\kappa < .4$ to represent poor agreement, κ-values between .4 and .6 as moderate agreement, and $\kappa > .6$ as good agreement.[27]

The association between self-reported productivity and actual work output was determined by linear regression, with actual work output as the dependent variable and self-reported productivity as the independent variable. Because the observation unit of productivity is a team of two persons, we used the mean self-reported productivity of both workers in a team.

All statistical analyses were performed with SPSS release 10.0.7 (SPSS, Chicago, IL, USA).

Results

Table 1 shows the health status of the construction workers and industrial workers. In both groups, the prevalence of musculoskeletal complaints in the past 6 months was high: 11% of industrial workers and 21% of construction workers had experienced musculoskeletal symptoms on the previous workday, and approximately 1 in 7 workers reported the presence of chronic symptoms. About half of the workers with complaints sought health care, and about 20% had sick leave at least once in the past 6 months. Back complaints were the most prevalent musculoskeletal problem and largely responsible for care seeking and sickness absence.

Table 1: Health indicators among construction workers and industrial workers.

Health indicators	**Industrial workers**, % (n = 388)	**Construction workers**, % (n = 182)
Musculoskeletal complaints in past 6 months	66	59
Chronic complaints[a]	15	14
Complaints with medical care	29	31
Sick leave due to musculoskeletal complaints	13	24
Low-back complaints in past 6 months	45	41
Chronic complaints[a]	4	6
Complaints with medical care	18	21
Sick leave due to low-back complaints	9	16
Musculoskeletal complaints on previous workday	11b	21
Scores		
PCS-12	50.5	na
MCS-12	53.8	na
EQ5D summary measure	0.886	na
EQ5D VAS	80.3	na

Abbreviations: EQ5D, EuroQol instrument; MCS, mental component summary scale; na, not available; PCS, physical component summary scale; VAS, visual analogue scale. [a] Complaints of > 3 months duration present during the past half year. [b] Low-back complaints only.

Table 2: Productivity loss at work due to health problems according to two assessment methods among industrial workers and construction workers.

	Industrial workers (n = 388)	**Construction workers** (n = 182)
Health and Labor Questionnaire[13]		
Limitations due to health problems	0.217	0.17
Limitations due to MSD problems	0.097	0.113
Lost work time due to health problems	0.053	0.065
Lost work time due to MSD problems	0.012	0.03
Average hours/day lost due to health problems[a]	1.0 hr/day	1.5 hr/day
Average hours/day lost due to MSD problemsa	0.5 hr/day	2.0 hr/day
Quality and Quantity Questionnaire[8]		
Health problems during previous work day	0.205	0.244
MSD problems during previous work day	0.109	0.209
Lost work time due to health problems	0.107	0.118
Lost work time due to MSD problems	0.045	0.089
Average hours/day lost due to health problems[a]	2.2 hr/day	1.8 hr/day
Average hours/day lost due to MSD problems[a]	1.9 hr/day	1.9 hr/day

Abbreviations: MSD, musculoskeletal disorders. [a] Among those with lost work time.

Table 2 presents the information on work productivity reported on both instruments. On the HLQ, 22% of industrial workers and 17% of construction workers reported work limitations due to health problems in the past 2 weeks. Musculoskeletal complaints accounted for the majority of all health problems; however, only 30% of construction workers and 25% of industrial workers with work limitations reported that they would need time to compensate for any lost work, whereas 27% of these did not answer this question. Industrial workers with health problems and associated productivity losses estimated an average loss of 1.0 hr/day (12%) and construction workers of 1.5 hr/day (19%). Among workers with musculoskeletal problems, the average productivity loss amounted to 0.5 hr/day (7%) for industrial workers and 2.0 hr/day (25%) for construction workers.

The likelihood of productivity loss measured with the HLQ was significantly ($P < .05$) associated with the occurrence of musculoskeletal complaints in the past 6 months, worse physical health (PCS-12), worse mental health (MCS-12), or worse general health measured by the EuroQol (Table 3). A high psychosocial load and recent work absence (past 2 weeks) were significantly associated with reduced work productivity. No significant associations were found with the presence of chronic musculoskeletal complaints and low-back complaints.

Among all workers with any health problems on the last work day, approximately 50% reported a loss in productivity as measured by the QQ questionnaire (Table 2). As a consequence, 10.7% of industrial workers and 11.8% of construction workers experienced reduced work performance through health problems, with a mean loss of 2.0 hr/day (any health problems) and 1.8 hr/day (musculoskeletal complaints). The proportion of workers reporting reduced productivity on the QQ was significantly higher than measured by the HLQ ($P < .01$). About 8% did not report work performance. Among workers who reported reduced work performance, slightly more than 50% was due to health problems, the remaining proportion being due to external factors.

Among workers with any health problems, the quantity (8.2, standard deviation SD = 2.6) and quality (8.9, SD = 1.9) of work performance reported on the QQ were significantly lower than among workers without health problems: 9.7 (SD = 1.0) and 9.7 (SD = 0.9), respectively ($P < .001$). The occurrence of production loss (quantity) was significantly associated with the occurrence of musculoskeletal complaints or low-back complaints in the past 6 months, the presence of chronic musculoskeletal complaints, worse physical and mental health (PCS-12 and MCS-12), worse general health (EuroQol), and recent work absence (Table 3). No significant associations were found between sickness presenteeism and high psychosocial work load or high physical load.

Table 3: Univariate associations between sickness presenteeism and personal health, physical, and psychosocial job characteristics.

	Reported work loss, QQ[a]		Reported work loss, HLQ	
	Yes (n = 58)	No (n = 512)	Yes (n = 22)	No (n = 548)
Musculoskeletal complaints in past 6 months				
All	0.91	61%*	0.86	63%*
Chronic	0.35	12%*	0.18	0.14
Low-back complaints in past 6 months				
All	0.69	41%*	0.59	0.43
Chronic	0.09	0.04	0	0.05
General health				
PCS-12, mean	38.5	51.9*	42.8	51.0*
MCS-12, mean	51.6	54.0*	49.3	54.0*
EQ5D summary measure, mean	0.646	0.912*	0.797	0.891*
EQ5D VAS, mean	66.3	81.7*	72.2	80.7*
Psychosocial load				
High job demands and low job control	0.24	0.23	0.46	23%*
Physical load				
High perceived exertion	0.47	0.34	0.46	0.35
Sickness absence in past 2 weeks	0.22	7%*	0.5	7%*

Abbreviations: EQ5D, EuroQol instrument; HLQ, Health and Labor Questionnaire; MCS, mental component summary scale; PCS, physical component summary scale; QQ, Quantity and Quality instrument; VAS, visual analog scale. * $P < 0.05$ (χ^2 test or ANOVA). [a] Quantity scale only.

The quantity and quality scales of the QQ instrument on self-reported productivity were significantly correlated among industrial workers (r = .73) and construction workers (r = .33). Similar to lost quantitative output, one in five workers reported reduced quality of work output. When assuming that qualitative productivity loss is additive to quantitative productivity loss, workers with lost work output due to health problems would lose an additional 1.1 hr/day (industrial workers) or 0.5 hr/day (construction workers).

The HLQ question on limitations due to health problems showed an agreement of 88% with the QQ question on health problems during the previous work day. This percentage agreement was strongly influenced by the large proportion of negative answers. The κ- value was .64 (95% CI .59 – .69), which indicates a moderate to good agreement between both questionnaires. The comparison of work loss due to health problems showed an agreement of 89% but a poor κ-value of 0.18 (95% CI 0.11 – 0.25). Among the 71 workers who reported health-related productivity loss in either the HLQ method or the QQ method, only 9 workers (13%) reported productivity loss on both instruments.

Among floor layers, actual production output was significantly correlated with the mean self-reported productivity of the team (QQ) (correlation coefficient r = 0.48, adjusted R^2 = 0.19, n = 19).

The correlation was compromised by ceiling effects of the QQ instrument (almost 50% reported no production loss). Due to the very low variation in actual production output in road pavers (coefficient of variation 9.5%), no correlation was found with self-reported productivity.

Discussion

We found that reduced work productivity at work due to health problems (sickness presenteeism) was prevalent in 5% to 12% of construction workers and industrial workers, with a mean loss in productivity of 12% to 28%. The occurrence of sickness presenteeism in many occupational groups has been noted before.[3] In our study, sickness presenteeism added substantially to sick leave as a cause of production loss. This makes a worker's disability on the job a burden to the employee, but also a significant cost to the company. If this is accounted for, interventions that reduce high-prevalence health problems, such as musculoskeletal disorders, will show a more favorable cost-effectiveness.

We observed that the proportion of workers that reported productivity loss on the QQ instrument was about two to three times higher than with the HLQ, leaving room for uncertainty. Mean hours lost per construction worker per day were 6.5% × 1.5 hours ≅0.1 hours as measured by the HLQ, and 11.8% × 1.8 hours≅ 0.2 hours as measured by the QQ instrument, equivalent to 1% to 3% of total work time. We hypothesize that the HLQ instrument yields a conservative estimate, due to framing of the question. Almost half the respondents, industrial workers as well as construction workers, reported no need for extra hours to compensate for any lost work time, although experiencing health-related work limitations in the past 2 weeks. This might be due to the nature of work activities that do not allow catching up on a backlog, such as processing activities in chemical plants. Another explanation might be the cognitive difficulty of the HLQ instrument. This is supported by the high number of missing answers that were found (about 25%). These interpretations would make the instrument not applicable in populations of low education or for jobs that do not allow catching up on backlogs.

In comparison with the HLQ, the QQ appeared to be more responsive to health indicators and job characteristics and in the expected direction, indicating a better construct validity. The external validity of the QQ, in our study determined with actual production output, was acceptable. The large number of missing answers n the QQ is of concern (8%), which is slightly higher than reported elsewhere.[8] Another concern is the high correlation between the quantity and quality scale of the QQ: $r = 0.73$ among industrial workers and $r = 0.33$ among construction workers. A strong correlation may indicate a strong underlying relationship between work performance in terms of quantity and quality; however, it might also indicate that the instrument does not discriminate sufficiently between the quantitative and qualitative aspects of work performance.

A positive significant association between self-reported productivity and psychosocial work load was found with the HLQ, but not with the QQ instrument. In the Karasek model, the combination of high work load and low job control is a health risk, and we therefore assumed that these job characteristics would also negatively influence work productivity.

A unique feature of our research was that self-reported work productivity could be verified by means of objective measures. Such data are generally not available or are difficult to access. The number of square meters is an obvious indicator of work performance in floor layers and road pavers, and appeared to be more reliable than the amount of material handled. The actual daily output that can be achieved is determined by many factors in addition to individual worker characteristics, such as the level of difficulty and complexity of the job. In our analysis, this could be adjusted for in part with information on floor thickness and level of work mechanization. In addition, the correlation between self-reported and actual productivity was compromised by ceiling effects of the QQ instrument. Nevertheless, the strength of the correlation (0.48; adjusted $R^2 = 0.19$) compares favorably with the findings of Lerner *et al,*[11] who found that self-reported work limitations explained only 1% of the total variation in work productivity.

We included specific populations of workers with manual jobs and high rates of musculoskeletal problems, although general health was comparable with the general population.[26,28] Nevertheless, the proportion of workers with reduced work productivity and the mean productivity loss per worker with reduced work productivity, is in line with those observed in workers of a trade company[8] and computer users with musculoskeletal problems.[9] Productivity loss in our study is lower than among migraine patients, who lost about five work days per year due to sickness presenteeism.[29] This is mainly because a minority of patients with musculoskeletal problems experience work limitations. Musculoskeletal problems, however, cause higher societal costs because the prevalence is much higher, especially among specific worker populations.

Information on the impact of health problems on worker productivity, as provided by the studies cited in the previous paragraph, is a relevant issue in economic evaluations of interventions for health improvement (specifically, interventions in worker populations). Intervention programs on musculoskeletal complaints at work should not be restricted to sickness absence, but should also include presenteeism, given that the indirect costs associated with presenteeism may surpass the indirect costs of sickness absence. Presenteeism may be reduced by ergonomic improvements, adjustment of work demands, and increased coping with complaints at work. On the other hand, presenteeism may be acceptable when the workplace accommodates workers with complaints in continuing their work, albeit at a lower level of productivity, instead of taking sick leave. Presenteeism can also be an essential part of programs for the timely return to work of workers with musculoskeletal complaints through the provision of modified work whereby activities in the job are adapted to the possibilities of the disabled employee.[30] A better appreciation of presenteeism versus sickness absence will further contribute to the planning and development of measures to improve the work environment and to health policy making. The economic relevance can be an extra stimulus for employers to invest in health promotion programs.

Although our study focused on musculoskeletal complaints in a working population, we acknowledge that musculoskeletal complaints are highly prevalent in the general population and may severely impact home and leisure activities.[31] Subjects with chronic musculoskeletal complaints may experience functional limitations in their daily activities and, hence, may need specific social services to compensate for this loss of productivity. We suggest that both instruments for productivity at work be converted for use in the general population to assess loss of productivity at home.

We conclude that productivity losses due to health problems at work are substantial and can be measured reliably with the QQ instrument. Specific characteristics of the instrument, however, need further validation, such as the high correlation between the quality and quantity scale. The HLQ instrument is not applicable in populations of low education or jobs that do not allow catching up on backlogs. In medical interventions, improvements in clinical health outcomes may result in reduction of productivity loss and as a consequence reduce the indirect costs of health. These effects should be taken into account when evaluating the cost-effectiveness of interventions.

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Part II
Chapter 7

Effectiveness of a back pain prevention program: a cluster randomized controlled trial in an occupational setting

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Effectiveness of a back pain prevention program: a cluster randomized controlled trial in an occupational setting
(accepted for publication in Spine)

Abstract

Background: Low back pain (LBP) accounts for high costs in Western societies, but little is known about the effectiveness and related costs and savings of prevention programs for LBP.

Objective: To assess the effectiveness of a prevention program for LBP in an occupational setting together with an economic evaluation.

Design: A cluster randomized controlled trial and economic evaluation with a 12-month follow-up, with the work department as unit of randomization.

Study population: Workers in physically demanding jobs from 9 large companies located throughout The Netherlands. In each company 2 comparable work units were randomly allocated, resulting in 18 clusters with 258 workers assigned to the intervention group and 231 workers to the control group.

Intervention: A multidimensional LBP prevention program (based on the principles of the biopsycho-social model) consisting of an integrated approach of three preventive measures: combining tailored education and training in work techniques; immediate treatment of (sub)acute LBP through an incompany physical therapy service and, if appropriate, a workplace visit with advice on ergonomic adjustments of the workplace or extra training sessions on appropriate work techniques at the worker's worksite. Usual care was provided according to Dutch health care guidelines.

Main outcome measures: The primary outcome measures were the occurrence and duration of LBP and subsequent sickness absence. Secondary outcome measures were pain intensity and functional limitations due to LBP, presence of upper extremity musculoskeletal complaints (UEC) and related sickness absence, general health, and health-related quality of life. The economic evaluation was conducted from a societal perspective and included both direct and indirect costs due to LBP and UEC.

Results: No significant differences were found in effects or costs savings of the program. Indirect costs related to work absence and productivity losses accounted for 84% of the total costs due to LBP.

Conclusions: No evidence was found to support adoption of this particular worksite prevention program for LBP.

Introduction

Work absence and disability due to non-specific low back pain (LBP) account for high economic costs in Western societies.[1] Total direct and indirect costs in the United Kingdom, United States, and the Netherlands were estimated at 11, 50, and 5 billion US $ per year, respectively.[2-4] Unfortunately, attempts to prevent the occurrence of LBP (primary prevention) have not been very successful;[5] nowadays the high burden of disease has focused the attention not only on the prevention of the onset of LBP, but also on minimizing the adverse consequences such as chronicity and (work) disability. Improvements might arise from interventions aimed at preventing cases that require considerable resources or become chronic. The European Guidelines for the prevention of LBP gives evidence-based recommendations on strategies to prevent LBP and its unfavorable consequences; the guidelines state that treatment to prevent the various consequences of LBP (secondary prevention) is feasible.[6,7] For workers, clinical interventions with a workplace component (e.g. including a workplace visit or ergonomic adjustments) and a natural involvement of the key stakeholders are recommended in the management of subacute LBP.[8,9] Another study showed that for acute LBP, early intervention consisting of a combination of biopsychosocial education and treatment with manual therapy and exercise was more effective on functional recovery, general health and quality of life than just advice on staying active that is recommended in some guidelines.[10] Furthermore, the guidelines state that education (based on biopsychosocial principles) that promotes staying active and emphasizes the good prognosis of LBP should preferably be incorporated into the workplace advice.[6]

Owing to the multidimensional nature of LBP, no single intervention is likely to be effective in preventing the overall problem of LBP. Therefore, it is recommended that new studies should focus more on broad-based multidimensional programs rather than monodimensional programs.[6,11] A multidimensional approach based on a biopsychosocial model combining ergonomic education and training tailored to the risk profile of the worker with an early stage intervention at the work site in the occurrence of (absenteeism due to) LBP is promising.[5,12] However, to date, little is know about the effectiveness of this approach.

Therefore the aim of the present study was to evaluate the effectiveness (with an economic evaluation) of a multidimensional LBP prevention program, based on the principles of the biopsychosocial model, integrating three preventive measures combining tailored education and training in work techniques; immediate treatment of (sub)acute LBP through an incompany physical therapy service and, if appropriate, a workplace visit with advice on ergonomic adjustments of the workplace or extra training sessions on appropriate work techniques at the worker's worksite.

Methods

The study was designed as a full economic evaluation alongside a cluster randomized controlled trial (RCT). The study was approved by the Medical Ethics Committee of the Erasmus MC.

Study population

The study population consisted of workers in physically demanding jobs recruited from 9 large companies (> 500 workers) located throughout the Netherlands. The in-company physical therapy service that conducted the intervention under study informed affiliated companies about the intervention program. Companies who wanted to take up the program within one year were asked to participate in the study. Inclusion criteria for companies were: the possibility to provide two clusters of workers with approximately the same estimated physically demanding jobs (mainly based on job title); and willingness to concur with randomization of the intervention and with the study protocol. All workers on contract for at least 24 hours per week were eligible to be invited to participate. Written informed consent was obtained from all participants at the time of enrolment, which was after randomization of their respective work units. The 18 clusters included order pickers and operators in two warehouses, maintenance workers in a stevedoring company and a petrochemical plant, railway workers, and groups of operators in four chemical plants.

Randomization and blinding

To minimize the transfer of relevant knowledge from workers receiving the intervention to those receiving usual care, and thus avoid potential bias due to contamination, we performed a cluster RCT with the work unit as unit of randomization. Within each company clusters consisting of comparable departments or workshifts (i.e. work units) were allocated by simple random allocation to the intervention or the control (usual care) group. Randomization was performed with a computer-generated table of random numbers (SAS version 8.12) by a researcher blinded to the identity of the work units. The principal investigator was blinded for the allocation of the intervention when performing the data analysis. Workers could not be blinded for the intervention. Also, participating physical therapists could not be blinded for treatment allocation, however, they were not involved in the assessment of outcome measurements.

Figure 1 shows the CONSORT diagram[13] of the flow of clusters and participants through the phases of the trial. In total, 9 clusters were assigned to the intervention program (n = 258) and 9 clusters to the usual care group (n=231). All 18 clusters remained in the study during the 12 months of follow-up and received the intervention as planned.

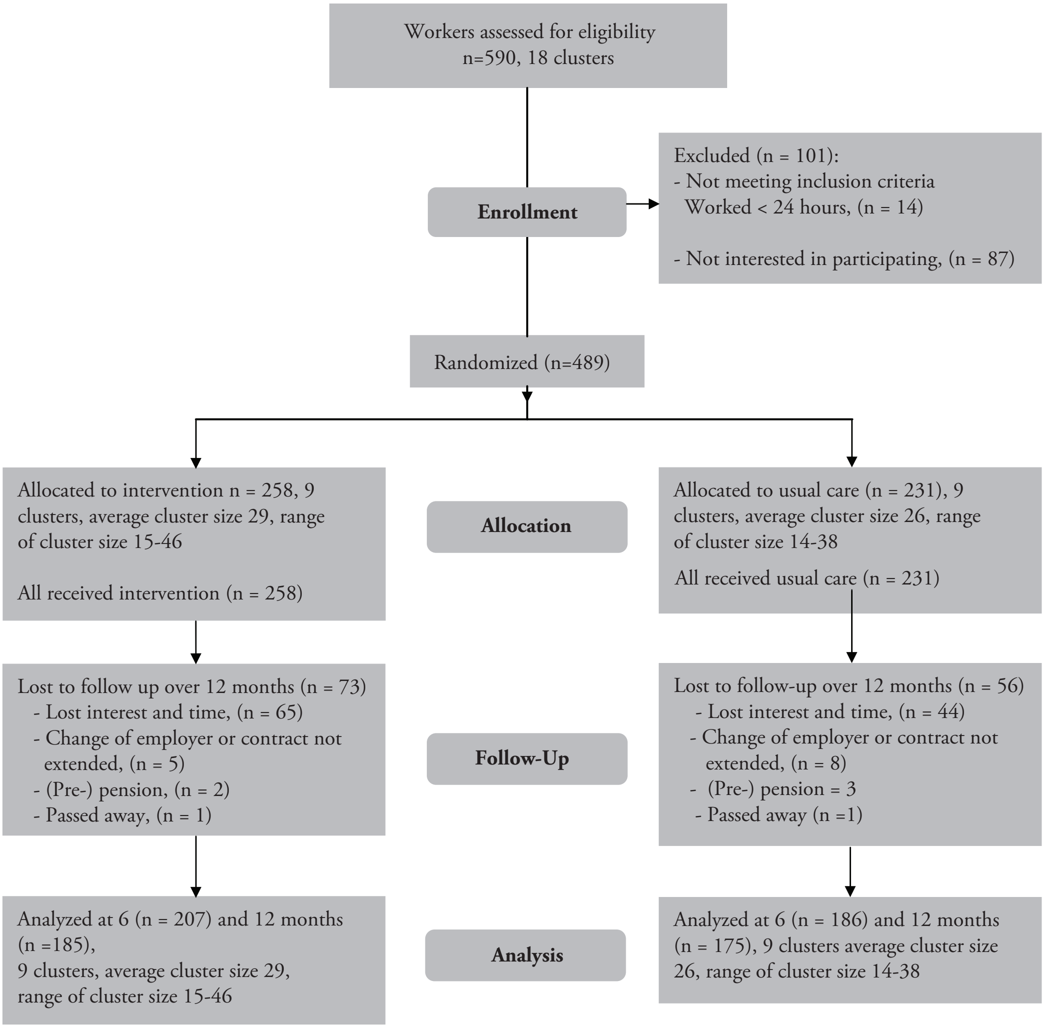

Fig 1 Flow of clusters and participants through the phases of the trial

Intervention

The back pain prevention program consisted of an integrated approach of three preventive measures (based on the principles of the biopsychosocial model), i.e. combining individually-tailored education and training, immediate treatment of (sub)acute LBP, and advice on ergonomic adjustment of the workplace. The rationale was that this integrated preventive approach would be more effective than the separate parts. The intervention had a strong workplace component and a natural involvement of the key stakeholders.

The first measure was offered to all workers in the intervention group and comprised 3 back training group sessions consisting of tailored education and training in appropriate working techniques on the actual work site. The self-limiting nature and favorable outcome of LBP, as well as the therapeutic benefit of movement and participation in normal work and leisure activities, was emphasized. In addition, coping strategies and helpful exercises were practiced.

The second preventive measure consisted of immediate treatment of (sub)acute LBP to prevent chronicity through an easily accessible incompany physical therapy service. The study adopted a pragmatic approach to physical therapy treatment. In keeping with normal clinical practice, the choice of initial and subsequent elements of the physical therapy care was at the treating therapist's discretion. The content and frequency of the treatment was individually tailored to the risk profile of the patient. Specific advice was given on how to cope with the complaint at the work station.

The third preventive measure was aimed at workers with LBP complaints. When needed, 3 extra sessions were given on appropriate work techniques at the worker's work site (on-the-job training) or a work place examination was performed; based on the results, advice on ergonomic adaptations was given to the employer.

Usual care

Usual care was given by the general practitioner (GP) or occupational physician (OP) according to the Dutch guidelines for the health care of patients with LBP.[14,15] In the Netherlands most workers with LBP complaints will first consult their GP. The first 6 weeks after consultation for LBP the GP guideline for LBP stresses to stay active and to prescribe, when necessary, analgesics or nonsteroidal anti-inflammatory drugs (NSAIDs). The GP may refer patients with sub-acute LBP (6 weeks duration) to physical therapy. The OP is responsible for sick leave management. The Dutch OP guidelines for LBP emphasize to resume daily activities and work within two weeks, when possible. Workplace interventions are mentioned as an option and a clinical intervention is recommended after 12 weeks of sick leave.

Contrast between the intervention and usual care group

Workers in both groups were not restricted in their option to obtain additional health care. During the intervention period, co-interventions were registered and evaluated. Subjects in the control group were informed that they could receive the intervention one year later, after the study had finished.

Data collection

On three occasions (with a 6-month interval in between) the workers completed a self-administered questionnaire on individual and job-related characteristics, on work-related psychosocial and physical risk factors, musculoskeletal complaints and subsequent sickness absence, productivity losses at work, medical consumption, general health status and on health- related quality of life.

Primary outcome measures

The primary outcomes were the occurrence and duration of LBP and subsequent sickness absence during the 1-year follow-up. The presence of musculoskeletal symptoms was determined with the standardized Nordic questionnaire on the nature, duration, and frequency of symptoms.[16] At baseline musculoskeletal pain was defined as "pain in the past 12 months" (yes/no), which referred to at least one episode of pain or discomfort in the past 12 months lasting for at least one day. Chronic complaints were defined as pain which was present almost every day in the preceding 12 months with a minimal presence for at least 3 months. The same questions were asked in the follow-up questionnaires using a recall period of 6 months.

Data on sick leave were collected by a questionnaire on the frequency and duration of sickness absence due to LBP, that has good validity.[17] The question on sickness absence due to LBP was phrased 'Have you been absent from work during the past 6 months due to back pain?' With a positive reply, subsequent questions were asked on an ordinal scale about the frequency and duration of sickness absence. The total number of sick leave days due to LBP was estimated as 3, 11, or 21 days by using the midpoint of the answer categories.

Secondary outcome measures.

Secondary outcome measures were mean pain intensity and functional limitations due to LBP, presence of upper extremity complaints UEC) and related sickness absence, productivity losses at work due to LBP and UEC, general health status (SF-12), and health-related quality of life (EQ-5D). Mean pain intensity was scored on a numerical rating scale ranging from 0 (no pain at all) to 10 (worst possible pain).[18]

Functional limitations were assessed with the Roland Morris Disability Questionnaire,[19] comprising 24 statements related to activities of daily living; each scored either 0 (disagree) or 1 (agree). A sum score was calculated which could range from 0 (no dysfunction) to 24 (maximum dysfunction).

The presence of UEC symptoms was determined with the standardized Nordic questionnaire.[16] Since the neck, shoulders and arms operate as a functional unit, we grouped musculoskeletal pain in the neck, shoulder, elbow, wrist and hand into the category 'upper extremity complaints'. Data on sick leave were collected in the same way as for LBP.

General health was measured with the SF12[20] (derived from the SF36[21]) which yields a physical component (PCS12) and mental component (MCS12),. both scores range from 0 to 100, with higher scores representing better health.

In the EuroQol (EQ-5D)[22] five dimensions are used as measures for preference-based health-related quality of life: mobility, self-care, usual activities, pain and discomfort, and anxiety and depression. The preference scores for each worker were calculated using weights for different health states as obtained from a general population in the UK.[23] The EQ-5D instrument has a good test-retest reliability[24] and a good validity.[25]

Prognostic measures

At baseline, various prognostic measures were collected to evaluate whether randomization successfully resulted in two groups with comparable prognosis, and (if necessary) to be able to adjust for baseline differences in the analyses. Socio-demographic information included age, height, weight, sex, and level of education. The Body Mass Index (BMI) was calculated (weight/height^2), and a subject with a BMI higher than 30 was considered as obese. The questions on physical work load were obtained from the Dutch Musculoskeletal Questionnaire (DMQ)[26] and concerned questions on manual materials handling and awkward working, and strenuous arm positions such as working with hands above shoulder level or repetitive movements of the arms. A four-point scale was used with ratings 'seldom or never', 'now and then', 'often', and 'always' during a regular workday. The answers 'often' and 'always' were classified as high exposure. The respondents also rated their perceived physical work load on a 10-point numerical rating scale, ranging from 0 (very light) to 10 (very heavy),[27] with a higher than median score regarded as high perceived workload.

Potential work-related psychosocial factors were assessed by means of a Dutch version of the Job Content Questionnaire (JCQ).[28] Job demands were measured by 11 questions relating to working fast, excessive work, insufficient time to complete the work, and conflicting demands. Job control was measured by 17 questions on skill discretion and decision latitude. All questions had a four- point categorical scale and a total sum score was calculated for each dimension. Similarly, 9 questions were asked on supervisor and 9 on co-worker support. Workers at risk were classified using the higher than median score.

Economic evaluation

Economic analysis was done from a societal perspective and aimed to contribute to the decision-making process of policymakers and insurers who are concerned with the reimbursement of LBP prevention programs. Costs were prospectively measured during the 12-month study period, and direct and indirect costs were taken into account. Relevant categories of resource utilization were identified and the volume was multiplied by the resource costs. **Table 1** provides an overview of the applied costs.[29,30] We included intervention costs, and costs related to medical consumption and sickness absence. Estimated days of sick leave were multiplied by the average wage per day (€244). Productivity loss at work was measured by the quantity scale of the Quality and Quantity-questionnaire (QQ).[31,32]

The estimated productivity loss on a workday with LBP was multiplied by the estimated total number of days with LBP, based on the midpoints of the duration categories of LBP on the Nordic Questionnaire.[16] The estimated productivity loss on a workday due to other health complaints was assigned for 33% to UEC, since the UEC prevalence was 33%.

Medical consumption

Medical consumption was determined by questions about medical care sought for musculoskeletal symptoms. The total number of visits for LBP and UEC to a general practitioner (GP), occupational physician (OP), medical specialist or an (incompany) physical therapist in both groups was calculated. For each patient the physical therapists on the worksite completed a registration form on the content of the treatment and the number of treatment sessions given.

Table 1: Unit costs used in the economic evaluation.

		Costs (€)
Intervention costs		
	Fixed implementation costs (per worker)[a]	90.0
	Variable implementation costs (per worker)[a]	142.2
	Workplace examination (per examination)[a]	232.0
	Training on the job (per treatment)[a]	328.0
Direct health care costs		
	General practitioner (per contact)[b]	24.8
	Occupational physician (per contact)[c]	48.0
	Physical therapist (per contact)[b]	21.5
	Medical specialist (per out-patient visit)[b, d]	56.0
Indirect costs		
	Absenteeism paid work (per day)[e]	244.0
	Productivity losses at work (per full day)	244.0

€1.00= £0.60, $0.90

a Price according to participating incompany physical therapy service. b Advised price according to Dutch guidelines.[29] c Price according to participating occupational health care service. d Tariff according to Dutch Central Organization for Health Care Charges.[30] e Cost approach based on mean salary of Dutch population according to age and sex.[29]

Statistical methods

In the sample size calculation an intracluster correlation of 0.05 was used, an average of 20 workers per cluster, an initial participation of 75%, and a loss-to-follow-up of 30%. Under these assumptions, we anticipated to be able to detect a difference of 10% in prevalence between the intervention and control group (power of 80%, one-sided significance level 0.05) with 350 workers with completed questionnaires in 9 clusters assigned to the intervention. This sample size is able to detect a difference of 5 days with LBP (prevalence 50%, 50% of episodes duration longer than 7 days) and 8 days of sickness absence (prevalence 10%, 50% of sick leave periods longer than 7 days) between both groups.

The baseline characteristics of both groups were compared with the chi-square test for dichotomous data and the *t*-test for continuous data. The effects of the intervention on outcome measures at 6 and 12 months follow-up were analyzed according to the intention-to-treat principle, including all subjects regardless of whether or not they actually received the complete intervention. The analysis was conducted with all available respondents at the time of follow-up and non-response analyses were conducted to evaluate whether drop- out during the first or second follow-up period of 6 months was associated with health status or intervention status. An imputation technique for missing responses on health outcomes during follow-up measurements was not used, since the choice for a particular imputation method may influence the overall estimate of the intervention effect.[33] The effects of the intervention on the continuous health measures were evaluated with mixed effects models with the intervention as fixed effect, taking into account the random variation between workers in the same cluster and between clusters under the assumption of a compound symmetry covariance structure. All mixed effects models were adjusted for cluster, sex, and age (fixed factors) and included the baseline value of the health measure of interest (SAS version 8.12 – procedure Mixed). These models were also used to calculate the intra-cluster correlation coefficient ICC which expresses the proportion of the within-cluster variance in the total variance among subjects.

The effects of the intervention on the dichotomous health measures were analyzed by a chi-square method (SAS version 8.12 – procedure Surveymeans), taking into account the cluster as sampling unit, and adjusted for sex and age. In the economic analysis the various costs measures had very skewed distributions and the two-sided Mann-Whitney U-test was used to test for a significant difference. All analyses were carried out with the statistical package SAS version 8.12.[34]

Results

Figure 1 shows that at baseline 590 workers were invited to participate in the study, of which 505 (86%) gave written consent and returned the completed questionnaire. The response at 12-months follow-up was 360 (74%) subjects.

The non-response analysis showed that in the intervention group the prevalence of sickness absence due to UEC among respondents for whom no follow-up information was available was significantly higher (27% versus 8%) than among the respondents who remained in the study. This effect was not observed in the control (usual care) group and also not for LBP sickness absence in either the intervention or the control group. Loss-to-follow-up was not related to any of the other outcome measures. At baseline the mean cluster size was 27.2 (range 14–46).

Table 2 presents the baseline characteristics of the two study groups. The randomization was successful in creating study groups with similar demographic characteristics, including current and past medical and health conditions. A minor difference between the groups was found for occupational characteristics. Job control and working with the arms in strenuous positions showed a small but significant baseline difference between the two groups, but had no influence on the estimated effects of the intervention.

Effects of the intervention

Table 3 gives data on the effects of the intervention on primary and secondary outcomes. There was no additional positive effect of the intervention on any of the LBP outcome measures compared with the control group. Sickness absence due to UEC was significantly lower in the intervention group than in the control group. No significant differences between intervention and control group were observed for any of the other secondary outcomes. There was no effect on recurrence of complaints or sickness absence. The results remained almost the same after additional adjustment for strenuous arm positions and low job control, i.e. the two characteristics that differed between intervention and usual care group at baseline.

Health care utilization

Table 4 presents data on the use of health care resources for LBP and UEC by both study groups during the intervention period. In general, health care resources for LBP were used equally by both groups. In the intervention group the incompany physical therapy option was used by only 10 workers, whereas 66 workers consulted physical therapists outside the company. There was a slight but not significant difference in utilization between the groups for physical therapy visits and visits to medical specialists. Health care utilization for UEC complaints was twice as high in the control group. There was no effect on recurrence of health care utilisation.

Costs

Table 5 presents data on the mean costs per worker in the intervention and control group during the 12-month follow-up period. Total costs during follow-up were slightly lower (€ 82) in the intervention group, but due to the very skewed distribution far from significant. In the present study 85% of the total costs were indirect costs, of which 54% was caused by sickness absence and 46% by productivity losses during work. The distribution of direct and indirect costs was similar in the two 6-month periods of follow-up.

Sensitivity analysis

There was no difference in results when using the patient as unit of observation (individual level) or when adjusting for the cluster effect (cluster level). In the sensitivity analyses no effect of the intervention was found for specific subgroups of subjects who reported musculoskeletal complaints, sick leave, or health care utilization at baseline.

Table 2: Characteristics of the study population and baseline values of outcome measures.

Variable	**Intervention group (n = 258)**	**Usual care group (n = 231)**
Mean age, y, SD	41.3 (9.6)	41.3 (9.8)
Women, %	5 (2%)	9 (4%)
Education		
Lower education	113 (45%)	90 (39%)
Intermediate education	127 (50%)	131 (57%)
Higher education	14 (6%)	7 (3%)
Body mass index > 30 (kg/m^2), %	36 (14%)	21 (9%)
Years employed in current job, mean (SD)	10.6 (10.1)	9.9 (8.7)
Work-related physical load:		
High manual materials handling, %	70 (27%)	37 (16%)
High awkward back postures, %	174 (67%)	129 (56%)
Strenuous arm positions,%	155 (60%)*	104 (45%)
High perceived exertion, %	74 (29%)	52 (23%)
Work-related psychosocial load:		
Low job control, %	135 (52%)*	98 (42%)
High job demands, %	126 (49%)	106 (46%)
Low social support colleagues, %	131 (51%)	102 (44%)
Low social support supervisors, %	106 (41%)	82 (36%)
Low back complaints (LBP)		
Presence in past 12 months	129 (50%)	114 (49%)
Duration of complaints > 3 months in past 12 months	14 (5%)	18 (8%)
Sickness absence in past 12 months	43 (17%)	39 (17%)
Upper extremities complaints (UEC)		
Presence in past 12 months	136 (53%)	134 (58%)
Duration of complaints > 3 months in past 12 months	23 (9%)	24 (10%)
Sickness absence in past 12 months	31 (12%)	33 (14%)
LBP intensity, mean (SD)[1]	4.2 (2.2)	3.9 (2.1)
Roland-Morris functional limitations LBP (0-24), mean (SD)[1]	5.2 (5.4)	3.9 (4.6)
Mental component SF-12 (0-100), mean (SD)	53.0 (7.4)	54.1 (6.5)
Physical component SF-12 (0-100), mean (SD)	50.1 (6.9)	49.5 (8.5)
Quality of life EQ5d (-1,1), mean (SD)	0.86 (0.17)	0.87 (0.16)
EQ5D-VAS (0-100), mean (SD	79.9 (14.8)	79.8 (13.9)

* Chi-square, $p < 0.05$; [1] only among those subjects with LBP

Table 3: Outcome measures at 6 and 12 months follow-up in the intervention and usual care group and the estimated effect of the intervention.

	Number of participants Intervention / usual care	Intervention group	Usual care group	Intraclass coefficient (ICC)	Estimated effect[2] (difference)
Low back pain (LBP):					
at 6 months	207 / 186	44.9%	44.1%		–0.8% (–7.7% – 6.2%)
at 12 months	185 / 175	49.7%	46.3%		–3.4% (–10.6% – 3.8%)
Chronic complaints LBP:					
at 6 months	207 / 186	7.3%	5.4%		–1.8% (–5.2% – 1.6%)
at 12 months	185 / 175	7.6%	7.4%		–0.2% (–4.1% – 3.7%)
LBP intensity[1]:					
at 6 months	207 / 186	5.2	5.0	0.10	–0.2 (–1.0 – 0.5)
at 12 months	185 / 175	5.4	5.4	0.07	–0.2 (–0.9 – 0.6)
Functional limitations LBP[1]:					
at 6 months	207 / 186	2.2	1.5	0.17	–0.2 (–1.7 – 1.3)
at 12 months	185 / 175	2.4	1.8	0.21	–1.2 (–2.8 – 0.3)
Sickness absence LBP:					
at 6 months	207 / 186	8.2%	9.7%		1.5% (–2.4% – 5.4%)
at 12 months	185 / 175	9.7%	10.3%		0.6% (–3.8% – 5.0%)
Upper extremity complaints UEC:					
at 6 months	207 / 186	44.0%	48.4%		4.4% (–2.5% – 11.3%)
at 12 months	185 / 175	44.9%	44.0%		–1.0% (–8.2% – 6.2%)
Chronic complaints UEC:					
at 6 months	207 / 186	9.2%	12.4%		3.2% (–1.1% – 7.5%)
at 12 months	185 / 175	9.2%	9.1%		0.0% (–4.2% – 4.2%)
Sickness absence UEC:					
at 6 months	207 / 186	3.9%	8.1%		4.2% (0.8% – 7.6%)*
at 12 months	185 / 175	3.2%	7.4%		4.2% (0.9% – 7.5%)*
Mental component SF–12:					
at 6 months	207 / 186	53.7	53.7	0.07	–0.4 (–2.0 – 1.2)
at 12 months	185 / 175	53.3	53.6	0.08	–0.0 (–1.9 – 1.8)
Physical component SF–12:					
at 6 months	207 / 186	50.7	50.7	0.06	–0.4 (–2.1 – 1.3)
at 12 months	185 / 175	50.7	50.6	0.12	0.5 (–1.2 – 2.1)
Quality of life EQ5d:					
at 6 months	207 / 186	0.89	0.89	0.07	–0.02 (–0.06 – 0.03)
at 12 months	185 / 175	0.87	0.88	0.07	–0.01 (–0.05 – 0.04)
EQ5d–VAS:					
at 6 months	207 / 186	81.9	79.1	0.07	–1.9 (–5.1 – 1.4)
at 12 months	185 / 175	81.3	80.1	0.10	0.1 (–3.1 – 3.2)

* Chi-square test, $P < 0.05$

[1] only among those subjects with LBP. [2] Difference was adjusted for age, gender, and cluster and in case of continuous outcome measures also for baseline values

Table 4: Health care utilization for low back pain (LBP) and upper extremities complaints (UEC) for the intervention and control group during the intervention period of 12 months

	Intervention group				Usual care group			
	0–6 months (n = 207)		7–12 months (n = 185)		0–6 months (n = 186)		7–12 months (n = 175)	
Low back complaints								
General practitioner:								
Prevalence of visit	21	10%	24	13%	19	10%	34	14%
Total number of visits (min–max)	34	(0–5)	38	(0–4)	30	(0–5)	34	(0–3)
Occupational physician:								
Prevalence of visit	10	5%	11	6%	7	4%	9	5%
Total number of visits (min–max)	16	(0–3)	20	(0–4)	16	(0–8)	15	(0–3)
Physical therapist incompany:								
Prevalence of visit	4	2%	3	2%	0	0%	0	0%
Total number of visits (min–max)	10	(0–4)	5	(0–3)	0		0	
Physical therapist outside company:								
Prevalence of visit	21	10%	21	11%	20	11%	23	13%
Total number of visits (min–max)	180	(0–24)	174	(0–60)	164	(0–40)	192	(0–40)
Medical specialist								
Prevalence of visit	1	0%	1	0%	3	2%	5	3%
Total number of visits (min–max)	2	(2)	2	(2)	9	(1–5)	9	(1–3)
Upper extremities complaints								
General practitioner:								
Prevalence of visit	10	5%	17	9%	24	13%	21	12%
Total number of visits (min–max)	21	(0–4)	28	(0–5)	74	(0–10)	57	(0–15)
Occupational Physician:								
Prevalence of visit	8	4%	4	2%	8	4%	12	7%
Total number of visits (min–max)	15	(0–5)	18	(0–8)	45	(0–13)	47	(0–12)
Physical therapist incompany:								
Prevalence of visit	1	0%	2	1%	0	0%	0	0%
Total number of visits (min–max)	1	(1)	13	(0–9)	0		0	
Physical therapist outside company:								
Prevalence of visit	11	5%	13	7%	23	13%	16	9%
Total number of visits (min–max)	114	(0–24)	153	(0–25)	251	(0–25)	160	(0–25)
Medical specialist								
Prevalence of visit	2	1%	5	3%	11	6%	5	3%
Total number of visits (min–max)	8	(1–3)	16	(1–8)	37	(1–6)	17	(1–9)

Table 5: Mean costs (euro) per worker at 6 and 12 months follow-up in the intervention and usual care group and the estimated effect of the intervention

	Intervention group		Usual care group		Estimated effect
	Mean	Range	Mean	Range	(difference)
Direct costs: costs of the intervention					
Fixed implementation costs (min–max)	85	(29 – 206)	0		85
Variable implementation costs (min–max)	143	(75 – 198)	0		143
Workplace examination (min–max)	3	(0 – 232)	0		3
Training on the job (min–max)		0	0		0
Total costs of intervention	231	(155–600)	0		231
Direct costs: medical consumption					
LBP 0 – 6 months (min–max)	28	(0 – 655)	30	(0 – 1102)	–2
LBP 7 – 12 months (min–max)	43	(0 – 1436)	35	(0 – 1141)	8
UEC 0 – 6 months (min–max)	20	(0 – 795)	62	(0 – 1493)	–42**
UEC 7 – 12 months (min–max)	33	(0 – 1062)	46	(0 – 1846)	–13
Total costs medical consumption	101	(0 – 1604)	165	(0 – 3110)	–64
Indirect costs: sickness absence and productivity losses at work					
LBP 0 – 6 months (min–max)	609	(0 – 31622)	672	(0 – 49288)	–61
LBP 7 – 12 months (min–max)	733	(0 – 22082)	389	(0 – 12639)	344
UEC 0 – 6 months (min–max)	246	(0 – 15372)	577	(0 – 15372)	–331*
UEC 7 – 12 months (min–max)	300	(0 – 13163)	422	(0 – 15372)	–122
Total indirect costs	1673	(0 – 49865)	1993	(0 – 54412)	–220
Overall costs	2118	(155–50096)	2200	(0–56655)	–82

* Mann-Whitney *U*-test, two-sided $0.05 < P < 0.10$, ** Mann-Whitney *U*-test, two-sided $P < 0.05$

Discussion

In this cluster RCT no statistically significant differences between the intervention and control group were found for LBP and related sickness absence or for any of the other outcome measures. The total direct and indirect costs in the intervention and control group were about the same. There are three possible reasons why the intervention was not effective: the study could not demonstrate an effect due to methodological limitations; the intervention was not successfully implemented; or the intervention was indeed not effective in this occupational setting.

The first explanation (methodological limitations) mainly relates to the measurement of outcomes, sampling and drop-out, sample size, and contrast between the two trial arms. For example, sickness absence might be underreported because of socially desirable answers.[31] In addition, inaccuracy might have occurred because the midpoints of the answer categories were taken as a crude proxy for the total number of sick leave days. Alternatively, we could have used sickness absence data from the company absence registers; however, these are often incomplete/inaccurate and/or lack specific information about the nature/location of symptoms. The questionnaire we used had a good validity, especially for sickness absence of two weeks or more.[17,35] Moreover, since the study design was an RCT, possible inaccuracy in the outcome measurement would occur in both trial arms and cannot explain a lack of sensitivity to show an effect of the intervention.

The presence of bias due to selective loss to follow-up explains our finding that sickness absence due to UEC was significantly reduced in the intervention group. A possible explanation is that workers with UEC complaints lost interest in the LBP prevention program. Another issue is that we had a smaller sample size than anticipated and consequently there was a reduced power to detect positive effects. However, a lack of power probably did not influence the conclusions of this study because all outcome measures were remarkably similar between the two groups.

A last methodological issue is lack of contrast between the two trial arms. In both groups the regular occupational health care was provided (which includes risk assessments of all work stations as is mandatory by Dutch law). Advice given or changes made on the basis of these assessments by occupational health staff as part of their regular activities might have reduced the contrast for the third measure. Furthermore, companies willing to take up the prevention program were likely to have a pro-active company policy towards the management of LBP and sick leave. Especially companies from the (petro-) chemical industry have a long tradition of occupational health and safety. The relatively low sickness absence at baseline (total days lost due to sickness absence in one year) for workers with physically demanding jobs in some of these multinational companies makes up a base rate of comparison that is difficult to alter.

Another possible explanation for the non-effectiveness of the intervention is the lack of exposure to the intervention due to failure of its implementation. For economic analysis a pragmatic trial is attractive, since this reflects what may happen in practice – which enhances the external validation. However, the absence of strict control over the experimental conditions will have hampered the full implement of the intervention in the companies and among study participants. Our results show that the implementation of the preventive measures aimed at immediate treatment and at workplace adjustments was very limited. In the intervention group the incompany physical therapy option was used by only 10 workers, whereas 66 workers consulted physical therapists outside the company. Thus, the incompany physical therapy service did not succeed in providing treatment for the majority of workers with LBP or UEC. Possible barriers for implementation are that workers prefer to seek care from their own GP or physical therapist which has been reported by others;[36] moreover, some workers may feel that an incompany physical therapist might not act independently. Another possibility is that the incompany physical therapist did not succeed in providing quick treatment. The third tier of this intervention, consisting of a workplace examination and ergonomic adaptations of the work station, was only received by three workers with LBP. This poor implementation could partly be explained by difficulties in changing work stations in most companies, since all jobs in the study were part of a team-based production process which hampers adjustment of individual work environments. Also, the additional costs of ergonomic measures can be a barrier to their implementation. It is possible that employers were only willing to invest substantially when a worker was on sick leave for his complaints on a regular basis. Other studies have shown that the implementation of ergonomic improvements was not always successful and that compliance of management and employees to ergonomic advice was less than 60%.[37,38] The third explanation could be that this multidimensional prevention program was just not effective in this occupational setting. Given that the second (immediate treatment) and third tiers (ergonomics) of this multidimensional intervention program were not enacted for most workers with (sub)acute LBP, the intervention thus consisted primarily of education and training. Because it has been shown that education and training as sole intervention is not effective in preventing LBP,[6] this may explain the ineffectiveness of the prevention program in this pragmatic trial.

The aim of this study was to explore whether the described prevention program was effective in the prevention and management of LBP in an occupational setting. Because our study did not reveal any benefits in effects or costs savings of the intervention program, it cannot be recommended to implement this particular LBP prevention program. The testing of the underlying concept of the program in other settings (with better adherence to intervention principles) might provide a more definite conclusion concerning the effectiveness of the program.

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Chapter 8

General Discussion

Introduction

Musculoskeletal complaints (MSC) are common in the general population and are characterised by spontaneous relapses and remissions in symptoms. Despite their benign nature, they are also a frequent cause of sick leave and care seeking, which potentially leads to substantial socio-economic consequences for the patient, the employer, and the society in general. The overall aim of this thesis is to contribute to the scientific knowledge of the prevention of MSC, especially low-back pain (LBP), and its unfavourable consequences such as chronicity and persistent (work) disabling symptoms, in occupational health care.

In the first part of this thesis (Chapters 2–6) the objectives were to describe the consequences of MSC and to evaluate which work-related physical and psycho-social factors, individual and health-related characteristics determine health care utilization, sickness absence, and productivity losses at work due to MSC.

In the second part of this thesis (Chapter 7) the main aim was to evaluate the effectiveness of a back pain prevention program for workers of which the concept seems promising. This program is already offered by some in-company physical therapy services and occupational health services in the Netherlands to manage (sub)acute LBP and related sickness absence, but has not yet been scientifically evaluated.

In this Chapter, the results of the studies in this thesis are summarized and integrated, and then some methodological issues are discussed. This Chapter ends with the main conclusions and general recommendations for practice and future research in this area.

Main Findings

Description of LBP and other MSC and related consequences

Prevalence and recurrence

In the occupational populations studied in this thesis musculoskeletal symptoms were highly prevalent, and within the range of prevalences reported for blue-collar workers.[1] The 12-month prevalence of LBP among the different occupational populations ranged from 45% to 58%. The 12-month recurrence of LBP was over 60%, which is very similar to reported recurrence in other studies.[2-4] The high recurrence of LBP supports the notion that pain may subside and disappear for a while but then recur a few months later. The pain may also linger for some time and flare up periodically. If the flare-ups are bothersome, this may prompt the subject to seek medical care or take sick leave.

Co-morbidity

Among workers with back pain in the past 12 months, over 60% (Chapters 4 and 5) of the subjects reported concurrent complaints in the upper extremities. The larger part of UEC among workers with LBP were located in the shoulder (42%–58%) and neck (37–46%). Among subjects with chronic LBP other chronic UEC were common (OR 3.6, CI 1.5-8.8; Chapter 5). This tendency of clustering of chronic complaints in certain subjects has been reported before and also reflects a more general musculoskeletal pain syndrome.[5,6]

Subjects with high pain intensity or disabling LBP were more likely to have musculoskeletal co-morbidity (Chapter 5). In comparison with subjects who reported back pain only, subjects with musculoskeletal co-morbidity demonstrated worse general health (Chapters 2 and 5) and a lower quality of life (Chapter 5).

Health care utilization

The studies described in Chapters 2, 4, and 5 showed that among all subjects with LBP and UEC approximately one third sought care for their complaints. Thus, the majority of workers with MSC dealt with this condition themselves. Workers who seek care for back pain are most likely to be treated by their general practitioner and a substantial proportion was referred to a physical therapist. Only few workers with LBP or UEC consulted an occupational physician, primarily limited to those workers on sick leave. Over 60% (Chapter 2) of the subjects with recurrent LBP who sought care for complaints at baseline sought care again during the 12-months follow-up. When a patient consulted a specific type of health care provider for his complaints, it was likely that he returned to the same provider during the follow-up (Chapter 2).

Sickness absence

In Chapters 2–5 we found that approximately one third of workers with LBP or UEC went on sick leave at least once for their back complaints. Among workers with an episode of sickness absence for musculoskeletal symptoms at baseline, about 30% had an episode of sickness absence again for the same complaint during the subsequent year, which is comparable to previous reports.[7] Overall, the results of the studies in part 1 of this thesis confirm that recurrent musculoskeletal symptoms are a major health problem, since most patients will present with symptoms again (over 60%), or will have to take sick leave for their complaints again.

Productivity losses at work

In two occupational populations the point prevalence of MSC ranged from 11% (industrial workers) to 21% (construction workers). About 40% of those workers with MSC on the last working day reported reduced work productivity, which was equivalent to approximately 1.9 hours/day of lost productivity (Chapter 6). Since most episodes of MSC have a duration of at least 1 week, this result demonstrates that workers with MSC who continue working contribute considerably to the indirect costs of MSC.

Determinants of health care utilization, sickness absence, and productivity losses at work due to MSC

Health care utilization

The longitudinal study with 1-year follow-up in Chapter 2 showed that severity, duration and functional limitations of LBP were the strongest determinants for the decision to seek care and that these factors seemed to supersede the potential impact of work-related factors. Recurrence of health care utilization was strongly associated with a history of severe symptoms and with previous care seeking behaviour.

In Chapter 3 it was found that the well-established work-related physical and psychosocial factors that were associated with musculoskeletal symptoms were quite similar to those associated with health care utilization. Both work-related and demographic factors influenced health care utilization for musculoskeletal symptoms, which has been also described for general health care utilization.[8] Female workers were more likely to seek care for symptoms of the upper extremities than men, a finding reported before.[9,10]

Sickness absence

In the cross-sectional study in Chapter 3 and the prospective study in Chapter 4 it was concluded that work-related physical and psychosocial factors are risk factors for the occurrence of MSC and, thus, also determine the occurrence of sick leave due to MSC. However, among workers with MSC in physically demanding jobs the decision to take sick leave seemed little influenced by the experienced physical and psychosocial work load. This modest effect of work-related risk factors on sickness absence was also shown in studies on the prognosis of prolonged sickness absence.[11] Working conditions were less important for the prognosis of return to work than individual factors such as pain intensity, perceived physical health, functional limitations, fear avoidance beliefs, one's own expectations, and depressive symptoms.

Influence of comorbidity on health care utilization and sickness absence

The study in Chapter 5 among 505 industrial workers showed that among workers with LBP co-morbidity of UEC had no influence on health care utilization and sickness absence due to LBP. It was concluded that the results of this study did not provide evidence that musculoskeletal co-morbidity of the neck and upper extremities influences the choice to seek care or take sick leave due to LBP among industrial manual workers.

Productivity losses at work

In Chapter 6 the feasibility and validity of two instruments for the measurement of health-related productivity loss at work are assessed in two occupational populations with a high prevalence of health problems: i.e. industrial workers (n = 153) and construction workers (n = 182).

The QQ outperformed the HLQ on construct validity, is better understandable, and more feasible in populations with low education, or for jobs with low opportunities for catching up on backlogs. Reduced work productivity on the HLQ and the QQ was significantly associated with MSC, worse physical health and recent absenteeism, whereas reduced productivity on the QQ was also significantly associated with the presence of chronic MSC, low back complaints, worse mental health, and worse general health. In a recent study it was also shown that reduced productivity was highly prevalent among workers who returned to full duty after a period of sickness absence due to MSC.[12]

Effectiveness of a back pain prevention program

Chapter 7 presents the results of a cluster randomized controlled trial that studied the effectiveness of a multidimensional LBP prevention program. The program, which was enacted in an occupational setting, was based on the principles of the biopsychosocial model and integrated three preventive measures: tailored ergonomic education and training for all workers; immediate treatment of (sub)acute LBP; and advice on ergonomic adjustment of the workplace or training sessions on appropriate work techniques at the worker's worksite. The first preventive measure was enacted upon all workers (with or without complaints). The second and third measure commenced when a worker with LBP sought care at the in-company physical therapist. During this (first) visit an intake was carried out aimed at identification of barriers for recovery related to the worker, workplace or its interface. This was followed by a quick modification of those factors that will play a role in sustaining of complaints in order to prevent aggravation of LBP and possible transition of (sub)acute LBP into a chronic problem. The primary outcomes in this RCT were the occurrence and duration of LBP and subsequent sickness absence during the 1-year follow-up. Secondary outcome measures were mean pain intensity and functional limitations due to LBP, presence of UEC and related sickness absence, productivity losses at work due to LBP and UEC, general health status (SF-12), and health-related quality of life (EQ-5D).

No significant differences between intervention and control group were observed for LBP and related sickness absence or any of the other outcome measures. The total direct and indirect costs in the intervention and usual care group were approximately the same. Our results showed that the implementation of the second and third measures of the intervention, aimed at immediate treatment and at workplace adjustments, was very limited. Thus, the in-company physical therapy did not succeed in providing treatment for the majority of workers with LBP or UEC. Possible barriers for implementation are workers' preference to seek care from their own general practitioner or physical therapist (as has been reported before[13]) and a feeling that an in-company physical therapist may not act independently. The poor implementation of the third tier of this intervention (consisting of a workplace examination and ergonomic adaptations of the work station) could partly be explained by difficulties in changing work stations in most companies, since all jobs in the study were part of a team-based production process which hampers adjustment of individual work environments. It is also possible that additional costs for adjustments hampered the implementation, since it is likely that employers are most willing to invest when a worker was on sick leave for his complaints on a regular basis.

The results of our RCT did not show benefits in effects or costs savings of the intervention program, and thus provide no evidence that the back pain prevention program should be preferred to usual care. Testing of the underlying concept of the program in other settings with better adherence to intervention principles might provide a more definite answer on the effectiveness of the program.

Methodological considerations

General considerations

As previously mentioned, it is assumed that MSC have a multifactorial origin. Possible risk factors are of work-related physical, psychosocial or personal origin. Their influence can be mediated by other factors, such as cultural and societal aspects. The importance of each factor, and hence its contribution to the occurrence of symptoms, varies among individuals and work environments.[14] Since most adults are in the active workforce (and due to the high prevalence of MSC), it is evident that risk factors are generally searched for at the workplace. In keeping with the tradition of epidemiological studies in work settings, the studies in Chapters 2 and 3 of this thesis only included well-known work-related physical and psychosocial risk factors that are often studied as risk factors for MSC. In this thesis the work-related psychosocial factors studied were job demands, job control and social support, or a combination of these factors. Lack of social support from the supervisor or colleagues was also considered to be a risk factor. It was hypothesised that, given the fact that a worker has complaints, work-related psychosocial factors could be of importance in the decision to take sick leave for complaints. For example, coping with complaints may be harder when the job demands are high and possibilities to regulate the job tasks are low, or a lack of support at work could influence sickness absence. However, the results of the studies in Chapters 3 and 4 could not demonstrate an additive effect of work-related risk factors on taking sick leave among workers with MSC. Individual factors seemed to supersede work-related risk factors for sickness absence due to musculoskeletal symptoms. An additional analysis incorporating factors on the nature of pain showed that factors relayed to severity of pain, history of LBP, history of sickness absence, and care seeking for LBP were very strong predictors for taking sick leave.

One of the limitations of the studies in Chapters 2 and 3 is that we did not incorporate more individual risk factors.

Recent evidence supports the importance of factors that are internal to the individual for unfavourable consequences associated with MSC: patients at risk for an unfavourable course of LBP seem to be more pessimistic about their prognosis, have pain catastrophizing thoughts, and do not experience a solicitous system of support.[15] In this literature these factors are also referred to as psychosocial factors.

Hay and colleagues[16] offer an explanation for the important role of these internal factors in the (sub)acute phase. They state that "psychological distress and misguided beliefs about pain seem to interfere with recovery and raise the risk of chronic disability". These clinical observations are lent support by epidemiological evidence, which has consistently shown that psychological factors are important determinants of outcome in patients with LBP.[17,18] Such evidence led to the strong recommendation in the UK clinical guidelines for early attention to psychosocial factors in the primary care management of LBP.[16] Another recent study developed an instrument for early identification of employees at risk for general sickness absence. In women, the main results of this study suggest that feeling depressed, having a burnout, being tired, being less interested in work, experiencing an obligatory change in working days, and living alone, were strong predictors of sickness absence due to psychosocial health complaints. In men, statistically significant predictors were having a history of sickness absence, being mentally fatigued, finding it hard to relax, lack of supervisor support, and having no hobbies.[19] Future research in this field should be directed to factors that are both internal and external to the individual, and should study the nature of interactions among these factors and their impact on sick leave.

Determinants of MSC consequences

Chapters 2 to 6 discuss several methodological issues, for example the relatively small sample sizes (n = 300 to 500) that we used to study determinants for the decision to take sick leave and seek care for complaints. Nested questions on number of days of sickness absence or number of visits to health care providers could not be analyzed due to lack of power. Further research on larger datasets aimed at replicating our results is warranted.

Several remarks concerning the internal validity of the descriptive studies have been made in these Chapters. Below the internal and external validity of the studies are considered.

Internal validity of the studies

Internal validity of a study refers to the extent to which the results are valid for the study subjects themselves; more specifically, the extent to which the results might be distorted by systematic errors.[20] Three possible sources of systematic errors are generally distinguished: selection bias, information bias, and confounding.[20,21]

All the studies in this part of the thesis used questionnaires. First, differential non-response might have caused selection bias if there was a difference in response to the questionnaire by health status, e.g. the workers on sick leave due to MSC did not respond. However, in all studies the questionnaire was filled out during working hours. Selected workers who were on vacation or sick leave were asked to fill out the questionnaire as soon as possible after return to work or a questionnaire was sent to the home address. This method yielded relatively high participation; however the presence of selection bias can not entirely be ruled out.

Second, the results presented here might be biased by loss to follow-up. Indeed, in Chapter 2, the respondents for whom no follow-up information was available were younger and had less years of service than the respondents who remained in the study. Loss to follow-up was not related to the prevalence of LBP; however, LBP with high perceived disability was more prevalent as well as medical care seeking for this condition. It is known, that in this population there is a high turnover rate in the first years of employment. This could explain the difference in age and years among those available and lost to follow-up. Hence, the presence of bias due to selective loss to follow-up in this study cannot be ruled out and we could have underestimated health care utilization. In the study among industrial workers the prevalence of risk factors, musculoskeletal symptoms, health care utilization or sickness absence was not associated with loss to follow-up.

Additionally, the data on work-related risk-factors as well as the outcomes (complaints, health care utilization and sickness absence) were self-reported. This could have biased the results if there would have been systematic differences in the answering of the questions on risk by complaints (information bias). Subjects with symptoms that urge them to seek care or take sick leave are probably more aware of awkward postures or possible disadvantageous actions at work than subjects with symptoms who can cope with the pain. The reason could be that they feel pain exerting these actions or remaining in these postures, or because they attribute symptoms to more or less known risk factors. This might lead to differential misclassification. Toomingas and colleagues [22] found no support for the idea of such bias in rating behaviour in studies where subjects rated both exposure and outcome variables such as physical exposure and pain. We therefore expect that this does not substantially affect our results.

Finally, we did not have information on all possible confounders of the association between work-related risk factors and sickness absence or health care utilization. An association between work-related risk factors and sick leave or care seeking could have been masked.

External validity

The external validity of a study refers to the generalizability of the study outcomes to people outside the study population, i.e., other occupational groups. All the studies performed to answer the research questions of this thesis were based upon occupational groups consisting of mainly blue-collar workers who experienced high physical workloads.

Other authors reported on work-related psychosocial and physical risk factors for the occurrence of LBP and neck pain, as well as sickness absence due to these complaints. In accordance with these studies we found that work-related psychosocial factors play a role in sickness absence due to musculoskeletal disorders.[23-26] However, due to the small sample size in our study not all associations were significant. The results in these studies also showed that physical factors were more strongly associated with sickness absence than with the occurrence of LBP or neck complaints, but an additive effect of work-related factors on sickness absence could not be demonstrated. The aforementioned studies included workers in various occupations of both white- and blue collar workers; therefore, the exposure to physical load was much more variable among workers, compared with the blue-collar workers in our study, who were all highly exposed to physical load. Therefore, a possible explanation for the lack of a strong effect of physical load on the occurrence of sick leave in our studies might be the lack of sufficient contrast in exposure to physical work load.

In Chapter 6 we concluded that productivity losses due to health problems at work are substantial and can be measured reliably with the QQ instrument. However, specific characteristics of the instrument need further validation, such as the high correlation between the quality and quantity scale. We hypothesize that the HLQ instrument yields a conservative estimate, due to framing of the question. Almost half of the respondents (industrial workers as well as construction workers) reported no need for extra hours to compensate for any lost work time, although experiencing health-related work limitations in the past two weeks. This might be due to the nature of work activities that do not allow to catch up on a backlog, such as team-based production or a continuous production process in chemical plants. Another explanation might be the cognitive difficulty of the HLQ instrument. This is supported by the high number of missing answers that were found (about 25%). These interpretations would make the instrument less suitable in populations with a low education level or for jobs that do not allow catching up on backlogs.

Considerations for an ineffective intervention

In this section the discussion on the intervention study will focus on the possible reasons why the back pain intervention we evaluated was not effective. This exploration may contribute to theory formation, and may yield valuable information for researchers planning to conduct a complex, pragmatic trial that resembles ours.

Chapter 7 has already presented three major putative explanations for the fact that we found no effectiveness; firstly the study could not demonstrate an effect due to methodological limitations, secondly the intervention was not successfully implemented, or thirdly the intervention is not an effective strategy to prevent LBP. Below some additional considerations will be discussed along this line of major explanations.

The study could not demonstrate an effect due to methodological limitations

Selective participation and lack of power

Following the start of the study in January 2001, the Netherlands has witnessed an important downturn in the business cycle. During the study there was a downsizing in one of the companies, which may have influenced sick leave.[27] Another consequence of the downturn in the business cycle was that companies had to cut expenses and since they had to pay for most of the intervention themselves, it became harder to recruit companies to participate in the study. Recruitment of companies was a challenge in itself. Companies had to take up the program within one year; however, company procedures do take time. Some companies were initially interested in participation but later decided not to participate because they were not willing to concur with randomization of the intervention. Several other factors that may have influenced the participation of companies in this trial include the relevance of the research question for the company, investment of time, burden on workers and normal production process, and additional costs of the interventions.

The result was that we ended up with fewer workers than anticipated in the power calculation. The lack of power of the study made it impossible to pick up on subgroup effects. Additional analyses might have shown whether specific subgroups of patients were more likely to respond to the intervention, and whether the subgroup of patients (for example, with a high risk of an unfavourable outcome) responded better to the intervention than to the usual care.

Contrast between the two trial arms: usual care in the Netherlands

The control group received care as usual. Occupational health care is constantly influenced by changes in legislation aimed at reducing sick leave and long-term disability; therefore it is difficult to maintain control over the content of usual care. For example, shortly after the start of the study an important change took place in the legislation with respect to sickness benefits and sickness management within companies which has put much more emphasis on active treatment and management of workers on sick leave.

In addition, during the study several guidelines for the treatment of LBP have been issued and disseminated in the Netherlands. In the past few years guidelines for LBP for general practitioners (GPs), occupational physicians (OPs) and physical therapists (PTs) have been developed and implemented. Usual care was given by the GP or OP and we assumed that they would generally follow the Dutch guidelines for health care of patients with LBP.[28-30]

In the Dutch health care system most workers with LBP complaints will consult their GP. The main messages in the guideline for LBP of the Dutch College of General Practitioners[28] are: 1) in the absence of indicators for specific somatic impairments the diagnosis 'non-specific' LBP is used; 2) acute LBP is treated in a time-contingent manner; 3) staying active is better than bed rest; 4) physical therapy within the first 6 weeks is not recommended; 5) staying active and continuing (or return to) normal activities including work are important; and 6) paracetamol is preferred for pain relief.[31] These guidelines comprise important elements that are similar to elements that the workers in the intervention group received, such as elements 3 and 5. Consequently, workers in the control group consulting their GP received the same kind of advice the in-company physical therapist gave to workers in the intervention group.

Since the start of the study in 2001, PT guidelines for patients with LBP have been issued in the Netherlands to enhance evidence-based interventions in practice.[30] The recommendations in these guidelines are very similar to the contents of some of the elements of the back pain program under study. For instance, these PT guidelines suggest that for all patients the intervention should consist of an active approach in which the patient learns to take control over his or her back pain.[30] The physical therapy intervention should focus on restoring physical functioning and improving participation as soon as possible, including retaining or returning to work. For patients with a normal course, a limited number of sessions are recommended. The most important interventions are reassurance, adequate information, and the advice to stay active.[30] These elements of the PT guidelines diminish the contrast with the second preventive measure of the back pain program.

In the Dutch system the OP is predominately responsible for sick leave management. In the Dutch OP guidelines for LBP it is emphasized to resume daily activities and work within two weeks, when possible. Workplace interventions are mentioned as an option. Again, usual care given to workers in the control group according to these guidelines may have caused a lack of contrast with the second and third measure of the back pain program.

In summary, the improved Dutch standard of usual care during the study period may have caused a lack of contrast or diminished effects of the intervention and could therefore be an explanation why we did not find better results for the effectiveness of the intervention. The program might be effective in other countries with different for usual care.

Follow-up time

Another important consideration in interpreting the outcomes of the intervention is the short time span of 12 months in which effects had to be achieved. Although the required length of an effective intervention period is still heavily debated in the literature, it is questionable whether an intervention lasting only one year can demonstrate an impact on outcomes.

The intervention was not successfully implemented

The use of process data has become increasingly important to move beyond the 'black box' of the intervention effectiveness. Furthermore, this kind of data is critical to avoid type III error. Type III errors occur when we draw incorrect conclusions about the effectiveness of a given intervention while a program was not adequately implemented. But, where we have consensus about optimal designs in the evaluation of effectiveness on the individual or population level, there is no such consensus for the evaluation of processes.[32,33] The first preventive measure was successfully implemented. The sessions were given during working time, and subsequently almost all workers (90%) participated in all three sessions of the first tier of the intervention (tailored ergonomic education and training for all workers). In our study success of implementation of the second preventive measure (advice, treatment in-company by physical therapists) was monitored by the number of consultations to the in-company physical therapists. Only 7 of all workers with LBP in the intervention group, who sought health care for their complaints, visited the in-company physical therapist, whereas 42 of workers with LBP visited their regular physical therapist. These data suggest that the intervention was far from fully implemented. These numbers illustrate the complexity of conducting an intervention study in a 'real life' setting. Chapter 7 already mentions possible reasons for the lack of implementation of this second preventive measure, most notably a worker's preference, or the in-company physical therapist did not succeed in providing quick treatment.

The third tier of this intervention, consisting of a workplace examination and ergonomic adaptations of the work station, was only received by a few workers with LBP. This poor implementation could partly be explained by difficulties in changing work stations in most companies, since all jobs in the study were part of a team-based production process which hampers adjustment of individual work environments. Also, the additional costs of ergonomic measures can be a barrier for its implementation. Employers might be willing to invest substantially only when a worker has been on sick leave for his complaints on a regular basis. Other studies have also shown that the implementation of ergonomic improvements was not always successful and that compliance of management and employees to ergonomic advice was less than 60%.[34,35] This suggests that imposing ergonomic interventions, as being one of the many options of (secondary) prevention, will only be successful when all stakeholders in the rehabilitation process (such as employers, workers, and physicians) sufficiently attune their activities. The lesson we can learn from the study in Chapter 7 is that having all the players onside may be essential, but it is probably not sufficient to bring about action in workplace strategies for patients with LBP. Implementation of programs to manage LBP in the workplace may require interventions targeted at practical and/or intrinsic barriers that limit its use. Potential practical barriers for the use of an intervention for workers on sick leave are for example: insufficient information on procedures for stakeholders, lack of time, and workflow constraints, such as poor communication and coordination of activities.[36] An elaborate process evaluation with interviews of the workers, and all other stakeholders involved should further elucidate why implementation of the intervention was difficult. A process evaluation by Anema et al. provides some information regarding the usual barriers to full implementation of the third tier. Main obstacles for implementation of ergonomic solutions identified by an ergonomist were: technical or organizational difficulties for work adjustments (50%), physical disabilities of the worker who was on prolonged sick leave and had to return to work (45%), high physical workload (35%) and financial situation of the employer (27%).[37]

We conclude that this multidimensional prevention program was not effective in this occupational setting due to a lack of implementation of the components of the program and lack of contrast with usual care. Given the fact that the second (immediate treatment) and third tiers (ergonomics) of this multidimensional intervention program were not enacted for most workers with (sub)acute LBP, the intervention consisted primarily of education and training. It has been shown, however, that education and training as sole intervention is not effective in preventing LBP.[6]

The intervention is not an effective strategy to prevent LBP

From the results of our trial alone it is not possible to conclude that the intervention is not an effective strategy, because the intervention was not fully implemented in this setting. In other countries, as we previously mentioned, with different standards of usual care this intervention might be effective. However, one wonders whether the concept of the intervention is less promising than we hoped for and may benefit from improvements.

The program might improve if the first measure is limited to workers with LBP, since it has been shown that education and training as (sole) intervention is not effective in the primary prevention of LBP.[6] However, there may be some practical barriers, such as the organisation of the sessions and employer's preference. Also one might argue that the first measure of the intervention lacked sufficient frequency or duration to establish change in outcomes.

In addition, another argument may be whether we included the most appropriate patient population. As many episodes of acute LBP resolve rapidly,[38] one might suggest that the fact that we found no effect may (partly) be explained by a favourable natural course of symptoms in both groups. Consequently, one may hypothesize that the second and third preventive measure should focus only on the subgroup of workers that do not seem to have a favourable prognosis rather than all workers with (sub)acute LBP. Another issue is that the intervention was based upon the educational principles of the biopsychosocial model. An element in the intervention was the use of behavioural principles, for example to change the patient's beliefs and coping. These skills to enact behavioural principles are difficult, because they need to be integrated in the entire diagnostic and treatment process. One wonders whether if the physical therapists in this trial were effectively be able to address these kind of factors. Therefore, it is possible that the strategy can be improved by training physical therapists to recognize and change, for example, patient illness beliefs and inappropriate coping strategies. Results from a recent study in general practice support this hypothesis.[39] It was shown that general practitioners, even though they all received training in recognizing psychosocial factors (such as fearavoidance, pain catastrophizing, and distress in patients with (sub)acute LBP), were only moderately successful in the identification of these factors. A screening tool might assist to identify those workers that do not have a favourable prognosis.[40,41]

Effectiveness versus efficacy

Our trial was an effectiveness study reflecting usual practice as much as possible. In an effectiveness study the aim is to examine the clinical effect of a treatment under 'normal' conditions, in contrast to efficacy studies in which the aim is to examine the clinical effect under standardised (=ideal) conditions. Efficacy studies are very informative when results are negative, as the chance that the results will be positive under 'normal' conditions may be zero. Because we did not find any effectiveness of the back pain prevention program over usual care one may claim that we should have performed an efficacy study first, or a study conducted in a well-controlled setting of one company. One of the reasons to perform our trial presented in Chapter 7 was that we had positive results from a study (not published) conducted in one company. However, positive results in an efficacy study do not guarantee that the intervention will show positive results under normal conditions, and this last condition is the one we were interested in.

Interpretations of the findings

The first objective of this thesis was to describe the consequences of MSC and to evaluate which work-related physical and psychosocial factors and individual and health-related characteristics determine health care utilization, sickness absence, and productivity losses at work due to MSC.

Our findings illustrate that even though most people will experience a period with LBP or another MSC at some time in their life, this does not necessarily constitute a major medical problem or urge the subject to take sick leave. Our results show that the majority of subjects in a working population deal with LBP themselves, less than one third seeks medical care. Furthermore, we observed that indeed a substantial proportion of workers continued their regular work while experiencing an episode of pain,and around one third has to take a period of sick leave (Chapters 2, 3, and 4). Work-related physical and psychosocial factors only play a modest role in care seeking, sickness absence and self-reported productivity losses at work among workers with MSC**.** Nature and severity of complaints and individual factors seem to be far more important in the decision to seek care or take sick leave. Recent evidence shows that psychological factors (such as such as coping behaviour and fear of movement) are important, but these factors were not included in the studies described in this thesis. The modest effect of work-related factors has also been shown in other studies on the prognosis of prolonged sickness absence. Taking into consideration the current evidence and the results of our studies, it is advocated that primary prevention strategies, aimed at minimising the risks of the occurrence of work-related MSC, and secondary prevention strategies, aimed at reducing the aggravation of existing MSC, may need to emphasize different sets of risk factors. Work-related factors are important in the occurrence of complaints, so they have to be addressed in primary prevention strategies for MSC to minimize the proportion of workers with complaints. It seems that secondary prevention strategies should give factors related to the worker more prominence.

The recently updated Dutch LBP guidelines for GPs[42] and new multidisciplinary national guidelines on LBP[43] as well as international guidelines, mention (with varying emphasis) the importance of early identification of individual-bound psychosocial factors as risk factors for the development of chronic disability. They also found that the amount of detail on how to assess these factors and when (the optimal timing) varies considerable.

In economic evaluation of health care interventions, it is widely recommended to consider all costs and savings relative to the benefits of the intervention, including the impact of health problems on worker productivity. Our findings illustrate that MSC presenteeism can lead to considerable productivity losses at work. The QQ questionnaire can be used as an instrument to measure productivity losses due to MSC presenteeism (Chapter 6). A better appreciation of presenteeism versus sickness absence will further contribute to the planning and development of measures to improve the work environment and to health policy making. The economic relevance can be an extra stimulus for employers to invest in health promotion programs.

The second objective of this thesis was to study the effectiveness of a multidimensional back pain prevention program in an occupational setting. The program integrates three preventive measures and is based upon the biopsychosocial model (Chapter 7). Our trial provides no evidence that the back pain prevention program in this occupational setting among workers with high workload is better than the Dutch standard of usual care.

We conclude that a lack of implementation of all components of the program has certainly contributed to the lack of effectiveness, as well as lack of contrast between the trial arms. Given the fact that the second (immediate treatment) and third tier (ergonomics) of this multidimensional intervention program were not enacted for most workers with (sub)acute LBP, the intervention consisted primarily of education and training. It has been shown that education and training as sole intervention is not effective in preventing LBP.[6] We believe that more studies into the (cost-)effectiveness of this intervention in different occupational settings and countries is valuable, provided that an optimal implementation of the intervention can be assured.

Recommendations for future research and practice

— The trial in Chapter 7 provides no evidence that the back pain prevention program in this occupational setting among workers with high workload is better than the Dutch standard of usual care. We conclude that a lack of implementation of all components of the program has certainly contributed to the lack of effectiveness. It is recommended to first study the practical and/or intrinsic barriers in the implementation of the proposed intervention in order to facilitate an unambiguous and appropriate intervention program.

— We recommend researchers of intervention studies to use a 'pragmatic' protocol to assess process measures at several levels (e.g. caregiver, worker, impact on health measures). By doing this the researcher may be able to explore why an intervention did (not) work and may, thereby, contribute to theory formation. Future research could be aimed at the development and validation of methods for studying process measures, such as methods to assess employers, workers and caregivers' attitudes, knowledge, and behaviour.

— Future studies investigating effective strategies to prevent the unfavourable consequences of MSC in the workplace should give factors related to the worker more prominence. An early identification of *indivual-bound* psychosocial factors as risk factors for the development of (chronic) disability is important for effective MSC prevention programs. Future research should focus on which factors to address, how to assess these factors, and the optimal timing for interventions to address these factors.

— We conclude that productivity losses due to health problems at work are substantial. Although productivity losses can be measured with reasonable reliability with the QQ instrument, specific characteristics of the instrument need further validation, such as the high correlation between the quality and quantity scale.

— Since productivity losses at work contribute considerably to the indirect costs of MSC, it is advised to take this productivity loss into account when evaluating the cost-effectiveness of interventions

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Summary

Musculoskeletal complaints (MSC) are common in the general population and are characterized by spontaneous relapses and remissions in symptoms. Despite their benign nature, they are also a frequent cause of sick leave and use of medical resources, which potentially leads to substantial socio-economic consequences for the patient, the employer, and the society in general. The first objective of this thesis was to describe the consequences of MSC, and to evaluate which work-related physical and psychosocial factors as well as individual and health-related characteristics determine health care utilization, sickness absence, and productivity losses at work due to MSC. The second objective was to study the effectiveness of a back pain prevention program in an occupational setting.

This thesis consists of two parts. The first part of this thesis (Chapters 2–6) addresses the first objective, and in the second part (Chapter 7) the second objective has been addressed.

Chapter 1 briefly introduces and defines the main concepts used in this thesis. Subsequently, the objectives are stated and an outline is provided of the chapters in this thesis.

Chapter 2 describes medical care seeking for low back pain (LBP) and investigates which factors influence the use of care due to LBP in a prospective longitudinal study with 1-year follow-up. We used a self-administered questionnaire to collect data on individual, health-related, and work-related factors and the type of medical care sought among 529 employees of nursing homes and homes for the elderly in the Netherlands. Logistic regression models were used to present associations between the aforementioned factors and care utilization for LBP.

This study showed that a large proportion of subjects in a working population is afflicted with LBP; however, the majority of subjects deal with this condition themselves, and less than one third seeks medical care. Two-thirds of the subjects with recurrent LBP who seek care for complaints at baseline sought care again during the follow-up. When patients consulted a specific type of health care provider for their complaints, it was likely that they returned to the same provider during the follow-up. Variables on the severity and nature of LBP were the strongest determinants for use of care for LBP complaints. Well-known work-related risk factors for the occurrence of LBP did not determine care seeking for workers with LBP. Factors related to impairment and disability due to LBP seem to supersede the potential impact of work-related factors. In agreement with other studies individual factors such as age, gender, education, number of children and being active in sports were not associated with the use of care for LBP.

Chapter 3 investigates whether individual, work-related physical and psychosocial risk factors involved in the occurrence of MSC also determine subsequent sickness absence. In a cross-sectional study a self-administered questionnaire was used to collect data on individual and work-related risk factors and the occurrence of MSC and musculoskeletal sickness absence among 373 employees of laundryworks and dry-cleaning establishments. Logistic regression models were used to determine associations between risk factors and the occurrence of MSC and sickness absence due to these complaints.

The results of the study showed that both work-related physical and psychosocial factors showed strong associations with LBP and upper extremity complaints. Work-related physical factors did not influence sickness absence, whereas psychosocial factors showed some associations with sickness absence. It was concluded that work-related physical and psychosocial factors largely determined the occurrence of LBP and upper extremity complaints, whereas there was no apparent additive effect of these work-related factors on sickness absence. Individual factors predominantly determined whether subjects with MSC took sick leave.

Chapter 4 further describes the consequences of MSC and elaborates on the question whether work-related risk factors for the occurrence of LBP also determine sickness absence and health care utilisation. In a prospective study with 6 months of follow-up among 407 industrial workers, a questionnaire provided data on demographics and work-related factors, musculoskeletal symptoms, and ensuing health care utilization and sickness absence. The analyses showed that within 6 months about one third of industrial workers with LBP or neck/upper extremity symptoms had a recurrence of sickness absence for the same complaint, and that the recurrence of health care utilization was over 40%.

Work-related factors that were associated with the occurrence of musculoskeletal symptoms were quite similar to those associated with health care utilization and sickness absence. However, for LBP older age and living alone, and for neck/upper extremity symptoms living alone and being female, had a stronger impact on whether subjects with these complaints took sick leave. These results imply that prevention strategies aimed at minimizing the risks for the occurrence of work-related musculoskeletal symptoms, and prevention programs aimed at reducing sickness absence may need to emphasize different sets of risk factors.

Chapters 5 and 6 address two methodological issues, that are of particular importance for estimating the consequences of LBP, and for economic evaluations. The aim of the study in **Chapter 5** was to describe the presence of musculoskeletal co-morbidity of the neck and upper extremities among industrial workers with LBP and to examine whether it has an impact on health care utilization and sickness absence for LBP. We used a self-administered questionnaire to collect data from the 505 industrial workers (response 86%) on individual characteristics, MSC, general health status, sickness absence, and health care utilization due to LBP.

The results indicate that a substantial number of subjects with LBP experienced musculoskeletal co-morbidity in the past 12 months. Subjects with high pain intensity or disabling LBP were more likely to have musculoskeletal co-morbidity. In comparison with subjects who reported back pain only, subjects with co-morbidity demonstrated worse general health and health-related quality of life. No impact of upper extremity co-morbidity was found on health care utilization and sickness absence due to LBP. It was concluded that the results of this study do not provide evidence that musculoskeletal co-morbidity of the neck and upper extremities influences the choice to seek care or take sick leave due to LBP among industrial manual workers.

Chapter 6 assesses the feasibility and validity of two instruments used to measure health-related productivity loss at work. Cross-sectional studies were conducted in two occupational populations with a high prevalence of health problems: industrial workers (n = 153) and construction workers (n = 182). We collected information on self-reported productivity during the previous two weeks and during the last working day with the Health and Labor Questionnaire (HLQ) and the Quantity and Quality questionnaire (QQ), together with data on job characteristics, general health, presence of MSC, work absence and medical consumption. For construction workers we evaluated self-reported productivity with information on actual daily work output from 19 work site observations. The results showed that about half of the workers with health problems on the last working day reported reduced work productivity (QQ), which is 10.2% of all industrial workers and 11.8% of all construction workers, resulting in a mean loss of 2.0 hours/day per worker with reduced work productivity. The proportion of workers with reduced productivity was significantly lower on the HLQ: 8.0% of industrial workers and 6.5% of construction workers. Reduced work productivity on the HLQ and the QQ was significantly associated with MSC, worse physical health and recent absenteeism, whereas reduced productivity on the QQ was also significantly associated with the presence of chronic MSC, low back complaints, worse mental health, and worse general health. The QQ outperformed the HLQ on construct validity, is easier to understand, and more feasible for jobs with a low opportunity to catch up on a backlog of work.

Chapter 7 presents the results of a cluster randomised controlled trial (RCT) with 12 months follow-up, on the effects of a back pain prevention program, compared with usual care. The evaluation includes an economic evaluation. The study population consisted of workers in physically demanding jobs from 9 large companies located throughout the Netherlands. In each company two comparable work units were randomly allocated, resulting in 18 clusters with 258 workers assigned to the intervention group and 231 workers to the control group. The intervention group received a multidimensional LBP prevention program. This was based on the principles of the biopsychosocial model consisting of an integrated approach of three preventive measures: ergonomic education and training of working techniques tailored to the specific work requirements; immediate treatment of (sub)acute LBP through an easily accessible in-company physical therapy service; and, if appropriate, a workplace visit with advice on ergonomic adjustments of the workplace or extra training sessions on appropriate work techniques at the worker's work site. Usual care was provided according to Dutch health care guidelines.

The primary outcome measures were the occurrence and duration of LBP and subsequent sickness absence. Secondary outcome measures were pain intensity and functional limitations due to LBP, presence of upper extremity MSC and related sickness absence, general health, and health-related quality of life. The economic evaluation was conducted from a societal perspective and included both direct and indirect costs due to LBP and upper extremity MSC.

No statistically significant differences between the two groups were found in either the occurrence or duration of LBP, subsequent sickness absence or any of the other outcome measures. Results in our study did not show costs savings of the program. Based on the results of the study it can therefore not be recommended to implement the prevention program.

Chapter 8 (the general discussion), integrates and discusses the results from these studies. This chapter also reflects on the main study results and points out several limitations of the main study (RCT). Furthermore, it addresses the question why we did not find a positive effect of the prevention program. Chapter 8 ends with general recommendations for future research in this area, and implications of the study findings for clinical practice.

Samenvatting

A-specifieke klachten aan het bewegingsappraat, met name rugklachten, komen veel voor in de Westerse samenleving. Hoewel het beloop van deze klachten over het algemeen gunstig is, vormen zij een frequente reden voor ziekteverzuim en gebruik van de gezondheidszorg. Dit heeft substantiële sociaal-economische gevolgen voor de patiënt, de werkgever en de maatschappij. Om deze negatieve gevolgen te voorkomen zijn effectieve preventiestrategiëen nodig.

Dit proefschrift handelt over de preventie van klachten aan het bewegingsapparaat, en over rugklachten in de bedrijfsgezondheidszorg in het bijzonder. Dit proefschrift bestaat uit twee delen.

Het eerste deel van dit proefschrift (Hoofdstuk 2–6) richt zich op de beschrijving van zorggebruik, ziekteverzuim en productiviteitsverliezen op het werk door klachten aan het bewegingsapparaat, en rugklachten in het bijzonder. Daarnaast wordt nagegaan welke werkgerelateerde fysieke en psychosociale factoren, welke individuele factoren en welke aan de gezondheid gerelateerde factoren hierop van invloed zijn.

In het tweede deel (Hoofdstuk 7) van dit proefschrift wordt de effectiviteit van een preventieprogramma voor rugklachten in bedrijven bestudeerd.

In **Hoofdstuk 1** worden allereerst de belangrijkste termen die aan de orde komen in het proefschrift toegelicht en worden de doelstellingen ervan beschreven.

In **Hoofdstuk 2** wordt in een 1-jarig prospectief longitudinaal onderzoek onderzocht welke individuele, aan de gezondheid en aan het werk gerelateerde factoren het zoeken van medische hulp voor rugklachten beïnvloeden. Bij de start van het onderzoek, én na 1 jaar zijn vragenlijsten afgenomen onder 529 werknemers van verpleeg- en verzorgingshuizen. Er werden gegevens verzameld over individuele factoren, aan de gezondheid en aan werkgerelateerde factoren alsmede het type medische hulp dat zij zochten voor hun rugklachten. Logistische regressie modellen zijn gebruikt om na te gaan of er associaties waren tussen bovengenoemde factoren en het zoeken van medische hulp voor rugklachten.

De resultaten laten zien dat hoewel een groot deel van de werknemers rugklachten heeft, het grootste deel van deze werknemers zelfstandig met zijn klachten omgaat. Van alle werknemers met rugklachten in de onderzoekspopulatie zocht ongeveer één derde medische hulp voor deze klachten. Twee derde deel van de werknemers die hulp zochten voor hun rugklachten, zocht hiervoor wederom medische hulp in het jaar dat erop volgde. Als een patiënt een bepaald type zorgverlener had geconsulteerd voor zijn rugklachten, dan was de kans groot dat hij weer bij hetzelfde type zorgverlener hulp zocht in het onderzoeksjaar. Uit de resultaten komt verder naar voren dat zorggebruik voor rugklachten slechts beperkt wordt beïnvloed door blootstelling aan werkgerelateerde fysieke en psychosociale factoren. Factoren die gerelateerd zijn aan de ernst van de rugklachten, zijn hiervoor veel meer van belang.

Individuele factoren zoals leeftijd, geslacht, opleidingsniveau, het aantal kinderen dat men verzorgt, en sportbeoefening waren niet geassocieerd met het zoeken van medische hulp voor rugklachten, zoals ook andere studies hebben aangetoond.

In **Hoofdstuk 3** wordt nagegaan of individuele en aan het werk gerelateerde fysieke en psychosociale factoren, die van belang zijn voor het ontstaan van klachten aan het bewegingsapparaat, ook het ziekteverzuim voor deze klachten beïnvloeden. Er werd hiervoor onderzoek gedaan onder 373 werknemers die werkzaam waren in de wasserij- en stomerijbranche. Door middel van vragenlijsten werden gegevens verzameld over werkgerelateerde factoren, klachten aan het bewegingsapparaat en ziekteverzuim. Logistische regressie modellen zijn gebruikt om de relatie tussen risicofactoren en klachten aan het bewegingsapparaat en daaraan gerelateerd ziekteverzuim te bepalen.

De resultaten laten zien dat werkgerelateerde fysieke als psychosociale factoren beiden een sterke relatie hebben met het voorkomen van klachten aan het bewegingsapparaat. Aan het werk gerelateerde fysieke factoren beïnvloedden het ziekteverzuim niet verder, terwijl psychosociale factoren enige relatie (niet significant) vertoonden met ziekteverzuim. Ziekteverzuim was geassocieerd met het geboorteland van de werknemer. Vrouwelijke werknemers verzuimden minder vaak voor rugklachten, maar vaker voor klachten aan de nek- en/of bovenste extremiteiten.

Er werd geconcludeerd dat werkgerelateerde fysieke en psychsociale factoren vooral de aanwezigheid van klachten bepaalden, terwijl individuele factoren vooral van invloed waren of iemand voor deze klachten verzuimde.

Hoofdstuk 4 gaat verder met de vraag of aan het werk gerelateerde fysieke en psychosociale risicofactoren die van belang zijn voor het ontstaan van klachten aan het bewegingsapparaat, ook ziekteverzuim en medische consumptie voor deze klachten beïnvloeden. Voor dit onderzoek zijn onder 407 werknemers met fysiek belastend werk vragenlijsten afgenomen. Er werden gegevens verzameld over individuele en werkgerelateerde factoren, klachten aan het bewegingsapparaat, ziekteverzuim en het gebruik van de gezondheidszorg voor deze klachten. Na 6 maanden werd nogmaals gevraagd de vragenlijst in te vullen. Om het verband tussen individuele en werkgerelateerde factoren en klachten aan het bewegingsapparaat en het daaraan gerelateerd ziekteverzuim te bepalen, zijn logistische regressie modellen gebruikt.

De analyses tonen aan dat ongeveer één derde van de werknemers die bij de eerste meting hadden aangegeven dat zij verzuimd hadden voor hun klachten, binnen 6 maanden hiervoor opnieuw verzuimden, en dat meer dan 40% hiervoor ook weer medische hulp zochten.

Er werd geen additief effect van werkgerelateerde fysieke en psychosociale factoren op het zoeken van medische hulp of op ziekteverzuim gevonden. Oudere werknemers en werknemers die alleen woonden verzuimden vaker voor rugklachten. Vrouwelijke werknemers en werknemers die alleen woonden verzuimden vaker voor klachten aan de nek en/of bovenste extremiteiten. We concludeerden dat werkgerelateerde fysieke en psychsociale factoren met name de aanwezigheid van klachten bepaalden, terwijl individuele factoren met name van invloed waren of iemand voor deze klachten verzuimde.

In **Hoofdstuk 5** wordt de invloed van comorbiditeit op de uitkomstmaten ziekteverzuim en zorggebuik voor rugklachten bestudeerd. Voor dit onderzoek zijn vragenlijsten afgenomen onder 505 werknemers in de industriële sector. Eerst wordt de aanwezigheid van klachten van de nek en/of bovenste extremiteiten in combinatie met rugklachten beschreven. Vervolgens is middels logistische regressie analyse onderzocht of de aanwezigheid van comorbiditeit invloed heeft op zorggebruik en ziekteverzuim voor rugklachten.

Uit de resultaten blijkt dat een groot deel (68%) van de werknemers met rugklachten ook andere klachten aan het bewegingsapparaat hebben. Comorbiditeit van de nek en/of bovenste extremiteiten kwam vaker voor onder werknemers met rugklachten die een hoge pijnintensteit rapporteerden of die aangaven door de rugklachten beperkingen te ervaren. Werknemers met rugklachten en comorbiditeit hadden een slechtere algemene gezondheid en een lagere aan de gezondheid gerelateerde kwaliteit van leven in vergelijking met werknemers die alleen rugklachten hadden. De resultaten laten verder zien dat het hebben van comorbiditeit aan het bewegingsapparaat, niet van invloed was op het zoeken van medische zorg of op ziekteverzuim voor rugklachten.

In economische evaluaties van gezondheidsmaatregelen en interventies wordt het aanbevolen om alle kosten en besparingen van de nieuwe interventie in kaart te brengen, inclusief de productiviteitsverliezen die ontstaan doordat werknemers die gezondheidsproblemen hebben, doorwerken. In **Hoofdstuk 6** is de validiteit en bruikbaarheid onderzocht van twee vragenlijsten om aan de gezondheid gerelateerde productieverliezen tijdens het werk te meten. Een tweede doel was om de invloed van individuele, werkgerelateerde en gezondheidsgerelateerde factoren op zelf gerapporteerde productiviteitsverliezen ten gevolge van het doorwerken met klachten te bepalen.

Er zijn gegevens van twee groepen werknemers met een hoge prevalentie van klachten aan het bewegingsapparaat gebruikt; namelijk, werknemers in de industrie (n = 153) en bouwvakkers (n = 182). Met de Health and Labour Questionnaire (HLQ) werd informatie verzameld over de productiviteit van de werknemers in de afgelopen twee weken en met de Quantity and Quality questionnaire (QQ) werd informatie verkregen over de productiviteit van werknemers op de laatste dag dat zij hadden gewerkt. Daarnaast werd informatie verzameld over eigenschappen van het werk, algemene gezondheid, aanwezigheid van klachten aan het bewegingsapparaat, ziekteverzuim en medische consumptie. Voor de groep bouwvakkers werd tevens de zelf gerapporteerde productiviteit vergeleken met 19 observaties op de werkplek.

De resultaten laten zien dat ongeveer de helft van de werknemers die gezondheidsproblemen meldden op hun laatste werkdag, ook een verminderde productiviteit (QQ) rapporteerden. Dit is 10,2% van alle werknemers in de industrie en 11,8% van alle bouwvakkers, hetgeen resulteert in een gemiddeld productiviteitsverlies van 2 uur/dag per werknemer. Het percentage werknemers met productiviteitsverliezen was lager indien gebruik werd gemaakt van de HLQ: 8,0% van de werknemers in de industrie en 6,5% van de bouwvakkers. Productiviteitsverlies (HLQ en QQ) was significant geassocieerd met klachten aan het bewegingsapparaat, slechte fysieke gezondheid en recent ziekteverzuim. Indien gebruik werd gemaakt van de QQ was productiviteitsverlies tevens geassocieerd met de aanwezigheid van chronische klachten aan het bewegingsapparaat, rugklachten, slechte mentale gezondheid, en slechte algemene gezondheid.

Er werd geconcludeerd dat de QQ en HLQ vragenlijsten niet dezelfde productiviteitsverliezen rapporteren. De QQ had een betere construct validiteit dan de HLQ, en is bruikbaarder voor beroepen waar niet de mogelijkheid is om werk dat is blijven liggen zelf op een later tijdstip in te halen, zoals bijvoorbeeld het geval is bij werknemers die aan de lopende band werken.

In **deel 2 (Hoofdstuk 7)** van dit proefschrift staat de werkzaamheid ('effectiviteit') van een preventieprogramma voor rugklachten centraal. De vraag daarbij is of door het preventieprogramma er minder werknemers met klachten zijn en of werknemers die de aanpak hebben gehad, sneller herstellen dan de werknemers die deze aanpak niet hebben gehad. Verder wordt in dit hoofdstuk ook een economische evaluatie gedaan.

De effectiviteit van het preventieprogramma is onderzocht door middel van een cluster gerandomiseerd gecontroleerd therapeutisch experiment. Het preventieprogramma is gebaseerd op een integrale aanpak van drie maatregelen. De eerste preventieve maatregel werd aan alle medewerkers uit de interventiegroep aangeboden. Deze bestond uit drie sessies, waarin voorlichting en training in goede werktechnieken werd gegeven, die specifiek afgestemd waren op de werkplek van de werknemers. Tevens werden er adviezen gegeven over hoe men het beste om kan gaan met rugklachten. De tweede maatregel bestond uit een snelle behandeling van rugklachten door de bedrijfsfysiotherapeut. Indien nodig werd ook de derde maatregel, bestaande uit een werkplekonderzoek en advies over ergonomische aanpassingen, uitgevoerd bij werknemers met rugklachten. Het was ook mogelijk dat een werknemer met rugklachten drie extra werkplektrainingen kreeg. Een belangrijk uitgangspunt bij al de drie maatregelen van het programma waren de principes van het biopsychosociale model, waarin de nadruk wordt gelegd op datgene wat de werknemer nog wel kan doen ondanks rugklachten en waarin het belang om actief te blijven bij rugklachten benadrukt wordt.

Het onderzoek is uitgevoerd in negen grote bedrijven (veelal multi-nationals) in Nederland. De deelnemers aan het onderzoek waren werknemers met fysiek belastend werk. De 489 werknemers werden door loting per ploeg of afdeling verdeeld over het preventieprogramma (n = 258) en de gebruikelijke zorg (n = 231). In elk bedrijf duurde het onderzoek 1 jaar. De werknemers van beide groepen vulden 3 keer een vragenlijst in, allereerst bij aanvang van het onderzoek, en vervolgens na 6 en 12 maanden. De belangrijkste uitkomstmaten waren rugklachten en daaraan gerelateerd ziekteverzuim, maar daarnaast werden bijvoorbeeld ook lichamelijk functioneren (Roland Disability

Questionnaire) en pijn (10-punts numerieke VAS-schaal) gemeten. Er werden in beide follow-up perioden geen statistisch significante verschillen gevonden tussen de interventie- en controlegroep in het aantal episodes rugklachten en het daaraan gerelateerde ziekteverzuim. De nieuwe aanpak leverde dus geen gezondheidswinst op. Om te zien of de invoer van het preventieprogramma mogelijk wel besparingen zou opleveren, zijn ook de kosten en de besparingen berekend. De nieuwe aanpak leverde echter ook geen kostenbesparingen op. Er werd geconcludeerd dat de resultaten van het onderzoek geen reden geven om de gebruikelijke zorg te vervangen door de nieuwe aanpak.

In **Hoofdstuk 8** worden de belangrijkste resultaten van de gepresenteerde onderzoeken uit de voorgaande hoofdstukken met elkaar in verband gebracht, en worden diverse aspecten van deze onderzoeken bediscusiëerd. Er wordt ook stilgestaan bij de vraag welke factoren verantwoordelijk zijn voor het gebrek aan effectiviteit van het preventieprogramma. Hoofdstuk 8 eindigt met enkele algemene aanbevelingen voor toekomstig onderzoek in dit veld en de consequenties van het uitgevoerde onderzoek voor de praktijk van de bedrijfsgezondheidszorg.

Curriculum Vitae
List of Publications
Dankwoord

About the author

Following VWO-β, Helma IJzelenberg started studying at the Faculty of Human Movement Sciences of the VU University Amsterdam. In 1993 she graduated with two majors, one in Health Science and one in Exercise Physiology. After a one-year trip around the world, she obtained more clinical experience by studying physical therapy at the polytechnic in Utrecht and subsequently worked a few years in a rehabilitation center and hospital. In 2001, she started working as a researcher at the Department of Public Health of the Erasmus University Medical Center Rotterdam, where she worked on the research presented here. Beside her research activities, she obtained her MSc-degree in Epidemiology at the Postgraduate Epidemiology Program of the Netherlands Institute for Health Sciences (NIHES) at the Erasmus University Medical Center in Rotterdam.

Since 2005 she has been working as a post-doctoral research fellow at the Institute of Health Sciences, Faculty of Earth and Life Sciences of the VU University Amsterdam.

As a member of the interfaculty working group on Diabetes and Obesity (DO!) of the Institute of Health Science and the Institute for Research in Extramural Medicine (EMGO) of the VU University Medical Center Amsterdam, she is currently conducting a cost-effectiveness study of a lifestyle intervention among patients with cardiovascular disease.

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Dankwoord

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