Gender differences in work-related risk factors for musculoskeletal symptoms and absenteeism

The study presented in this thesis was performed at the EMGO Institute of the VU University Medical Center, Amsterdam, the Netherlands. The EMGO Institute participates in the Netherlands School of Primary Care Research (CaRe), which was re-acknowledged in 2000 by the Royal Netherlands Academy of Arts and Sciences (KNAW).

The study was funded by a grant of The Netherlands Organization for Health Research and Development (ZonMw)

Financial support for the printing of the thesis has been kindly provided by body@work and the EMGO Institute.

ISBN-10: 90-5669-108-2
ISBN-13: 978-90-5669-108-0
NUR: 890

Printing: Ponsen en Looijen bv, Wageningen

© Wendela Hooftman, 2006
No part of this book may be reproduced or transmitted in any form or by any means, electronically or mechanically, including photocopying, recording or using any information storage and retrieval system, without the permission in writing of the author, or, when appropriate, of the publishers of the publication

VRIJE UNIVERSITEIT

Gender differences in work-related risk factors for musculoskeletal symptoms and absenteeism

ACADEMISCH PROEFSCHRIFT

ter verkrijging van de graad Doctor aan
de Vrije Universiteit Amsterdam,
op gezag van de rector magnificus
prof.dr. L.M. Bouter,
in het openbaar te verdedigen
ten overstaan van de promotiecommissie
van de faculteit der Geneeskunde
op dinsdag 19 december 2006 om 13.45 uur
in de aula van de universiteit,
De Boelelaan 1105

door
Wendela Elisabeth Hooftman-Schimmel
geboren te Haarlem

promotoren: prof.dr. W. van Mechelen
prof.dr.ir. P.M. Bongers
copromotor: dr. A.J. van der Beek

Voor Paul
Omdat je niet in het dankwoord wilde

Voor Robin
Omdat je vol blijft houden “mamma dom”

Voor Myrthe
Omdat je zo’n lieverd bent

Contents

1

Introduction

Introduction

Women are often considered to be 'the weaker sex'. This seems to be in contradiction with the fact that women worldwide have a higher life expectance than men. Although the gap in life expectancy is not as big as it used to be, in most European countries women have been outliving men for the past 150 years.[1] However, women do report more health complaints, and make more use of medical care for health problems, especially for relatively minor and subjective complaints.[2-5] This seems to indicate that, while women suffer from relatively mild, transient conditions, men suffer from more serious conditions, and women are not necessarily, 'the weaker sex'.

Musculoskeletal symptoms

One of the conditions that is more prevalent among women than among men are musculoskeletal symptoms. Musculoskeletal symptoms are, in general, one of the most prevalent causes of pain and discomfort in the Netherlands. Picavet et al[6] reported that the one year prevalence of musculoskeletal pain in the Dutch population was almost 75 percent, with low back, neck and shoulder pain constituting the top 3 of complaint sites. It was also found that about half of the persons with musculoskeletal symptoms seeks some sort of medical help, usually from a general practitioner (GP), a result that is in agreement with the results of another Dutch study that reports that 16.2 percent of all visits to a GP concern musculoskeletal symptoms, with back or neck problems being the second most prevalent among all reasons for visiting a GP.[7] Among those with symptoms, 13-24% of the persons with paid work report that they have been sick for work during the past year. Although the duration of absenteeism is usually of short duration, about 25% of all long-term (>1 year) absenteeism is due to musculoskeletal symptoms.[8] Furthermore, the costs of low back symptoms have been estimated at €4 billion[9], and the costs of arm-neck and shoulder symptoms at € 2.1 billion[10], with the vast majority due to indirect costs such as decreased productivity, and work absenteeism.[9,10]

Gender differences

The prevalence of musculoskeletal symptoms in the Netherlands was found to be 79.3% in women and 71.5% in men[11], but this gender difference is not a specifically Dutch problem. Gender differences in the prevalence of musculoskeletal symptoms are consistently found in western countries. For example, in the United States the prevalence of chronic joint symptoms was 37.3% for women and 28.4% for men in general[12], while among older adults prevalences were 64% and 52% for women and men, respectively[13]. In Sweden, the one-year prevalence of self-reported spinal pain (including lower back, upper back and neck) in a sample of 35-45 year old residents was 69.5% for women and 63.2% for men[14], while the two-week prevalence was found to be 50% for women and 38% for men.[15] Urwin et al[16] found that, depending on age, 35-64% of the women in an area in the north west of England reported having a musculoskeletal complaint in at least one body region, but only 36-52% of the men. However, Harkness et al[17] found that English women nowadays report more musculoskeletal pain (12-19% for women and 9-18% for men, depending on the region), whereas 40 years ago the opposite was found and men tended to report more pain. The exact prevalences of the symptoms may vary between the several studies because of different definitions, but these results consistently show that women nowadays more often report musculoskeletal symptoms.

When gender differences in musculoskeletal symptoms are reviewed more closely it is found that the female excess in musculoskeletal symptoms is not so clear for all body regions. For neck and upper extremity symptoms women tend to report higher prevalences. Picavet et al[6] found that the odds of reporting neck, or upper extremity symptoms were 1.8 for Dutch women compared to men, with the highest point prevalences found for the shoulder region (26% for women, and 16% for men). Bot et al[19] showed that in the general practice the incidence of all upper extremity problems was higher for women than for men, with the highest prevalences for neck symptoms (11.6 and 19.3 per 1000 patients for men and women, respectively). In Sweden Bingefors and Isacson[15] found a gender ratio (women/men) of 1.8 for shoulder pain, with 26.3% of women and 14.9% of men reporting shoulder symptoms. In England Urwin et al[16] found higher prevalences of neck, shoulder, as well as hand pain for women, while the prevalence of elbow pain was equal for men and women. Walker-Bone et al[19], found that 44% of women reported an upper extremity musculoskeletal symptom in the past week (compared to 41% of men), but men reported higher prevalences of elbow pain. And these are just a few examples of studies that show that women more often report upper extremity symptoms, although Harkness et al[17] showed that while women nowadays report more shoulder pain (18.7% in women versus 15.9% in men) 40 years ago the opposite was true, and men reported more symptoms (6.9% of men and 5.8% of women).

For back symptoms it is not so clear who (men or women) experience more problems. Picavet et al[6] found that a slightly higher percentage of Dutch women compared to men report back pain (28.1 and 25.6%, respectively). Similar results were found in Sweden[15] and England[16] where 24% of the women, but only 21-22% of the men reported low back pain. Harkness et al[17] furthermore showed that the prevalence of low back pain is higher for women, both now and 40 years ago. Leino-Arjas[20,] on the other hand, reported that Finnish men had more back pain, both with and without consultation, than Finnish women. Cole et al[21] also reported higher prevalences of back problems for men, with prevalences up to 20% for men and 18% for women. Higher prevalences of chronic back problems were also found in France[22]. Finally, Leboeuf-

Yde et al[23] found no gender difference in the prevalence of low back pain in Denmark, and, when they compared their results with the results of earlier studies in Nordic countries, concluded that it is unlikely that there are major gender differences in the prevalence of low back pain.

Gender differences in the prevalence of sickness absenteeism due to musculoskeletal symptoms show a similar pattern. Brage et al[24] calculated the incidence of sickness absenteeism due to musculoskeletal symptoms, and found a higher cumulative incidence for women (80.6 per 1000) than for men (64.1 per 1000). IJzelenberg et al[25] also found that sickness absenteeism due to musculoskeletal symptoms was related to gender, but the direction varied by body region. Women were more often sick due to upper extremity symptoms (odds ratio (OR) 2.2), while men were significantly more often absent due to low back symptoms (OR 0.5). Finally, Leijon et al[26] found that in the 80's more women than men were sick listed due to musculoskeletal symptoms, except for the diagnosis low back pain. They furthermore found that sickness absenteeism due to musculoskeletal symptoms had increased, but that this increase was larger for women than for men.

It thus seems that women more often report neck and upper extremity problems (and are more often absent from work due to these problems), while for back problems the gender difference is only small, or even non-existent. The results also show that these gender differences have not been consistent over time, and the prevalence of symptoms has increased at a higher rate for women than for men.

Etiology of musculoskeletal symptoms

The etiology of (sickness absenteeism due to) musculoskeletal symptoms is multifactorial, i.e. it is not caused by one specific factor, but can be caused by (a combination of) several physical, psychosocial and individual factors. Musculoskeletal complaints have been studied for several years, and many risk factors have been found. Recent reviews[27-35] showed that low back pain has consistently been associated with lifting; awkward posture/bending/twisting; heavy physical workload; and whole body vibration, while neck and upper extremity problems have been related to repetition; (hand-arm) vibration; arm, wrist and head posture; and arm force. Furthermore, several (work-related) psychosocial risk factors were identified: job demands; job control; social support; and job satisfaction. Results on the effect of individual factors are not always clear, but factors that have been associated with musculoskeletal complaints are for example: gender, age, body mass index, smoking, and individual psychosocial factors, such as depression, coping behavior and personality characteristics.[36-39] Viikari-Juntura et al[32] furthermore showed that when several risk factors are combined they may enlarge each others effect.

In figure 1 a conceptual model is presented that shows how exposure to these risk factors may lead to (sickness absence due to) musculoskeletal symptoms. The model is based on the models by Van Dijk et al[40], Westgaard and Winkel[41], Philipsen[42] and Veerman[43]. Figure 1a shows that persons are exposed to risk factors both at home and at work. On the one hand because of the tasks they have, and on the other hand because of the way they perform these tasks. The tasks, task performance and extent to which consequences develop might be influenced by individual factors such as age, physical capacity and gender. As a result of exposure to these factors both short-term (e.g. fatigue during the day and at the end of the day) and long-term (e.g. musculoskeletal pain) consequences may develop. However, individual factors, such as physical capacity, might also be altered as a result of the exposure. Long term consequences, such as pain, could finally cause a person to call in sick for work.

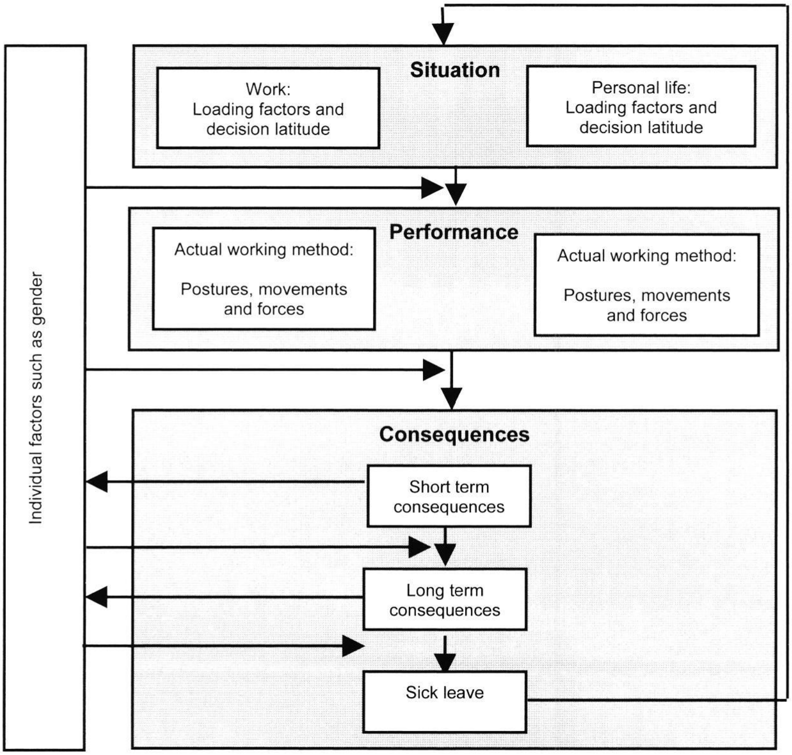

Figure 1a: Conceptual model of how exposure to risk factors may lead to musculoskeletal symptoms. The model is based on Van Dijk et al[40], Westgaard and Winkel[41], Philipsen[42] and Veerman[43]

Figure 1b shows the decision-making process regarding sickness absenteeism. Sickness absenteeism is not a black and white situation. Although in some situations, such as hospitalization, there will be no other choice but to be absent, in many cases it is not so clear whether absenteeism is needed, and workers to a certain extent have the choice whether to be absent or not. This decision is based on several factors, often summarized as the threshold for absenteeism. This threshold is different for each individual, and based on three factors: (1) the *need* to be absent (i.e. the long-term consequences from figure 1a), (2) the *desire* to be absent (e.g. because of personal factors) and (3) the *opportunity* to be absent (e.g. because of social values of society, and practical issues such as getting paid). Based on these three factors a person decides to be absent (or not). This decision, however, is not a split second decision. From the moment a person has complaints to the moment one decides to call in sick for work, factors are continuously considered. And when the decision to be absent had been taken, a similar process occurs, aimed at returning to work.

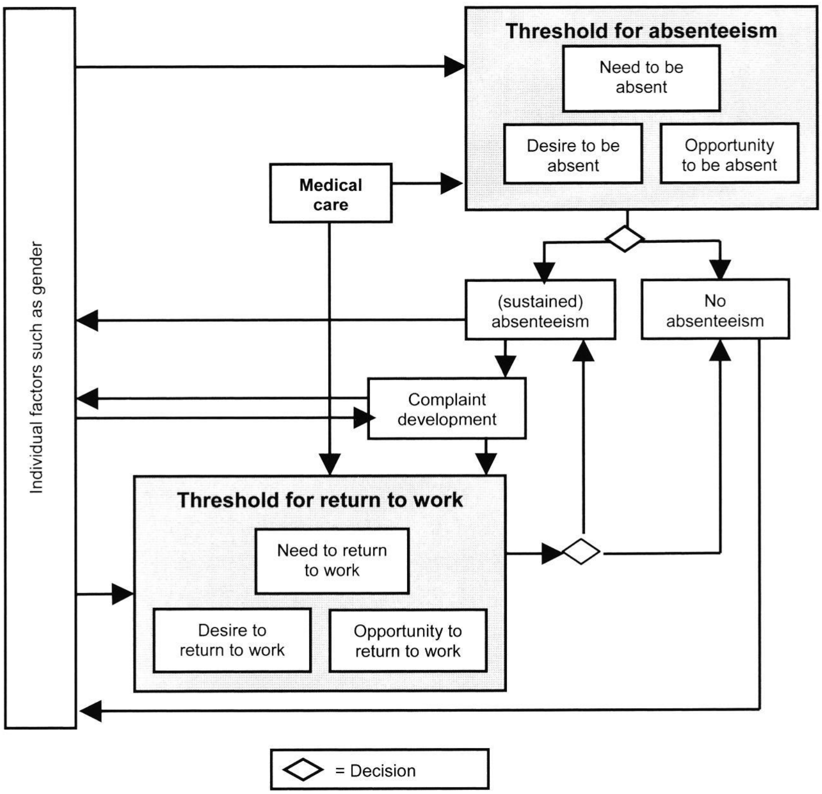

Figure 1b: Conceptual model of how musculoskeletal symptoms may lead to sickness absence (1b). The model is based on Van Dijk et al[40], Westgaard and Winkel[41], Philipsen[42] and Veerman[43]

Gender differences in etiology

Gender is one of the individual factors that seem to matter in the development of (sickness absence due to) musculoskeletal pain, and several explanations for the gender difference in musculoskeletal symptoms have been proposed.

The first explanation is that, gender differences in the development of musculoskeletal pain could be caused by gender differences in the prevalence of exposures to (work-related) risk factors, the so-called ‘exposure hypothesis’. The majority of women in modern western societies have a paid job outside of the house. However, there still is a clear gender segregation in the labor market: men and women often have different jobs, and because of that different exposures. In typical male jobs exposures to heavy physical work and lifting are common, while in typical female jobs exposure to repetitive work is quite frequent. And even when men and women have the same job, their tasks are often not the same, which also results in differences in exposure. Finally, even when jobs and task are the same there may be differences in the way men and women perform a certain task. The average woman is smaller, and has less physical strength than the average man. The ergonomic features of workplaces however, are often designed to fit male workers, and not female workers. Because of this, women may be forced to perform a task in a different way than men. In addition to these differences in work exposure there are differences at home as well. Household responsibilities are not equally divided between men and women. Men and women often have different tasks at home, and even when women have a paid job, the majority of the household responsibilities (such as childcare, cleaning and cooking) are still carried out by women. This so-called double exposure (i.e. exposure at home and at work) has been argued to have positive effects on health[44-49], but the general opinion is that this double exposure causes health problems, because of time pressure, role conflict and role overload.[44]

The second explanation is that women are just more vulnerable to develop complaints, the so-called ‘vulnerability hypothesis’. This is attributed to (sex linked) biological, social and/or psychological differences between men and women. Women, usually, have smaller body dimensions, lower muscle strength and a lower aerobic capacity. Thus, tasks performed with the same (absolute) exposure might therefore result in a higher relative workload for women[49-51], which could lead to more (severe) health effects. Furthermore, both the male sex hormone testosterone as well as the female sex hormone estrogen seem to both quantitatively and qualitatively influence pain.[52] Data on testosterone indicate that these hormones may have an analgesic effect on pain, but not enough data is available to draw firm conclusions.[53] Data on the influence of estrogen, however, are abundant. Both in rodents and in humans, higher levels of estrogen, or comparable hormones, are associated with higher levels of pain.[52-54] This seems to be caused by the effect of estrogens on the central nervous system (CNS), although it is not clear exactly where in the CNS they are of influence.[53]

In addition to this biological explanation, differences in pain (perception) might also be influenced by psychological and social differences. For women pain is not always associated with (tissue) damage. For example, many women experience pain during their menstrual cycle, but this pain is considered to be ’normal’. Women therefore carefully need to monitor their pain and learn to distinguish between pain as a symptom of illness, and pain from normal biological processes. For men on the other hand pain is more often associated with damage, mild pain might therefore be ignored because the related damage is probably insignificant.[55] In addition to this boys and girls in western societies are not raised equally, and boys are often taught not to cry[2], causing the gender difference in pain expression to increase even more. Because of these differences in pain (experience), men and women might also develop different coping strategies for dealing with pain. Unruh et al[55] reviewed the literature on this topic, and found that men and women indeed use different strategies. They found that women use a larger variety of coping strategies (e.g. active behavioral and cognitive coping, seeking support, and relaxation), while men rely on problem focused coping, and tension reducing activities, such as the use of alcohol or drug abuse. They also found that women more often use medication, make more health care visits and are more often absent from work. However, recent studies have shown that women also more often go to work while they value their complaints as too serious to work with.[56,57]

It thus seems that based on the vulnerability hypothesis women have a higher risk of developing musculoskeletal symptoms in general. Furthermore, based on the exposure hypothesis men seem to be more exposed to work-related risk factors for back symptoms, while women are more exposed to work-related risk factors for neck and upper extremity symptoms, and to risk factors in private life in general. This may explain why women are consistently found to have a higher prevalence of neck and upper extremity symptoms, while for back problems the gender difference is not so clear.

Aims and outline of the thesis

The main objective of this thesis is to explore to what extent gender differences in the risk of (sickness absence due to) musculoskeletal symptoms can be explained by differences in (work-related) exposures. Furthermore, it is examined whether the gender difference in the prevalence of (sickness absenteeism due to) musculoskeletal symptoms disappears after adjustment for exposures at home and at work, and it is investigated how workers with musculoskeletal symptoms decide to call in sick for work.

Chapters 2-4 and 6 are based on the Study on Musculoskeletal disorders, Absenteeism Stress and Health (SMASH). In this longitudinal, nearly 1800 employees from 34 companies participated. At baseline (1994), and during three annual follow-up measurements, participants filled out questionnaires on exposures at work and in private life, and on symptoms. Furthermore, from a selection of workers video recordings were made at their workplace. A more detailed description of the study can be found elsewhere[58,59]. In chapters 2-4 the exposure hypothesis is examined. Chapter 2 describes differences in work-related exposures between men and women with the same job, while in chapter 3 gender differences in exposures of men and women performing the same tasks are examined. In chapter 4 exposure at home is included in the analyses, and it is attempted to explain the gender difference in musculoskeletal symptoms by simultaneously adjusting for exposures at home and at work. Chapter 5 and 6 examine the vulnerability hypothesis. Based on a review of the literature (chapter 5) and the results of the SMASH data (chapter 6) gender differences in the effect of exposure to work-related risk factors are examined. In chapter 7 the step from complaints to absenteeism is made. Based on interviews with absent workers, the process that leads to the decision to call in sick for work, and possible gender differences therein, is explored. Finally, this thesis ends with a general discussion and overall conclusions, after which recommendations are given.

References

1. Barford A, Dorling D, Davey Smith G, Shaw M. Life expectancy: women now on top everywhere. BMJ 2006;332(7545):808.
2. Gijsbers van Wijk CMT, Kolk AM. Sex differences in physical symptoms: the contribution of symptom perception theory. Soc Sci Med 1997;45:231-46.
3. Ladwig KH, Marten-Mittag B, Formanek B, Dammann G. Gender differences of symptom reporting and medical health care utilization in the German population. Eur J Epidemiol 2000;16(6):511-8.
4. Wyke S, Hunt K, Ford G. Gender differences in consulting a general practitioner for common symptoms of minor illness. Soc Sci Med 1998;46(7):901-6.
5. Macintyre S, Hunt K, Sweeting H. Gender differences in health: are things really as simple as they seem? Soc Sci Med 1996;42(4):617-24.
6. Picavet HS, Schouten JS. Musculoskeletal pain in the Netherlands: prevalences, consequences and risk groups, the DMC(3)-study. Pain 2003;102(1-2):167-78.
7. Van der Linden M, Westert GP, de Bakker DH, Schellevis FG. Complaints and disorders in the population and general practice [In Dutch: Klachten en aandoeningen in de bevolking en de huisartsen praktijk]. Bilthoven: NIVEL/RIVM, 2005.
8. Landelijk instituut sociale verzekeringen (LISV). Ziektediagnosen bij uitkeringen voor arbeidsongeschiktheid Statistische informatie over medische classificaties in WAO, WAZ en Wajong 1999. Amsterdam: LISV, 2001.
9. Van Tulder MW, Koes BW, Bouter LM. A cost-of-illness study of back pain in The Netherlands. Pain 1995;62(2):233-40.
10. Blatter BM, Houtman IDL, Van den Bossche S, Kraan K, Van den Heuvel SG. Gezondheidsschade en kosten als gevolg van RSI en psychosociale arbeidsbelasting in Nederland.
11. Picavet HSJ, van Gils HWV, Schouten JSGA. Klachten van het bewegingsapparaat in de Nederlandse bevolking. Prevalenties, consequenties en risicogroepen (Musculoskeletal complaints in the Dutch population: prevalences, consequences and risk groups). Bilthoven, Netherlands: Rijksinstituut voor volksgezondheid en milieu (RIVM), 2000.
12. Centers for Disease Control and Prevention (CDC). Prevalence of self-reported arthritis or chronic joint symptoms among adults--United States, 2001. MMWR 2002;51(42):948-50.
13. Leveille SG, Zhang Y, McMullen W, Kelly-Hayes M, Felson DT. Sex differences in musculoskeletal pain in older adults. Pain 2005;116(3):332-8.
14. Linton SJ, Hellsing AL, Halldén K. A population-based study of spinal pain among 35-45-year-old individuals. Prevalence, sick leave, and health care use. Spine 1998;23:1457-63.
15. Bingefors K, Isacson D. Epidemiology, co-morbidity, and impact on health-related quality of life of self-reported headache and musculoskeletal pain--a gender perspective. Eur J Pain 2004;8(5):435-50.
16. Urwin M, Symmons D, Allison T, Brammah T, Busby H, Roxbym M., et al. Estimating the burden of musculoskeletal disorders in the community: the comparative prevalence of symptoms at different anatomical sites, and the relation to social deprivation. Ann Rheum Dis 1998;57:649-55.
17. Harkness EF, Macfarlane GJ, Silman AJ, McBeth J. Is musculoskeletal pain more common now than 40 years ago?: two population-based cross-sectional studies. Rheumatology (Oxford) 2005 Mar.
18. Bot SD, van der Waal JM, Terwee CB, van der Windt DA, Schellevis FG, Bouter LM, et al. Incidence and prevalence of complaints of the neck and upper extremity in general practice. Ann Rheum Dis 2005;64(1):118-23.
19. Walker-Bone K, Palmer KT, Reading I, Coggon D, Cooper C. Prevalence and impact of musculoskeletal disorders of the upper limb in the general population. Arthritis Rheum 2004;51(4):642-51.
20. Leino-Arjas P, Hänninen K, Puska P. Socioeconomic variation in back and joint pain in Finland. Eur J Epidemiol

1998;14:79-87.

21. Cole DC, Ibrahim SA, Shannon HS, Scott F, Eyles J. Work correlates of back problems and activity restriction due to musculoskeletal disorders in the Canadian national population health survey (NPHS) 1994-5 data. Occup Environ Med 2001;58(11):728-34.
22. Leclerc A, Chastang JF, Ozguler A, Ravaud JF. Chronic back problems among persons 30 to 64 years old in France. Spine 2006;31(4):479-84.
23. Leboeuf-Yde C, Klougart N, Lauritzen T. How common is low back pain in the Nordic population? Data from a recent study on a middle-aged general Danish population and four surveys previously conducted in the Nordic countries. Spine 1996;21(13):1518-25; discussion 1525-6.
24. Brage S, Nygard JF, Tellnes G. The gender gap in musculoskeletal-related long-term sickness absence in Norway. Scand J Soc Med 1998;26(1):34-43.
25. IJzelenberg W, Molenaar D, Burdorf A. Different risk factors for musculoskeletal complaints and musculoskeletal sickness absence. Scand J Work Environ Health 2004;30(1):56-63.
26. Leijon M, Hensing G, Alexanderson K. Gender trends in sick-listing with musculoskeletal symptoms in a Swedish county during a period of rapid increase in sickness absence. Scand J Soc Med 1998;26(3):204-13.
27. Ariëns GAM, van Mechelen W, Bongers PM, Bouter LM, van der Wal G. Psychosocial risk factors for neck pain: a systematic review. Am J Ind Med 2001;39(2):180-93.
28. Burdorf A, Sorock G. Positive and negative evidence of risk factors for back disorders. Scan J Work Environ Health 1997;23(4):243-56.
29. Van der Windt DAWM, Thomas E, Pope DP, de Winter AF, Macfarlane GJ, Bouter LM, et al. Occupational risk factors for shoulder pain: a systematic review. Occup Environ Med 2000;75:433-42.
30. Ariëns GAM, van Mechelen W, Bongers PM, Bouter LM, van der Wal G. Physical risk factors for neck pain. Scand J Work Environ Health 2000;26(1):7-19.
31. Hoogendoorn WE, van Poppel MNM, Bongers PM, Koes BW, Bouter LM. Physical load during work and leisure time as risk factors for back pain. Scan J Work Environ Health 1999;25(5):387-403.
32. Viikari-Juntura E, Silverstein B. Role of physical load factors in carpal tunnel syndrome. Scan J Work Environ Health 1999;25(3):163-85.
33. Bongers PM, Kremer AM, ter Laak J. Are psychosocial factors, risk factors for symptoms and signs of the shoulder, elbow, or hand/wrist?: a review of the epidemiological literature. Am J Ind Med 2002;41(5):315-42.
34. Sluiter JK, Rest KM, Frings-Dresen MHW. Criteria document for evaluating the work-relatedness of upper-extremity musculoskeletal disorders. Scand J Work Environ Health 2001;27 Suppl 1:1-102.
35. National Research Council and Institute of Medicine. Panel on Musculoskeletal Disorders and the Workplace, Commission on Behavioral and Social Sciences and Education, National Research Council. Musculoskeletal Disorders and the Workplace. Low back and Upper extremities. National Academic Press, Washington D.C., 2000.
36. Van den Heuvel SG, Boshuizen HC, Mikkelsen S, Bonde JP, van der Beek AJ, Bongers PM. Overcommitment and effort/reward imbalance in relation to neck and upper limb symptoms. submitted.
37. Malchaire J, Cock N, Vergracht S. Review of the factors associated with musculoskeletal problems in epidemiological studies. Int Arch Occup Environ Health 2001;74(2):79-90.
38. Van Eijsden-Besseling MD, Peeters FP, Reijnen JA, de Bie RA. Perfectionism and coping strategies as risk factors for the development of non-specific work-related upper limb disorders (WRULD). Occup Med (Lond) 2004;54(2):122-7.
39. Leboeuf-Yde C. Smoking and low back pain. A systematic literature review of 41 journal articles reporting 47 epidemiologic studies. Spine 1999;24(14):1463-70.
40. Van Dijk F, Van Dormolen M, Kompier Mea. Herwaardering model belasting belastbaarheid (reappraisal of the model of workload and capacity). Tijdschrift Sociale Gezondheidszorg 1990;68:3-10.
41. Westgaard RH, Winkel J. Guidelines for occupational musculoskeletal load as a basis for intervention: a critical review. Appl Ergon 1996;27(2):79-88.
42. Philipsen H. Absenteeism due to sickness, a study of causes of sickness absenteeism in 83 companies [in Dutch: Afwezigheid wegens ziekte een onderzoek naar oorzaken in ziekteverzuim in 83 middelgrote bedrijven]. Groningen: Wolters-Noordhof, 1969.
43. Veerman T. Ziekteverzuim in de gezinsverzorging. Resultaten van een onderzoek naar achtergronden, alsmede aanbevelingen voor aanpak van het probleem. Amsterdam/Leiden: Nederlands Instituut voor Arbeidsomstandigheden (NIA), Werkgroep arbeidsvraagstukken en Welzijn (A&W), 1989.
44. Martikainen P. Women's employment, marriage, motherhood and mortality: a test of the multiple role and role accumulation hypotheses. Soc Sci Med 1995;40(2):199-212.
45. Walters V, Lenton R, French S, Eyles J, Mayr J, Newbold B. Paid work, unpaid work and social support: a study of the health of male and female nurses. Social Science and Medicine 1996;43(11):1627-36.
46. Mastekaasa A. Parenthood, gender and sickness absence. Soc Sci Med 2000;50:1827-42.
47. Hall E. Double exposure: The combined impact of the home and work environments on psychosomatic strain in Swedish

women and men. Int J Health Serv 1992;22(2):239-60.
48. Krantz G, Ostergren PO. Double exposure. The combined impact of domestic responsibilities and job strain on common symptoms in employed Swedish women. Eur J Public Health 2001;11(4):413-9.
49. Punnett L, Herbert R. Work-Related musculoskeletal disorders: Is there a gender differential, and if so, what does it mean? In: Women and health (Goldman MB, Hatch MC, editors). San Diego, CA: Academic Press, 2000: p 474-92.
50. Van der Beek AJ, Kluver BDR, Frings-Dresen MHW, Hoozemans MJM. Gender differences in exerted forces and energetic workload during pushing and pulling of wheeled cages by postal workers. Ergonomics 2000;43(2):269-81.
51. Lindbeck L, Kjellberg K. Gender differences in lifting technique. Ergonomics 2001;44(2):202-14.
52. Craft RM, Mogil JS, Aloisi AM. Sex differences in pain and analgesia: the role of gonadal hormones. Eur J Pain 2004;8(5):397-411.
53. Aloisi AM, Bonifazi M. Sex hormones, central nervous system and pain. Horm Behav 2006 Jan.
54. Fillingim RB, Ness TJ. Sex-related hormonal influences on pain and analgesic responses. Neurosci Biobehav Rev 2000;24(4):485-501.
55. Unruh AM. Gender variations in clinical pain experience. Pain 1996;65(2-3):123-67.
56. Aronsson G, Gustafsson K. Sickness presenteeism: prevalence, attendance-pressure factors, and an outline of a model for research. J Occup Environ Med 2005;47(9):958-66.
57. Aronsson G, Gustafsson K, Dallner M. Sick but yet at work. An empirical study of sickness presenteeism. J Epidemiol Community Health 2000;54(7):502-9.
58. Ariëns GAM, Bongers PM, Douwes M, Miedema M, Hoogendoorn WE, van der Wal G, et al. Are neck flexion, neck rotation and sitting at work risk factors for neck pain? Results of a prospective cohort study. Occup Environ Med 2001;58(3):200-7.
59. Hoogendoorn WE, Bongers PM, de Vet HCW, Douwes M, Koes BW, Miedema M, et al. Flexion and rotation of the trunk and lifting at work are risk factors for low back pain: results of a prospective cohort study. Spine 2000;25:3087-92.

2

Gender differences in self-reported physical and psychosocial exposures in jobs with both female and male workers.

Published as:
Hooftman WE, Van der Beek AJ, Bongers PM, Van Mechelen W.
Gender differences in self-reported physical and psychosocial exposures in jobs with both female and male workers.
J Occup Environ Med. 2005;47:244–2

Abstract:

Gender differences in the prevalence of musculoskeletal complaints, might be due to differences in exposure to risk factors. We therefore examined whether men and women with the same job report equal exposure to work-related physical and psychosocial risk factors for musculoskeletal complaints. Men (N=491) and women (N=342) in jobs with both female and male workers completed a questionnaire on exposure. We found gender differences in exposure for most risk factors, even when differences in job title were accounted for. However, the direction of the difference was not consistent. Although a limitation of the study is that the exposure assessment relied on self-report, we found it unlikely that gender differences in reporting behavior completely explained the gender differences in exposure. Thus it is likely that there truly are gender differences in exposure within the same job.

Introduction

Gender differences in the prevalence of musculoskeletal complaints have been reported in many studies. Both in the general population[1-5] and in working populations[6-9] women have been found to have more complaints than men. This difference seems to be most distinct for neck and upper extremity complaints, where the prevalences are consistently higher for women than for men.[5-8] For back complaints, prevalences have been found to be markedly higher for women[9], slightly higher for women[4,5,7], but also slightly higher for men.[1]

Explanations for this difference in prevalence can be roughly divided in three categories.[10-13] Firstly, there could be differences in the expression of pain. Either because women are more willing to report pain, since this is socially more accepted for women than for men, or because women have a lower threshold for detecting pain.[14] Even so, some of the largest gender differences have been found in studies in which objective measures, rather than self-reports, were used.[13]

Secondly, equal risk factors could have a different effect on men and women. This could be due to the fact that because of their, on average, smaller body dimensions, lower muscle force and lower aerobic capacity tasks performed with the same (absolute) exposure will result in a higher relative workload for women.[13,15,16] Differences in the effect of exposure could also be caused by the influence of sex hormones on the onset and perception of complaints[17-19], or by the fact that men and women use different coping strategies to deal with occupational stressors.[20] Yet, in a recent literature review, evidence for a difference in the effect of risk factors, was only found for three risk factors, two of them with men having a higher risk.[21]

Thirdly, differences in prevalence could be caused by differences in the exposure to risk factors. Due to the gender segregation of the labor market men and women have different jobs, and therefore obviously different exposures. Furthermore, several studies[22-28] found that even when men and women have the same job they have different tasks, which results in differences in physical exposure. Another possibility is that gender differences in prevalence are partly caused by differences in exposure to psychosocial risk factors at work. For example, women generally get paid less, which according to the effort-reward imbalance model could cause an imbalance between the invested efforts and obtained rewards.[29] There might also be gender differences in exposure to risk factors, such as those proposed in Karasek's widely accepted Job-Demand-Control-Support (JDC-S) model[30,31] or those described in the broader literature on psychosocial or organizational hazards.[32]

Two studies[23,28] assessed exposure to psychosocial risk factors, such as job control, job demands, job strain, and social support, and found differences in exposure between men and women in the same job. Exposure to these risk factors has been argued to influence the development of musculoskeletal complaints both on its own and through interactions with physical risk factors.[33] Furthermore, it is also possible that equal exposure to these risk factors may cause gender differences in complaints, since men and women deal differently with occupational stressors. However, most of these studies are based on a small amount of workers, and in a limited number of occupations.

In this study we therefore focus on gender differences in the exposure to risk factors within the same job. The aim is to determine whether men and women with the same job are equally exposed to work-related physical and psychosocial risk factors for musculoskeletal complaints.

Methods

Design

The data for the present study were collected during the baseline measurements of the Study on Musculoskeletal disorders, Absenteeism Stress and Health (SMASH). In this longitudinal study, which focused on the determination of risk factors for musculoskeletal complaints, nearly 1800 employees in 34 companies participated. At the 1994 baseline measurements participants filled out a questionnaire, which included questions on both physical and psychosocial exposures at work. A more detailed description of the study design can be found elsewhere.[34,35]

Table 1: Descriptive information of the study population (N=833)

		Men (N=491)	**Women (N=342)**
Age (year)	*Mean (sd)*	36.7 (8.2)	33.4 (9.4)
Dutch nationality [a †]	*N (%)*	474 (96.5)	318 (93.3)
Working hours per week [‡]	*Mean (sd)*	39.8 (3.3)	36.8 (5,7)
Years of employment in current job [‡]	*Mean (sd)*	10.1 (7.8)	7.3 (5,4)
Education [b †]	*N (%)*		
– No education or primary school		50 (10.2)	24 (7.1)
– Lower secondary or vocational school		144 (29.4)	122 (36.3)
– Intermediate secondary or vocational school		135 (27.6)	105 (31.3)
– Higher secondary or vocational school		86 (17.6)	42 (12.5)
– University		74 (15.1)	43 (12.8)
ISCO codes [‡]	*N (%)*		
– 2113 chemists		13 (2.6)	35 (10.2)
– 2132 computer programmers		34 (6.9)	13 (3.8)
– 3439 administrative professionals not elsewhere classified		127 (25,9)	33 (9.6)
– 4112 word processor and related operators		78 (15.9)	37 (10.8)
– 4190 other office clerks		21 (4.3)	24 (7.0)
– 8284 metal-rubber and plastic products assemblers		20 (4.1)	32 (9.4)
– 9321 assembling laborers		18 (3.7)	49 (14.3)
– 9322 hand packers and other manufacturing laborers		180 (36.7)	119 (34.8)

[a] Data missing for 1 women; [b] Data missing for 2 men and 6 women;† significant difference between men and women at p=0.05, ‡ significant difference between men and women at p=0.001

Population

At baseline 87% of the workers (N=1789) filled out the questionnaire. For the current analyses workers who worked less than 20 hours a week (N=40), were employed in their current job for less than one year (N=37), had a second job (N=100), or had a permanent disability pension, or were on sickness benefit (N=34) were excluded. Furthermore, to ensure that we would not be looking at the odd woman in an all male profession (or the odd man in an all female profession) we restricted the analyses to those jobs (classified according to the International Standard Classification of Occupations (ISCO)) in which at least 10 men and 10 women were employed (N=745 excluded). Therefore, the analyses were based on a total of 833 workers, 491 males and 342 females. A description of the study population can be found in table 1.

Physical risk factors

Exposure to work-related physical risk factors was assessed using the Dutch Musculoskeletal Questionnaire.[36,37] Workers were asked how often they performed activities (e.g. 'How often do you have to lift loads more than 5 kilo?') on a four-point scale ('never', 'occasionally', 'often', or 'very often'). The questions about adverse head and wrist postures (e.g. 'Do you often have to work with your neck bend?') and climbing stairs were scored on a dichotomous scale ('no' or 'yes').

Psychosocial risk factors

Exposure to psychosocial risk factors was measured with the Dutch translation of Karasek's Job Content Questionnaire (JCQ).[30] The individual questions were scored on a four-point scale ('strongly disagree', 'disagree', 'agree', 'strongly agree'). These single items were combined into the dimensions according to Karasek: Job demands (alpha=0.65), job control (consisting of skill discretion (alpha=0.74) and decision authority (alpha=0.65)), and social support (alpha=0.81), which was divided in supervisor social support and co-worker social support. The calculation of the items has been described by De Jonge et al.[38]

A central concept of the JDC-S model is the interaction between job demands and job control. If an employee is simultaneously exposed to high demands and low control, this is called a high strain situation, which is believed to be the most unfavorable psychological working condition.[30,31] Based on the JCQ we, therefore, calculated exposure to job strain. Individuals who rated their job demands as high (i.e. higher than the 50th percentile) and their job control as low (i.e. lower than the 50th percentile) were regarded as exposed to high job strain.

In addition to the JCQ a single question about job satisfaction was asked ("Do you mostly enjoy your work?"), which was scored on a four-point scale ('seldom or never', 'sometimes', 'often', or '(almost) always'). Although, obviously, no alpha could

Table 2: Self-reported exposure to work-related risk factors.

		Desk work		Assembly work	
		Men(n=273)	Women(N=142)	Men (N=218)	Women(N=200)
		N(%)	N(%)	N (%)	N (%)
Risk factors for back complaints					
Lift loads >5kg	*never*	192 (70.3)	89 (62.7)	10 (4.6)	80 (40.0)
	occasionally	70 (25.6)	50 (35.2)	33 (15.1)	53 (26.5)
	often	8 (2.9)	3 (2.1)	82 (37.6)	44 (22.0)
	very often	3 (1.1)	-	93 (42.7)	23 (11.5)
Lift loads >25 kg	*never*	249 (91.2)	136 (95.8)	54 (24.8)	148 (74.4)
	occasionally	21 (7.7)	5 (3.5)	95 (43.6)	34 (17.1)
	often	2 (0.7)	1 (0.7)	43 (19.7)	12 (6.0)
	very often	1 (0.4)	-	26 (11.9)	5 (2.5)
Flexion/rotation of the upper part of the body	*never*	130 (47.8)	48 (33.8)	15 (6.9)	38 (19.1)
	occasionally	67 (24.6)	32 (22.5)	26 (12.0)	53 (26.6)
	often	66 (24.3)	52 (36.6)	98 (45.2)	68 (34.2)
	very often	9 (3.3)	10 (7.0)	78 (35.9)	40 (20.1)
Uncomfortable working postures	*never*	191 (70.5)	63 (44.4)	47 (21.7)	70 (35.2)
	occasionally	66 (24.4)	56 (39.4)	99 (45.6)	82 (41.2)
	often	10 (3.7)	19 (13.4)	45 (20.7)	31 (15.6)
	very often	4 (1.5)	4 (2.8)	26 (12.0)	16 (8.0)
Driving a vehicle	*never*	230 (84.6)	124 (87.9)	107 (49.3)	192 (97.5)
	occasionally	32 (11.8)	16 (11.3)	38 (17.5)	3 (1.5)
	often	7 (2.6)	1 (0.7)	38 (17.5)	1 (0.5)
	very often	3 (1.1)	-	34 (15.7)	1 (0.5)
Risk factors for neck and upper extremity complaints					
Repeated movements with hands or arms, many times a minute	*never*	72 (26.4)	26 (18.3)	23 (10.6)	4 (2.0)
	occasionally	54 (19.8)	27 (19.0)	35 (16.1)	11 (5.5)
	often	102 (37.4)	50 (35.2)	75 (34.6)	49 (24.5)
	very often	45 (16.5)	39 (27.5)	84 (38.7)	136 (68.0)
Working with the hands above shoulder level	*never*	260 (95.2)	117 (82.4)	49 (22.6)	96 (48.7)
	occasionally	12 (4.4)	19 (13.4)	100 (46.1)	60 (30.5)
	often	1 (0.4)	5 (3.5)	52 (24.0)	25 (12.7)
	very often	-	1 (0.7)	16 (7.4)	16 (8.1)
Working with the hands below knee level	*never*	259 (94.9)	129 (90.8)	53 (24.4)	152 (77.2)
	occasionally	12 (4.4)	13 (9.2)	94 (43.3)	34 (17.3)
	often	1 (0.4)	-	57 (26.3)	7 (3.6)
	very often	1 (0.4)	-	13 (6.0)	4 (2.0)
Force exertion with hands/arms	*never*	223 (81.7)	90 (63.8)	14 (6.4)	65 (32.5)
	occasionally	42 (15.4)	43 (30.5)	51 (23.4)	59 (29.5)
	often	7 (2.6)	7 (5.0)	80 (36.7)	42 (21.0)
	very often	1 (0.4)	1 (0.7)	73 (33.5)	34 (17.0)

Table 2: Continued

Often bend the neck or keep the neck bend forwards	*yes*	194 (71.1)	121 (85.2)	128 (59.0)	173 (87.4)
	no	79 (28.9)	21 (14.8)	89 (41.0)	25 (12.6)
Often bend the neck or keep the neck bend backwards	*yes*	12 (4.4)	5 (3.5)	48 (22.1)	10 (5.1)
	no	259 (95.6)	136 (96.5)	169 (77.9)	187 (94.9)
Often twist the neck or keep the neck twisted	*yes*	111 (40.7)	90 (63.4)	123 (56.7)	105 (53.0)
	no	162 (59.3)	52 (36.6)	94 (43.3)	93 (47.0)
Often bend the wrist or keep the wrist bend	*yes*	84 (30.9)	57 (40.1)	132 (61.1)	137 (69.2)
	no	188 (69.1)	85 (59.9)	84 (38.9)	61 (30.8)
Often twist the wrist or keep the wrist twisted	*yes*	44 (16.2)	33 (23.2)	118 (54.9)	123 (62.8)
	no	228 (83.8)	109 (76.8)	97 (45.1)	73 (37.2)
Squeeze firmly with the hands	*never*	236 (86.4)	110 (77.5)	51 (23.6)	110 (55.0)
	occasionally	29 (10.6)	23 (16.2)	64 (29.6)	53 (26.5)
	often	8 (2.9)	5 (3.5)	60 (27.8)	23 (11.5)
	very often	-	4 (2.8)	41 (19.0)	14 (7.0)
Risk factors for lower extremity complaints					
Walk for a prolonged time	*never*	180 (66.7)	83 (58.9)	27 (12.4)	115 (58.1)
	occasionally	71 (26.3)	33 (23.4)	35 (16.1)	47 (23.7)
	often	19 (7.0)	18 (12.8)	89 (41.0)	20 (10.1)
	very often	-	7 (5.0)	66 (30.4)	16 (8.1)
Kneel or squat for a prolonged time	*never*	259 (94.9)	126 (88.7)	108 (49.5)	167 (84.3)
	occasionally	11 (4.0)	16 (11.3)	80 (36.7)	30 (15.2)
	often	2 (0.7)	-	5 (11.5)	1 (0.5)
	very often	1 (0.4)	-	5 (2.3)	-
Frequently climb stairs	*yes*	58 (21.3)	23 (16.2)	70 (32.4)	27 (13.6)
	no	214 (78.7)	119 (83.8)	146 (67.6)	171 (86.4)
Psychosocial risk factors	Range	**Mean (Sd)**	**Mean (Sd)**	**Mean (Sd)**	**Mean (Sd)**
Job control	*24-96*	73.2 (9.2)	67.6 (9.9)	62.5 (9.9)	58.4 (10.7))
Job demands	*12-48*	32.1 (4.3)	31.9 (4.3)	33.1 (4.8)	34.4 (4.7)
Coworker social support	*4-16*	12.0 (1.3)	12.1 (1.5)	11.7 (1.8)	12.0 (1.6)
Supervisor social support	*4-16*	10.8 (2.1)	10.7 (2.2)	11.0 (2.1)	11.1 (2.0)
		N(%)	**N(%)**	**N(%)**	**N(%)**
High job strain	*Yes*	22 (8.2)	32 (23.0)	72 (35.1)	92 (51.4)
	No	246 (91.8)	107 (77.0)	133 (64.9)	87 (48.6)
Do you mostly enjoy your work?	*Seldom / never*	2 (0.7)	1 (0.7)	4 (1.9)	1 (0.5)
	Sometimes	21 (7.7)	7 (5.0)	41 (19.0)	17 (8.5)
	Often	121 (44.3)	63 (44.7)	77 (35.6)	66 (33.0)
	Almost always	129 (47.3)	70 (49.6)	94 (43.5)	116 (58.0)

be calculated, single-item measurements have been found to be a good measure for general job satisfaction and have a fairly good correlation with multiple item scales.[39]

Statistics

Since it was expected that the relation between gender and exposure would vary by the type of work we performed separate analyses for desk workers (ISCO 2113, 2132, 3439, 4112 and 4190) and assembly workers (ISCO 8284, 9321 and 9322). All statistical analyses were performed with SPSS version 10.0 for Windows. To test the association between gender and the selected risk factors logistic and ordinal regression analyses were performed for the dichotomous and the ordinal dependent variables, respectively. For the continuous dependent variables an analysis of variance (ANOVA) was used.

The basic model included gender and ISCO. Age, education, years of employment, working hours, and nationality were considered as potential confounders. However, since age and years of employment were correlated with r=0.55, only age was used in the analyses. The continuous independent variables were recoded into five categories to check for linearity. If a linear relation with the exposure was not shown the categorized variable was used. The potential confounders were manually and stepwise entered into the basic model as independent variables. First they were individually entered and included as confounders if they changed the Odds Ratio (OR) or the estimate with at least 10%. Then these confounders were simultaneously entered into the model as independent variables. Finally, the interaction between gender and ISCO was added to this model and included if it was significant.

Results

Physical risk factors

Table 2 describes the self-reported exposure to work-related risk factors. In the full model the odds for reporting flexion/rotation of the upper body, uncomfortable working postures, making repeated movements with the hands, working with the hands above shoulder level, bending the neck forwards, twisting the neck, and bending the wrist were significantly higher for female desk workers than for their male counterparts (OR 1.69 through 3.12) (table 3a), Men, on the other hand, reported more exposure to driving a vehicle (OR 0.50). In the basic model men also reported more exposure to lifting loads>25kg (OR 0.22), but there were not enough persons exposed to perform the analyses for the full model. For the remaining risk factors no significant gender differences were found.

Among assembly workers the odds for reporting repeated movements with the hands (OR 3.60), and bending the neck forwards (OR 3.73) were significantly higher for women. No gender difference was found for twisting the neck, and bending or twisting

Table 3a: Multivariate analyses of the relation between gender and self-reported exposure to physical risk factors. Odds Ratios (OR) and 95% Confidence interval (95%CI). OR>1 means women have a higher exposure than men, OR<1 means women have a lower exposure than men.

	Desk work		**Assembly work**	
	Basic model [a,b]	**Full model** [c]	**Basic model**	**Full model**
	OR (95% CI)	**OR (95% CI)**	**OR (95% CI)**	**OR (95% CI)**
Risk factors for back complaints				
– Lift loads >5kg	0.83 (0.51-1.34)	0.83 (0.51-1.34)	**0.15 (0.10-0.22)**	**0.19 (0.12-0.29)***
– Lift loads >25 kg	**0.22 (0.08-0.62)**	¶	**0.14 (0.09-0.22)**	**0.20 (0.12-0.32)***
– Flexion/rotation of the upper part of the body	**1.91 (1.27-2.87)**	**1.91 (1.27-2.87)**	**0.42 (0.29-0.60)**	**0.47 (0.30-0.75)~***
– Uncomfortable working postures	**1.97 (1.27-3.06)**	**1.69 (1.06-2.69)~**	**0.63 (0.44-0.91)**	**0.63 (0.44-0.91)**
– Driving a vehicle	**0.50 (0.25-0.97)**	**0.50 (0.25-0.97)**	**0.03 (0.01-0.07)**	¶
Risk factors for neck and upper extremity complaints				
– Repeated movements with hands or arms, many times a minute	**2.00 (1.34-2.98)**	**1.74 (1.15-2.65)~**	**3.49 (2.33-5.23)**	**3.60 (2.18-5.94)~***
– Working with the hands above shoulder level	**3.12 (1.46-6.67)**	**3.12 (1.46-6.67)**	**0.57 (0.39-0.83)**	¶
– Working with the hands below knee level	¶	¶	**0.12 (0.08-0.19)**	**0.12 (0.08-0.19)**
– Force exertion with hands/arms	1.67 (1.0-2.78)	1.67 (1.0-2.78)	**0.29 (0.20-0.42)**	**0.33 (0.21-0.52)~***
– Often bend the neck or keep the neck bend forwards	**2.56 (1.45-4.51)**	**2.56 (1.45-4.51)**	**4.17 (2.50-6.96)**	**3.73 (2.16-6.45)~**
– Often bend the neck or keep the neck bend	0.62 (0.19-2.01)	0.80 (0.22-2.87)'	**0.21 (0.10-0.43)**	**0.23 (0.11-0.48)-**
– Often twist the neck or keep the neck twisted	**3.52 (2.18-5.70)**	**2.91 (1.74-4.87)'**	0.90 (0.60-1.35)	0.79 (0.51-1.22)~
– Often bend the wrist or keep the wrist bend	1.46 (0.92-2.32)	**1.79 (1.06-2.93)'**	1.22 (0.80-1.87)	1.00 (0.63-1.58)~
– Often twist the wrist or keep the wrist twisted	1.34 (0.76-2.37)	1.48 (0.80-2.73)'	1.26 (0.83-1.87)	1.11 (0.72-1.73)~
– Squeeze firmly with the hands	1.00 (0.54-1.83)	1.00 (0.54-1.83)	**0.25 (0.17-0.37)**	**0.23 (0.14-0.36)***
Risk factors for lower extremity complaints				
– Walk for a prolonged time	0.92 (0.57-1.48)	0.92 (0.57-1.48)	**0.13 (0.09-0.20)**	**0.15 (0.10-0.24)~**
– Kneel or squat for a prolonged time	1.72 (0.75-3.93)	1.72 (0.75-3.93)	**0.20 (0.12-0.31)**	**0.26 (0.16-0.44)***
– Frequently climb stairs	0.59 (0.33-1.07)	0.59 (0.33-1.07)	0.39 (0.23-0.65)	0.39 (0.23-0.65)

[a] Basic model: adjusted for ISCO; [b] Bold indicates significant difference between men and women at p=0.05; [c] Full model: adjusted for ISCO and: ~ working hours; ' age; - education * significant interaction between gender and isco; ¶ not enough persons exposed to perform the analysis

the neck. For the remaining risk factors the odds were significantly higher for men (range ORs 0.12-0.63). However, for driving a vehicle (OR=0.03) and working with the hands above shoulder level (OR=0.57) this was only found in the basic model, since, again, not enough persons were exposed to perform the analyses for the full model.

Psychosocial risk factors

Both male desk and male assembly workers reported significantly more job control. Female assembly workers also reported more job demands (table 3b). In accordance to this both among desk workers and among assembly workers women more often reported exposure to high job strain (OR 2.23 and 1.82, respectively). No significant gender differences in both supervisor and co-worker social support were found for desk workers. For assembly workers no differences were found in co-worker support, but female assembly workers reported significantly more supervisor social support. Furthermore, female assembly workers reported more job satisfaction (OR 2.71).

Table 3b: Multivariate analyses of self-reported exposure to psychosocial risk factors. Mean and or Odds Ratio (OR) and 95% Confidence interval (95%CI). OR>1 means women have a higher exposure than men, OR<1 means women have a lower exposure than men.

	Basic model [a, b]		**Full model [c]**	
	Men	**Women**	**Men**	**Women**
	Mean (95%CI)	**Mean (95%CI)**	**Mean (95%CI)**	**Mean (95%CI)**
Desk work				
Job control	**60.6 (59.5-61.7)**	**55.7 (54.3-57.0)**	**58.5 (56.4-60.5)**	**54.9 (52.8-57.1)'-~**
Job demands	32.3 (31.7-32.9)	32.1 (31.3-32.8)	33.3 (31.3-35.2)	33.0 (31.0-34.9)+
Supervisor social support	12.7 (10.4-11.0)	10.8 (10.4-11.1)	9.5 (8.3-10.7)	9.5 (8.3-10.8)-'~+
Coworker social support	11.9 (11.7-12.1)	12.0 (11.8-12.3)	12.1 (11.7-12.5)	12.2 (11.8-12.6)-'~
High Job strain [d]	**2.77 (1.47-5.22)**		**2.23 (1.14-4.44)'**	
Do you mostly enjoy your job?[d]	1.25 (0.82-1.92)		1.25 (0.82-1.92)	
Assembly work				
Job control	**51.3 (49.7-52.9)**	**47.8 (46.4-49.3)**	**51.3 (49.6-53.0)**	**48.7 (46.8-50.7)~**
Job demands	**32.8 (32.0-33.7)**	**34.3 (33.5-35.0)**	**32.8 (32.0-33.7)**	**34.3 (33.5-35.0)**
Supervisor social support	11.2 (10.8-11.5)	11.2 (10.9-11.5)	**10.9 (10.2-11.7)**	**11.8 (11.0-12.5)-"~***
Coworker social support	11.9 (11.7-12.2)	12.2 (11.9-12.4)	11.7 (11.1-12.3)	11.9 (11.3-12.5)'-
High Job strain [d]	**1.95 (1.27-2.99)**		**1.82 (1.15-2.89)~**	
Do you mostly enjoy your job? [d]	**2.12 (1.43-3.12)**		**2.71 (1.75-4.19)-~**	

[a] Basic model: adjusted for ISCO; [b] Bold indicates significant difference between men and women at p=0.05; [c] Full model: adjusted for ISCO and: ~ working hours; ' age; - education; + nationality * significant interaction between gender and isco; ¶ not enough persons exposed to perform the analysis; [d] OR (95%CI)

Discussion

Due to the gender segregation of the labor market men and women have different jobs and tasks within the same occupations. This may result in different exposures to risk factors. The results of this study show that gender differences in self-reported exposure to physical and psychosocial risk factors exist, even when differences in job title are accounted for. This finding is in agreement with earlier studies.[22-28] We stratified the analyses by work type, but the interaction between gender and ISCO remained significant for a few risk factors. When univariate analyses were performed for the individual ISCO codes (results not shown) it was found that the direction of the difference was either equal for all jobs (lifting, flexion/rotation of the upper body, kneeling/squatting), or a nonsignificant difference in the opposite direction was found for one of the jobs (repetitive movements, force exertion with the hands, squeeze with the hands, supervisor social support). These interactions, therefore, represent differences in the magnitude of the gender difference.

Physical Risk factors

The most obvious explanations for the differences in self-reported exposure to physical risk factors is that men and women were assigned to, or choose to, perform different tasks within the same job. This is mostly based on the assumption that men have more physical strength. Messing et al. observed and interviewed male and female workers in various occupations[25-27], and noticed that within the same job title men and women indeed performed different tasks. Men usually performed the more physically strenuous tasks, while women more often performed tasks that required precision and were repetitive in nature. Their finding is in line with our results that men reported more exposure to lifting (very) heavy loads, and that women reported more exposure to repeated movements.

A second explanation might be that men and women perform the same task in a different way. Workplaces have often been designed for men and not for the, on average, smaller and less powerful women. Because of this there may be a poor ergonomic match between the work environment and the individual woman, and women may, for example, be forced to work with their hands above shoulder level, or to use more extreme wrist postures when working with a computer mouse.[40]

Psychosocial risk factors

We found that men reported more job control while, among assembly workers, women reported more job demands. Within the framework of Karasek's Demand-Control model[30] these findings indicate that men more often work in a low strain environment, while women work in the less favorable high strain environment. When we combined these two measurements into a single measurement for job strain and we indeed found women more often reported working in a high strain environment.

One aspect of job control is decision authority, which reflects to what extent employees have freedom to make their own decisions on, for example, how to perform their job. Hence, it could be argued that, since men report to have more job control, men do not only have a better psychosocial work environment, but they might also have more opportunities to influence or shape their physical workplace to become less physically strenuous. This hypothesis is in agreement with an earlier study[23] reporting that female shop assistants were more often exposed to a combination of high physical load and job strain than their male colleagues. The same study reported that 14% of assistant nurses were exposed to high job strain, but none of them were male.[23] However, in the present study gender differences in physical exposures did not always reflect a more strenuous workplace for women. Therefore, it is still unknown whether job control is indeed linked with the opportunity to influence physical demands at work.

Since exposure to high job strain is considered to be a risk factor for musculoskeletal complaints, a practical implication of the present study is that a reduction of job strain among the female workers, for example by control-oriented strategies, could be a valuable avenue for reducing musculoskeletal complaints among working women.

We also found that women reported more job satisfaction. Several studies have shown that, in spite of the fact that women usually have jobs with less favorable working conditions, they often report higher job satisfaction than men.[41,42] Clark [42] tested several hypotheses on this difference and concluded that women have lower expectations from work, and therefore are more easily satisfied. This relation between expectations and job satisfaction was confirmed in a study among lawyers.[41] In this study men and women had equal expectations from work, but working conditions (financial rewards, promotional opportunities, and influence over work) were less favorable for women than for men. Because of this, women rated their job satisfaction lower than men. This shows that job satisfaction is influenced by the (mis)match between expectations and working conditions.

Limitations of the study

A limitation of the study is that the exposure assessment relied solely on self-report, which seems to be influenced by both the anxiety about and the experience with a risk factor.[43] If either men or women would systematically have under- or over-estimated their exposure this could (at least partly) explain the differences in exposure. Since women are generally more concerned about health matters[44], they could be expected to over-report their exposure compared to men. Hansson et al.[45] indeed found that, when questionnaire data were compared with direct measurements of exposure, women rated their exposure higher than men. However, Leijon et al.[46] compared questionnaire data with a structured interview, and found no systematic difference in reporting between the genders. Therefore, it is unlikely that gender differences in reporting behavior completely explains the gender differences in exposure, although it cannot be ruled out that it influenced the differences in exposure.

Furthermore, several studies compared self-reported exposure with more objective measurements of exposure and found differences in reporting between people with and without complaints. Hansson et al.[45] and Thomson et al.[47] compared questionnaires with inclinometers and video-recordings, respectively, and found that persons with neck-shoulder complaints rated their exposure higher than persons without complaints. Moreover, Viikari-Juntura et al.[48] found differences in reporting behavior for persons with and without low back pain when self-assessed and observed exposure were compared. However, these results have been contradicted both in lab and field situations.[46,49] Considering the fact that women generally have more complaints, they could be expected to systematically report higher exposures compared to men, especially for risk factors for neck and upper extremity complaints. However, while we found that this was indeed true for desk workers, among assembly workers men reported more exposure to almost all risk factors. Furthermore, when we restricted the analyses to those persons without complaints (results not shown) this did not change the results. It is therefore concluded that the found gender differences represent true differences between the genders, and not between people with and without complaints.

Conclusions

Given the gender differences in complaints it was expected that women would have a higher self-reported exposure to risk factors for musculoskeletal complaints, especially for risk factors for neck and upper extremity complaints. We found gender differences for almost all risk factors, but the exposure was not always higher for women. However, we did find that female desk workers systematically reported more exposure to risk factors for upper extremity complaints. Furthermore, women are more often employed in a high strain working environment. These differences might be influenced by differences in the reporting of exposure, but it seems unlikely that this completely explains the found differences. Thus it is likely that there indeed truly are gender differences in exposure within the same job.

To explain gender differences in the prevalence of musculoskeletal complaints, not only gender differences in exposure within jobs, but also differences in the number of male and female workers exposed is relevant. We already stated that men and women have different exposures due to the gender difference in the labor market, and this effect may be larger than the effect of gender differences in exposures within jobs. Further studies are therefore needed to determine to which extent gender differences in the prevalence of musculoskeletal complaints are caused by both gender differences in exposure between jobs and differences within jobs.

References

1. Leino-Arjas P, Hänninen K, Puska P. Socioeconomic variation in back and joint pain in Finland. Eur J Epidemiol 1998;14:79-87.
2. Centers for Disease Control and Prevention (CDC). Prevalence of self-reported arthritis or chronic joint symptoms among adults--United States, 2001. MMWR 2002;51(42):948-50.
3. Urwin M, Symmons D, Allison T, Brammah T, Busby H, Roxbym M., et al. Estimating the burden of musculoskeletal disorders in the community: the comparative prevalence of symptoms at different anatomical sites, and the relation to social deprivation. Ann Rheum Dis 1998;57:649-55.
4. Linton SJ, Hellsing AL, Halldén K. A population-based study of spinal pain among 35-45-year-old individuals. Prevalence, sick leave, and health care use. Spine 1998;23:1457-63.

5. Picavet HSJ, van Gils HWV, Schouten JSGA. Klachten van het bewegingsapparaat in de Nederlandse bevolking. Prevalenties, consequenties en risicogroepen (Musculoskeletal complaints in the Dutch population: prevalences, consequences and risk groups). Bilthoven, Netherlands: Rijksinstituut voor volksgezondheid en milieu (RIVM), 2000.
6. Cassou B, Derriennic F, Monfort C, Norton J, Touranchet A. Chronic neck and shoulder pain, age, and working conditions: longitudinal results from a large random sample in France. Occup Environ Med 2002;59(8):537-44.
7. De Zwart BCH, Broersen JP, Frings-Dresen MH, van Dijk FJ. Musculoskeletal complaints in The Netherlands in relation to age, gender and physically demanding work. Int Arch Occup Environ Health 1997;70(5):352-60.
8. Gerr F, Marcus M, Ensor C, Kleinbaum D, Cohen S, Edwards A, et al. A prospective study of computer users: I. Study design and incidence of musculoskeletal symptoms and disorders. Am J Ind Med 2002;41(4):221-35.
9. Krause N, Ragland DR, Greiner BA, Syme SL, Fisher JM. Psychosocial job factors associated with back and neck pain in public transit operators. Scand J Work Environ Health 1997;23(3):179-86.
10. Kilbom Å, Messing K. Aches and Pains-an affliction of women. Work-related musculoskeletal disorders. In: Kilbom Å, Messing K, Bildt-Thorbjörnsson C, editors. Women's health at work. Solna, Sweden: National Institute for Working Life, 1998: p 203-27.
11. Buckle P, Devereux J. Work-related neck and upper limb disorders. Luxembourg: European Agency for Safety and Health at work, 1999.
12. Karlqvist L. The importance of gender sensitive studies of work related neck and upper limb disorders. In: Bild C, Karlqvist L, editors, Women's conditions in working life. Solna, Sweden: Arbetslivsinstitutet. 2001 p: 66-72. Arbete Och Hälsa 2001:17.
13. Punnett L, Herbert R. Work-Related musculoskeletal disorders: Is there a gender differential, and if so, what does it mean? In: Women and health (Goldman MB, Hatch MC, editors). San Diego, CA: Academic Press, 2000: p 474-92.
14. Gijsbers van Wijk CMT, Kolk AM. Sex differences in physical symptoms: the contribution of symptom perception theory. Soc Sci Med 1997;45:231-46.
15. Van der Beek AJ, Kluver BDR, Frings-Dresen MHW, Hoozemans MJM. Gender differences in exerted forces and energetic workload during pushing and pulling of wheeled cages by postal workers. Ergonomics 2000;43(2):269-81.
16. Lindbeck L, Kjellberg K. Gender differences in lifting technique. Ergonomics 2001;44(2):202-14.
17. Musgrave DS, Vogt MT, Nevitt MC, Cauley JA. Back problems among postmenopausal women taking estrogen replacement therapy: the study of osteoporotic fractures. Spine 2001;26(14):1606-12.
18. Brynhildsen JO, Björs E, Skarsgård C, Hammar ML. Is hormone replacement therapy a risk factor for low back pain among postmenopausal women? Spine 1998;23(7):809-13.
19. Fillingim RB, Ness TJ. Sex-related hormonal influences on pain and analgesic responses. Neurosci Biobehav Rev 2000;24(4):485-501.
20. Bellman S, Forster N, Still L, Cooper CL. Gender differences in the use of social support as a moderator of occupational stress. Stress Health 2003;19(1):45-58.
21. Hooftman WE, van Poppel MN, van der Beek AJ, Bongers PM, van Mechelen W. Gender differences in the relations between work-related physical and psychosocial risk factors and musculoskeletal complaints. Scand J Work Environ Health 2004;30(4):261-78.
22. Fransson-Hall C, Bystrom S, Kilbom Å. Self reported physical exposure and musculoskeletal symptoms of the forearm-hand among automobile assembly line workers. J Occup Environ Med 1995;37(9):1136-44.
23. Josephson M, Pernold G, Ahlberg-Hulten G, Harenstam A, Theorell T, Vingard E, et al. Differences in the association between psychosocial work conditions and physical work load in female- and male-dominated occupations. Am Ind Hyg Assoc J 1999;606:673-8.
24. Messing K, Dumais L, Courville J, Seifert AM, Boucher M. Evaluation of exposure data from men and women with the same job title. J Occup Med 1994;36:913-7.
25. Messing K, Chatigny C, Courville J. 'Light' and 'Heavy' work in the housekeeping services of a hospital. Appl Ergon 1998;29(6):451-9.
26. Messing K, Doniol-Shaw G, Haëntjes S. Sugar and Spice and everything nice: Health effects of the sexual division of labor among train cleaners. Int J Health Serv 1993;23(1):133-46.
27. Messing K, Reveret J. Are women in female jobs for their health? A study of working conditions and health effects in the fish processing industry in Quebec. Int J Health Serv 1983;13(4):365-47.
28. Nordander C, Ohlsson K, Balogh I, Rylander L, Palsson B, Skerfving S. Fish processing work: the impact of two sex dependent exposure profiles on musculoskeletal health. Occup Environ Med 1999;56(4):256-64.
29. De Jonge J, Bosma H, Peter R, Siegrist J. Job strain, effort-reward imbalance and employee well-being: a large-scale cross-sectional study. Soc Sci Med 2000 May;50(9):1317-27.
30. Karasek R, Brisson C, Kawakami N, Houtman ILD, Bongers PM, Amick B. The job content questionnaire (JCQ): An instrument for internationally comparative assessment of psychosocial job characteristics. J Occup Health Psychol 1998;3(4):322-55.
31. Levi L, Bartley M, Marmot M, Karasek R, Theorell T, Siegrist J, et al. Stressors at the workplace: theoretical models. Occup

Med 2000 Jan-2000 Mar;15(1):69-106.
32. Cox T, Cox S. Occupational health: control and monitoring of psychosocial and organisational hazards at work. J R Soc Health 1993 Aug;113(4):201-5.
33. Bongers PM, Kremer AM, ter Laak J. Are psychosocial factors, risk factors for symptoms and signs of the shoulder, elbow, or hand/wrist?: a review of the epidemiological literature. Am J Ind Med 2002 May;41(5):315-42.
34. Hoogendoorn WE, Bongers PM, de Vet HCW, Douwes M, Koes BW, Miedema M, et al. Flexion and rotation of the trunk and lifting at work are risk factors for low back pain: results of a prospective cohort study. Spine 2000;25:3087-92.
35. Ariëns GAM, Bongers PM, Douwes M, Miedema M, Hoogendoorn WE, van der Wal G, et al. Are neck flexion, neck rotation and sitting at work risk factors for neck pain? Results of a prospective cohort study. Occup Environ Med 2001;58(3):200-7.
36. Hildebrandt VH. Prevention of work related musculoskeletal disorders: setting priorities using the standardized Dutch Musculoskeletal Questionnaire. Doctoral thesis. Hoofddorp: TNO Work and Employment, 2001.
37. Hildebrandt VH, Bongers PM, van Dijk FJ, Kemper HC, Dul J. Dutch Musculoskeletal Questionnaire: description and basic qualities. Ergonomics 2001;44(12):1038-55.
38. De Jonge J, Reuvers MMEN, Houtman ILD, Bongers PM, Kompier MA. Linear and nonlinear relations between psychosocial job characteristics, subjective outcomes and sickness absence: Baseline results from SMASH. J Occup Health Psychol 2000;5(2):256-68.
39. Wanous JP, Reichers AE, Hudy MJ. Overall job satisfaction: how good are single-item measures? J Appl Psychol 1997;82:247-52.
40. Karlqvist L, Bernmark E, Ekenvall L, Hagberg M, Isaksson A, Rosto T. Computer mouse and track-ball operation: Similarities and differences in posture, muscular load and perceived exertion. Int J Ind Ergon 1999;23:157-69.
41. Chiu C. Do professional women have lower job satisfaction than professional men? Lawyers as a case study. Sex-Roles 1998;38(7-8):521-37.
42. Clark AE. Job satisfaction and gender: Why are women so happy at work? Labour Economics 1997;4(4).
43. Kennedy AM, Koehoorn M. Exposure assessment in Epidemiology: Does gender matter? Am J Ind Med 2003;44:567-83.
44. Green CA, Pope CR. Gender, psychosocial factors and the use of medical services: a longitudinal analysis. Soc Sci Med 1999;48(10):1363-72.
45. Hansson GA, Balogh I, Bystrom JU, Ohlsson K, Nordander C, Asterland P, et al. Questionnaire versus direct technical measurements in assessing postures and movements of the head, upper back, arms and hands. Scand J Work Environ Health 2001;27(1):30-40.
46. Leijon O, Wiktorin C, Harenstam A, Karlqvist L. Validity of a self-administered questionnaire for assessing physical work loads in a general population. J Occup Environ Med 2002;44(8):724-35.
47. Thomsen JF, Mikkelsen S, and the PRIM Health study group. Do musculoskeletal symptoms influence reporting of ergonomic exposure? Proceedings of the 27th International Congress on Occupational Health, Igassu Falls Brazil, 2003.
48. Viikari-Juntura E, Rauas S, Martikainen R, Kuosma E, Riihimaki H, Takala EP, et al. Validity of self-reported physical work load in epidemiologic studies on musculoskeletal disorders. Scand J Work Environ Health 1996;22(4):251-9.
49. Toomingas A, Alfredsson L, Kilbom Å. Possible bias from rating behavior when subjects rate both exposure and outcome. Scand J Work Environ Health 1997;23(5):370-7.

3

Equal task, equal exposure? Are men and women with the same tasks equally exposed to physical risk factors for work-related musculoskeletal disorders?

Submitted as:
Hooftman WE, van der Beek AJ, van de Wal G, Burdof A, Knol DL, Bongers PM, van Mechelen W
Equal task, equal exposure? Are men and women with the same tasks equally exposed to physical risk factors for work-related musculoskeletal disorders?

Abstract

The aim of the study was to determine whether men and woman with equal tasks perform these tasks in the same way. Video-recordings of 37 male and 43 female workers in 6 task groups were observed, from which data regarding frequency and duration of exposure to awkward postures were derived. These data were also compared to self-reported exposures. The results showed that when level, duration and frequency of exposure were analyzed at the same time, men and women had slightly different exposure patterns. However, these differences were not found when duration and frequency were analyzed separately. From the questionnaires it appeared that men and women generally report similar exposures, but they seemed to over-report their exposure compared to the observed exposures. It is concluded that gender differences in exposure to awkward postures within the same task were very small at the most, and cannot explain the female excess in musculoskeletal symptoms.

Introduction

Gender differences in the prevalence of musculoskeletal symptoms have been found in many studies (e.g.[1-8]). Most studies reported higher prevalences among women.[1,3-5,7-9] However, for back symptoms prevalences have also been reported to be higher for men.[5,7]

One often suggested explanation for this difference is that men and women have different exposures to work-related risk factors. Firstly, due to the gender segregation of the labor market, women often have different jobs, with different exposure patterns. Secondly, even if men and women have the same job, they do not always perform the same tasks, which can also result in differences in exposure. However, after correction for self-reported work exposures[10,11] gender differences in the prevalence of musculoskeletal symptoms remained. Furthermore, gender differences in symptoms have also been found in groups of workers with similar tasks.[12]

Therefore, a third explanation may be that, even if men and women have the same tasks, they do not perform these tasks in the same way, which may also lead to differences in exposure. These differences in task performance could be imposed by external factors, such as a poorer ergonomic fit with the workplace for women than for men, or voluntarily because men and women choose to perform the same task in a different way. Van der Beek et al[13] measured exerted forces and physiological load of men and women pushing and pulling a wheeled postal cage. It was found that, even after correction for personal factors, men used a significantly higher mean and ending force than women when moving the cage. This was attributed to the fact that men and women used different strategies when performing the task. Dahlberg et al[14] examined video-recordings of men and women in a manufacturing company, and found differences between men and women regarding variables such as handling materials above shoulder or below knee height, working in a stooping or knee sitting posture, and natural breaks. Although none of these 'differences' were statistically significant, they were regarded as relevant, and were ascribed to a poorer ergonomic fit with the workplace for women. In a population of office workers Balogh et al[15] found no significant gender differences, neither in self-assessed nor in directly measured exposure to risk factors such as sitting and walking. However, these studies were generally performed in a small study population, involving a single occupational group. On the one hand, these studies lack statistical power (which may explain why only one out of three studies found a significant gender difference). On the other hand, this makes it difficult to generalize the results to the working population. In the present study we focus on a large group of workers with a variety of occupations. Based on real-time video observations all dimensions of exposure (intensity, duration and frequency) were simultaneously analyzed. Furthermore, these results were compared to self-reported exposure. The aim of the present study is to determine whether men and women with the same tasks are equally exposed to work-related physical risk factors for musculoskeletal symptoms, and whether these exposures differ between self-reported and observed assessment.

Methods

Data of the Study on Musculoskeletal disorders, Absenteeism Stress and Health (SMASH) were used. In this longitudinal study, which focused on the determination of risk factors for musculoskeletal symptoms, nearly 1800 employees in 34 companies participated. Questionnaire data on sociodemographic variables, exposure and symptoms were collected at baseline (1994), and during three annual follow-up measurements. Furthermore, a selection of workers was video-recorded at their workplace. A more detailed description of the study can be found elsewhere.[16,17]

Population

At baseline 87% of the workers (N=1789) filled out the questionnaire. Based on on-site inspection of the work, each worker was assigned to a task group of workers who performed similar tasks. For the current analyses workers were selected only if: 1) they were video-recorded at their workplace; 2) no more than 80% of the workers in a their task group was from the same gender; and 3) data of at least 2 men and 2 women in the task group were available.

This resulted in a total of 121 workers eligible for analyses. However, an arbitrary upper limit of 10 workers per gender was set for each task, in order to limit the number of video-recordings that had to be observed. This selection of a maximum of 10 workers per gender was made based on the quality (i.e. how well the person was visible on the tape) of the video-recordings of the individual workers, and the presence of missing values on the socio-demographic variables in the baseline questionnaire. Therefore, the analyses were based on a total of 80 workers: 37 males and 43 females. A description of the study population can be found in table 1.

Observations

From each worker four video-recordings were made randomly during a single working day. Each recording lasted 10-15 minutes. All video-recordings were analyzed by a trained observer (BW) using the program 'the Observer' (version 5.0, Noldus Information Technology, Wageningen, The Netherlands). Observations were made of upper arm posture (elevation; <30, 30-60 and> 60 degrees), trunk posture (flexion; <20, 20-40, 40-60 and >60 degrees, and rotation; <30 and > 30 degrees), neck posture (flexion; <20, 20-45 and >45 degrees, and rotation; <45 and > 45 degrees), general body posture (sitting, standing, walking, kneeling/squatting), and manual material handling (lifting/carrying, pushing/pulling). Since it was not possible to observe all body regions at the same time, each video-recording was viewed several times. Continuous, i.e. real-time, observations were made for all body regions. In order to facilitate the observations, the observer could slow down the speed of the video-recording. From the observations data on duration (% of time) and frequency (times per minute) of exposure to the observed postures were derived.

Furthermore, for arm elevation, neck flexion and trunk flexion Exposure Variation Analyses (EVA) matrices were calculated. The EVA method was introduced by Mathiassen and Winkel[18], in order to overcome the shortcomings of existing methods. These matrices combine the three core dimensions of exposure, i.e. intensity, duration and frequency, at the same time. The continuously registered postures of each worker were used as the basis for the EVA matrix. First, for each uninterrupted time period spend at a certain exposure level the duration was calculated. Then, these durations were assigned to time period classes. In this case 0-2 seconds; 2-10 seconds; 10-30 seconds; 30-60 seconds; and >60 seconds. Since trunk flexions lasting >60 seconds almost never occurred, for trunk flexion the highest time period was >30 seconds. Finally, the accumulated time spent in each of these classes was calculated, and expressed as a total percentage of time.[18]

Table 1: descriptive information of the study population

	Men (n=37)		Women (n=43)	
Personal characteristics				
Age (years), mean(sd)‡	39.3	(8.2)	32.3	(8.0)
Height (cm), mean(sd)‡	180.0	(6.5)	169.4	(6.9)
Weight (kg), mean(sd)‡	79.5	(11.0)	64.7	(8.8)
General Work characteristics				
Years employed, mean(sd)‡	10.9	(8.4)	6.6	(5.3)
Task group, n(%)				
Nursery school teachers	3	(8.1)	10	(23.3)
Laboratory technicians	5	(13.5)	10	(23.3)
Cooks	7	(18.9)	2	(4.7)
Administration, telephone operators	9	(24.3)	6	(14.0)
Office workers	10	(27.0)	10	(23.3)
Assembly line workers	3	(8.1)	5	(11.6)
Posture, % time (mean, pooled sd)				
Sitting	67.3	(39.6)	60.5	(37.1)
Standing with support	2.7	(6.6)	4.2	(9.3)
Standing without support	24.0	(31.9)	27.2	(28.9)
Walking	4.6	(9.0)	4.5	(7.2)
Kneeling/squatting	1.3	(6.5)	3.4	(9.3)
Other	0.0	(0.0)	0.2	(2.2)
Manual material handling, % time(sd)				
Lifting/carrying	4.3	(8.7)	5.9	(14.9)
Pushing/pulling	1.4	(5.5)	1.2	(5.6)
Nothing	92.40	(13.6)	90.4	(19.1)
Other	1.9	(6.7)	2.5	(11.3)

‡ significant difference between men and women at p=0.000

Questionnaires

In addition to the observations, workers were also asked to rate their exposure. These self-reports were obtained using the Dutch Musculoskeletal Questionnaire[19,20]. This questionnaire contains a wide variety of questions, but for the present analyses five questions were selected that matched the observes exposures as closely as possible. Namely: "How often do you work with your hands above shoulder level?"; "How often do you work with the upper part of you body flexed/rotated?"; "Do you often have to bend the neck or keep the neck bend forwards?"; "Do you often have to bend the neck or keep the neck bend backwards?"; and "Do you often have to twist the neck or keep the neck twisted?". Questions were rated on a 4 point scale ("never", "occasionally", "often", or "very often"), or on a dichotomous scale ("yes", "no").

Statistics

In order to analyze the three core dimensions of exposure at the same time multilevel techniques need to be used, as first shown by Jansen et al.[21] We described differences between men and women in the EVA matrices according to Jansen et al[21], using MLwiN (version 2.02).

Differences between men and women in the frequency and duration of observed postures were tested with a generalized linear model for repeated measures, with the four observation periods as repetitive measurements, and task group as potential confounder in the model. These analyses were performed with SPSS version 12.0 for Windows.

To test the association between gender and the self-reported exposures, logistic and ordinal regression analyses were performed for the dichotomous and the ordinal dependent variables, respectively. Again, task group was considered as a potential confounder, and the analyses were performed with SPSS.

Results

Observations

Table 1 shows the descriptive information of the study population. Men, on average, were older, taller and heavier than the women, and had been employed for more years in their current job. Both men and women spent most of their time in a sitting or standing position. Manual material handling was uncommon, with both men and women spending most of their time (about 90% of the time) not handling any materials.

Figures 1-3 present the results for the EVA analyses. It can be seen that for arm elevation (figure 1) women spent a significantly larger percentage of their work time with high arm elevations, for longer time periods at a time. This was especially true for arm elevations >60 degrees. For neck flexion (figure 2) an opposite pattern was found. Women spent a larger percentage of their work time with no or only little neck flexion, and for short periods at a time, while men kept their neck flexed more, and for longer periods at a time. For trunk flexion (figure 3) no clear gender differences in exposure patterns could be found. Women spent higher percentages of time in almost all time/angle combinations, although the differences were small, and rarely significant.

When duration and frequency were analyzed separately it was found that workers spent only a small amount of time with their arms elevated (table 2). About 75% of the time the elevation was less than 30 degrees, and about 19% of the time between 30 and 60 degrees. Elevations above 60 degrees were observed for about 3% of the time in men and 6% of the time in women, but this difference was not significant. Workers were furthermore observed to spend most time (slightly more than 80%) with the trunk flexed less than 20 degrees, and less than 5% of time with the trunk flexed more than 40 degrees. Trunk rotation was also uncommon, with the trunk rotated less than 30 degrees for 97% of time. Neck flexions, on the other hand, were observed quite often. More than 90% of the time was spent with the neck flexed to some extent, with about 32% of the time for more than 45 degrees. Neck rotations were less common, but still about 16% of the time was spent with the neck rotated for more than 45 degrees. None of these results were significantly different between men and women, and correction for task group only resulted in small changes in the percentages.

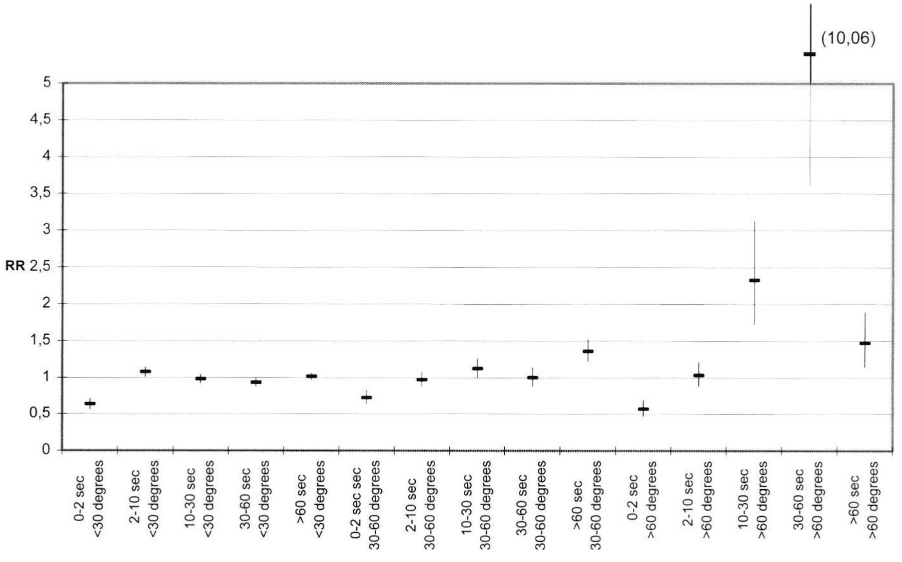

Figure 1: Results of the EVA analysis for Arm elevation. Relative Risk (RR) and 95% confidence interval. RR>1 means women are more exposed, RR< 1 means men are more exposed

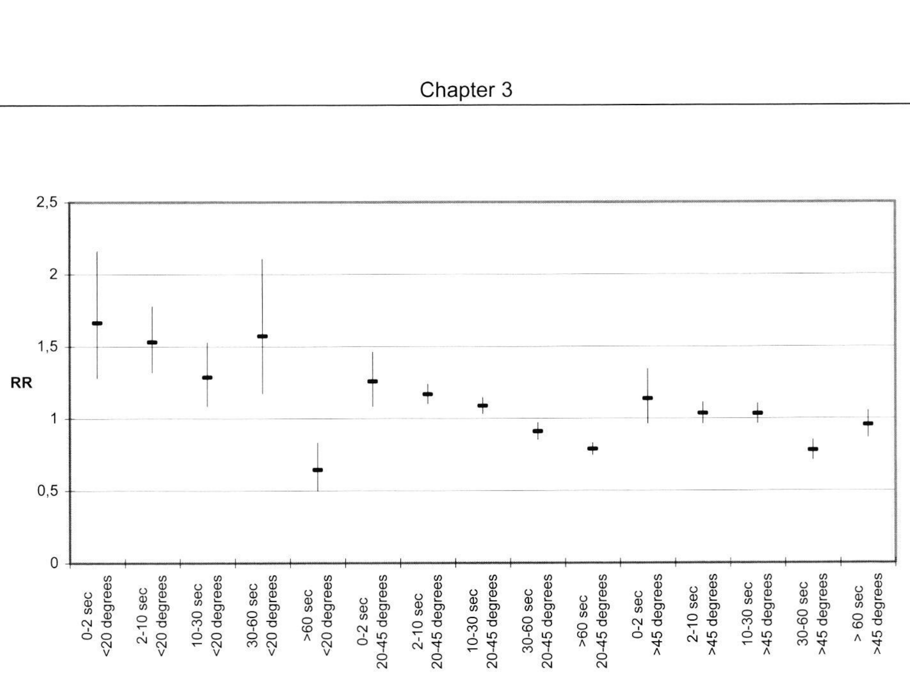

Figure 2: Results of the EVA analysis for Neck flexion. Relative Risk (RR) and 95% confidence interval. RR>1 means women are more exposed, RR< 1 means men are more exposed

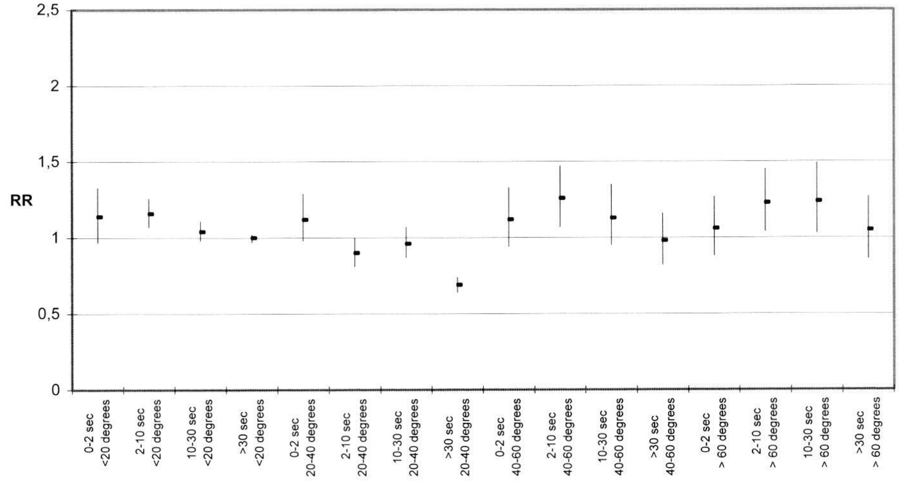

Figure 3: Results of the EVA analysis for Trunk flexion. Relative Risk (RR) and 95% confidence interval. RR>1 means women are more exposed, RR< 1 means men are more exposed

The frequencies of exposure to these postures ranged between 0.1 times per minute (men, trunk flexion > 60 degrees) to 3.9 times per minute (women, neck rotation <45 degrees). After correction for task group, the observed frequencies changed only slightly. Men had higher frequencies of arm elevation <30 degrees and 30-60 degrees, while women were observed to be more frequently exposed to all other risk factors. However, differences were small, and not statistically significant, except for trunk flexion 40-60 degrees, which, after correction for task group, was observed 0.3 times per minute in men and 0.4 times per minute in women (p=0.035).

Table 2: Mean exposure to observed postures (univariate)

	Duration (% time)*				**Frequency (times/minute)**				
	Men		**Women**		**Men**		**Women**		
	mean	**(pooled sd)**	**mean**	**(pooled sd)**	**mean**	**(pooled sd)**	**mean**	**(pooled sd)**	
Arm elevation									
<30 degrees	78.0	(21.3)	75.1	(23.5)	2.3	(3.0)	2.2	(1.9)	
30-60 degrees	19.2	(19.6)	18.7	(19.5)	1.8	(3.0)	1.6	(1.7)	
>60 degrees	2.9	(5.6)	6.1	(13.1)	0.3	(0.6)	0.5	(0.8)	
Trunk flexion									
<20 degrees	81.9	(19.8)	83.5	(18.3)	1.6	(1.2)	1.9	(1.8)	
20-40 degrees	15.9	(18.8)	12.5	(16.2)	1.3	(1.1)	1.5	(1.7)	
40-60 degrees	1.5	(4.0)	2.3	(4.0)	0.2	(0.4)	0.4	(0.6)	†
>60 degrees	0.7	(1.8)	1.8	(4.9)	0.1	(0.2)	0.2	(0.4)	
Trunk rotation									
<30 degrees	97.4	(5.5)	97.2	(7.1)	0.7	(0.7)	0.9	(1.0)	
>30 degrees	2.6	(5.5)	2.8	(7.1)	0.4	(0.5)	0.5	(0.8)	
Neck flexion									
<20 degrees	4.9	(11.4)	6.4	(13.4)	0.5	(0.6)	0.6	(1.6)	
20-45 degrees	62.5	(24.0)	61.2	(22.2)	2.9	(1.4)	3.1	(1.7)	
>45 degrees	32.6	(24.3)	32.4	(23.6)	2.1	(1.4)	2.2	(1.4)	
Neck rotation									
<45 degrees	84.0	(14.3	84.3	(12.0)	3.6	(2.0)	3.9	(2.3)	
>45 degrees	16.0	(14.3)	15.7	(12.0)	3.2	(1.4)	3.4	(1.4)	

† significant difference between men and women at p=0.05 after correction for task group

Questionnaires

In the questionnaires (table 3) most workers reported not to work with their hands above shoulder level at all. However, in the univariate analyses, significantly more women than men (21.6% vs. 48.8%) reported exposure. Furthermore, almost 14% of the women reported to be exposed often or very often. Flexion and rotation of the upper part of the body was more common, with about 62% of the workers reporting to be exposed to these postures. Many workers also reported to often work with the neck bend forwards (79%), while only 5 workers reported bending the neck backwards often. For often twisting the neck about 50% of the men reported exposure, which was significantly higher for women (74%). This difference remained significant after correction for task group.

Table 3: self-reported exposure to risk factors

		Men n (%)	Women n (%)
Working with hands above shoulder level †	*Never*	29 (78.4)	22 (51.2)
	Occasionally	6 (16.2)	15 (34.9)
	Often	2 (5.4)	5 (11.6)
	Very often	0 (0)	1 (2.3)
Flexion/rotation of the upper part of the body	*Never*	14 (37.8)	16 (37.2)
	Occasionally	11 (29.7)	3 (7.0)
	Often	11 (19.7)	18 (41.9)
	Very often	1 (2.7)	6 (14.0)
Often bend the neck or keep the neck bend forwards	Yes	29 (78.4)	34 (79.1)
	No	8 (21.6)	9 (20.9)
Often bend the neck or keep the neck bend backwards	Yes	2 (5.4)	3 (7.0)
	No	35 (94.6)	40 (93.0)
Often twist the neck or keep the neck twisted†; ¶	Yes	18 (48.6)	32 (74.4)
	No	19 (51.4)	11 (25.6)

† significant difference between men and women at p=0.05 in the univariate analyses
¶ significant difference between men and women at p=0.05 after correction for task group

Discussion

When duration and frequency of the observed postures were analyzed separately, only one significant difference between men and women was found. This result resembles the results of earlier studies on gender differences in exposure to awkward postures[14] and movements.[15] However, the results of the EVA analyses showed that, when all dimensions of exposure are analyzed at the same time, men and women had different exposure patterns for arm elevation and neck flexion, but not for trunk flexion. Unfortunately, due to the limited number of workers in the higher exposure/time categories it was not possible to correct the EVA analyses for the potential confounding effect of task group, and it can not be ruled out that these differences are (partly) due to gender differences in tasks group. However, in the separate analyses for duration and frequency, and those for the questionnaires, we included task group as a confounder, and this only slightly influenced the results. It is therefore believed that although the results of the EVA analyses might be affected by differences between men and women in task group, this only had a small effect. The results therefore indicate that, while men and women with the same task in fact might have somewhat different exposure patterns, traditional methods do not show these differences.

Questionnaires are probably one of the most widely used assessment methods in large epidemiological studies, mainly because they are relatively cheap, and easy to administer. However, these self reports are not considered to be the most precise and accurate measurements, since due to several forms of bias (e.g. information bias, recall bias) workers can be found to misclassify their exposure.[22] When this error in reporting of exposure is random, and does not depend on a specific characteristic of the worker this will usually lead to a reduction in risk estimate. However, misclassification might also depend on a specific characteristic of the worker, such as gender. When this happens this is a larger problem, since it is not clear what the effect on the risk estimate will be.[23,24] Reporting exposure seems to be influenced by the experience with as well as the anxiety about a risk factor.[25] Women generally are more concerned about health matters,[26] and have more health complaints. It could therefore be expected that they, more often than men, report to be exposed to a risk factor, when they in fact are not.

We attempted to overcome these limitations by using video-observations to assess exposure. However, video-observations also have limitations.[22] First of all, video-recordings are 2-dimensional, making it relatively difficult to judge rotations.[27] Second, workers may disappear from the video image when the move around on their workplace, which makes it impossible to judge their exposure. Thirdly, observations are sensitive to inter- as well as intra-observer bias. Finally, video recordings were made from a part of the working day only, which may give a distorted view of the exposures during a complete working day.[28] To reduce the influences of these limitations in the present study video recordings were made at several moments during the working day, to capture some of the within day variation of exposure. Furthermore, to exclude the possibility of intra-observer bias, only one well-trained observer judged the video recordings. This observer was able to slow down the speed of the video-recording when observing fast movements, and to review the video-tapes as often as possible to get a good view of the worker. Finally, to limit the influence of inter-observer bias on the possible gender differences it was made sure that videos of male and female workers were observed in turn.

The observed exposures were compared with the self-reported data, in order to determine possible gender differences in the reporting of exposure. It was found that workers were observed to spend only small amounts of time in the higher exposure categories, while substantial amounts of workers reported to be often of very often exposed. Our results furthermore showed that the difference between the average time workers were observed to be exposed and the number of workers that reported to be (very) often exposed seemed to be larger for women than for men. It thus seems as if both men and women report exposure more often than it is observed, and that the difference between observed and reported exposure is larger for women than for men. This corresponds with the results of Spielholz et al[29], who compared self-reports with video observations, and found that the self-reported exposures were always higher than observed exposures.

However, it should be noted that the observed exposure and the reported exposure were not quite the same. The questionnaire asked about exposure on an average work day, while the observations assessed exposure during a limited time frame. Furthermore, questions on how often activities are performed can be interpreted in terms of frequency, in terms of duration, or a as combination of both. Furthermore, although e.g. working with the hands above shoulder level, and working with the arms elevated >60 degrees attempt to cover the same risk factor, they are not exactly the same. Therefore, the conclusion that women over-report their exposure to a larger extent than men should be interpreted with some caution.

One of the reasons for performing the present study was that higher prevalence of musculoskeletal symptoms in women might be explained by gender differences in exposures to work-related risk factors. We found small gender differences in exposure patterns. However, when the exposures of both men and women are compared with studies on risk factors for neck[16] and low back[17] symptoms, it seems both the men and the women in our population had an elevated risk of developing neck symptoms, but neither had an elevated risk of low back symptoms. Therefore, it seems unlikely that these gender differences in exposure patterns are of large influence when explaining gender differences in musculoskeletal symptoms.

Conclusion

We found differences in the exposure pattern between men and women. However, it should be noted that these differences were small, and when looked at with traditional methods not statistically significant. These gender differences in exposure within the same task can not explain the gender difference in musculoskeletal symptoms.

References

1. Centers for Disease Control and Prevention (CDC). Prevalence of self-reported arthritis or chronic joint symptoms among adults--United States, 2001. MMWR 2002;51(42):948-50.
2. De Zwart BC, Frings-Dresen MH, Kilbom A. Gender differences in upper extremity musculoskeletal complaints in the working population. Int Arch Occup Environ Health 2001; 74(1):21-30.
3. De Zwart BCH, Broersen JP, Frings-Dresen MH, van Dijk FJ. Musculoskeletal complaints in The Netherlands in relation to age, gender and physically demanding work. Int Arch Occup Environ Health 1997;70(5):352-60.
4. Krause N, Ragland DR, Greiner BA, Syme SL, Fisher JM. Psychosocial job factors associated with back and neck pain in public transit operators. Scand J Work Environ Health 1997;23(3):179-86.
5. Leino-Arjas P, Hänninen K, Puska P. Socioeconomic variation in back and joint pain in Finland. Eur J Epidemiol 1998;14:79-87.
6. Linton SJ, Hellsing AL, Halldén K. A population-based study of spinal pain among 35-45-year-old individuals. Prevalence, sick leave, and health care use. Spine 1998;23:1457-63.
7. Picavet HS, Hazes JM. Prevalence of self reported musculoskeletal diseases is high. Ann Rheum Dis 2003;62(7):644-50.
8. Picavet HSJ, van Gils HWV, Schouten JSGA. Klachten van het bewegingsapparaat in de Nederlandse bevolking. Prevalenties, consequenties en risicogroepen (Musculoskeletal complaints in the Dutch population: prevalences, consequences and risk groups). Bilthoven, Netherlands: Rijksinstituut voor volksgezondheid en milieu (RIVM), 2000.

9. Ekman A, Andersson A, Hagberg M, Hjelm EW. Gender differences in musculoskeletal health of computer and mouse users in the Swedish workforce. Occup Med (Lond) 2000;50(8):608-13.
10. Hooftman WE, van der Beek AJ, Bongers PM, Punnett L, van Mechelen W. Gender differences in the prevalence of musculoskeletal symptoms are not caused by exposure differences. Submitted .
11. IJzelenberg W, Molenaar D, Burdorf A. Different risk factors for musculoskeletal complaints and musculoskeletal sickness absence. Scand J Work Environ Health 2004;30(1):56-63.
12. Coury HJCG, Portcatti IA, Alem MER, Oisho J. Influence of gender on work-related musculoskeletal disorders in repetitive tasks. Int J Ind Ergon 2002;29:33-9.
13. Van der Beek AJ, Kluver BDR, Frings-Dresen MHW, Hoozemans MJM. Gender differences in exerted forces and energetic workload during pushing and pulling of wheeled cages by postal workers. Ergonomics 2000;43(2):269-81.
14. Dahlberg R, Karlqvist L, Bildt C, Nykvist K. Do work technique and musculoskeletal symptoms differ between men and women performing the same type of work tasks? Appl Ergon 2004;35(6):521-9.
15. Balogh I, Orbaek P, Ohlsson K, Nordander C, Unge J, Winkel J, et al. Self-assessed and directly measured occupational physical activities--influence of musculoskeletal complaints, age and gender. Appl Ergon 2004;35(1):49-56.
16. Ariëns GAM, Bongers PM, Douwes M, Miedema M, Hoogendoorn WE, van der Wal G, et al. Are neck flexion, neck rotation and sitting at work risk factors for neck pain? Results of a prospective cohort study. Occup Environ Med 2001;58(3):200-7.
17. Hoogendoorn WE, Bongers PM, de Vet HCW, Douwes M, Koes BW, Miedema M, et al. Flexion and rotation of the trunk and lifting at work are risk factors for low back pain: results of a prospective cohort study. Spine 2000;25:3087-92.
18. Mathiassen SE, Winkel J. Quantifying variation in physical load using exposure-vs.-time data. Ergonomics 1991;34(12):1455-68.
19. Hildebrandt VH. Prevention of work related musculoskeletal disorders: setting priorities using the standardized Dutch Musculoskeletal Questionnaire. Doctoral thesis. Hoofddorp: TNO Work and Employment, 2001.
20. Hildebrandt VH, Bongers PM, van Dijk FJ, Kemper HC, Dul J. Dutch Musculoskeletal Questionnaire: description and basic qualities. Ergonomics 2001;44(12):1038-55.
21. Jansen JP, Burdorf A, Steyerberg E. A novel approach for evaluating level, frequency and duration of lumbar posture simultaneously during work. Scand J Work Environ Health 2001;27(6):373-80.
22. Van der Beek AJ, Frings-Dresen MH. Assessment of mechanical exposure in ergonomic epidemiology. Occup Environ Med 1998;55(5):291-9.
23. Armstrong BG. Effect of measurement error on epidemiological studies of environmental and occupational exposures. Occup Environ Med 1998;55(10):651-6.
24. Hofler M. The effect of misclassification on the estimation of association: a review. Int J Methods Psychiatr Res 2005;14(2):92-101.
25. Kennedy AM, Koehoorn M. Exposure assessment in Epidemiology: Does gender matter? Am J Ind Med 2003;44:567-83.
26. Green CA, Pope CR. Gender, psychosocial factors and the use of medical services: a longitudinal analysis. Soc Sci Med 1999;48(10):1363-72.
27. Paul JA, Douwes M. Two-dimensional photographic posture recording and description: a validity study. Appl Ergon 1993;24(2):83-90.
28. Hoozemans MJ, Burdorf A, van der Beek AJ, Frings-Dresen MH, Mathiassen SE. Group-based measurement strategies in exposure assessment explored by bootstrapping. Scand J Work Environ Health 2001;27(2):125-32.
29. Spielholz P, Silverstein B, Morgan M, Checkoway H, Kaufman J. Comparison of self-report, video observation and direct measurement methods for upper extremity musculoskeletal disorder physical risk factors. Ergonomics 2001;44(6):588-613.

4

Gender differences in the prevalence of musculoskeletal symptoms are not explained by exposure differences

Submitted as:
Hooftman WE, van der Beek AJ, Bongers PM, Punnett L, van Mechelen W,
Gender differences in the prevalence of musculoskeletal symptoms are not caused by exposure differences.

Abstract

Objectives:

The aim of this study is to determine whether gender differences in (sickness absence due to) back, neck, shoulder, and hand/arm symptoms can be explained by gender differences in socio-demographic variables, exposures at work and in private life.

Methods:

Data were used from a prospective cohort (SMASH) with a follow-up period of 3 years. Exposure to risk factors and musculoskeletal symptoms were assessed using questionnaires. Work absences due to musculoskeletal symptoms were extracted from company records. Logistic Generalized Estimation Equations (GEE) regression analyses were performed to determine the relation between musculoskeletal symptoms, gender, and exposures one year before the symptoms.

Results:

The odds of self-reported symptoms were significantly higher for women for the neck (Odds Ratio (OR)=2.70), shoulder (OR=2.30) and hand-arms (OR 1.61). The odds for sickness absence due to neck-shoulder-arm-hand symptoms were also higher for women than for men (OR 1.60). After the addition of sociodemographic and exposure variables, the OR for gender generally did not change. There was no difference between men and women in back symptoms, or sickness absenteeism for back symptoms, in either the univariate or the multivariate analyses.

Conclusions:

Contrary to our expectations, the higher prevalence of upper extremity symptoms and absenteeism was not diminished after adjusting for other risk factors. Hence, it seems likely that at least some of the gender difference in this population is due to factors other than exposure differences between male and female workers.

Introduction

Women generally report more musculoskeletal symptoms than men. This difference is consistently found in the general population[1-9] as well as in working populations[10-13]. It seems to be more pronounced for neck and upper extremity symptoms, where the prevalences are consistently higher for women than for men[1,2,6,7,9-12], compared to back symptoms, where results have been less consistent.[1,4-7,11,13]

Several explanations for this phenomenon have been suggested.[14] Firstly, women are said to be more likely to express pain and symptoms. This may be either because they have a lower pain tolerance threshold[15], or because they are more willing to express pain, since men are taught not to complain.[16] It could therefore be argued that the gender difference might be higher for symptoms than for more objective endpoints. However, some of the largest gender differences have been found in studies where case definitions were not entirely dependent on self-report.[14]

Secondly, there may be gender differences in the effects of ergonomic exposures. Women, on average, have smaller body dimensions, lower muscle force and a lower aerobic capacity. Therefore, tasks performed with the same (absolute) exposure will often result in a higher relative workload for women[14,17,18], which could lead to more severe effects. However, the literature is very sparse on possible gender differences in the effect of exposure to physical risk factors. In a recent literature review only three factors have been found to show such differences, two of them with a stronger effect for men.[19]

Thirdly, and perhaps most important, are gender differences in the prevalence of (occupational) exposures.[20-22] Men and women often have different working conditions[23-31], either because of the gender segregation of the labor market, or due to differences between men and women in tasks or task performance within the same job. However, gender differences in musculoskeletal symptoms have also been found between men and women within the same occupational class[32] and with the same work tasks.[33] Furthermore, men and women generally have different tasks, and therefore different exposures, at home. Nowadays the majority of women in Western economies have a paid job outside of the house, but the majority of the household responsibilities (childcare, cleaning and cooking) are still carried out by women.

The aim of this study was therefore to determine, given the gender segregation of the labor market and the double workload of women due to the gender division in household chores, whether gender differences in (sickness absence due to) low back, neck, shoulder, and hand/arm symptoms would be reduced by correcting for gender differences in socio-demographic variables, exposures at work and exposures in private life.

Methods

Questionnaire data from the Study on Musculoskeletal disorders, Absenteeism, Stress and Health (SMASH) were used. In this longitudinal study, which focused on the determination of risk factors for musculoskeletal symptoms, nearly 1800 employees in 34 companies participated. Questionnaire data on exposure and symptoms were collected at baseline (1994) and during three annual follow-up measurements. A more detailed description of the study can be found elsewhere.[34,35]

Risk factors

The Dutch Musculoskeletal Questionnaire was used for the assessment of exposure to physical risk factors in work and private life.[36,37] At baseline and during the follow up measurements questions on how often activities were performed (e.g. "how often do you have to lift loads more than 5 kilograms?") were asked on a 4 point scale ("never", "occasionally", "often" or "very often"). Questions on neck and wrist postures (e.g. "do you often have to work with your neck bend?") were asked on a dichotomous scale ("yes", "no").

Exposure to work-related psychosocial risk factors was assessed using the Dutch translation of Karasek's Job Content Questionnaire. The individual questions were scored on a 4-point scale ("strongly disagree", "disagree", "agree" and "strongly agree"), and were combined into the dimensions according to Karasek: Job demands, Job control (consisting of skill discretion and decision authority), and Social support. The calculation of these dimensions has been described by De Jonge et al.[38] A single question was asked about job satisfaction.

Finally, a set of questions was developed about exposure to psychosocial risk factors in private life, including demands and control at home, work-home and home-work interference, social support in private life, and adverse life events.[39]

A summary of the risk factors identified as relevant for each of the outcome measure can be found in table 1.

Symptoms

During baseline and each of the follow-up measures musculoskeletal pain was assessed using an adapted Nordic questionnaire.[40] Workers were asked whether they experienced pain or discomfort in the past 12 months in their back, neck, shoulders, elbows or hands/wrist on a 4 point scale ("no, never", "yes, sometimes", "yes, regular", "yes, prolonged"). The answers on elbow and hand/wrist symptoms were combined into one measure for hand/arm symptoms. Symptom cases were defined as those workers who reported regular or prolonged symptoms in the past 12 months in any of the four surveys.

Table 1: Descriptive information of the study population (n=1578), and the baseline values of the confounders used in the analyses.

		Men (n=1096) *n (%)*	**Women (n=482)** *n (%)*	**missing** *n*	**region**[b]
Socio-demographic [a]					
Age[‡,0,§]		36.6 (8.4)	33.1 (9.2)	0	B, N, S, A
Education[0,§]	*No education or primary school*	146 (13.4)	26 (5.5)	15	B, N, S, A
	Lower secondary or vocational school	480 (44,1)	154 (32.4)		
	Intermediate secondary or vocational school	266 (24.4)	179 (37.7)		
	Higher secondary or vocational school	106 (9.5)	53 (11.2)		
	University	93 (8.5)	63 (13.3)		
Dutch nationality[0]		1051 (95.9)	454 (94.6)	2	B, N, S, A
BMI[‡,0,§]		25.0 (3.4)	23.7 (4.2)	6	B, N, S, A
Number of family members [‡,0,§]		3,2 (1.3)	2.5 (1.1)	90	B, N, S, A
Smoker[0,3]		457 (43.4)	196 (52.2)	60	B, N, S, A
Alcoholic beverages a week[‡,0,§]		8,7 (10.4)	2.7 (4.3)	0	B, N, S, A
Healthy eating[0]		942 (89.8)	413 (89.4)	67	B, N, S, A
Strenuous activity in private life[0,1,2,3,¶]	*Never*	256 (24.4)	136 (29.6)	68	B, N, S, A
	<1 time / month	59 (5.6)	34 (7.4)		
	1 time / month	75 (7.1)	22 (4.8)		
	2-3 times /month	157 (14.9)	66 (14.4)		
	1-2 times / week	330 (31.4)	157 (34.2)		
	>3 times / week	174 (16.6)	44 (9.6)		
Work duration					
Years employed[‡,0,§]		10.7 (8.3)	7.0 (5.4)	0	B, N, S, A
Working days a week[‡,0,§]		4.9 (0.4)	4.5 (0.7)	24	B, N, S, A
Hours working[‡,0,§]		39.2 (3.7)	35.2 (6.4)	0	B, N, S, A
Work-related physical risk factors					
Lift loads > 5kg[0,1,2,3,§]	*Never*	261 (23.8)	182 (37.8)	1	B
	Occasionally	237 (21.6)	128 (26.6)		
	Often	302 (27.6)	106 (22.0)		
	Very often	295 (26.9)	66 (13.7)		
Lift loads >25 kg[0,1,2,3,§]	*Never*	448 (41.1)	352 (73.5)	5	B
	Occasionally	347 (31.7)	68 (14.2)		
	Often	197 (18.0)	43 (9.0)		
	Very often	103 (9.3)	16 (3.3)		
Flexion/rotation of the upper part of the body[0,1,2,3]	*Never*	242 (22.1)	116 (24.1)	3	B
	Occasionally	253 (23.1)	119 (24.7)		
	Often	349 (31.9)	164 (34.1)		
	Very often	250 (22.9)	82 (17.0)		
Uncomfortable working postures[0,1,2,3]	*Never*	366 (33.5)	153 (31.8)	6	B
	Occasionally	437 (40.1)	202 (42.0)		
	Often	196 (18.0)	84 (17.5)		
	Very often	92 (8.4)	42 (8.7)		

Table 1: continued

Driving a vehicle[0,§]	*Never*	673 (63.0)	442 (92.5)	32	B
	Occasionally	251 (23.5)	27 (5.6)		
	Often	89 (8.3)	8 (1.7)		
	Very often	55 (5.1)	1 (0.2)		
Repeated movements with hands or arms [0,§]	*Never*	232 (21.2)	91 (18.9)	3	N, S, A
	Occasionally	214 (19.6)	73 (15.1)		
	Often	349 (31.9)	129 (26.8)		
	Very often	298 (27.3)	189 (39.2)		
Force exertion with hands[0,§]	*Never*	279 (26.5)	173 (36.0)	2	N, S
	Occasionally	228 (20.8)	126 (26.2)		
	Often	337 (30.8)	112 23.3)		
	Very often	251 (22.9)	70 (14.6)		
Hand-arm vibration[0,§]	*Never*	732 (67.2)	451 (94.2)	9	N, S, A
	Occasionally	194 (17.8)	19 (4.0)		
	Often	99 (9.1)	3 (0.6)		
	Very often	65 (6.0)	6 (1.3)		
Working with hands above shoulder level[0,1,2,3,¶]	*Never*	536 (49.2)	268 (55.9)	10	N, S
	Occasionally	381 (35.0)	141 (29.4)		
	Often	145 (13.4)	52(10.9)		
	Very often	26 (2.4)	18 (3.8)		
Working with the hands below knee level[0,1,2,3,§]	*Never*	507 (46.5)	308 (64.5)	9	N, S
	Occasionally	385 (35.3)	117 (24.5)		
	Often	149 (13.7)	42 (8.8)		
	Very often	50 (4.6)	11 (2.3)		
Reaching[0]	*Never*	432 (40.2)	208 (43.7)	28	N, S
	Occasionally	432 (40.1)	189 (38.7)		
	Often	176 (16.4)	67 (14.1)		
	Very often	35 (3.3)	12 (2.5)		
Squeeze firmly with the hands[0,§]	*Never*	404 (37.0)	287 (59.5)	5	A
	Occasionally	294 (26.9)	125 (25.9)		
	Often	242 (22.2)	47 (9.8)		
	Very often	151 (13.8)	23 (4.8)		
Often bend the neck or keep the neck bend forwards[0,1,2,3,§]		681 (62.4)	401 (83.5)	7	N, S
Often bend the neck or keep the neck bend backwards[0,1,2,3,§]		173 (15.9)	23 (4.8)	12	N, S
Often twist the neck or keep the neck twisted[0,1,2,3]		546 (50.0)	227 (57.8)	6	N, S
Often bend the wrist or keep the wrist bended[0,1,2,3]		552 (50.5)	261 (54.5)	6	A
Often twist the wrist or keep the wrist twisted[0,1,2,3]		432 (39.7)	208 (43.5)	13	A
Work related psychosocial risk factors					
Skill discretion[‡,0,1,2,3,§]		14.8 (2.5)	13.9 (2.7)	9	B, N, S, A
Psychological demands[‡,0,1,2,3]		12,9 (2.3)	13.1 (2.2)	9	B, N, S, A
Coworker support[‡,0,1,2,3,¶]		11.9 (1.6)	12.2 (1.7)	17	B, N, S, A
Supervisor support[‡,0,1,2,3]		10.9 (2.2)	11.0(2.2)	15	B, N, S, A

Table 1: continued

Job satisfaction[‡,0,1,2,3,§]	*Never*	11 (1.0)	2 (0.4)	4	B, N, S, A
	Occasionally	154 (14.1)	31 (6.4)		
	Often	432 (39.5)	185 (38.5)		
	Very often	496 (45.4)	263 (54.7)		
Physical risk factors in private life					
Lift loads > 5kg[0,1,2,3,¶]	*Never*	225 (21.0)	135 (28.1)	25	B
	Occasionally	626 (58.3)	257 (53.5)		
	Often	158 (14.7)	75 (15.6)		
	Very often	64 (6.0)	13 (2.7)		
Lift loads >25 kg[0,1,2,3,§]	*Never*	512 (47.8)	341 (71.3)		B
	Occasionally	460 (42.9)	124 (25.9)		
	Often	78 (7.3)	13 (2.7)		
	Very often	22 (2.1)	0 (0.0)		
Flexion/rotation of the upper part of the body[0,1,2,3]	*Never*	546 (51.0)	256 (53.3)	27	B
	Occasionally	371 (34.6)	168 (35.0)		
	Often	121 (11.3)	45 (9.4)		
	Very often	33 (3.1)	11 (2.3)		
Uncomfortable working postures[0,1,2,3]	*Never*	577 (53.9)	254 (52.9)	27	B
	Occasionally	435 (40.6)	203 (42.3)		
	Often	48 (4.5)	20 (4.2)		
	Very often	11 (1.0)	3 (0.6)		
Driving a vehicle [0,¶]	*Never*	258 (24.1)	151 (31.6)	30	B
	Occasionally	439 (41.0)	166 (34.7)		
	Often	318 (29.7)	134 (28.0)		
	Very often	55 (5.1)	27 (5.6)		
Repeated movements with hands or arms [0]	*Never*	588 (54.9)	249 (51.9)	26	N, S, A
	Occasionally	324 (30.2)	157 (32.7)		
	Often	119 (11.1)	51 (10.6)		
	Very often	41 (3.8)	23 (4.8)		
Force exertion with hands[0,¶]	*Never*	253 (23.6)	140 (29.2)	25	N, S
	Occasionally	580 (54.1)	254 (52.9)		
	Often	199 (18.5)	78 (16.3)		
	Very often	41 (3.8)	8 (1.7)		
Hand-arm vibration[0,§]	*Never*	718 (67.2)	437 (91.2)	30	N, S, A
	Occasionally	315 (29.5)	39 (8.1)		
	Often	24 (2.2)	3 (0.6)		
	Very often	12 (1.1)	-		
Working with hands above shoulder level[0,1,2,3]	*Never*	536 (50.0)	207 (43.2)	26	N, S
	Occasionally	477 (44.5)	235 (49.1)		
	Often	52 (4.8)	33 (6.9)		
	Very often	8 (0.7)	4 (0.8)		
Working with the hands below knee level[0,1,2,3]	*Never*	569 (53.1)	234 (49.0)	28	N, S
	Occasionally	437 (40.8)	215 (45.0)		
	Often	58 (5.4)	26 (5.4)		
	Very often	8 (0.7)	3 (0.6)		

Table 1: continued

Reaching[0,¶]	*Never*	628 (58.9)	262 (54.8)	34	N, S
	Occasionally	389 (36.5)	202 (42.3)		
	Often	37 (3.5)	14 (2.9)		
	Very often	12 (1.1)	-		
Squeeze firmly with the hands[0,§]	*Never*	436 (40.6)	250 (52.3)	27	A
	Occasionally	487 (45.4)	182 (38.1)		
	Often	122 (11.4)	41 (8.6)		
	Very often	28 (2.6)	5 (1.0)		
Psychosocial risk factors in private life					
Work influence personal life[0,2,3]		193 (17.7)	67 (13.9)	7	B, N, S, A
Personal life influences work[0,2,3]		93 (8.5)	50 (10.4)	6	B, N, S, A
Disassociate from work[0,2,3]		997 (94.5)	427 (92.4)	61	B, N, S, A
Able to relax at home[0,2,3,¶]		1001 (95.3)	424 (92.2)	68	B, N, S, A
Busy home environment[0,2,3]		421 (40.2)	179 (39.3)	75	B, N, S, A
Club membership[0,2,3,¶]		551 (52.3)	212 (45.9)	63	B, N, S, A
Visiting friends frequently[0,2,3,¶]		891 (84.9)	441 (89.2)	67	B, N, S, A
Delegate home responsibilities[0,2,3]		800 (76.2)	336 (74.0)	74	B, N, S, A
Life events in the past year[0,1,2,3,§]	*Never*	713 (68.8)	254 (55.6)	85	B, N, S, A
	Once	159 (15.3)	88 (19.3)		
	More than once	164 (15.8)	115 (25.2)		

[a] †= mean(sd), Measured at: 0= baseline, 1=follow up 1, 2= follow up 2, 3= follow up 2, § significant difference between men and women at p=0,00; ¶ significant difference between men and women at p=0,05; [b] used as independent variable in analyses concerning B the back, N the neck, S the shoulders and A the arms

Sickness absence

Sickness absenteeism was registered in a standardized way by the companies, with the first and last date and the reason for each absence. The reasons for absenteeism were coded by the occupational physician according to an adapted Dutch code of the International Classification of Diseases. From these data information on the frequency of sickness absenteeism was derived. Since very few people were absent due to neck or shoulder symptoms these categories were combined with absenteeism due to hand-arm symptoms. Furthermore, since it was not mandatory for the companies to register very short absences, we only included absences that lasted for at least 3 days. Therefore, absenteeism cases were defined as workers who were absent for work for at least 3 days due to back symptoms and upper extremity symptoms.

Statistics

Differences between men and women in baseline exposure were tested with a χ^2 test. Logistic Generalized Estimation Equations (GEE) analyses with a 1-year time lag, meaning that that exposures were related to outcomes one year later, were performed. The odds ratio (OR) for gender and each MSD outcome was estimated first with univariate and then multivariable modeling. All analyses were performed with STATA version 7.0 for Windows.

In the multivariate analyses the relevant variables were manually and stepwise entered into the model as independent variables. Socio-demographic variables were entered in the 1st step. In the 2nd step variables on work duration were added to the model. The 3rd and 4th step contained work-related physical and psychosocial risk factors, respectively. Finally, physical and psychosocial exposures in private life were entered in the 5th and 6th step, respectively. Within each step the variables were first entered individually to the model. The variable that caused the largest change in the OR (with a minimum of 5% change) was included in the model, and the remaining variables were again individually entered to the model. If none of the variables in that specific step caused a change in OR of more than 5%, this process was repeated for the variables in the next step.

To gain some insight into what kind of exposure might explain the gender difference (i.e., physical or psychosocial, work or private life) the relevant exposure variables were manually and stepwise entered into the univariate model as independent variables. However, the focus of the study was on the difference between the ORs in the univariate analyses and those in the multivariate analyses after the 6th step.

Results

Population

At baseline 87% of the workers (n=1789) filled out the questionnaire, 92% of whom also filled out at least one follow up questionnaire. For the current analyses we excluded workers who, at baseline, worked less than 20 hours a week (n=40), were employed in their current job for less than 1 year (n=37), had a second job (n=100) or had a permanent disability pension or were on sickness benefit (n=34). Furthermore we restricted the analyses to those people for whom data on all relevant variables were present for at least 2 out of 4 measurements. Therefore, the final number of workers in the analyses was: 1247 (low back symptoms); 1211 (neck and shoulder symptoms); 1251 (arm-hand symptoms). Since sickness absenteeism was not registered by all companies, the number of workers for absenteeism are lower, namely 754 (low back absenteeism) and 742 (neck-shoulder-arm-hand absenteeism) (table 2).

Risk factors

Women reported more work-related exposures to repetitive hand motions and bending the neck backwards, while men reported more lifting, forceful exertions with the hands, hand-arm vibration, reaching, working below knee level, bending the neck forwards and driving a vehicle (table 1). Psychosocial work conditions at work were less beneficial for men. At home men also reported more exposure to lifting, forceful exertions with the hands, hand-arm vibration, reaching, and driving a vehicle. Women did not report a significantly higher exposure at home for any of the physical risk factors. Psychosocial conditions at home were slightly worse for women, who were less able to relax at home, were less often member of a club, and reported more stressful life events in the past year. However, women reported that they more often visited friends.

Table 2: Overview of rate of absenteeism of the study population (n=1578)

	Men (n=1096)		Women (n=482)		Missing
	n	(%)	n	(%)	n
Symptoms					
Low back (n=1247)					
– Baseline	302	(34.5)	133	(36.2)	5
– Follow up 1	233	(27.6)	109	(30.5)	46
– Follow up 2	248	(30.0)	112	(32.3)	72
– Follow up 3	219	(26.8)	93	(27.6)	88
Neck (n=1211)					
– Baseline§	143	(17.1)	139	(38.1)	9
– Follow up 1§	109	(13.5)	113	(32.4)	52
– Follow up 2§	122	(15.3)	105	(30.2)	67
– Follow up 3§	91	(11.5)	83	(24.6)	81
Shoulder(n=1211)					
– Baseline§	139	(16.5)	130	(35.7)	5
– Follow up 1§	109	(13.6)	97	(27.9)	63
– Follow up 2§	107	(13.6)	90	(26.2)	79
– Follow up 3§	104	(13.2)	83	(24.9)	87
Hand-Arm (n=1251)					
– Baseline¶	124	(14.2)	69	(18.7)	10
– Follow up 1¶	86	(10.4)	56	(15.9)	70
– Follow up 2§	97	(11.9)	69	(19.9)	90
– Follow up 3	92	(11.2)	51	(15.0)	90
Sickness absence					
Low Back (n=754)					
– Baseline	49	(9.8)	12	(7.2)	87
– Follow up 1	49	(9.7)	15	(8.9)	83
– Follow up 2	56	(11.1)	10	(6.3)	89
– Follow up 3§	57	(11.7)	3	(1.7)	90
Neck-Shoulder-Arm-Hand (n=742)					
– Baseline	19	(3.9)	9	(5.5)	87
– Follow up 1	24	(4.8)	10	(6.0)	80
– Follow up 2	17	(3.4)	8	(5.0)	88
– Follow up 3¶	19	(4.0)	14	(7.9)	87

† For age, education and working hours, numbers are for the complete baseline population (N=1578), for symptoms and sickness absence the numbers are for the population used in the respective analyses; § significant difference between men and women at p=0.00; ¶ significant difference between men and women at p=0.05

Symptoms

For low back symptoms there was no effect of gender (Table 3), and this was not altered by addition of sociodemographic and exposure variables. In the univariate analysis the odds of reporting neck symptoms were significantly higher for women compared to men (OR 2.70), with negligible change after addition of the relevant sociodemographic and exposure variables (OR 2.55). Univariate odds of reporting shoulder symptoms were significantly higher for women than for men (OR 2.30), which was also modified only slightly (OR 2.11) by inclusion of other variables. Similarly, hand-arm symptoms were more frequent in women than men (univariate OR 1.61) and remained higher (OR 1.95) in the multivariable models.

Table 3: Results of the analyses for the relationship between gender and self-reported musculoskeletal symptoms, Odds Ratios (OR) and 95% Confidence intervals, OR>1 indicates a higher prevalence of symptoms for women, OR<1 indicates women have a lower prevalence of symptoms

		Low back		Neck		Shoulders		Hand-Arm	
		OR[a]	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
	univariate	1.11	(0.89-1.38)	**2.70**	**(2.09-3.48)**	**2.30**	**(1.79-2.95)**	**1.61**	**(1.22-2.11)**
Step 1	Socio-demographic variables	1.24	(0.95-1.57)	**2.47**	**(1.89-3.23)**	**2.34**	**(1.92-3.20)**	**1.85**	**(1.39-2.47)**
Step 2	Physical workload	1.16	(0.91-1.47)	**2.33**	**(1.77-3.07)**	**2.11**	**(1.60-2.79)**	**1.97**	**(1.47-2.64)**
Step 3	Psychosocial workload	1.16	(0.91-1.47)	**2.55**	**(1.89-3.44)**	**2.11**	**(1.60-2.79)**	**2.11**	**(1.57-2.85)**
Step 4	Work duration	1.16	(0.91-1.47)	**2.55**	**(1.89-3.44)**	**2.11**	**(1.60-2.79)**	**2.11**	**(1.57-2.85)**
Step 5	Physical load in private life	1.16	(0.91-1.47)	**2.55**	**(1.89-3.44)**	**2.11**	**(1.60-2.79)**	**2.11**	**(1.57-2.85)**
Step 6	Psychosocial load in private life	1.16	(0.91-1.47)	**2.55**	**(1.89-3.44)**	**2.11**	**(1.60-2.79)**	**1.95**	**(1.40-2.70)**

[a] Bold indicates a significant gender difference at p=0.05

Sickness absence

The odds of sickness absence due to back problems were almost equal for men and women, with or without adjustment for sociodemographic and exposure factors (Table 4). For sickness absence due to neck-shoulder-hand-arm symptoms the gender OR was 1.60 in the univariate analyses and 2.28 in the multivariate analyses.

Discussion

A literature review[14] found that the higher crude rates of upper extremity musculoskeletal disorders usually found for women are inconsistently affected by adjustment for occupational exposures. This discrepancy might be attributable in part to differences in exposure adjustment between studies, i.e., differences in the quality and extent of the exposure assessment. It was recommended that studies should be carried out that adjust adequately for exposures before drawing final conclusions. In the present study we used validated questionnaires[36,37] to obtain categorical self-reported exposures. This enabled us to adjust for a variety of exposures, both at work and in private life. Given the gender segregation of the labor market and the often-mentioned double workload of women due to the gender division in household chores, it was assumed that women would spend more hours in housework and would have different exposures to risk factors for the upper extremities both at work and at home. It was therefore expected that correction for exposures would reduce the gender differences in (absenteeism due to) upper extremity symptoms. In general, however, the OR for gender did not change in the multivariable models.

In fact we found that, while the female respondents reported more repetitive hand motions at work (but not at home), the male respondents reported more forceful exertions both at work and at home. The psychosocial exposures showed a less clear gender difference, but it seemed as if men had a slightly higher psychosocial workload at work, while the psychosocial load at home might have been slightly higher for women. This might explain why, at least in our population, the gender difference in symptoms could not be explained by gender differences in exposure.

Table 4: Results of the analyses for the relationship between gender and sickness absence due to musculoskeletal symptoms, Odds Ratios (OR) and 95% Confidence intervals, OR>1 indicates a higher prevalence of symptoms for women, OR<1 indicates women have a lower prevalence of symptoms

		Low back		Neck-Shoulder-Hand-Arm	
		OR[a]	95% CI	OR	95% CI
	univariate	0.97	(0.72-1.30)	1.60	(0.69-2.67)
Step 1	Socio-demographic variables	**0.60**	**(0.38-0.96)**	**1.77**	**(1.04-3.00)**
Step 2	Physical workload	0.80	(0.49-1.28)	**2.19**	**(1.21-3.95)**
Step 3	Psychosocial workload	0.92	(0.57-1.48)	**2.62**	**(1.38-4.97)**
Step 4	Work duration	0.84	(0.52-1.37)	**2.62**	**(1.38-4.97)**
Step 5	Physical load in private life	0.84	(0.51-1.38)	**2.62**	**(1.36-5.02)**
Step 6	Psychosocial load in private life	0.84	(0.51-1.38)	**2.28**	**(1.10-4.73)**

[a] Bold indicates a significant gender difference at p=0.05

Examining the separate steps in the modeling, it seemed as if the addition of socio-demographics increased the gender difference slightly, while work-related physical exposure seemed to explain a little bit of the gender difference. It has been argued (e.g. [41-45]) that the so-called double exposure to paid and household work is beneficial for the health of women due to positive psychosocial effects of employment, such as better social networks and financial independence. However, the general opinion is that resultant time pressures, role conflict and role overload also cause health problems.[41-46] Krantz and Ostergren[42] calculated that the population attributable risk (PAR) of common symptoms due to the combination of high domestic responsibilities and high job strain was 12%, and that the attributable risk (AR) was almost 55%. This means that if double exposure would be eliminated 12% of the common symptoms in working women in general, and 55% of the symptoms of women with double exposure, would be eliminated. In the present analyses, however, exposures in private life had virtually no additional effect on the gender OR. This result is in agreement with a narrative review of De Rijk et al.[47]

A limitation of the present study is that both exposure and outcome were self-reported. Given the potential error in the exposure variables available[48], there could still be residual confounding in these results. Furthermore, there could be differential information bias if either men or women systematically under- or over-estimated their exposure or their symptoms. Self-reports of exposure and symptoms might be influenced by the anxiety about as well as the experience with a particular factor.[49] On average, women seem to be more concerned about health matters[50], and therefore could be expected to over-report either their symptoms or their exposures compared to men. Hansson et al.[51] found that women indeed over-report their ergonomic exposures at work, but this was contradicted by Leijon et al.[52]

However, when the analyses were repeated in the subset of the population without MSD symptoms at baseline (results not shown), the results were similar to these, except that the gender OR for shoulder symptoms declined from 1.48 to 0.99. This suggests that our present findings were not an artifact of women disproportionately over-reporting their symptoms because of their earlier symptom experiences.

If the women in the present study had over-reported their exposures, this would make it statistically easier to reduce the gender difference in symptoms by correcting statistically for exposure. However, our results generally showed no change in gender OR. We therefore find it unlikely that our results can be explained by any gender difference in reporting behavior.

We chose relevant exposures based on the literature.[53-61] If we missed some exposures that were in fact risk factors in this population, or measured them inadequately (e.g., hours of housework or work-family balance), this could have led to uncontrolled confounding. Because we included a broad variety of risk factors, especially at work, we feel that it is unlikely that this had a major effect on the results.

In our multivariate analyses the variables were stepwise entered into the model. Furthermore, since we wanted to use as much of the gender difference as possible, we used the sensitive criterion of 5% change, rather than statistical significance, to enter the variables into the model. To determine the influence of these choices we also performed analysis (results not shown) where all variables were simultaneously entered into the model, and where change was defined as 'any change at all'. However, this procedure only marginally influenced the results.

Although we expected the gender difference in musculoskeletal symptoms and absenteeism to lessen by correcting for exposures, in general the results did not show a change in gender OR. Therefore, it seems likely that at least some of the gender difference in upper extremity musculoskeletal endpoints does not exist *because* of, but *in spite* of the occupational and non-occupational exposures for which we had information.

Gender differences in pain experience have been reported in many studies, and explanations for this generally focus on either biological factors, such as sex hormones, or psychological factors such as gender role expectancies and coping behavior. Fillingim and Ness[62] reviewed the existing literature on the hormonal influences on pain. Among other things, it was found that in women pain sensitivity fluctuated during their menstrual cycle, with lower pain thresholds during the periovulatory and luteal phases when the estrogen, progesterone, luteinizing hormone (LH) and follicle stimulating hormone (FSH) levels peak. Similar results were found in female rats, where it was found that pain sensitivity fluctuated during their estrous cycle (comparable to the human menstrual cycle). They concluded that the effect of sex hormones partially, but not completely, accounts for the difference in pain sensitivity between men and women.

In addition to women's greater pain sensitivity, gender role expectancies could cause women to be more inclined to report pain[16,63], since this is socially more accepted for women than for men. Robinson et al.[64] examined the effect of gender role expectations (GREP) on the willingness to report pain, and found that both men and women expected the average man to be less willing to report pain than the average woman. In addition Wise et al.[63] examined the influence of GREP on pain tolerance time, and found that the GREP score was a significant predictor of pain threshold, tolerance, and unpleasantness.

Unruh et al.[65] examined differences in coping strategies between men and women. Both men and women were found to use behavioral distraction and problem solving coping strategies. However, in addition to this men more often relied on cognitive coping strategies, while women used positive self-statements and palliative behaviors. When in an experimental setting subjects were given the instruction to use an acceptance-based coping strategy, this reduced the pain in both men and women[66], while the instruction to use an emotional focusing strategy was associated with elevated pain.[67] It thus seems that gender differences in both biological and social factors influence pain perception. Furthermore it has been shown that pain coping strategies can be influenced, leading to a reduction of pain, especially in women. This indicates that encouraging women to adapt more masculine gender role expectations, and more effective pain coping strategies could be useful in the prevention of musculoskeletal symptoms among women. However, the origin of these coping differences might for a large part be embedded into western society, where boys and girls traditionally have been raised differently and with different moral values, and men and women are approached differently on a day-to-day basis. Consequently, coping strategies may be hard to influence outside of a laboratory situation. It is therefore recommended that research is done to examine whether it is possible to influence these coping patterns in a day-to-day situation. However, since boys and girls nowadays are more and more raised equally, in the long run these differences in coping strategies might disappear on their own.

In conclusion, to prevent and resolve gender differences in musculoskeletal symptoms, broader social factors need to be addressed in addition to the reduction of ergonomic exposures among female workers.

References

1. Bingefors, K. and Isacson, D.(2004) Epidemiology, co-morbidity, and impact on health-related quality of life of self-reported headache and musculoskeletal pain--a gender perspective. Eur J Pain 8:435-50.
2. Bot, S.D., van der Waal, J.M., Terwee, C.B., van der Windt, D.A., Schellevis, F.G., Bouter, L.M., and Dekker, J. (2005) Incidence and prevalence of complaints of the neck and upper extremity in general practice. Ann Rheum Dis 64:118-23.
3. Centers for Disease Control and Prevention (CDC). (2002) Prevalence of self-reported arthritis or chronic joint symptoms among adults--United States, 2001. MMWR 51: 948-50.
4. Leino-Arjas, P., Hänninen, K., and Puska, P. (1998) Socioeconomic variation in back and joint pain in Finland. Eur J Epidemiol 14:79-87.
5. Linton, S.J., Hellsing, A.L., and Halldén, K. (1998) A population-based study of spinal pain among 35-45-year-old individuals. Prevalence, sick leave, and health care use. Spine 23:1457-1463.
6. Picavet, H.S. and Hazes, J.M.(2003) Prevalence of self reported musculoskeletal diseases is high, Ann Rheum Dis 62:644-50.
7. Picavet, H S J, van Gils, H W V, and Schouten, J S G A. (2000) Klachten van het bewegingsapparaat in de Nederlandse bevolking. Prevalenties, consequenties en risicogroepen (Musculoskeletal complaints in the Dutch population: prevalences, consequences and risk groups). Bilthoven (Netherlands):Rijksinstituut voor volksgezondheid en milieu (RIVM).
8. Urwin, M., Symmons, D., Allison, T., Brammah, T., Busby, H., Roxbym M., Simmons, A., and Williams, G(1998). Estimating the burden of musculoskeletal disorders in the community: the comparative prevalence of symptoms at different anatomical sites, and the relation to social deprivation. Ann Rheum Dis 57:649-655.
9. Walker-Bone, K., Palmer, K.T., Reading, I., Coggon, D., and Cooper, C.(2004) Prevalence and impact of musculoskeletal disorders of the upper limb in the general population. Arthritis Rheum 51:642-51.
10. Cassou, B., Derriennic, F., Monfort, C., Norton, J., and Touranchet, A. (2002) Chronic neck and shoulder pain, age, and working conditions: longitudinal results from a large random sample in France. Occup Environ Med 2002;59(8): 537-44.
11. De Zwart, B.C.H., Broersen, J.P., Frings-Dresen, M.H., and van Dijk, F.J. (1997) Musculoskeletal complaints in The Netherlands in relation to age, gender and physically demanding work. Int Arch Occup Environ Health 70: 352-360.
12. Gerr, F., Marcus, M., Ensor, C., Kleinbaum, D., Cohen, S., Edwards, A., Gentry, E., Ortiz, D. J., and Monteilh, C. (2002) A prospective study of computer users: I. Study design and incidence of musculoskeletal symptoms and disorders. Am J Ind Med 41(4):221-35..
13. Krause, N., Ragland, D. R., Greiner, B. A., Syme, S. L., and Fisher, J. M. (1997) Psychosocial job factors associated with back and neck pain in public transit operators. Scand J Work Environ Health 23(3):179-86.
14. Punnett, L., Herbert, R.(2000), Work-Related musculoskeletal disorders: Is there a gender differential, and if so, what does it mean? In: Goldman MB, Hatch MC, editors. Women and health San Diego, CA: Academic Press, pp. 474-492.
15. Mitchell S, Reading I, Walker-Bone K, Palmer K, Cooper C, Coggon D. (2003) Pain tolerance in upper limb disorders: Findings from a community survey. Occup Environ Med 60(3): 217-21.
16. Gijsbers van Wijk, C.M.T. and Kolk, A.M. (1997) Sex differences in physical symptoms: the contribution of symptom perception theory. Soc Sci Med 45:231-246.
17. Lindbeck, L. and Kjellberg, K. (2001) Gender differences in lifting technique. Ergonomics 44(2):202-14.
18. Van der Beek, A.J., Kluver, B.D.R., Frings-Dresen, M.H.W., and Hoozemans, M.J.M. (2000) Gender differences in exerted forces and energetic workload during pushing and pulling of wheeled cages by postal workers. Ergonomics 43:269-281.
19. Hooftman, W.E., van Poppel, M.N., van der Beek, A.J., Bongers, P.M., and van Mechelen, W. (2004) Gender differences in the relations between work-related physical and psychosocial risk factors and musculoskeletal complaints. Scand J Work Environ Health 30:261-78.
20. Buckle, P and Devereux, J. (1999) Work-related neck and upper limb disorders. Luxembourg: European Agency for Safety and Health at work
21. Karlqvist, L. (2001) The importance of gender sensitive studies of work related neck and upper limb disorders. In: Bild C,

Karlqvist L, editors, Women's conditions in working life. Solna (Sweden): Arbetslivsinstitutet, 2001, p: 66-72. Arbete Och Hälsa:17.

22. Kilbom, Å., Messing, K. (1998) Aches and Pains-an affliction of women. Work-related musculoskeletal disorders. In: Kilbom Å, Messing K, Bildt-Thorbjörnsson C, editors. Women's health at work. National Institute for Working Life: Solna (Sweden), pp 203-227.
23. Fransson-Hall, C., Bystrom, S., and Kilbom, Å. (1995), Self reported physical exposure and musculoskeletal symptoms of the forearm-hand among automobile assembly line workers. J Occup Environ Med 37:1136-1144.
24. Hooftman, W.E., van der Beek, A.J., Bongers, P.M., and van Mechelen, W. (2005) Gender differences in self-reported physical and psychosocial exposures in jobs with both female and male workers. J Occup Environ Med 47:244-52.
25. Josephson, M., Pernold, G., Ahlberg-Hulten, G., Harenstam, A., Theorell, T., Vingard, E., Waldenstrom, M., and Hjelm, E.W. (1999), Differences in the association between psychosocial work conditions and physical work load in female- and male-dominated occupations. Am Ind Hyg Assoc J 606: 673-678.
26. Messing, K., Chatigny, C., and Courville J. (1998), 'Light' and 'Heavy' work in the housekeeping services of a hospital. Appl Ergon 1998;29:451-459.
27. Messing, K., Doniol-Shaw, G., and Haëntjes, S. (1993), Sugar and Spice and everything nice: Health effects of the sexual division of labor among train cleaners. Int J Health Serv 23:133-146.
28. Messing K, Dumais L, Courville J, Seifert AM, and Boucher M. (1994) Evaluation of exposure data from men and women with the same job title. J Occup Med 36:913-917.
29. Messing, K. and Reveret, J. (1983) Are women in female jobs for their health? A study of working conditions and health effects in the fish processing industry in Quebec. Int J Health Serv 13:365-347.
30. Nordander C, Ohlsson K, Balogh I, Rylander L, Palsson B, and Skerfving S. (1999) Fish processing work: the impact of two sex dependent exposure profiles on musculoskeletal health. Occup Environ Med 56(4):256-64.
31. Leijon O, Bernmark E, Karlqvist L, Harenstam A. (2005) Awkward work postures: association with occupational gender segregation. Am J Ind Med 47:381-93.
32. De Zwart, B.C.H., Frings-Dresen, M.H.W., and Kilbom, Å. (2000) Gender differences in upper extremity musculoskeletal complaints in the working population. Int Arch Occup Environ Health 74:21-30.
33. Coury, H.J.C.G., Portcatti, I.A., Alem, M.E.R., and Oisho, J.(2002) Influence of gender on work-related musculoskeletal disorders in repetitive tasks. Int J Ind Ergon 29:33-39.
34. Ariëns, GAM., Bongers, PM., Douwes, M., Miedema, M., Hoogendoorn, WE, van der Wal, G., Bouter, L.M., and van Mechelen, W.(2001) Are neck flexion, neck rotation and sitting at work risk factors for neck pain? Results of a prospective cohort study. Occup Environ Med 58:200-207.
35. Hoogendoorn, W.E., Bongers, P.M., de Vet, H.C.W., Douwes, M., Koes, B.W., Miedema, M., Ariëns, G.A.M., and Bouter, L.M. (2000), Flexion and rotation of the trunk and lifting at work are risk factors for low back pain: results of a prospective cohort study. Spine 25:3087-92.
36. Hildebrandt, V. H. (2001) Prevention of work related musculoskeletal disorders: setting priorities using the standardized Dutch Musculoskeletal Questionnaire. Doctoral thesis. Hoofddorp (The Netherlands): TNO Work and Employment.
37. Hildebrandt, V.H., Bongers, P.M., van Dijk, F.J., Kemper, H.C., and Dul, J. (2001) Dutch Musculoskeletal Questionnaire: description and basic qualities. Ergonomics 44:1038-55.
38. De Jonge, J., Reuvers, M.M.E.N., Houtman, I.LD., Bongers, P.M., and Kompier, M.A. (2000), Linear and nonlinear relations between psychosocial job characteristics, subjective outcomes and sickness absence: Baseline results from SMASH. J Occup Health Psychol 5:256-268.
39. Bongers, P. M., Miedema, M., Douwes M. , Hoogendoorn, W E, Ariëns, G A M., Hildebrandt, V. H., van der Grinten, M, and Dul, J (2000). Longitudinaal onderzoek naar rug-, nek en schouderklachten. Deelrapport 1: Opzet en uitvoering van het onderzoek. (Longitudinal study on low back, neck, and shoulder complaints. Sub report 1: Design and execution of the study). Hoofddorp (The Netherlands): TNO work and employment.
40. Kuorinka, I., Jonsson, B., Kilbom, A., Vinterberg, H., Biering-Sorensen, F., Andersson, G., and Jorgensen, K. (1987) Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. Appl Ergon 18:233-7.
41. Hall, E. (1992) Double exposure: The combined impact of the Home and Work environments on Psychosomatic strain in Swedish women and men. International journal of health services 22:239-260.
42. Krantz, G. and Ostergren, P.O. (2001) Double exposure. The combined impact of domestic responsibilities and job strain on common symptoms in employed Swedish women. Eur J Public Health 11:413-9.
43. Martikainen, P. (1995) Women's employment, marriage, motherhood and mortality: a test of the multiple role and role accumulation hypotheses. Soc Sci Med 40:199-212.
44. Mastekaasa, A.(2000) Parenthood, gender and sickness absence. Soc Sci Med 50:1827-42.
45. Walters, V., Lenton, R., French, S., Eyles, J., Mayr, J., and Newbold, B. (1996) Paid work, unpaid work and social support:

a study of the health of male and female nurses. Soc Sci Med 43:1627-36.

46. Strazdins L, Bammer G. (2004) Women, work and musculoskeletal health. Soc Sci Med 58:997-1005.
47. De Rijk, A, Van Lierop, B, Janssen, N, and Nijhuis, F (2002) Geen kwestie van motivatie maar van situatie. Een onderzoek naar man/vrouw verschillen in werkhervatting gedurende het eerste jaar na ziekmelding (Situation not motivation. An investigation of gender differences in work resumption during the first year of sickness absenteeism). Doetinchem / 's Gravenhage (The Netherlands): Ministry of Social Affairs and Employment.
48. Van der Beek AJ, Frings-Dresen MH (1998). Assessment of mechanical exposure in ergonomic epidemiology. Occup Environ Med; 55(5):291-9.
49. Kennedy, A.M. and Koehoorn, M. (2003) Exposure assessment in Epidemiology: Does gender matter? Am J Ind Med 44:567-83.
50. Green, C.A. and Pope, C.R. (1999) Gender, psychosocial factors and the use of medical services: a longitudinal analysis, Soc Sci Med. 48:1363-72.
51. Hansson, G.A., Balogh, I., Bystrom, J.U., Ohlsson, K., Nordander, C., Asterland, P., Sjolander, S., Rylander, L., Winkel, J., and Skerfving, S.(2001) Questionnaire versus direct technical measurements in assessing postures and movements of the head, upper back, arms and hands. Scand J Work Environ Health 27:30-40.
52. Leijon, O., Wiktorin, C., Harenstam, A., and Karlqvist, L. (2002), Validity of a self-administered questionnaire for assessing physical work loads in a general population. J Occup Environ Med 44:724-35.
53. Ariëns GAM, van Mechelen W, Bongers PM, Bouter LM, van der Wal G. (2000). Physical risk factors for neck pain [review]. Scand J Work Environ Health 26:7-19.
54. Van der Windt DAWM, Thomas E, Pope DP, de Winter AF, Macfarlane GJ, Bouter LM. (2000) Occupational risk factors for shoulder pain: a systematic review. Occup Environ Med 75:433-42.
55. Hoogendoorn WE, van Poppel MNM, Bongers PM, Koes BW, Bouter LM. (1999) Physical load during work and leisure time as risk factors for back pain [review]. Scand J Work Environ Health 25:387-403.
56. Bongers PM, Kremer AM, ter Laak J. (2002) Are psychosocial factors, risk factors for symptoms and signs of the shoulder, elbow, or hand/wrist?: a review of the epidemiological literature. Am J Ind Med 41:315-42.
57. Viikari-Juntura E, Silverstein B.(1999) Role of physical load factors in carpal tunnel syndrome [review]. Scand J Work Environ Health 25:163-85.
58. Sluiter JK, Rest KM, Frings-Dresen MHW. (2001) Criteria document for evaluating the work-relatedness of upper-extremity musculoskeletal disorders. Scand J Work Environ Health 27: Suppl 1:1-102.
59. Bernard BP (1997). Musculoskeletal disorders and workplace factors. A critical review of epidemiologic evidence for work-related musculoskeletal disorders of the neck, upper extremity, and low back. National Institute for Occupational Safety and Health (NIOSH).
60. Burdorf A, Sorock G. (1997) Positive and negative evidence of risk factors for back disorders [review]. Scand J Work Environ Health 23:243-56.
61. Ariëns GAM, van Mechelen W, Bongers PM, Bouter LM, van der Wal G. (2001) Psychosocial risk factors for neck pain: a systematic review. Am J Ind Med 39:180-93.
62. Fillingim, R. B. and Ness, T. J. (2000) Sex-related hormonal influences on pain and analgesic responses. Neurosci Biobehav Rev 24(4):485-501.
63. Wise, E. A., Price, D. D., Myers, C. D., Heft, M. W., and Robinson, M. E. (2002) Gender role expectations of pain: relationship to experimental pain perception. Pain 96:335-42.
64. Robinson, M.E., Riley, J.L. 3rd, Myers, C.D., Papas, R.K., Wise, E.A., Waxenberg, L.B., and Fillingim, R.B.,(2001) Gender role expectations of pain: relationship to sex differences in pain. J Pain 2:251-7.
65. Unruh, A.M., Ritchie, J., and Merskey, H. (1999) Does gender affect appraisal of pain and pain coping strategies? Clin J Pain 15 31-40.
66. Keogh, E., Bond, F.W., Hanmer, R., and Tilston, J. (2005) Comparing acceptance- and control-based coping instructions on the cold-pressor pain experiences of healthy men and women. Eur J Pain 9:591-8.
67. Keogh, E. and Herdenfeldt, M. (2002) Gender, coping and the perception of pain. Pain 97(3):195-201.

5

A systematic review on gender differences in the relations between work-related physical and psychosocial risk factors and musculoskeletal complaints.

Published as:
Hooftman WE, Van Poppel MNM, Van der Beek AJ, Bongers PM, Van Mechelen W.
A Systematic Review on Gender Differences in the Relations Between Work-related Physical and Psychosocial Risk Factors and Musculoskeletal complaints.
Scand J Work Environ Health. 2004; 30(4):261-278.

Abstract

Gender differences in the prevalence of musculoskeletal complaints might be explained by differences in the effect of exposure to work-related physical and psychosocial risk factors. To examine gender differences in the relations between these risk factors and musculoskeletal complaints a systematic review was conducted. Several electronic databases were searched. Based on methodological quality and consistency of results of the included studies, the strength of evidence was determined. For lifting strong evidence was found that men have a higher risk of back complaints than women. The same was found for the relation between hand-arm vibration and neck-shoulder complaints. For arm posture strong evidence was found that women have a higher risk of neck-shoulder complaints than men. For social support, no evidence for a gender difference was found for either neck-shoulder or back complaints. For hand-wrist and lower extremity complaints inconclusive evidence was found due to a lack of high quality studies.

Introduction

Many studies have reported gender differences in the prevalence of musculoskeletal complaints. For example, in a large population based study in the Netherlands 79.3% of the women and 71.5% of the men reported one or more musculoskeletal complaints in the past year[1]. The one-year prevalence of self-reported spinal pain (including lower back, upper back and neck) in a sample of 35-45 year old Swedish residents was 69.5% for women and 63.2% for men[2]. In the United States the prevalence of chronic joint symptoms in 2001 was 37.3% for women and 28.4% for men[3].

This gender difference seems to be more distinct for neck and upper extremity complaints than for back complaints. Prevalences of neck and upper extremity complaints were consistently higher for women than for men[1,4,5], while the prevalence of back complaints has been shown to be markedly higher for women[6], slightly higher for women[1,4], but also slightly higher for men[7].

Several explanations for the gender difference in prevalence have been proposed[8-11]. The first explanation is that men and women have a different exposure to risk factors. Either because of differences in exposures outside work, or because of differences in work exposure due to the sex segregation of the labor market. This last factor has been suggested to be the most important explanation for the sex difference in the prevalence of musculoskeletal complaints. However, the difference in prevalence remains when men and women from the same occupational class[12], or with the same work tasks[13] are compared. The second explanation is that women are more prone to express pain and symptoms. Either because they have a lower threshold for detecting this, or because they are more willing to express it, since men are taught not to complain[14]. If this were true, one would expect that the gender difference in the prevalence of self-reported pain or symptoms is larger than for objectively measured problems. Yet, Punnett and Herbert[8], who reported that some of the largest gender differences were found in studies in which objective measures were used, did not find this. The third explanation is that the same risk factors might have a different effect on men and women. Firstly, joint laxity seems to be influenced by sex hormones[15,16] making women more vulnerable for musculoskeletal pain. Secondly, women, on average, have smaller body dimensions, lower muscle force and a lower aerobic capacity. Therefore tasks performed with the same (absolute) exposure will in most cases result in a higher relative workload for women[8,17,18], which could lead to more complaints. Thirdly, men and women have been found to use different coping strategies for dealing with occupational stressors[19], which may also result in different outcomes.

In this review we focus on gender differences in the effect of risk factors. The aim is to determine whether there are gender differences in the relations between work-related physical and psychosocial risk factors and musculoskeletal complaints of the back, neck-shoulder, hand-wrist and lower extremities.

Methods

Selection of the literature

Several electronic databases (MEDLINE (1966-December 2002), CINAHL (1982-December 2002), Psychinfo (1887-December 2002), CisDoc, NIOSHtic2, HSEline, RILOSH (1977-February 2002) and Biological abstracts (1990-January 2002)) were checked in order to identify relevant studies. The databases were searched with the following search string: (risk factor OR predictor OR determinant or causality OR (a)etiology OR causal factor) AND (gender (difference) OR sex (difference)) AND (work(-)(related) OR work environment OR job OR employment OR workplace OR occupation(al)) AND (back (pain) OR musculoskeletal (disorder) OR upper extremity (disorder) OR lower extremity (disorder) OR shoulder OR wrist OR elbow OR neck OR knee OR RSI OR repetitive strain injury OR cumulative strain disorder OR hand OR arm OR leg OR foot OR feet). In addition, a snowball search was performed and the references of some recent reviews[20-25] were checked for relevant publications. Finally, articles from personal databases were included.

Articles were included if they met the following criteria: 1) The study design was Cohort (CH), Case-Control (CC) or cross-sectional (CS); 2) The study population included both men and women who came from a working or community based population; 3) The study addressed a musculoskeletal complaint; 4) The exposure to relevant risk factors was measured separately for men and women, and for example not based on job title or a job exposure matrix; 5) Separate analyses for men and women were performed, or an interaction effect for gender was calculated, and 6) The study was published in a peer reviewed journal in English. Two reviewers (WH and MP) read the titles and abstracts of all studies to decide whether the inclusion criteria were met. If no abstract was present, or based on title and abstract it still was unclear whether an article should be in- or excluded, the whole article was retrieved and checked.

Quality assessment

The quality of the studies was assessed using a quality assessment list (table 1), based on lists used in earlier reviews of observational studies[22,25]. The items on the list were rated as '+' (the minimal requirements were met), '-' (the minimal requirements were not met) or '?' (unclear whether the minimal requirements were met). For all studies the number of positive items was calculated. Studies were rated high quality if they scored positive on at least 50% of the relevant items. Two reviewers (WH and MP) separately evaluated the quality of the studies. A consensus meeting was arranged to sort out differences between both reviewers.

Table 1: Items for scoring the methodological quality

	CH	CC	CS
Design			
1. The participation rate at baseline was at least 80% or not selective	✓	✓	✓
Population			
2. Cases and controls were drawn from the same population, and a clear definition of cases and controls was stated		✓	
3. The response after one year follow up was at least 80% or the non response was not selective	✓		
Exposure assessment			
4. Data on physical load at work were collected and used in the analysis	✓	✓	✓
5. Data on physical load were collected using standardized methods of acceptable quality[a]	✓	✓	✓
6. Data on psychosocial load at work were collected and used in the analysis	✓	✓	✓
7. Data on psychosocial load were collected using standardized methods of acceptable quality[a]	✓	✓	✓
8. Data on historical exposure at work were collected and used in the analysis[b]	✓	✓	✓
9. Data on physical load during leisure time were collected and used in the analysis	✓	✓	✓
10. Data on psychosocial load during leisure time were collected and used in the analysis	✓	✓	✓
11. The exposure assessment was blinded with respect to disease status		✓	✓
12. The exposure was measured in an identical way in cases and controls		✓	
13. The exposure was assessed prior to the occurrence of the outcome		✓	
14. Data on history of (relevant) musculoskeletal complaints were collected and used in the analysis	✓	✓	✓
Outcome assessment			
15. Data on outcome were collected with standardized methods of acceptable quality[c]	✓	✓	✓
16. Incident cases were used		✓	
17. Data on outcome were collected for at least one year	✓		
18. Data on outcome were collected at least every three months or from a continuous registration system	✓		
Analysis			
19. The statistical model used was appropriate for the outcome studied, and a measure of association (including confidence intervals) was presented	✓	✓	✓
20. The study controlled for confounding[d]	✓	✓	✓
21. The number of cases in the multivariate analysis was at least ten times the number of independent variables	✓	✓	✓
Maximum score	**16**	**18**	**14**

[a]Information in article of reference: Direct measurements: ICC>0.6 or kappa>0.4; observations: ICC>0.6 or kappa>0.4 for inter/intra observer reliability; self report: ICC>0.6 or kappa>0.4 for inter/intra observer reliability; [b]Only years of employment in current job not enough. At least several jobs, or exposure in certain time period; [c]Self report: ICC>0.6 or kappa>0.4 for test-retest reliability; Registration system: data should show a valid and reliable system. Physical examination: ICC>0.6 or kappa>0.4 for inter/intra observer reliability; [d]At least corrected for age and (if applicable) different worksites.

Data extraction

From all studies information on design, population, response rate, exposure, outcome and the risk estimates (Relative Risk (RR), Odds Ratio (OR)) for men and women were extracted. When risk estimates were not presented, but enough data were given, the risk estimates were calculated. When multiple outcome measures were presented, for example pain and sick leave, the outcome that was closest to the complaint level was used in the analysis.

To determine whether there is a gender difference for a risk factor it is not sufficient for a risk estimate to be statistically significant in one group and not in the other group. It is also not correct to say that if confidence intervals overlap the risk estimates are not significantly different[26]. Therefore, the risk for women was divided by the risk for men in order to calculate a gender ratio. A ratio higher than 1.25, meaning women have a higher risk, or lower than 0.75, meaning women have a lower risk, was regarded as a relevant gender difference.

It was anticipated that a wide variety of risk factors would be found in the various studies. Therefore, based on the results of several recent reviews[20-24, 27-32], the following risk factors were selected and used in the analysis.

<u>Physical risk factors:</u>
- Back: lifting/manual material handling/patient handling; awkward posture/ bending/twisting; heavy physical workload; whole body vibration.
- Neck-shoulder: repetition; hand-arm vibration; arm posture; arm force; head posture
- Hand-wrist: repetition; vibration; wrist posture; use of force.
- Lower extremities: heavy physical work; kneeling/squatting; walking; climbing

<u>Psychosocial risk factors:</u>
- All areas: job demands; job control; social support; job satisfaction

Levels of evidence

Based on the reviews of Ariëns et al.[22] and Hoogendoorn et al.[25] four levels of evidence were constructed to determine the strength of evidence for a gender difference.

<u>Strong evidence</u>: Consistent gender differences found in multiple high quality CH or CC studies.
<u>Moderate evidence</u>: Consistent gender differences found in one high quality CH or CC study and at least one low quality CH or CC study, or consistent gender differences found in multiple low quality CH or CC studies, or consistent gender differences found in multiple high quality CS studies.
<u>Inconclusive evidence</u>: Consistent gender differences found in multiple low quality CS studies, or inconsistent results found in multiple studies, or results based on one study.
<u>No evidence for a difference</u>: Consistent no gender differences found.
Results were regarded as consistent if at least 75% of the results were in the same direction.

Table 2: Scoring of the methodological quality

Study / Item[a]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Score
Bildt-Thorbjörnsson et al (CH)	+	·	-	+	+	+	+	-	+	+	·	·	·	+	+	·	+	-	+	+	+	81
[59,79-84] (CC)	+	+	·	+	+	+	+	-	+	-	-	+	-	-	+	+	·	·	+	+	+	72
Vingard et al[60,85-92]	?	+	·	+	+	+	+	+	+	-	-	+	-	+	+	+	·	·	+	+	+	78
Mäkelä et al[64,93]	+	·	·	+	+	+	+	-	-	-	-	·	·	+	+	·	·	·	+	+	+	71
Cassou et al[61]	+	·	+	+	?	+	?	+	-	-	·	·	·	+	?	·	+	-	+	+	+	63
Cole et al[48,94]	+	·	·	+	?	+	+	-	+	-	-	·	·	-	?	·	·	·	+	+	+	57
Hemingway et al[51]	-	·	-	-	-	+	+	-	+	-	·	·	·	+	?	·	+	+	+	+	+	56
Alcouffe et al[47]	+	·	·	+	?	-	-	-	+	-	-	·	·	+	?	·	·	·	+	+	+	50
Barnekow-Bergkvist et al[58]	?	·	?	+	?	+	+	-	+	-	·	·	·	-	+	·	+	-	+	+	-	50
Walsh et al (1989)[56]	+	·	·	+	?	-	-	+	-	-	-	·	·	+	?	·	·	·	+	+	+	50
Coggon et al (2000)[69]	-	+	·	+	?	-	-	+	-	-	-	+	-	+	?	-	·	·	+	+	+	44
Heliövaara[50]	?	+	·	+	?	-	-	-	-	-	+	+	+	-	?	+	·	·	-	+	+	44
Manninen et al[72]	-	+	·	+	-	-	-	+	+	-	-	+	-	+	?	-	·	·	+	-	+	44
Macfarlane et al[54,95-97]	-	·	-	+	?	+	?	+	-	-	·	·	·	?	?	·	+	-	+	+	+	44
Foppa and Noach[49]	+	·	·	+	?	+	?	-	-	+	-	·	·	-	?	·	·	·	+	-	+	43
Walsh et al (1991)[57]	-	·	·	+	?	-	-	+	-	-	-	·	·	+	?	·	·	·	+	+	+	43
Coggon et al (1998)[70]	-	+	·	+	?	-	-	+	-	-	-	+	-	+	?	-	·	·	+	-	+	39
Lau et al[71,98]	?	-	·	+	?	-	-	-	+	-	-	+	-	+	?	-	·	·	+	+	+	39
Jensen et al[65,99]	-	·	·	+	?	+	?	-	-	-	-	·	·	-	?	·	·	·	+	+	+	36
Matsui et al[55]	+	·	·	+	?	-	-	-	-	-	-	·	·	?	?	·	·	·	+	+	+	36
Tanaka et al[68,100,101]	+	·	·	+	?	-	-	-	-	-	-	·	·	-	?	·	·	·	+	+	+	36
Palmer et al[62,75]	-	·	·	+	?	+	?	-	-	-	-	·	·	-	?	·	·	·	+	+	+	36
Fransson-Hall et al[67]	+	·	·	+	?	+	?	-	-	-	-	·	·	-	?	·	·	·	-	+	+	36
Karlqvist et al[66]	+	·	·	+	?	+	?	-	-	-	-	·	·	-	?	·	·	·	+	-	-	29
Latza[53,102]	-	·	·	+	?	-	-	-	-	-	-	·	·	-	?	·	·	·	+	+	+	29
Pope et al[63b]	-	·	·	+	?	+	?	+	-	-	-	·	·	-	?	·	·	·	+	-	-	29
Kelsey[52,103,104]	-	+	·	+	?	-	-	-	-	-	-	+	-	-	?	+	·	·	-	+	-	28

[a] + the study described the item and it met the minimal requirements; - the study described the item but did not meet the minimal requirements; ? the item wasn't clearly described or it wasn't clear whether the minimal requirements were met; · not applicable; [b] The article stated a Case-Control design, but since we found the matching procedure questionable, the study was regarded as cross-sectional.

Results

Selection of the literature

The search resulted in a total of 1653 articles. After the exclusion of doubles, 1473 titles and abstracts were reviewed for their relevance. Initially there was a 7% disagreement between the reviewers about whether a paper met the inclusion criteria. After these disagreements were resolved, the full text of 185 articles was retrieved. Based on the full text, 31 studies were included. Another nine studies were included based on the snowball search, reference check and personal databases.

Eight studies[33-40] were excluded after data extraction, because they did not present a risk estimate, or enough data to calculate one. Two studies[41,42] were excluded, because they did not report on musculoskeletal complaints in a specific region. Finally, four studies[43-46] that met all the inclusion criteria and presented their data in a usable way, could not be used in the analysis, because they did not report on any of the predetermined risk factors. Therefore, 14 studies[47-60] on back complaints, nine studies[58-66] on neck-shoulder complaints, four studies[65-68] on hand-wrist complaints and four studies[69-72] on lower extremity complaints were used in the analyses. A description of the studies that were used in the analyses is given in Appendix 1A-D. Only relevant outcome and exposure measures are presented.

Quality assessment

The overall agreement between the two reviewers was 86% (Kappa 0.76) and the agreement for the individual items ranged from 50% (item 18) to 100% (item 6, 14 and 19). All disagreements were resolved in the consensus meeting. An overview of the scoring of the individual studies is given in table 2. Three out of seven CH studies were regarded as high quality. For the CC studies, again, three out of seven studies were of high quality. The study of Bildt-Thorbjörnsson et al[59] that consisted of a CH and a CC part, was regarded high quality for both designs. Only four of the 15 CS studies were of high quality.

Back complaints

A summary of the determination of the levels of evidence for back complaints can be found in table 3.1. Eight studies[47,52-54,56-58,60] reported on lifting. The high quality CH study[58] found a gender ratio of 0.18, while in the high quality CC study[60] gender ratios of 0.57 and 0.80 were found for heavy lifting, and manual material handling, respectively. The low quality CH and CC[52,54], and a high quality CS study[47] found gender ratios between 1.35 and 2.27. The second high quality CS study[56] and a low quality CS study[57] found no difference between men and women, while in another low quality CS study[53] a ratio of and 0.55 was found. Based on the results of the high quality CH and CC studies, it is concluded that there is strong evidence that men have a higher risk than women of back complaints due to lifting.

Posture was investigated in four studies[47,53,58,60]. The high quality CH study[58] and the high quality CS study[47] found no difference between men and women. The high quality CC study[60] and the low quality CS study[53] showed risk ratios of 0.67 and 0.40, respectively. Since the results of the high quality CH and CC studies were not consistent, there is inconclusive evidence for a gender difference for posture.

Four CC[50,55,59,60], and two CS[48,49] studies reported on heavy physical work as a risk factor for back pain. One high quality[60] and two low quality CC studies[50,55] found a larger risk for women (gender ratios ranging from 1.36 to 3.43). No difference in the risk estimate between men and women was found in the other high quality CC study[59], and the CS studies[48,49]. Since these results were not consistent, there is inconclusive evidence for a gender difference for heavy physical workload.

Table 3.1: Summary of the determination of levels of evidence for back complaints

Risk factor		Direction of the difference[b]						Level of evidence
		M>F		M=F		F>M		
	MQ[a]	CC/CH	CS	CC/CH	CS	CC/CH	CS	
Lifting	HQ	60,58			56		47	Strong evidence M>F
	LQ		53		57	52,54		
Awkward postures	HQ	60		58	47			Inconclusive evidence
	LQ		53					
Heavy physical work	HQ			59	58	60		Inconclusive evidence
	LQ				49	50,55		
Whole body vibration	HQ	58	56			60	56	Inconclusive evidence
	LQ			52,54			57	
Job demands	HQ			51,59		58	48	Inconclusive evidence
	LQ				49			
Job control	HQ	51		60	47,48	58		Inconclusive evidence
	LQ							
Job satisfaction	HQ	60		51,58				Inconclusive evidence
	LQ				49			
Social support	HQ			51,59,60	48	58		No evidence for a difference
	LQ							

[a] methodological quality score, High quality (HQ) or Low Quality (LQ); [b] Cohort (CH), Case-Control (CC) or Cross-sectional (CS)

Whole body vibration, measured as vibration or driving, was investigated in six studies[52,54,56-58,60]. The high quality CC[60] and the low quality CS study[57] found gender ratios of 3.11 and 1.40, respectively. However, the high quality CH study[58] found a gender ratio of 0.58. In the high quality CS study[56] gender ratios of 0.24-0.67 for driving, and a gender ratio of 3.80 for exposure to vibration machinery were found. Finally, the low quality CH[54] and CC[52] studies did not find a gender difference. Since these results were not consistent, there is inconsistent evidence of a gender difference for whole body vibration

Job demands were assessed in five studies[48,49,51,58,59]. One high quality CH study[58] and one high quality CS study[48] found gender ratios of 1.90 and 1.35 respectively. The second high quality CH study[51], the high quality CC study[59] and a low quality CS study[49] did not find a gender difference. Due to the inconsistency of these results there is inconclusive evidence for a gender difference for job demands.

Five high quality studies[47,48,51,58,60] examined job control. One CH study[58] found a gender ratio of 1.35, while for the other CH study[51] a gender ratio of 0.70 was calculated. The CC study[60] and both CS studies[47,48] did not find a gender difference.

Because of the inconsistency of these results, there is inconclusive evidence for a gender difference for job control.

A gender ratio of 1.41 for social support as a risk factor was found in a high quality CH study[58]. However, the other high quality CH study[51], both high quality CC studies[59,60] and the high quality CS study[48] did not find a gender difference. The conclusion, therefore, is that there is no evidence for a gender difference.

A gender difference in the relation between job satisfaction and back pain was only found in one high quality CC study[60], with a gender ratio of 0.33. No gender difference was found in two high quality CH studies[51,58] and one low quality CS study[49]. Due to the inconsistency in the high quality studies, there is inconclusive evidence for a gender difference for job satisfaction.

Neck-shoulder complaints

Table 3.2 provides an overview of the determination of the levels of evidence for neck-shoulder complaints. A total of five studies[59-61,63] assessed the relation between repetition and neck-shoulder complaints. One high quality CC study[60] found a gender ratio of 1.33, while the second high quality CC study[59] did not find a gender difference. The high quality CH study[61] found a gender ratio of 1.44 for the exposure at baseline, but no difference for exposure before baseline. The results of the low quality CS studies[63,65] were not consistent either, with gender ratios of 0.53-2.34, depending on the exact outcome and exposure. Because of these inconsistent results, there is inconclusive evidence for a gender difference for repetition.

The relation between hand-arm vibration and neck-shoulder complaints was measured in four studies[59,60,62,63]. Both high quality CC studies[59,60] and one low quality CS study[63] found a larger risk for men (gender ratios 0.50, 0.54 and 0.73, respectively). The second low quality CS study[62] found a gender ratio of 0.22 for pain in the past seven days, but no difference for pain in the past 12 months. Because the CC studies[59,60] consistently showed a higher risk estimate for men, it is concluded that there is strong evidence that exposure to hand-arm vibration is a larger risk for men.

Arm posture was investigated in one high quality CH study[58], one high quality CC study[60], and three low quality CS studies[62,63,66]. The CH and CC studies found larger risk estimates for women, with gender ratios of 6.39[58] and 1.44[60]. The CS studies found no difference between men and women[62,66], or a larger risk for men[63]. Based on the results of the CH[58] and CC[60] studies, it is concluded that there is strong evidence that exposure to awkward arm postures is a larger risk factor for women than for men.

Arm force, measured as lifting, was measured in one high quality CH study[58], one high quality CC study[60] and two low quality CS studies[62,63]. The CC study[60] and one of the CS studies[63] found a larger risk for men (gender ratios from 0.20 to 0.67). No gender difference was found in the second CS study[62] and the CH study[58], in which

Table 3.2: Summary of the determination of levels of evidence for neck-shoulder complaints

Risk factor		Direction of the difference[b]						Level of evidence
		M>F		M=F		F>M		
	MQ[a]	CC/CH	CS	CC/CH	CS	CC/CH	CS	
Repetition	HQ			61[c],59		60,61[d]		Inconclusive evidence
	LQ		63[e]		65[f],63[g]		65[h]	
Hand arm vibration	HQ	59,60						Strong evidence M>F
	LQ		63		62			
Arm posture	HQ					58,60		Strong evidence F>M
	LQ		63		62,66			
Arm force	HQ	60		58				Inconclusive evidence
	LQ		63		62			
Job demands	HQ	58		61	64	59,60		Inconclusive evidence
	LQ				65,66			
Job control	HQ			60		58,59		Inconclusive evidence
	LQ							
Social support	HQ			58,60				No evidence for a difference
	LQ				66			

[a] methodological quality score, High quality (HQ) or Low Quality (LQ); [b] Cohort (CH), Case-Control (CC) or Cross-sectional (CS); [c] for exposure at baseline; [d] exposure before baseline; [e] for using the arm repetitive; [f] for neck pain; [g] for using the wrist repetitive; [h] for shoulder pain

men and women with a heavy lift index had a lower risk of neck-shoulder complaints. Therefore, the conclusion is that there is inconclusive evidence.

Job demands were investigated in seven studies[58-61,64-66]. One high quality CH study[58] found a gender ratio of 0.64, but the two high quality CC studies[59,60] found gender ratios from 1.57 to 4.50. No gender difference was found in the second high quality CH study[61] and the CS studies[64-66]. Since these results were not consistent, there is inconclusive evidence for a gender difference for job demands.

Three high quality studies[58-60] measured job control. One CC study[60] found no gender difference, but the second CC study[59] found a gender ratio of 5.0. The gender ratio in the CH study[58] was 1.33. Due to the inconsistency of the results, there is inconclusive for a gender difference for job control.

One high quality CH[58], one high quality CC[60] and one low quality CS study[66] reported on social support. Since none of them found differences between men and women, it is concluded that there is no evidence for a gender difference.

Hand-wrist complaints

Two low quality CS studies[65,67] reported on repetitive movements. Since only one of them[67] found a gender difference (gender ratio 1.29), there is inconclusive evidence for a gender difference.

One study[68] reported on the relation between vibration and hand-wrist complaints (gender ratio 0.49), but since this was a low quality CS study there is inconclusive evidence for a gender difference.

Three studies[66-68] reported on wrist postures. One of them[67] found gender differences, with ratios of 0.71 and 1.29 depending on the exact exposure, but the other two studies found no gender differences. Since these results were inconsistent, and based on low quality CS studies, there is inconclusive evidence for a gender difference.

Job demands were measured in two studies[65,66], but only one of them[66] found a gender difference. Due to the inconsistency and the low quality of the studies, there is inconclusive evidence for a gender difference.

One low quality CS study[66] reported on the relation between social support and hand-wrist complaints. No gender difference was found, but since the results are based on only one study there is inconclusive evidence for a gender difference

Lower extremity complaints

Only one low quality study[72] reported on the relation between heavy physical workload and lower extremity complaints. This study found a gender ratio of 1.33. With only one study, there is inconclusive evidence for a gender difference.

Four low quality CC studies[69-72] reported on kneeling or squatting. Two studies[69,72] used exposures that combined kneeling and squatting. Both studies found no gender difference. Two studies[70,71] found a gender difference for kneeling (gender ratio 0.33-0.64) and in one study[69] a gender ratio of 1.27 was found for squatting. Since the results of these studies were not consistent, there is inconclusive evidence for a gender difference for kneeling or squatting.

Much walking was a larger risk factor for men in two out of four low quality CC studies[71,72], with gender ratios from 0.36 to 0.72. The third study showed no difference between men and women, while in the fourth study gender ratios of 1.36 and 1.88 were found. Due to the inconsistency of the results, there is inconclusive evidence for a gender difference for walking.

Climbing was measured in all four low quality CC studies[69-72]. Two studies[69-72] found a larger risk for men (gender ratios 0.30-0.54). In one study[71] the direction of the gender difference depended on the outcome (gender ratio 0.18 for hip complaints and 2.04 for knee complaints), and in one study[70] on the duration of the exposure (gender ratio 0.57-1.28). Since these results were not consistent, there is inconclusive evidence for a gender difference for climbing.

Discussion

The purpose of this review was to examine gender differences in the effect of exposure to work-related physical and psychosocial risk factors. Considering the gender differences in prevalence we expected that women would have higher risks. The results show evidence for a gender difference for a few risk factors, but in most cases men had the higher risk.

Back complaints

On beforehand we presumed, that women would have a higher risk of back complaints due to lifting than men, but we found strong evidence that men have a higher risk. However, it could be argued that, since the weight of the on average larger male torso has to be added to the weight of the lifted object, men in fact have a higher exposure than women when lifting an equal object. This might lead to a higher risk of developing back complaints for men. Several studies[18,73,74] indeed found that, men have a greater absolute exposure, due to their greater body mass. However, those same studies also showed that women are not merely scaled down versions of men, but in fact use different techniques while lifting. In the end this resulted in a greater relative workload, and therefore a greater risk of complaints, for women. Another remarkable point is that Vingard et al.[60] found a (not significant) RR of 0.8 for women, while Barnekow-Bergkvist et al.[58] found odds ratios <1 for both men and women. This clearly contrasts the generally accepted view that lifting is a risk factor for back pain[23,32]. It should be mentioned, however, that the study population in this last study was relatively young (mean age 34 ± 0.74 years). Together with the possible selection bias in this study this may explain this unexpected result. Finally, although the high quality CH and CC studies found gender ratios below 0.75, the low quality CH and CC studies consistently found ratios above 1.25. Therefore, the conclusion that men have a higher risk than women due to lifting should be taken with due caution.

Neck-shoulder complaints

As for back complaints, it was expected that women would have a higher risk. This was indeed found for arm posture, but for hand-arm vibration men had the higher risk. The studies in the current review used a rather low cut-off point for exposure (30 minutes and 16% of the time), hence a large range of exposures within the highest exposure category is possible. Total daily exposure to vibrations has been found to be much higher for men than for women[75], and therefore men may still have had a higher exposure than women within the same exposure category. Furthermore, the effect of vibration on complaints may be rather small for women, since the one-week prevalence of exposure was found to be only 6% for working women, but 32% for working men[75].

Hand-wrist complaints

Very few studies on hand-wrist complaints were found. Although initially nine studies were identified, four were excluded because they did not report on the selected risk factors. Three studies[44,65,66] reported on duration of computer use as a risk factor, but the results were not consistent. While in the study by Blatter et al.[44] the risk was larger for women (gender ratios ranging from 1.05 to 1.38), Jensen et al.[65] and Karlqvist et al.[66] found larger risks for men (ratios ranging from 0.55 to 0.99). Nevertheless, only a few studies reported risk factors for men and women separately, and the reason for the inconclusiveness should primarily be sought in the lack of (high quality) studies. Furthermore, since all these studies were cross-sectional no causal relation could be established. It is recommended that more, preferably prospective, studies on hand-wrist complaints make separate analyses for men and women.

Lower extremity complaints

Due to the inconsistency and the small number of low quality studies, inconclusive evidence was found for all risk factors. As for hand-wrist complaints, we would like to underline the need for more (high quality) studies.

Selection of the literature

To our knowledge this is the first review that systematically examined gender differences in the relation between work-related risk factors and musculoskeletal complaints. In spite of our extensive literature search it is likely that both selection and publication bias influenced the results. Most studies on risk factors do not aim at examining gender differences and do not use key words referring to this. By including the terms gender (difference) and sex (difference) in the search string these studies may have been missed. Another potential source of bias is publication bias. While some studies tested for all possible interactions or made separate analyses for all risk factors, most studies only did this for a few variables. It could very well be that this was only done because (significant) gender differences were found for these risk factors. The results of this review may therefore overestimate the gender difference.

Analysis

We have chosen to use a percentage difference in risk estimates rather than an absolute number or a significant difference to identify relevant differences. However, we could not find a theoretical ground as to how high the cut-off point should be. By using this definition we had to exclude studies that did not present risk estimates, or only reported a non-significant difference. Four of these studies did mention that there was no difference between men and women, or no significant interaction with gender[37-40]. One study[37] assessed the relation between lifting and back complaints, three studies job demands and neck-shoulder complaints[38-40] while job control, social support, and working with hands above shoulder level were each assessed in one study[39,40]. Considering these studies did not change the strength of evidence.

Methodological quality and levels of evidence

The combination of a quality scale and levels of evidence is often used, but not without criticism[76,77]. Our quality list was very similar to lists used earlier[20,22,23,25]. One of these lists[22] was rated by West et al.[78] and scored positive on six and partially positive on one out of nine domains for assessing study quality. A point of criticisms on this and similar lists is that all items have the same weight, and studies that have only a few, but very important, flaws can still be regarded high quality[21,22]. In the present study the three studies with the highest quality[59,60,64] scored positive on all items regarding validity of outcome and exposure measures. Another three high quality studies[48,51,58] scored positive on at least one of these items, while none of the low quality studies scored positive on these items. Therefore, these items are important in discriminating between high and low quality studies. Another point of criticism is that when different levels of evidence are compared, their agreement is poor, which may result in differences in the conclusion[76]. Unfortunately, to our knowledge no other levels of evidence for observational studies have been published, and no comparison can be made with our levels.

Concluding remarks

Strong evidence of a gender difference was found for only three risk factors, but for two out of three factors this was not in the expected direction. These findings seemed fairly insensitive to the limitations of the present study, but are likely to be an overestimation of the gender difference. Therefore, the results have to be interpreted with some caution. For hand-wrist and lower extremity complaints only few low quality studies were found, and it is recommended that more studies make separate analyses for men and women.

Since gender differences in the effect of risk factors do not seem to provide an explanation for the higher prevalence of musculoskeletal complaints among women alternative explanations have to be considered, such as gender differences in the number of workers exposed, in exposure within the same exposure category, or the expression of pain[8-11]. In terms of prevention, until more clarity is achieved, the focus should remain on the reduction of exposure among female workers.

References

1. Picavet HSJ, van Gils HWV, Schouten JSGA. Klachten van het bewegingsapparaat in de Nederlandse bevolking. Prevalenties, consequenties en risicogroepen (Musculoskeletal complaints in the Dutch population: prevalences, consequences and risk groups). Bilthoven, Netherlands: Rijksinstituut voor volksgezondheid en milieu (RIVM), 2000.
2. Linton SJ, Hellsing AL, Halldén K. A population-based study of spinal pain among 35-45-year-old individuals. Prevalence, sick leave, and health care use. Spine 1998;23:1457-63.
3. Centers for Disease Control and Prevention (CDC). Prevalence of self-reported arthritis or chronic joint symptoms among

adults--United States, 2001. MMWR Morb Mortal Wkly Rep 2002;51(42):948-50.
4. De Zwart BCH, Broersen JP, Frings-Dresen MH, van Dijk FJ. Musculoskeletal complaints in The Netherlands in relation to age, gender and physically demanding work. Int Arch Occup Environ Health 1997;70(5):352-60.
5. Gerr F, Marcus M, Ensor C, Kleinbaum D, Cohen S, Edwards A, et al. A prospective study of computer users: I. Study design and incidence of musculoskeletal symptoms and disorders. Am J Ind Med 2002;41(4):221-35.
6. Krause N, Ragland DR, Greiner BA, Syme SL, Fisher JM. Psychosocial job factors associated with back and neck pain in public transit operators. Scand J Work Environ Health 1997;23(3):179-86.
7. Leino-Arjas P, Hänninen K, Puska P. Socioeconomic variation in back and joint pain in Finland. Eur J Epidemiol 1998;14:79-87.
8. Punnett L, Herbert R. Work-Related musculoskeletal disorders: Is there a gender differential, and if so, what does it mean? In: Women and health (Goldman MB, Hatch MC, editors). San Diego, CA: Academic Press, 2000: p 474-92.
9. Kilbom Å, Messing K. Aches and Pains-an affliction of women. Work-related musculoskeletal disorders. In: Kilbom Å, Messing K, Bildt-Thorbjörnsson C, editors. Women's health at work. Solna, Sweden: National Institute for Working Life, 1998: p 203-27.
10. Buckle P, Devereux J. Work-related neck and upper limb disorders. Luxembourg: European Agency for Safety and Health at work, 1999.
11. Karlqvist L. The importance of gender sensitive studies of work related neck and upper limb disorders. In: Bild C, Karlqvist L, editors, Women's conditions in working life. Solna, Sweden: Arbetslivsinstitutet. 2001 p: 66-72. Arbete Och Hälsa 2001:17.
12. de Zwart BCH, Frings-Dresen MHW, Kilbom Å. Gender differences in upper extremity musculoskeletal complaints in the working population. Int Arch Occup Environ Health 2000;74(1):21-30.
13. Coury HJCG, Portcatti IA, Alem MER, Oisho J. Influence of gender on work-related musculoskeletal disorders in repetitive tasks. Int J Ind Ergon 2002;29:33-9.
14. Gijsbers van Wijk CMT, Kolk AM. Sex differences in physical symptoms: the contribution of symptom perception theory. Soc Sci Med 1997;45:231-46.
15. Musgrave DS, Vogt MT, Nevitt MC, Cauley JA. Back problems among postmenopausal women taking estrogen replacement therapy: the study of osteoporotic fractures. Spine 2001;26(14):1606-12.
16. Brynhildsen JO, Björs E, Skarsgård C, Hammar ML. Is hormone replacement therapy a risk factor for low back pain among postmenopausal women? Spine 1998;23(7):809-13.
17. Van der Beek AJ, Kluver BDR, Frings-Dresen MHW, Hoozemans MJM. Gender differences in exerted forces and energetic workload during pushing and pulling of wheeled cages by postal workers. Ergonomics 2000;43(2):269-81.
18. Lindbeck L, Kjellberg K. Gender differences in lifting technique. Ergonomics 2001;44(2):202-14.
19. Bellman S, Forster N, Still L, Cooper CL. Gender differences in the use of social support as a moderator of occupational stress. Stress Health 2003;19(1):45-58.
20. Ariëns GAM, van Mechelen W, Bongers PM, Bouter LM, van der Wal G. Psychosocial risk factors for neck pain: a systematic review. Am J Ind Med 2001;39(2):180-93.
21. Van der Windt DAWM, Thomas E, Pope DP, de Winter AF, Macfarlane GJ, Bouter LM, et al. Occupational risk factors for shoulder pain: a systematic review. Occup Environ Med 2000;75:433-42.
22. Ariëns GAM, van Mechelen W, Bongers PM, Bouter LM, van der Wal G. Physical risk factors for neck pain [review]. Scand J Work Environ Health 2000;26(1):7-19.
23. Hoogendoorn WE, van Poppel MNM, Bongers PM, Koes BW, Bouter LM. Physical load during work and leisure time as risk factors for back pain [review]. Scand J Work Environ Health 1999;25(5):387-403.
24. Bongers PM, Kremer AM, ter Laak J. Are psychosocial factors, risk factors for symptoms and signs of the shoulder, elbow, or hand/wrist?: a review of the epidemiological literature. Am J Ind Med 2002 May;41(5):315-42.
25. Hoogendoorn WE, van Poppel MN, Bongers PM, Koes BW, Bouter LM. Systematic review of psychosocial factors at work and private life as risk factors for back pain. Spine 2000;25(16):2114-25.
26. Altman DG, Bland MJ. Interaction revisited: the difference between two estimates. BMJ 2003;326:218.
27. Maetzel A, Mäkelä M, Hawker G, Bombardier C. Osteoarthritis of the hip and knee and mechanical occupational exposure-a systematic overview of the evidence. J Rheumatol 1997;24(8):1599-607.
28. Kirkeskov Jensen L, Eenberg W. Occupation as a risk factor for knee disorders [review]. Scand J Work Environ Health 1996;22(3):165-75.
29. Viikari-Juntura E, Silverstein B. Role of physical load factors in carpal tunnel syndrome [review]. Scand J Work Environ Health 1999 Jun;25(3):163-85.
30. Sluiter JK, Rest KM, Frings-Dresen MHW. Criteria document for evaluating the work-relatedness of upper-extremity musculoskeletal disorders. Scand J Work Environ Health 2001;27 Suppl 1:1-102.
31. Bernard BP (editor). Musculoskeletal disorders and workplace factors. A critical review of epidemiologic evidence for work-related musculoskeletal disorders of the neck, upper extremity, and low back. National Institute for Occupational Safety and Health (NIOSH), 1997.

32. Burdorf A, Sorock G. Positive and negative evidence of risk factors for back disorders [review]. Scand J Work Environ Health 1997;23(4):243-56.
33. Burton AK, Tillotson KM, Troup JDG. Prediction of low-back trouble frequency in a working population. Spine 1989;14,(9):939-46.
34. Leino P, Hasan J, Karppi SL. Occupational class, physical workload, and musculoskeletal morbidity in the engineering industry. Br J Ind Med 1988;45(10):672-81.
35. Rundcrantz BL, Johnsson B, Moritz U. Cervical pain and discomfort among dentists. Epidemiological, clinical and therapeutic aspects. Part 1. a survey of pain and discomfort. Swed Dent J 1990;14:71-80.
36. Saraste J, Hultman G. Life conditions of persons with and without low-back pain. Scand J Rehab Med 1987;19:109-13.
37. Sobti A, Cooper C, Inskip H, Searle S, Coggon D. Occupational physical activity and long-term risk of musculoskeletal symptoms: A national survey of post office pensioners. Am J Ind Med 1997;32,(1):76-83.
38. Strasser PB, Lusk SL, Franzblau A, Armstrong TJ. Perceived psychological stress and upper extremity cumulative trauma disorders. AAOHN Journal 1999;47(1):22-30.
39. Vasseljen O, Westgaard RH, Larsen S. A case-control study of psychological and psychosocial risk factors for shoulder and neck pain at the workplace. Int Arch Occup Environ Health 1995;66(6):375-82.
40. Viikari-Juntura E, Martikainen R, Luukkonen R, Mutanen P, Takala EP, Riihimäki H. Longitudinal study on work related and individual risk factors affecting radiating neck pain. Occup Environ Med 2001;59(5):345-52.
41. Derriennic F, Iwatsubo Y, Monfort C, Cassou B. Evolution of osteoarticular disorders as a function of past heavy physical work factors: longitudinal analysis of 627 retired subjects living in the Paris area. Br J Ind Med 1993;50(9):851-60.
42. Räsänen K, Notkola V, Husman K. Perceived work conditions and work-related symptoms among employed Finns. Soc Sci Med 1997;45(7):1099-110.
43. Gorsche RG, Wiley JP, Renger RF, Brant RF, Gemer TY, Sasyniuk TM. Prevalence and incidence of carpal tunnel syndrome in a meat packing plant. Occup Environ Med 1999;56(6):417-22.
44. Blatter BM, Bongers PM. Duration of computer use and mouse use in relation to musculoskeletal disorders of neck or upper limb. Int J Ind Ergon 2002;30(4-5):295-306.
45. Feveille H, Jensen C, Burr H. Risk factors for neck-shoulder and wrist-hand symptoms in a 5-year follow up study of 3,990 employees in Denmark. Int Arch Occup Environ Health 2002;75:243-51.
46. Xu Y, Bach E, Orhede E. Occupation and risk for the occurrence of low back pain (LBP) in Danish employees. Occup Med 1996;56(2):131-6.
47. Alcouffe J, Manillier P, Brehier M, Fabin C, Faupin F. Analysis by sex of low back pain among workers from small companies in the Paris area: severity and occupational consequences. Occup Environ Med 1999;56(10):696-701.
48. Cole DC, Ibrahim SA, Shannon HS, Scott F, Eyles J. Work correlates of back problems and activity restriction due to musculoskeletal disorders in the Canadian national population health survey (NPHS) 1994-5 data. Occup Environ Med 2001;58(11):728-34.
49. Foppa I, Noach RH. The relation of self-reported back pain to psychosocial, behavioural, and health-related factors in a working population in Switzerland. Soc Sci Med 1996;43(7):1119-26.
50. Heliovaara M. Occupation and risk of herniated lumbar intervertebral disc or sciatica leading to hospitalization. J Chronic Dis 1987;40(3):259-64.
51. Hemingway H, Shipley MJ, Stansfeld S, Marmot M. Sickness absence from back pain, psychosocial work characteristics and employment grade among office workers. Scand J Work Environ Health 1997;23(1):121-9.
52. Kelsey JL. An epidemiological study of acute herniated lumbar intervertebral discs. Rheumatol Rehabil 1975;14(3):144-59.
53. Latza U, Kohlmann T, Deck R, Raspe H. Influence of occupational factors on the relation between socioeconomic status and self-reported back pain in a population-based sample of German adults with back pain. Spine 2000 Jun;25(11):1390-7.
54. Macfarlane GJ, Thomas E, Papageorgiou AC, Croft PR, Jayson MI, Silman AJ. Employment and physical work activities as predictors of future low back pain. Spine 1997 May;22(10):1143-9.
55. Matsui H, Maeda A, Tsuji H, Naruse Y. Risk indicators of low back pain among workers in Japan. Association of familial and physical factors with low back pain. Spine 1997 Jun;22(11.):1242-7.
56. Walsh K, Varnes N, Osmond C, Styles R, Coggon D. Occupational Causes of Low-Back Pain. Scand J Work Environ Health 1989;15,(1):54-9.
57. Walsh K, Cruddas M, Coggon D. Interaction of Height and Mechanical Loading of the Spine in the Development of Low-Back Pain. Scand J Work Environ Health 1991;17,(6):420-4.
58. Barnekow-Bergkvist M, Hedberg GE, Janlert U, Jansson E. Determinants of self-reported neck-shoulder and low back symptoms in a general population. Spine 1998;23(2):235-43.
59. Thorbjörnsson COB, Alfredsson L, Fredriksson K, Koster M, Michelsen H, Vingard E, et al. Psychosocial and physical risk factors associated with low back pain: A 24 year follow up among women and men in a broad range of occupations. Occup Environ Med 1998;55,(3):84-90.
60. Vingard E, Alfredsson L, Hagberg M, Josephson M, Kilbom A, Theorell T, et al. Age and gender differences in exposure

patterns and low back pain in the MUSIC-Norrtalje study. Am J Ind Med 1999 Sep;Suppl1:26-8.
61. Cassou B, Derriennic F, Monfort C, Norton J, Touranchet A. Chronic neck and shoulder pain, age, and working conditions: longitudinal results from a large random sample in France. Occup Environ Med 2002;59(8):537-44.
62. Palmer KT, Walker-Bone K, Griffin MJ, Syddall H, Pannett B, Coggon D, et al. Prevalence and occupational associations of neck pain in the British population. Scand J Work Environ Health 2001;27(1):49-56.
63. Pope DP, Croft PR, Pritchard CM, Silman AJ, Macfarlane GJ. Occupational factors related to shoulder pain and disability. Occup Environ Med 1997;54(5):316-21.
64. Mäkelä M, Heliövaara M, Sievers K, Impivaara O, Knekt P, Aromaa A. Prevalence, determinants, and consequences of chronic neck pain in Finland. Am J Epidemiol 1991;134(11):1356-67.
65. Jensen C, Ryholt CU, Burr H, Villadsen E, Christensen H. Work related psychosocial, physical and individual factors associated with musculoskeletal symptoms in computer users. Work and Stress 2002;16(2):107-20.
66. Karlqvist L, Tornqvist EW, Hagberg M, Hagman M, Toomingas A. Self reported working conditions of VDU operators and associations with musculoskeletal symptoms: a crossectional study focusing on gender differences. Int J Ind Ergon 2002;30:277-84.
67. Fransson-Hall C, Bystrom S, Kilbom A. Self-reported physical exposure and musculoskeletal symptoms of the forearm-hand among automobile assembly-line workers. J Occup Environ Med 1995 Sep;37(9):1136-44.
68. Tanaka S, Wild DK, Seligman PJ, Halperin WE, Behrens VJ, Putz-Anderson V. Prevalence and work-relatedness of self-reported carpal tunnel syndrome among U.S. workers: analysis of the Occupational Health Supplement data of 1988 National Health Interview Survey. Am J Ind Med 1995;27(4):451-70.
69. Coggon D, Croft P, Kellingray S, Barrett D, McLaren M, Cooper C. Occupational physical activities and osteoarthritis of the knee. Arthritis Rheum 2000;43(7):1443-9.
70. Coggon D, Kellingray S, Inskip H, Croft P, Campbell L, Cooper C. Osteoarthritis of the hip and occupational lifting. Am J Epidemiol 1998;147(6):523-8.
71. Lau EC, Cooper C, Lam D, Chan VN, Tsang KK, Sham A. Factors associated with osteoarthritis of the hip and knee in Hong Kong Chinese: obesity, joint injury, and occupational activities. Am J Epidemiol 2000;152(9):855-62.
72. Manninen P, Heliovaara M, Riihimaki H, Suoma-lainen O. Physical workload and the risk of severe knee osteoarthritis. Scand J Work Environ Health 2002;28(1):25-32.
73. Marras WS, Davis KG, Jorgensen M. Gender influences on spine loads during complex lifting. Spine J 2003;3(2):93-9.
74. Marras WS, Davis KG, Jorgensen M. Spine loading as a function of gender. Spine 2002;27(22):2514-20.
75. Palmer KT, Griffin MJ, Bendall H, Pannett B, Coggon D. Prevalence and pattern of occupational exposure to hand transmitted vibration in Great Britain: findings from a national survey. Occup Environ Med 2000;57:218-28.
76. Ferreira PH, Ferreira ML, Maher CG, Refshauge K, Herbert RD, Latimer J. Effect of applying different "levels of evidence" criteria on conclusions of Cochrane reviews of interventions for low back pain. J Clin Epidemiol 2002;55:1126-9.
77. Colle F, Rannou F, Revel M, Fermaninan J, Poidraudeau S. Impact of quality scales on levels of evidence inferred from a systematic review of exercise therapy and low back pain. Arch Phys Med Rehabil 2002;83(12):1745-52.
78. West S, King V, Carey TS, Lohr KN, McKoy N, Sutton SF, et al. Systems to Rate the Strength of Scientific Evidence. Evidence Report/Technology Assessment No. 47 (Prepared by the Research Triangle Institute University of North Carolina Evidence-based Practice Center under Contract No. 290-97-0011). Rockville, MD: Agency for Healthcare Research and Quality (AHRQ), 2002 Apr. Report No.: AHRQ Publication No. 02-E016.
79. Köster M, Alfredsson L, Michélsen H, Vingärd E, Kilbom Å. Retrospective versus original information on physical and psychosocial exposure at work. Scand J Work Environ Health 1999;25(5):410-4.
80. Fredriksson K, Alfredsson L, Thorbjörnsson CB, Punnett L, Toomingas A, Torgen M, et al. Risk factors for neck and shoulder disorders: a nested case-control study covering a 24-year period. Am J Ind Med 2000;38(5):516-28.
81. Fredriksson K, Alfredsson L, Koster M, Thorbjörnsson CB, Toomingas A, Torgen M, et al. Risk factors for neck and upper limb disorders: results from 24 years of follow up. Occup Environ Med 1999;56(1.):59-66.
82. Thorbjörnsson COB, Alfredsson L, Fredriksson K, Michelsen H, Punnett L, Vingard E, et al. Physical and psychosocial factors related to low back pain during a 24 year period. Spine 2000;25(3):369-75.
83. Torgen M, Alfredsson L, Köster M, Wiktorin C, Smith K, Kilbom Å. Reproducibility of a questionnaire for assessment of present and past physical activities. Int Arch Occup Environ Health 1997;70:107-18.
84. Bildt-Thorbjörnsson C, Michélsen H, Kilbom Å. Method for retrospective collection of work-related psychosocial risk factors for musculoskeletal disorders: Reliability and aggregation. J Occup Health Psychol 1999;4(3):193-206.
85. Tornqvist EW, Kilbom A, Vingard E, Alfredsson L, Hagberg M, Theorell T, et al. The influence on seeking care because of neck and shoulder disorders from work-related exposures. Epidemiology 2001 Sep;12(5):537-45.
86. Vingard E, Alfredsson L, Hagberg M, Kilbom A, Theorell T, Waldenstrom M, et al. To what extent do current and past physical and psychosocial occupational factors explain care-seeking for low back pain in a working population? Results from the Musculoskeletal Intervention Center-Norrtalje Study. Spine 2000;25(4):493-500.
87. Wiktorin C, Selin K, Ekenvall L, Alfredsson L. An interview technique for recording work postures in epidemiological studies. Int J Epidemiol 1996;25(1):171-80.

88. Waldenstrom M, Josephson M, Persson C, Theorell T. Interview reliability for assessing mental work demands. J Occup Health Psychol 1998;3(3):209-16.
89. Wiktorin C, Hjelm EW, Winkel J, Köster M. Reproducibility of a questionnaire for assessment of physical load during work and leisure time. J Occup Environ Med 1996;38(2):190-201.
90. Wiktorin C, Vingård E, Mortimer M, Pernold G, Wigaeus-Hjelm E, Kilbom Å, et al. Interview versus questionnaire for assessing physical loads in the population-based MUSIC-Norrtälje study. Am J Ind Med 1999;35:441-55.
91. Torgén M, Winkel J, Alfredsson L, Kilbom Å, Stockholm MUSIC 1 Study Group. Evaluation of questionnaire-based information on previous physical work loads. Scand J Work Environ Health 1999;25(3):246-54.
92. Mortimer M, Wiktorin C, Pernold G, Vingård E. Interrater reliability of a physical examination of the low-back and the neck and shoulder. In: Proceedings of the 1998 PREMUS-ISEOH symposium. Helsinki, Finland, Finnish Institute of Occupational Health. 1998:61.
93. Mäkelä M, Heliövaara M, Sainio P, Knekt P, Impivaara O, Aromaa A. Shoulder joint impairment among Finns aged 30 years or over: prevalence, risk factors and co-morbidity. Rheumatology (Oxford) 1999;38(7):656-62.
94. Dollard MF, Winefield AH. A test of the demand-control/support model of work stress in correctional officers. J Occup Health Psychol 1998;3(3):243-64.
95. Croft PR, Papageorgiou AC, Thomas E, Macfarlane GJ, Silman A J. Short-term physical risk factors for new episodes of low back pain: Prospective evidence from the South Manchester Back Pain Study. Spine 1999;24(15):1556-61.
96. Papageorgiou AC, Macfarlane GJ, Thomas E, Croft PR, Jayson MI, Silman AJ. Psychosocial factors in the workplace-Do they predict new episodes of low back pain? Spine 1997;22:1137-42.
97. Papageorgiou AC, Croft PR, Ferry S, Jayson MI, Silman AJ. Estimating the prevalence of low back pain in the general population. Spine 1995;20(17):1889-94.
98. Cooper C, McAlindon T, Coggon D, Egger P, Dieppe P. Occupational activity and osteoarthritis of the knee. Ann Rheum Dis 1994;53(2):90-3.
99. Jensen C, Finsen L, Sogaard K, Christensen H. Musculoskeletal symptoms and duration of computer and mouse use. Int J Ind Ergon 2002;30:265-75.
100. Tanaka S, Petersen M, Cameron L. Prevalence and risk factors of tendinitis and related disorders of the distal upper extremity among U.S. workers: comparison to carpal tunnel syndrome. Am J Ind Med 2001;39(3):328-35.
101. Tanaka S, Wild DK, Cameron LL, Freund E. Association of occupational and non-occupational risk factors with the prevalence of self-reported carpal tunnel syndrome in a national survey of the working population. Am J Ind Med 1997;32(5):550-6.
102. Michel A, Kohlmann T, Raspe H. The association between clinical findings on physical examination and self reported severity in back pain. Spine 1997;22(3):297-303.
103. Kelsey JL. An epidemiological study of the relationship between occupations and acute herniated lumbar intervertebral discs. Int J Epidemiol 1975;4(3):197-205.
104. Kelsey JL, Hardy RJ. Driving of motor vehicles as a risk factor for acute herniated lumbar intervertebral disc. Am J Epidemiol 1975;102(1):63-73.

Appendix 1A: Description of the studies on back complaints. For references see the general reference list of the review.

Study, Design[a], MQ (%)[b]	Population	Outcome	Exposure	Association[c] F (95%CI)	M (95% CI)		Gender Ratio[d]
Bildt-Thorbjörnsson et	Working persons aged	Low back pain in the	High mental load	1.1 (0.7-1.8)	1.1 (0.6-1.8)	PR	1.00
al[59,79,84]	18-34 N=2579	previous 12 months	High physical load	1.0 (0.9-1.5)	1.1 (0.8-1.6)		0.91
CH, 81			Monotonous work	0.9 (0.5-1.5)	1.5 (0.9-2.4)		0.60
			Over time work	1.0 (0.7-2.1)	0.6 (0.3-1.3)		1.67
			Poor social support	1.2 (0.8-1.9)	1.1 (0.6-1.8)		1.09
Hemingway et al[51]	Non industrial civil	Sickness absence <7	Job satisfaction (low vs. high)	1.15 (0.83-1.58)	1.17 (0.92-1.48)	RR	0.98
CH, 56	servants aged 35-55	days due to back pain	Job satisfaction (medium vs. high)	1.08 (0.78-1.5)	1.04 (0.8-1.33)		1.04
	N= 6894 men and		Social support (low vs. high)	0.87 (0.63-1.19)	1.12 (0.89-1.41)		0.78
	3414 women		Social support (medium vs. high)	0.81 (0.58-1.14)	1.01 (0.8-1.27)		0.80
			Work control (low vs. high)	1.01 (0.7-1.47)	1.44 (1.11-1.85)		0.70
			Work control (medium vs. high)	1.04 (0.71-1.53)	1.31 (1.04-1.64)		0.79
			Work pace (medium vs. high)	1.5 (1.05-2.15)	1.21 (0.96-1.54)		1.24
			Work pace (low vs. high)	1.42 (0.98-2.07)	1.79 (1.39-2.31)		0.79
Barnekow-Bergkvist et	Students aged 16 at	Back symptoms	High decision latitude	1.35 (0.34-5.39)	1.00 (0.22-4.48)	OR	1.35
al[58] CH, 50	baseline N=220	lasting >1/month	High demand index	1.2 (0.31-4.71)	0.63 (0.18-2.13)		1.90
	men and 205 women		High job satisfaction	0.95 (0.37-2.32)	0.83 (0.37-1.99)		1.14
			Lift index (heavy)	0.17 (0.02-1.37)	0.94 (0.24-3.6)		0.18
			Posture work index (monotonous)	6.39 (1.25-32.7)	5.45 (1.07-27.9)		1.17
			Social support index (high)	1.91 (0.47-7.78)	1.35 (0.38-4.74)		1.41
			Vibration	1.90 (0.47-7.69)	3.29 (1.34-8.08)		0.58
Macfarlane et al[54,95-97]	Adults with 2 family	Non consulting	Drive a car in current/previous job	1.4 (0.3-5.9)	1.3 (0.7-2.4)	OR	1.08
CH, 44	practices N=1884 men	low back pain	Drive a truck in current/previous job	0	1.2 (0.5-3.1)		0.00
	and 2617 women		Lift>/ 25lbs	2.5 (1.5-4.1)	1.1 (0.7-1.7)		2.27
Vingard et al[60,85-92]	Persons aged 20-59	Seeking treatment for	Bend>60min/day	1.2 (0.7-1.8)	1.8 (1.1-3.1)	RR	0.67
CC, 78	N= cases 315 men	low back pain	Drive>240 min/day	2.8 (1.8-8.5)	0.9 (0.6-1.5)		3.11
	and 380 women,		Heavy lifting	0.8 (0.6-1.2)	1.4 (1.0-2.0)		0.57
	controls 610 men and		Low influence over work	1.0 (0.7-1.5)	1.0 (0.6-1.6)		1.00

Appendix 1A: continued

	813 women		Manual material handling	1.2 (0.7-2)	1.5 (0.8-2.9)		0.80
			Medium influence over work	1.2 (0.9-1.6)	1.6 (1.2-2.2)		0.75
			No social support at work	0.9 (0.6-1.3)	1.0 (0.7-1.4)		0.90
			Poor job satisfaction	0.7 (0.3-1.7)	2.1 (0.9-5.2)		0.33
			TWA METf >3.0	1.9 (1.2-2.8)	1.4 (1.0-2.0)		1.36
			TWA MET >3.5	1.5 (1.4-4.6)	1.1 (0.8-1.7)		1.36
Heliövaara[50] CC, 44	Persons discharged from hospital due to HLD[9] or sciata $N_{(HLD)}$ cases 212 men and 124 women controls 767 men and 454 women $N_{(HLD\ or\ sciata)}$ cases 364 men and 228 women, controls1298 men and 842 women	HLD	Work strenuousness (heavy vs. light)	2.4	0.7	RR	3.43
			Work strenuousness (normal vs. light)	3.8	0.7		5.43
		HLD or sciata	Work strenuousness (heavy vs. light)	2.5	1.1		2.27
			Work strenuousness (normal vs. light)	2.0	0.9		2.22
Kelsey[52,103,104]	Persons aged 20-64	HLD	Drive a car	1.92 (1.18-3.11)	2.46 (1.03-5.87)	OR	0.78
CC, 28			Lifting	1.73	1.17	RR	1.48
Cole et al[48,94]	Persons aged 18-64. N=4230 men and 4043 women	Back problems (excluding arthritis) expected to last for >6 months	Decision latitude (high vs. low)	1.00 (0.77-1.29)	0.87 (0.69-1.11)	RR	1.15
			Psychological demands (high vs low)	1.63 (1.26-2.1)	1.21 (0.96-1.53)		1.35
			Work physical exertion (high vs. low)	1.58 (1.08-2.3)	1.37 (1.1-1.72)		1.15
			Work social support (high vs low)	1.08 (0.85-1.38)	1.21 (0.96-1.51)		0.89
Alcouffe et al[47]	Random sample of workers N=1342 men and 3168 women	Low back pain in the Previous month	Manual lifting 10 kg every day	1.69 (1.27-2.25)	1.27 (1.06-1.53)	OR	1.33
			Manual lifting 10 kg <once/week	1.35 (1.04-1.75)	1.23 (1.01-1.53)		1.10
			Manual lifting 10 kg ≥once/week	1.62 (1.25-2.1)	1.20 (10.1-1.44)		1.35
			No means to achieve good quality work	1.38 (1.15-1.65)	1.39 (1.19-1.63)		0.99
			No uncomfortable working postures	0.49 (0.41-0.59)	0.54 (0.46-1.6)		0.91
Walsh et al (1989)[56]	Persons aged 20-70	Low back pain ever	Drive car/van >4 hr (at B-day prior to onset)	0.4 (0.1-3.2)	1.7 (1-2.9)	RR	0.24
CS, 50	N=436		Drive car/van >4 hr (lifetime)	0.8 (0.1-7.1)	1.2 (0.5-2.8)		0.67
			Drive truck/tractor/digger (B-day prior to onset)	0.6 (0.1-5.2)	0.7 (0.4-1.4)		0.86
			Drive truck/tractor/digger (lifetime)	1.6 (0.1-16.6)	0.5 (0.2-1)		3.20

Appendix 1A: continued

			Lift/move weights>2kg by hand (at birthday prior to onset)	2.0 (1.1-3.7)	2.0 (1.3-3.1)		1.00
			Use vibrating machinery (birthday prior to onset)	1.1 (0.1-9.4)	1.3 (0.7-2.4)		0.85
			Use vibrating machinery (lifetime)	5.7 (1.1-29.3)	1.5 (0.7-3.1)		3.80
Foppa and Noach[49]	Workers	Severe/moderate back	High responsibility	0.87 (0.43-1.78)	0.99 (0.78-1.26)	RR	0.88
CS, 43	N=623 men and 227	back pain during	Job demands	1.56 (1.16-2.09)	1.63 (1.23-2.06)		0.96
	women	previous 4 months	Low job satisfaction	1.16 (0.85-1.58)	1.40 (1.1-1.77)		0.83
			Physically demanding job	1.37 (1.02-1.84)	1.37 (1.08-1.74)		1.00
			Subjective workload	1.39 (1.04-1.88)	1.36 (1.07-1.73)		1.02
			Time pressure	1.39 (1.02-1.9)	0.90 (0.7-1.15)		1.54
Walsh et al (1991)[57]	Persons from general	Low back pain lasting	Drive car/van >4 hr (at birthday prior to onset)	1.4 (0.2-8.2)	1.0 (0.6-1.8)	RR	1.40
CS, 43	practitioners offices	>1 day	Drive truck/tractor/digger (birthday prior to	4.5 (0.3-65)	1.1 (0.7-1.7)		4.09
	N=1172men and		Lift/move weights >2kg by hand (lifetime)	2.2 (1.3-3.5)	2.0 (1.4-2.8)		1.10
	1495 women		Use vibrating machinery (lifetime)	2.7 (0.6-12.8)	0.8 (0.5-1.3)		3.38
Matsui et al[55]	Workers of a	Low back pain at time	Physical work demands (light vs. sedentary)	1.2 (0.4-3.4)	1.5 (1.1-1.9)	RR	0.80
CS, 36	manufacturing	of the interview	Physical work demands (moderate vs sedentary)	3.5 (1.1-10.8)	3.2 (1.9-5.2)		1.09
	company N= 517 men	Low back pain ever	Heavy physical work demands	1.38 (1.09-1.74)	0.68 (0.6-0.78)		2.03
	and 525 women,						
Latza et al[53,102]	Persons from the	Low back pain grade	Work in bent position	0.75 (0.41-1.37)	1.89 (1.03-3.46)	RR	0.40
CS, 29	general population	II/III					
	aged 25-74. N= 459	Unremitting	Drive truck/tractor/digger (lifetime)	1.1 (0.1-13.2)	1.4 (0.4-5.1)	RR	0.79
		low back pain	Lift/move weights>2kg by hand (lifetime)	2.9 (0.8-10.2)	5.3 (1.3-20.9)		0.55
			Use vibrating machinery (lifetime)	3.3 (0.3-41)	1.3 (0.3-5.3)		2.54

[a]Cohort (CH), Case-Control (CC) or Cross-sectional (CS); [b] methodological quality score; [c] Odds ratio (OR), Relative risk (RR) or Prevalence ratio (PR) and 95% Confidence interval (95%CI); [d] The ratio of the risk in women to the risk in men (F/M) ; [e] Follow up ; [f] Time weight average metabolic rate; [g] Herniated lumbar intevertebral disc

Appendix 1B: Description of the studies on neck-shoulder complaints. For references see the general reference list of the review

Study Design[a], MQ (%)[b]	population	outcome	exposure	Association[c] F (95%CI)	M (95% CI)		Gender ratio[d]
Bildt-Thorbjörnsson et al[59,79-84] CH, 81;CC, 72	Working people aged 18-34 N=2579	Consult, symptom or sick leave					
		- for the neck	High mental load at work	1.1 (0.2-4.9)	1.5 (0.5-5.1)	PR	0.73
		- for the shoulder	High mental load	1.2 (0.3-4.4)	1.7 (0.6-4.9)		0.71
		- for the neck/ shoulder	Frequent hand/finger movement	1.5 (1.0-2.3)	1.6 (0.9-2.8)	PR	0.94
			Hand held vibrating tools	0.7 (0.2-2.4)	1.3 (0.7-2.1)		0.54
			High perceived workload	1.6 (0.9-2.6)	0.9 (0.4-1.8)		1.78
			Influence over work index (low)	1.2 (0.7-1.9)	0.9 (0.5-1.7)		1.33
			Time pressure	0.9 (0.5-1.8)	0.3 (0.1-1.0)		3.00
Cassou et al[61] CH, 63	Random selection of workers N=9787 men and 7163 women	Chronic neck and shoulder pain	Repetitive work under time constraints				
			- at baseline	1.3 (1.0-1.6)	0.9 (0.7-1.2)	OR	1.44
			- before baseline	1.2 (1.0-1.5)	1.3 (1.0-1.7)		0.92
			High job demands	1.2 (1.0-1.4)	1.2 (1.0-1.4)		1.00
Barnekow-Bergkvist et al[58] CH, 50	Students aged 16 at baseline N= 220 men and 205 women	Neck Shoulder symptoms >1/month	Decision latitude (high)	3.80 (1.00-14.4)	0.76 (0.22-2.57)	OR	5.00
			Demand index (high)	0.49 (0.13-1.84)	0.76 (0.23-2.48)		0.64
			Lift index (heavy)	0.20 (0.05-0.85)	0.26 (0.08-0.87)		0.77
			Posture work index (monotonous)	5.88 (1.52-22.8)	0.92 (0.29-2.94)		6.39
			Social support index (high)	0.91 (0.27-3.07)	1.11 (0.39-3.22)		0.82
Vingard et al[60,85-92] CC,78	Persons aged 20-59 N= cases 118 men and 274 women controls 662 men and 849 women	Seeking treatment for neck/shoulder pain	Hand above shoulder>30min/day	1.3 (0.9-2.0)	0.9 (0.6-1.4)	RR	1.44
			High creativity and low routine	0.9 (0.7-1.3)	0.6 (0.4-1.0)		1.50
			High demands in relation to competence	0.8 (0.5-1.1)	0.9 (0.6-1.5)		0.89
			High psychosocial demands	1.1 (0.8-1.5)	0.7 (0.4-1.0)		1.57
			High quantitative demands	0.9 (0.5-1.5)	0.2 (0.1-0.9)		4.50
			High routine and low creativity	1.1 (0.7-1.5)	1.2 (0.7-1.8)		0.92
			High time pressure	1.3 (0.9-1.8)	0.5 (0.3-1.0)		2.60
			Job strain	1.4 (1.1-2.0)	1.1 (0.7-1.9)		1.27

Appendix 1B: continued

			Decision latitude (low)	1.2 (0.9-1.6)	1.3 (0.8-1.9)		0.92
			Demands in relation to competence (low)	1.0 (0.7-1.4)	1.5 (1.0-2.4)		0.67
			Participation & demands in planning (low)	1.2 (0.7-2.1)	0.9 (0.4-2.2)		1.33
			Manual material handling (>50N >60 min day)	0.8 (0.4-1.5)	1.2 (0.7-2.0)		0.67
			Poor general support at work	1.2 (0.9-1.6)	1.3 (0.9-1.9)		0.92
			Repetitive movements	1.6 (1.2-2.2)	1.2 (0.8-1.8)		1.33
			Vibrating tools>30 min day	0.8 (0.4-2.0)	1.6 (1.0-2.3)		0.50
Mäkelä et al[64,93]	Persons from the	Chronic neck	Mental stress index (high vs. other)	1.78 (0.48-2.13)	1.63 (1.29-2.07)	RR	1.09
CS, 71	general population N= 7217	syndrome	Physical work index (high vs. other)	1.90 (1.62-2.21)	1.95 (1.58-2.39)		0.97
Jensen et al[65,99]	Workers using a	musculoskeletal	Repetitive movements	1.26	1.27	OR	0.99
CS, 50	computer at work	symptoms in the	Repetitive movements and tasks	1.59	1.86		0.85
	N=7125 men and 821	neck in the past year	Quantitative demands and development possibilities				
	women		- low-low	1.37	1.24		1.10
			- high-high	1.28	1.17		1.09
			- high-low	2.21	2.05		1.08
		Musculoskeletal	Repetitive movements	1.71	1.20	OR	1.43
		symptoms in the	Repetitive movements and tasks	1.78	0.76		2.34
		shoulder in the past	Quantitative demands (Medium low)	0.94	1.39		0.68
		year	Quantitative demands (Medium high)	1.27	1.31		0.97
			Quantitative demands (high)	1.60	1.50		1.07
Palmer et al[62,75]	Persons aged 16-64	Neck pain during	Hand above shoulder >1 hr	1.4 (1.2-1.6)	1.3 (1.1-1.4)	PR	1.08
CS, 36	N=9368	previous 12 months	Hand arm vibration	1.2 (1-1.4)	1.0 (0.9-1.1)		1.20
			Lift 10-25 kg by hand	1.1 (1-1.3)	1.0 (0.9-1.1)		1.10
			Lift>25 kg by hand	1.1 (0.9-1.3)	1.1 (1.0-1.2)		1.00
		Neck pain during	Hand above shoulder >1 hr	1.7 (1.3-2.1)	1.4 (1.2-1.6)	PR	1.21
		previous 7 days	Hand arm vibration	0.2 (0.9-1.5)	0.9 (0.8-1.1)		0.22
			Lift 10-25 kg by hand	1.1 (0.9-1.3)	0.9 (0.7-1.0)		1.22
			Lift>25 kg by hand	1.1 (0.9-1.4)	1.1 (1.0-1.3)		1.00
Karlqvist et al[66]	Workers from 46	Reported symptoms in	Position of non keyboard input device (non optimal)	1.1 (1.0-1.3)	1.3 (1.0-1.7)	PR	0.85

Appendix 1B: continued

CS, 29	worksites N=489 men and 785 women	the neck/shoulders during the previous 3 months	Medium and high job strain	1.3 (1.1-1.6)	1.2 (0.8-1.8)		1.08
			Demands not in relation to competence	1.1 (1.0-1.2)	1.4 (1.1-1.8)		0.79
			Probability of meeting time limits and quality demands (Less good/low vs. high)	1.1 (1.0-1.2)	1.1 (0.8-1.4)		1.00
			Social support (Medium/low vs. high)	1.1 (0.9-1.2)	0.9 (0.7-1.2)		1.22
			Supervisor social support (Medium/low vs. high)	1.0 (0.9-1.2)	1.1 (0.8-1.4)		0.91
		Reported symptoms in the shoulder joint/ upper arm during the previous3 months	Position of non keyboard input device (non optimal)	1.0 (0.80-1.20)	1.2 (0.8-1.9)	PR	0.83
			Medium and high job strain	1.5 (1.0-2.3)	0.9 (0.6-1.5)		1.67
			Demands not in relation to competence	0.9 (0.7-1.1)	0.8 (0.5-1.2)		1.13
			Probability of meeting time limits and quality demands (Less good/low vs. high)	1.3 (1.1-1.6)	0.6 (0.4-1.0)		2.17
			Social support (Medium/low vs. high)	1.1 (0.9-1.3)	1.1 (0.7-1.6)		1.00
			Supervisor social support (Medium/low vs. high)	1.3 (1.0-1.7)	1.0 (0.7-1.6)		1.30
Pope et al[63] CS, 29	Persons from a general practice N= Cases 16 men and 23 Women Controls 79 men and 100 women	Shoulder pain	Carry weight on one shoulder	1.1 (0.1-8.1)	5.5 (1.8-17.4)	RR	0.20
			Lift/carry weights>25lbs	0.8 (0.3-2.2)	1.2 (0.1-3.5)		0.67
			Stretch to reach below knee	1.4 (0.6-3.3)	2.0 (0.7-5.7)		0.70
			Use arms in repetitive way	0.9 (0.4-2.1)	1.7 (0.6-4.8)		0.53
			Use vibrating machinery	0.8 (0.2-2.7)	1.1 (0.4-3.6)		0.73
			Use wrist in repetitive way	2.0 (0.9-4.6)	2.0 (0.7-5.9)		1.00
			Work with hands above shoulder	0.7 (0.5-2.9)	2.1 (0.8-5.8)		0.33

[a]Cohort (CH), Case-Control (CC) or Cross-sectional (CS); [b] methodological quality score; [c] Odds ratio (OR), Relative risk (RR) or Prevalence ratio (PR) and 95% Confidence interval (95%CI); [d] The ratio of the risk in women to the risk in men (F/M); [e] Follow up;

Appendix 1C: Description of the studies on hand-wrist complaints. For references see the general reference list of the review.

Study, Design[a], MQ (%)[b]	population	outcome	exposure	Association[c] F (95%CI)	M (95% CI)		Gender ratio[d]
Jensen et al[65,99] CS, 50	Workers using a computer at work N=7125 men and 821women	Musculoskeletal symptoms in the hand/wrist in the past year	Repetitive movements	1.35	1.59	OR	0.85
			Repetitive movements and tasks	1.58	1.88		0.84
			Quantitative demands (medium low)	0.91	1.16		0.78
			Quantitative demands (medium high)	1.02	1.45		0.70
			Quantitative demands (high)	1.76	1.27		1.39
Tanaka et al [68,100,101] CS, 36	Workers from a household survey N=15427 men and 14627 women	Carpal tunnel syndrome in the last 12 months	Bending/twisting	2.91 (2.25-3.76)	3.66 (2.52-5.32)	RR	0.80
			Vibrations	1.38 (0.96-2.0)	2.80 (1.08-3.77)		0.49
Fransson-Hall et al[67] CS, 36	Workers random selected from assembly line workers at a Swedish automobile factory N=521	pain, ache or discomfort during the last 7 days in the elbow, forearm, wrist, hand and/or fingers	Wrist extension and ulnar deviation	1.3 (0.9-1.9)	1.6 (1.1-2.3)	PR	0.81
			Wrist extension and radial deviation	1.2 (0.8-1.8)	1.7 (1.2-2.4)		0.71
			Wrist flexion and ulnar deviation	1.4 (1.0-2.0)	1.5 (1.1-2.2)		0.93
			Wrist flexion and radial deviation	1.4 (1.0-2.0)	1.5 (1.1-2.2)		0.93
			Wrist ulnar deviation, repetitive movements and precision movements	1.7 (1.2-2.4)	1.5 (0.9-2.3)		1.13
			Wrist radial deviation, repetitive movements and precision movements	1.8 (1.3-2.5)	1.4 (0.8-2.2)		1.29
			Wrist ulnar/radial deviation, extension/flexion and repetitive movements and precision movements	1.8 (1.2-2.6)	1.6 (1.0-2.6)		1.13
Karlqvist et al[66] CS, 29	Employees from 46 worksites N=489 men and 785 women	Reported symptoms in the elbow, forearm, or hands during the previous 3 months	Position of non keyboard input device (non optimal)	1.1 (0.9-1.4)	1.2 (0.8 -1.7)	PR	0.92
			Medium and high job strain	1.7 (1.1-2.6)	1.2 (0.7-1.9)		1.42
			Demands not in relation to competence	1.1 (0.9-1.3)	1.4 (1.0-1.9)		0.79
			Less good/low probability of meeting time	1.1 (0.9-1.3)	0.9 (0.6-1.3)		1.22
			Medium/low social support	1.1 (0.9-1.3)	1.3 (0.8-1.9)		0.85
			Medium/low supervisor social support	1.1 (0.9-1.3)	1.2 (0.8-1.8)		0.92

[a]Cohort (CH), Case-Control (CC) or Cross-sectional (CS); [b] methodological quality score; [c] Odds ratio (OR), Relative risk (RR) or Prevalence ratio (PR) and 95% Confidence interval (95%CI); [d] The ratio of the risk in women to the risk in men (F/M);

Appendix 1D.:Description of the studies on lower extremity complaints. For references see the general reference list of the review.

Study, Designa, MQ (%)[b]	population	outcome	Exposure	Association[c] F (95%CI)	M (95% CI)		Gender ratio[d]
Coggon et al (2000)[69]	Persons living in 3	On waiting list for knee	Climb ladder/stairs >30x/day	0.7 (0.3-1.6)	2.3 (1.3-4.0)	OR	0.30
CC, 44	health districts	surgery due to OA	Get up from kneel/squat >30x/day	1.8 (1.0-3.2)	2.0 (1.1-3.5)		0.90
	N= cases 675, controls		Kneel or squat>1hr/day	2.1 (1.2-3.6)	2.0 (1.1-3.6)		1.05
	667		Kneel>2hr/day	2.0 (1.1-3.5)	1.7 (1.0-3.0)		1.18
			Squat > 1hr/day	2.8 (1.1-7.2)	2.2 (1.0-4.9)		1.27
			Stand or walk> 2hr/day	0.5 (0.8-2.9)	4.1 (0.3-65.5)		0,12
			Walk>2miles/day	2.1 (1.4-3.2)	1.7 (0.8-3.6)		1.24
Manninen et al[72]	Persons aged 55-75	Knee surgery due to	Heavy physical workload (medium vs. low)	1.60 (0.83-3.06)	2.23 (0.64-7.72)	OR	0.72
CC,44	N=194 men and 640	primary OA	Heavy physical workload (high vs. low)	2.03 (1.03-3.99)	1.53 (0.42-5.56)		1.33
	women		Kneeling or Squatting <2hrs	0.97 (0.59-1.59)	0.58 (0.21-1.64)		1.67
			Kneeling or Squatting >2 hrs	1.81 (1.11-2.95)	1.68 (0.66-4.28)		1.08
			Climbing (medium vs. low level)	1.08 (0.71-1.63)	3.06 (1.25-7.46)		0.35
			Climbing (high vs. low level)	1.50 (0.81-2.77)	2.79 (0.96-8.16)		0.54
			Walking (medium vs. low level)	0.89 (0.56-1.42)	2.07 (0.73-5.89)		0.43
			Walking (high vs. low level)	1.06 (0.64-1.76)	1.47 (0.55-3.89)		0.72
Coggon et al (1998)[70]	Persons living in 2	On waiting list due to	Exposure up to 10 years before entering the study				
CC, 39	health districts	hip OA	Kneeling>1hrs (0,1.-9.9 years)	0.9 (0.6-1.4)	0.8 (0.4-1.4)	OR	1.13
	N =420 men and 802		Kneeling>1hrs (10-19.9 years)	0.7 (0.4-1.3)	2.0 (0.8-4.7)		0.35
	women		Kneeling>1hrs (>20 years)	1.2 (0.5-3.0)	1.0 (0.6-1.7)		1.20
			Squatting>1hrs (0,1-9.9 years)	1.1 (0.6-1.9)	0.9 (0.5-1.6)		1.22
			Squatting>1hrs (10-19.9 years)	1.5 (0.6-3.4)	1.4 (0.5-3.6)		1.07
			Squatting >1hrs (>20 years)	0.7 (0.3-1.8)	0.9 (0.5-1.6)		0.78
			Walking>2 miles (0.1-9.9 years)	1.5 (1.0-2.3)	0.8 (0.4-1.9)		1.88
			Walking>2 miles (10-19.9 years)	1.5 (1.0-2.0)	1.1 (0.4-2.5)		1.36
			Walking>2 miles (>20 years)	1.3 (0.8-2.0)	1.2 (0.6-2.5)		1.08
			Climbing>30 flights of stairs (0.1-9.9 years)	1.4 (0.8-2.0)	1.3 (0.7-2.5)		1.08
			Climbing>30 flights of stairs (10-19.9 years)	1.3 (0.4-4.0)	2.3 (1.1-4.9)		0.57

Appendix 1D: continued

			Climbing >30 flights of stairs (>20 years)	2.3 (0.8-6.3)	1.8 (0.9-3.4)		1.28
Lau et al[71,98]	Cases: patients with	OA of hip grade III / IV	Climbing	2.3 (0.6-8.1)	12.5 (1.5-104.3)	OR	0.18
CC, 39	OA the hip and knee		Kneel	1.3 (0.7-2.5)	3.9 (1.1-14.2)		0.33
	Controls: consecutive		Squat > 1 hr/day	1.6 (1.0-2.8)	1.3 (0.5-3.2)		1.23
	patients who attended		Walk	1.4 (0.9-2.3)	3.9 (1.3-12.1)		0.36
	8 general practices	OA of knee grade III/	Climbing	5.1 (2.5-10.2)	2.5 (1.0-6.4)	OR	2.04
	$N_{(hip)}$= Cases 30 men	IV	Kneel	0.9 (0.6-1.3)	1.4 (0.7-3.0)		0.64
	and 108 women		Squat > 1 hr/day	1.1 (0.8-1.5)	1.2 (0.7-2.0)		0.92
	Controls 90 men and		Walk	0.8 (0.5-1.1)	1.0 (0.5-2.1)		0.80
	324 women $N_{(knee)}$= Cases 166 men and 492 women Controls 166 men and 492 women						

[a]Cohort (CH), Case-Control (CC) or Cross-sectional (CS); [b] methodological quality score; [c] Odds ratio (OR) and 95% Confidence interval (95%CI); [d] The ratio of the risk in women to the risk in men (F/M); [e] Osteo Arthritis (OA)

6

Physical and psychosocial risk factors at work in relation to (sickness absence due to) musculoskeletal symptoms; is there a gender difference?

Submitted as:
Hooftman WE, van der Beek AJ, Bongers PM, van Mechelen W,
Physical and psychosocial risk factors at work in relation to (sickness absence due to) musculoskeletal symptoms; is there a gender difference?

Abstract

Objectives

Many studies reported higher prevalences of (sickness absence due to) musculoskeletal symptoms for women. One explanation is that exposure to the same risk factors might have a larger effect on women than on men. The objective of the present study is to determine whether there are gender differences in the effect of exposure to work-related physical and psychosocial risk factors on (sickness absence due to) low back, neck, shoulder or hand-arm symptoms.

Methods:

Data of a prospective cohort (SMASH) with a follow-up period of 3 years was used. Exposure to risk factors and musculoskeletal symptoms were assessed using questionnaires. Sickness absence was registered continuously. Gender ratios (GR) were calculated to determine differences in effect. Gender ratios higher than 1.33 (women having a higher risk) or lower than 0.75 (men having a higher risk) were regarded as relevant.

Results:

Except for bending the wrist and bending the neck backwards (GR 1.52-2.55) men generally had a higher risk of symptoms (GR range 0.50-0.68). For sickness absence a GR >1.33 was found for twisting the upper body, working in uncomfortable postures, twisting the wrist, bending the neck backwards, coworker and supervisor support (GR range 1.66-2.63). For driving vehicles, hand-arm vibration, squeezing, working above shoulder or below knee level, reaching, twisting the neck, job demands and skill discretion the GR was <0.75. For job satisfaction a GR of 0.50 was found for absence due to back symptoms and a GR of 1.78 for sickness absence due to neck-shoulder-hand-arm symptoms

Conclusions:

It was expected that women would be more vulnerable to exposure to work-related risk factors. As the results show that in many cases men were more vulnerable, this study could not explain the gender difference in musculoskeletal symptoms among workers.

Introduction

Many studies have reported gender differences in the prevalence of musculoskeletal symptoms (e.g.[1-3]). Most studies report higher prevalences among women[3-7]. However, for back symptoms prevalences have also been reported to be higher for men in some studies[4,8]. Similar gender differences have also been found for sickness absence due to musculoskeletal symptoms[9-12].

One explanation for this gender difference lies in the so-called vulnerability hypothesis[13,14]. That is that, due to differences in biological (e.g. hormones, physiology[15-18]) or psychological factors (e.g. coping strategies[19]), similar exposure to the same risk factors might have a larger effect for women than for men. In an earlier review[20] it was attempted to answer the question of whether there indeed are gender differences in vulnerability to work-related physical and psychosocial risk factors between men and women. Strong evidence for a gender difference was found for the effect of exposure to heavy lifting, hand-arm vibration, and awkward arm postures. However, only for the relation between awkward arm postures and neck-shoulder symptoms women were found to be more vulnerable to exposure. No evidence for a gender difference was found for the effect of social support. Due to a lack of high quality studies for the remaining risk factors inconclusive evidence was concluded. Furthermore, the majority of the studies assessed in the review focused on symptoms, while sickness absence was assessed in one study on back symptoms and one study on neck-shoulder symptoms only.

Therefore, the objective of the present study is to determine whether there are gender differences in the effect of exposure to work-related physical and psychosocial risk factors and (sickness absence due to) low back, neck, shoulder or hand-arm symptoms. The hypothesis is that, given the gender difference in musculoskeletal symptoms, women are more vulnerable to exposure to work-related risk factors.

Methods

Data of the Study on Musculoskeletal disorders, Absenteeism Stress and Health (SMASH) were used. In this longitudinal study, which focused on the determination of risk factors for musculoskeletal symptoms, nearly 1800 employees in 34 companies participated. At baseline (1994), and during three annual follow-up measurements, participants filled out questionnaires on exposures and symptoms. Data on sickness absence was registered continuously by the companies. A more detailed description of the study can be found elsewhere[21,22].

Population

At baseline 87% of the workers (n=1789) filled out the questionnaire, 92% of whom also filled out at least one follow-up questionnaire. Workers who, at baseline, worked less than 20 hours a week (n=40), were employed in their current job for less than 1 year (n=37), had a second job (n=100), or had a permanent disability pension or were on sickness benefit (n=34), were excluded in the current analyses. Furthermore, workers with missing data on relevant variables in 2 or more out of 4 measurements were excluded, leaving the final number of workers in the analyses at 1259 (low back symptoms), 1222 (neck and shoulder symptoms) and 1263 (hand/arm symptoms). Since sickness absence was not registered by all companies, the number of workers for absence are lower; namely 762 (low back absence) and 748 (neck-shoulder-arm-hand absence) (table 1).

Symptoms

Musculoskeletal pain was assessed using an adapted Nordic questionnaire[23]. Workers were asked whether they had experienced pain or discomfort in the past 12 months in their back, neck, shoulders, elbows or hands/wrist on a 4 point scale ("no, never", "yes, sometimes", "yes, regular", "yes, prolonged"). Answers on elbow and hand/wrist symptoms were combined into one measure for hand/arm symptoms. Cases were defined as those workers who reported regular or prolonged symptoms in the past 12 months.

Sickness absence

The companies supplied the date of the first and last day of each episode of sickness absence, and the reason of all sickness absences. An occupational physician coded the reasons for absence according to a modified Dutch code of the International Classification of Diseases. From these data information on the occurrence of sickness absence was gathered. Since few people were absent due to neck or shoulder symptoms, we combined these with absence due to hand-arm symptoms. Cases were defined as workers who were absent from work for at least 3 days due to back or neck-shoulder-hand-arm symptoms.

Risk factors

Exposure to physical risk factors was assessed using the Dutch Musculoskeletal Questionnaire[24,25]. Questions on how often activities were performed (e.g. "how often do you have to lift loads more than 5 kilograms?") were asked on a 4 point scale ("never", "occasionally", "often" or "very often"). Questions on neck and wrist postures (e.g. "do you often have to work with your neck bend?") were asked on a dichotomous scale ("yes", "no").

Exposure to work-related psychosocial risk factors was assessed using the Dutch translation of Karasek's Job Content Questionnaire. Individual questions were later combined into the dimensions according to Karasek: i.e. Job demands, Job control and Social support[26]. Furthermore, a single question was asked about job satisfaction.

Finally, several questions about exposure to psychosocial risk factors in private life were asked[27].

Table 1 Descriptive information of the study population (n=1578)

	Men (n=1096)		Women (n=482)		Missing
	n	(%)	n	(%)	n
Age, mean (sd) † §	36.6	(8.4)	33.1	(9.2)	0
Education §					15
No education or primary school	146	(13.4)	26	(5.5)	
Lower secondary of vocational school	480	(44.1)	154	(32.4)	
Intermediate secondary or vocational school	266	(24.4)	179	(37.7)	
Higher secondary or vocational school	103	(9.5)	53	(11.2)	
University	93	(8.5)	63	(13.3)	
Years employed, mean (sd) §	10.7	(8.3)	7.0	(5.4)	0
Hours working, mean (sd) §	39.2	(3.7)	35.2	(6.4)	24
Symptoms					
Low back (n=1259)					
– Baseline	306	(34.8)	137	(36.5)	4
– Follow up 1	236	(27.9)	113	(31.0)	47
– Follow up 2	246	(29.6)	116	(32.6)	73
– Follow up 3	219	(26.7)	95	(27.5)	92
Neck (n=1222)					
– Baseline§	143	(17.0)	146	(39.0)	8
– Follow up 1§	110	(13.6)	118	(33.0)	53
– Follow up 2§	119	(14.9)	112	(31.3)	67
– Follow up 3§	91	(11.5)	85	(24.6)	83
Shoulder(n=1222)					
– Baseline§	134	(15.9)	138	(37.0)	6
– Follow up 1§	108	(13.5)	101	(28.3)	64
– Follow up 2§	105	(13.3)	95	(26.9)	79
– Follow up 3§	102	(12.9)	84	(24.5)	90
Arm-Hand (n=1263)					
– Baseline¶	120	(13.7)	69	(18.3)	11
– Follow up 1¶	87	(10.5)	57	(15.8)	71
– Follow up 2§	95	(11.6)	71	(20.0)	91
– Follow up 3	91	(11.1)	52	(15.0)	94
Sickness absence					
Low Back (n=762)					
– Baseline	50	(9.9)	12	(7.2)	89
– Follow up 1	52	(10.3)	14	(8.3)	86
– Follow up 2	59	(11.5)	12	(7.5)	90
– Follow up 3§	57	(11.7)	3	(1.7)	96
Neck-Shoulder-Arm-Hand (n=748)					
– Baseline	22	(4.5)	9	(5.4)	89
– Follow up 1	25	(5.0)	10	(6.0)	84
– Follow up 2	17	(3.4)	8	(5.0)	89
– Follow up 3¶	18	(3.8)	14	(7.9)	91

† For age, education and working hours, numbers are for the complete baseline population (N=1578), for symptoms and sickness absence the numbers are for the population used in the respective analyses.; § significant difference between men and women at p=0.00; ¶ significant difference between men and women at p=0.05

Statistics

Logistic Generalized Estimation Equations (GEE) analyses with a 1-year time lag were carried out to estimate the odds ratio (OR) for exposure and (sickness absence due to) low back, neck, shoulder and hand/arm symptoms. Separate analyses were made for men and women. All analyses were performed with STATA version 7.0 for Windows.

In the multivariate analyses symptoms at baseline, age, education, nationality, years of employment, working hours, working days, physical exposure at work and in private life, and psychosocial exposure at work and in private life were considered as confounders. Not all risk factors were relevant for all outcome measures. First, univariate analyses were performed to test the relation between the individual potential confounders and the outcome variables. Variables that were related with the outcome with a p>0.25 in men or women were not considered as confounders. Furthermore, to prevent collinearity, variables that were correlated with the individual risk factors with a correlation >0.5 were not included as confounders. Second, the remaining confounders were individually entered into the univariate models. Variables that changed the univariate Odds Ratio (OR) with more than 10% in men or women were included in the multivariate model.

In order to determine the difference in the effect of exposure between men and women we calculated gender ratios as described by Altman and Bland.(28) Gender ratios (GR) higher than 1.33 (women having a higher risk) and lower than 0.75 (men having a higher risk) were regarded as relevant gender differences.

Results

Symptoms

Table 2 shows the multivariate OR for men and women separately, in figure 1 the relevant GR with their confidence intervals are shown for symptoms. For the majority of risk factors (16 out of 22) we found no relevant GR (i.e. the GRs were between 0.75 and 1.33). The relation between lifting loads>25 kilograms and low back symptoms was larger for men than for women (GR 0.67). Working below knee level was a stronger risk for men for shoulder (GR 0.63) as well as hand-arm symptoms (GR 0.68). For both neck- and hand-arm symptoms we found a relevant GR of 0.50 for the effect of bending the neck forwards. For twisting the neck a GR of 0.69 was found for the relation with shoulder symptoms. Bending the neck backwards, on the other hand, was a larger risk factor for women for neck as well as for hand-arm symptoms (GRs of 2.55 and 1.52, respectively). Finally, bending the wrist was a larger risk factor for hand-arm symptoms for women (GR 1.54).

Table 2: Results of the multivariate analyses. Odds Ratios (OR) and 95% Confidence intervals (95%CI)

Symptoms [a,b]	**Low Back**													
	Men			**Women**				**Men**			**Women**			
	OR	**95% CI**		**OR**	**95% CI**			**OR**	**95% CI**		**OR**	**95% CI**		
Work-related physical risk factors[c]														
Lift loads > 5kg[§,†,‡,¶]	**1.15**	**1.05**	**1.27**	1.06	0.93	1.22								
Lift loads >25 kg[§,†,‡,¶]	**1.26**	**1.11**	**1.42**	0.84	0.67	1.06	1							
Flexion/rotation of the upper part of the body[§,†,‡,¶]	**1.22**	**1.11**	**1.34**	**1.21**	**1.05**	**1.38**								
Uncomfortable working postures[§,†,‡,¶]	**1.41**	**1.24**	**1.60**	**1.48**	**1.22**	**1.80**	1,2							
Driving a vehicle[§]	**1.16**	**1.01**	**1.33**	1.23	0.84	1.79	2							
Repeated movements with hands or arms [§]								1.12	0.98	1.27	**1.21**	**1.05**	**1.39**	
Hand-arm vibration[§]								1.05	0.88	1.25	0.85	0.62	1.16	
Often bend the wrist or keep the wrist bended[§,†,‡,¶]														
Often twist the wrist or keep the wrist twisted[§,†,‡,¶]														
Squeeze firmly with the hands[§]														
Working with hands above shoulder level[§,†,‡,¶]								**1.30**	**1.12**	**1.52**	**1.24**	**1.05**	**1.47**	
Working with the hands below knee level[§,†,‡,¶]								1.17	0.97	1.41	**0.74**	**0.58**	**0.96**	1,2
Reaching[§]								**1.28**	**1.05**	**1.56**	**1.53**	**1.20**	**1.96**	
Force exertion with hands[§]								**1.19**	**1.03**	**1.38**	1.00	0.86	1.16	
Often bend the neck or keep the neck bend forwards[§,†,‡,¶]								1.27	1.68	0.96	1.04	1.34	0.80	3,7
Often bend the neck or keep the neck bend backwards[§,†,‡,¶]								**0.60**	**0.37**	**0.99**	**1.54**	**0.78**	**3.04**	1,2,3,4,5,6,8
Often twist the neck or keep the neck twisted[§,†,‡,¶]								**1.44**	**1.05**	**1.97**	0.99	0.70	1.39	1,2,4
Work-related psychosocial risk factors														
Psychological demands[§,†,‡,¶]	**1.28**	**1.05**	**1.56**	1.34	0.97	1.85	1,2	**1.58**	**1.19**	**2.11**	1.22	0.90	1.67	1,2
Skill discretion[§,†,‡,¶]	**1.29**	**1.09**	**1.52**	1.06	0.82	1.36		1.19	0.90	1.58	**1.52**	**1.10**	**2.11**	1,2
Coworker support[§,†,‡,¶]	**1.28**	**1.05**	**1.57**	1.29	0.92	1.79	2	**1.41**	**1.07**	**1.85**	1.26	0.89	1.78	1,2
Supervisor support[§,†,‡,¶]	**1.26**	**1.06**	**1.51**	**1.41**	**1.07**	**1.87**	2	**1.40**	**1.07**	**1.82**	1.29	0.98	1.70	1,2
Job satisfaction[§,†,‡,¶]	**1.17**	**1.02**	**1.33**	1.12	0.90	1.39		0.94	0.76	1.18	0.99	0.74	1.33	1

Table 2: continued

Symptoms[a,b]	Neck							Arm-Hand						
	Men			Women				Men			Women			
	OR	95% CI		OR	95% CI			OR	95% CI		OR	95% CI		
Work-related physical risk factors[c]														
Lift loads > 5kg[§,†,‡,¶]														
Lift loads >25 kg[§,†,‡,¶]														
Flexion/rotation of the upper part of the body[§,†,‡,¶]														
Uncomfortable working postures[§,†,‡,¶]														
Driving a vehicle[§]														
Repeated movements with hands or arms [§]	1.11	0.99	1.25	**1.26**	**1.09**	**1.45**		**1.12**	**1.00**	**1.25**	**1.25**	**1.05**	**1.48**	
Hand-arm vibration[§]	1.07	0.89	1.28	0.87	0.62	1.23	[1,2]	**1.20**	**1.02**	**1.41**	1.05	0.71	1.55	
Often bend the wrist or keep the wrist bended[§,†,‡,¶]								1.40	0.97	2.02	**2.15**	**1.39**	**3.32**	[1,2,10]
Often twist the wrist or keep the wrist twisted[§,†,‡,¶]								1.15	0.81	1.63	1.32	0.85	2.05	[1,2,10]
Squeeze firmly with the hands[§]								**1.26**	**1.10**	**1.45**	1.18	0.99	1.41	
Working with hands above shoulder level[§,†,‡,¶]	1.13	0.96	1.32	0.97	0.83	1.13		0.96	0.75	1.22	0.79	0.57	1.09	[1,2,10]
Working with the hands below knee level[§,†,‡,¶]	1.16	0.94	1.43	0.92	0.71	1.20	[1,2,9]	1.05	0.88	1.24	0.71	0.50	1.02	[1,2]
Reaching[§]	1.20	0.97	1.47	1.18	0.92	1.52		1.20	0.98	1.46	1.03	0.77	1.36	
Force exertion with hands[§]	1.06	0.92	1.22	0.99	0.87	1.13		**1.20**	**1.04**	**1.38**	0.89	0.75	1.06	
Often bend the neck or keep the neck bend forwards[§,†,‡,¶]	**2.07**	**2.86**	**1.49**	1.04	1.52	0.71	[1,2]	1.21	0.85	1.73	0.61	0.35	1.04	[1,2,11]
Often bend the neck or keep the neck bend backwards[§,†,‡,¶]	0.92	0.59	1.44	0.72	0.38	1.39	[1,2,4,3]	1.03	0.64	1.67	1.58	0.74	3.38	[1,2,10,12]
Often twist the neck or keep the neck twisted[§,†,‡,¶]	1.42	0.95	2.13	**1.79**	**1.21**	**2.66**	[1,2,4,9]	1.15	0.79	1.65	1.14	0.76	1.71	[1,2,11]
Work-related psychosocial risk factors														
Psychological demands[§,†,‡,¶]	**1.45**	**1.10**	**1.91**	**1.18**	**1.13**	**1.58**	[1,2]	1.14	0.90	1.45	1.23	0.91	1.65	
Skill discretion[§,†,‡,¶]	1.16	0.87	1.54	1.34	0.99	1.82	[1,2]	1.06	0.82	1.36	0.96	0.71	1.28	
Coworker support[§,†,‡,¶]	**1.37**	**1.13**	**1.67**	1.12	0.95	1.32	[1,2]	1.30	0.95	1.76	1.07	0.73	1.57	[2]
Supervisor support[§,†,‡,¶]	**1.70**	**1.30**	**2.23**	**1.43**	**1.02**	**2.02**		1.27	1.02	1.57	0.97	0.74	1.25	
Job satisfaction[§,†,‡,¶]	1.20	0.98	1.48	1.13	0.85	1.51	[1,2]	1.19	0.98	1.43	1.12	0.86	1.44	

Table 2: continued

Absence[a,b]	Low Back							Neck-Shoulddder-Arm-Hand						
	Men			Women				Men			Women			
	OR	95% CI		OR	95% CI			OR			OR	95%CI		
Work-related physical risk factors[c]														
Lift loads > 5kg[§,†,‡,¶]	**1.26**	**1.07**	**1.49**	1.24	0.81	1.88	14							
Lift loads >25 kg[§,†,‡,¶]	1.05	0.85	1.31	0.99	0.49	2.01	13,14,15							
Flexion/rotation of the upper part of the body[§,†,‡,¶]	1.11	0.90	1.37	**1.65**	**1.07**	**2.55**	14,2							
Uncomfortable working postures[§,†,‡,¶]	**1.26**	**1.02**	**1.56**	**1.79**	**1.17**	**2.75**	14,2							
Driving a vehicle[§]	1.21	0.96	1.52	0.90	0.40	1.99	14,20,16							
Repeated movements with hands or arms [§]								1.10	0.85	1.44	0.86	0.53	1.39	21,10, 5, 6, 23
Hand-arm vibration[§]								1.18	0.87	1.60	0.88	0.39	2.00	5, 24, 25, 6, 4,
Often bend the wrist or keep the wrist bended[§,†,‡,¶]								0.80	0.37	1.73	0.81	0.30	2.22	26, 10, 5, 24, 25, 6,4, 23, 28
Often twist the wrist or keep the wrist twisted[§,†,‡,¶]								0.88	0.40	1.91	2.02	0.88	4.67	26, 10, 5, 24, 25, 6, 4,28
Squeeze firmly with the hands[§]								**1.74**	**1.25**	**2.42**	1.24	0.74	2.07	21, 28
Working with hands above shoulder level[§,†,‡,¶]								**1.61**	**1.08**	**2.39**	1.21	0.77	1.90	21, 23, 28
Working with the hands below knee level[§,†,‡,¶]								1.35	0.94	1.95	0.89	0.48	1.66	21, 23,
Reaching[§]								**1.58**	**1.08**	**2.31**	0.86	0.48	1.54	21, 7, 23
Force exertion with hands[§]								**1.56**	**1.20**	**2.02**	**1.50**	**1.07**	**2.11**	
Often bend the neck or keep the neck bend forwards[§,†,‡,¶]								0.89	0.46	1.72	1.11	0.32	3.81	10, 21, 10, 5, 25,6, 28
Often bend the neck or keep the neck bend backwards[§,†,‡,¶]								0.89	0.40	1.98	2.33	0.63	8.66	21, 10, 5, 24, 25, 23, 28
Often twist the neck or keep the neck twisted[§,†,‡,¶]								1.66	0.77	3.60	1.09	0.42	2.85	10,11 21, 10, 5, 24, 25,6, 4, 28
Work-related psychosocial risk factors														
Psychological demands[§,†,‡,¶]	1.01	0.75	1.36	0.98	0.47	2.06	16	1.23	0.70	2.19	0.56	0.28	1.15	10, 21, 10, 5, 25,6, 28
Skill discretion[§,†,‡,¶]	1.31	0.96	1.78	0.70	0.29	1.68	16,13,17,18,20	1.04	0.61	1.76	0.46	0.21	1.00	21, 10, 5, 24, 25, 23, 28
Coworker support[§,†,‡,¶]	**1.42**	**1.00**	**2.03**	1.84	0.97	3.47	20	0.48	0.26	0.86	0.92	0.46	1.86	10,11 21, 10, 5, 24, 25,6, 4, 28
Supervisor support[§,†,‡,¶]	1.11	0.80	1.53	0.89	0.43	1.86	13,19,20	0.86	0.54	1.35	1.42	0.79	2.57	28
Job satisfaction[§,†,‡,¶]	**1.31**	**1.03**	**1.67**	0.72	0.28	1.81	13	1.28	0.88	1.86	2.27	1.27	4.07	10, 23, 28

[a] Bold= significant at p=0.05, underline = relevant gender ratio (GR<0.75 or GR>1.33); [b] Adjusted for: 1) Work-Home interference, 2) Home-Work interference 3) Twisting the neck 4) Bending the neck forwards 5) working above shoulder level 6) force exertion with hands 7) job satisfaction 8) baseline shoulder complaints 9) Baseline neck complaints 10) Squeeze firmly with the hands 11) bending the wrist 12) Baseline arm-hand complaints 13) Coworker support 14) education15) Flexion/rotation of the upper part of the body 16) Lift loads > 5kg 17) working days 18) working hours 19) busy home environment 20) baseline low back absence 21) twisting the wrist 23) education 24) working below knee level 25) reaching 26) Repeated movements with hands or arms 27) working days 28 Baseline neck-shoulder-arm-hand absence; [c] Measured at: §= baseline, †=follow up 1, ‡= follow up 2, ¶= follow up 3

Sickness absence

Figure 2 shows the relevant GRs for sickness absence. We found no relevant GR for 8 out of 22 risk factors. The effect of driving vehicles (GR 0.74) and low skill discretion (GR 0.53) on sickness absence due to low back symptoms was larger for men than for women. Bending and twisting the upper body (GR 1.48) and working in uncomfortable postures (GR 1.42), on the other hand, were larger risk factors for women. For sickness absence due to neck-shoulder-hand-arm symptoms relevant gender differences < 0.75 (range GR 0.44-0.71) were found for squeezing (GR 0.71), working below knee level (GR 0.66), reaching (GR 0.55), twisting the neck (GR 0.65), high job demands (GR 0.46) and low skill discretion (GR 0.44). For twisting the wrist (GR 2.31), bending the neck backwards (GR 2.63) and low coworker (GR 1.93) or supervisor support (GR 1.66) the effect of exposure was larger for women. For low job satisfaction the results were inconsistent with a GR of 0.55 for the low back, and a GR of 1.78 for sickness absence due to neck-shoulder-arm-hand symptoms.

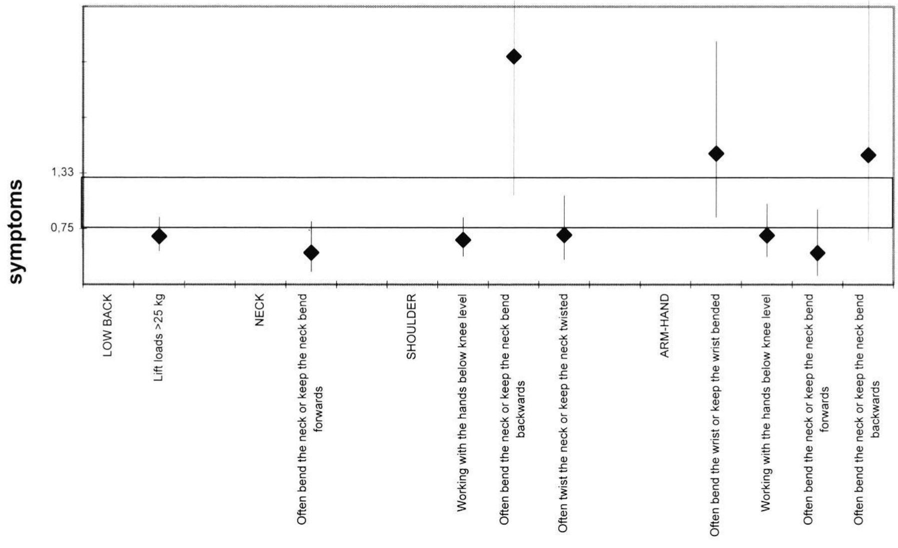

Figure 1: Results of the relevant gender differences (Gender ratio (GR) <0.75 or GR>1.33) for musculoskeletal symptoms

Discussion

We expected that women would be more vulnerable, and that the effect of exposure would generally be larger for women than for men. For musculoskeletal symptoms we found a relevant gender difference in at least one symptom region for 6 out of 22 risk factors. Only two of them with women having the higher risk. In an earlier systematic review[20] strong evidence for gender differences was only found for three risk factors, two of them with men having the higher risk. For the remaining risk factors either inconclusive evidence or no evidence for a difference was concluded. The present results seem similar, but only for lifting and low back symptoms the results are in the same direction. In the review strong evidence was found that women have a higher risk of neck-shoulder symptoms due to exposure to awkward arm postures, while in the present study a GR of 0.63 was found for shoulder symptoms. Furthermore, we found no gender difference in the effect of hand-arm vibration, while in the review it was concluded that there was strong evidence that men have a higher risk of neck-shoulder symptoms due to exposure to hand-arm vibration. If we combine the results of the present study with the results of the review, there still is strong evidence that the effect of lifting is larger for men than for women. However, the evidence for a gender difference in the effect of hand-arm vibration of arm posture becomes inconclusive. For the remaining risk factors there remains either no evidence for a difference or inconclusive evidence.

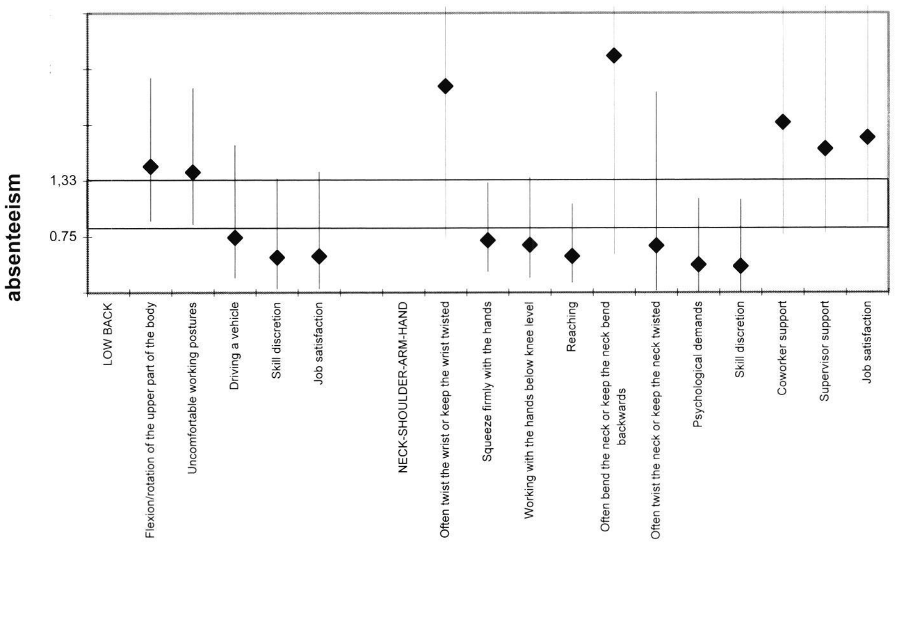

Figure 2: Results of the relevant gender differences (Gender ratio (GR) <0.75 or GR>1.33) for absence due to musculoskeletal symptoms

For sickness absence we found a relevant gender difference in 14 out of 22 risk factors. For six risk factors women had the higher risk, for seven risk factors men had the higher risk, and for one risk factor the results were inconsistent for the different symptom regions. The review[20] included only two studies on sickness absence, which makes it hard to compare results. It should be noted that for sickness absence we found much more gender differences than for symptoms. This difference seems to be predominantly caused by the psychosocial risk factors. We found no gender differences in the effect of psychosocial risk factors on symptoms at all, but for sickness absence we found a relevant gender difference in at least one symptom region for all psychosocial risk factors. Low (supervisor or coworker) support seemed to have a larger effect on women, while high demands or low skill discretion seemed to have a larger effect on men. The results for job satisfaction were ambiguous.

Following the comment by Leino-Arjas[29], we used cut off points of 0.75 and 1.33 to determine relevant gender differences. This is in contrast to the cut off points used in the earlier mentioned review[20], namely 0.75 and 1.25. This means that in the present study it was harder to find a work-related risk factor that implied a larger risk for women than in the review. We found three GRs between 1.25 and 1.33. For bending the neck forwards and neck symptoms a GR of 1.26 was found, for skill discretion and shoulder symptoms a GR of 1.28 was found, and for coworker support and low back absence a GR of 1.29 was found. Had these GRs been interpreted as a relevant GR this would have clouded the present results, since except for supervisor support, they point in a direction opposite from the GR we considered relevant thus far.

Vice versa, if the cut off points in the review would be altered to 1.33, this would change the conclusion for the relation between kneeling/squatting and lower extremity complaints from inconclusive to no evidence for a gender difference. For the remaining risk factors the review conclusions would not change, because most results were inconclusive already.

Limitations of the study

A limitation of the study is that both exposure and outcome were based on self-reports. If either men or women would have systematically under- or over-reported this could have biased the results. We asked workers to rate both their exposure and their symptoms on a four point scale ("never", "occasionally", "often" or "very often" for exposure and "no, never", "yes, sometimes", "yes, regular", "yes, prolonged" for symptoms). This poses two possible problems. First, do men and women interpret these terms in the same way? Man and women have been found to differ in symptom description. E.g. Ekman et al.[30] found that men and women with chronic heart failure choose different descriptors of breathlessness when they had to describe their symptoms. Similarly, Vodopiutz et al.[31] found that men with chest pain described their pain concretely, while women used a more diffuse description of chest pain. However, these results only show that women use different words than men; they do not use more (or less) severe descriptors. Furthermore, exposure reporting might be influenced by the anxiety about, as well as the experience with a risk factor[32]. On average, women seem to be more concerned about health matters[33], and therefore could be expected to over-report their exposure compared to men. This phenomenon was indeed found by

Hansson et al.[34], but contradicted by Leijon et al.[35]. Since the results of these studies do not consistently show that either men or women over-report their symptoms, we find it unlikely that our results can be explained completely by a gender difference in reporting about exposure. Second, women in the Netherlands work part-time more often than men. Therefore, even when the terms have the same meaning to men and women, this would still mean that the weekly cumulative work exposure for women in fact is lower. In our population about 90% of the men worked at least 5 days per week. Among women this was only 63%. Therefore, if men and women report equal exposure the cumulative exposure in men, in fact, may have been higher. This could mean that if the effect of exposure in men and women was equal, we would find a larger effect for men. However, since we found no gender difference for the majority of risk factors, this can not completely explain our results.

For the majority of risk factors we found no relevant gender differences. If we did find a difference this more often meant that men had a higher risk. Therefore, our results can not explain the gender differences in musculoskeletal symptoms, and the question of what does explain these gender differences remains unanswered. One possible explanation is that women might simply be more exposed to risk factors than men. Both at work and at home the division of labor seems to run al least partly along the gender line, resulting in different jobs and tasks for men and women. This may lead to different and possibly higher exposure for women. However, gender differences have also been found between men and women with the same occupational class[36], and with the same tasks[37]. Furthermore, it was shown that the gender difference in (sickness absence due to) musculoskeletal symptoms did not disappear after correction for a wide variety of both physical and psychosocial risk factors at work as well as at home[38].

A second possibility is that men and women differ in their pain experience. Because of the influence of sex hormones[39] and the influence of gender role expectancies[40] women have been said to more easily detect and report pain. Furthermore, men and women have been shown to use different coping strategies when dealing with pain, which may result in different outcomes. If women indeed more easily report pain it could be argued that the gender difference in musculoskeletal pain would be higher for symptoms than for more objective endpoints. However, Punnet and Herbert[13] showed that some of the largest gender differences have been found in studies with relatively restrictive case definitions. It therefore remains unclear to what extent gender differences in pain experience can explain the gender differences in musculoskeletal symptoms.

In conclusion, as the results show that in many cases men were more vulnerable, this study could not explain the gender difference in musculoskeletal symptoms among workers. It is recommended to perform further studies, both epidemiological and laboratory based, to gain more insight into whether gender differences in pain experience can explain the gender difference in musculoskeletal symptoms.

Main Messages

- Women are not more vulnerable to exposure to work-related risk factors for musculoskeletal symptoms than men.
- Gender differences in the prevalence of (sickness absence due to) musculoskeletal pain can not be explained by gender differences in vulnerability to risk factors.
- Gender differences in (pain) reporting behavior may have influenced the results. However, it remains unclear to what extent gender differences in pain experience can explain the gender differences in symptoms.

Policy implications

- To resolve gender differences in musculoskeletal symptoms in terms of prevention the main focus should not solely be on reduction of exposure or the enhancement of work capacity among female workers.
- More research is needed to examine to what extent gender differences in pain experience can explain the gender difference in musculoskeletal symptoms.

References

1. Linton SJ, Hellsing AL, Halldén K. A population-based study of spinal pain among 35-45-year-old individuals. Prevalence, sick leave, and health care use. *Spine* 1998;**23**:1457-63.
2. Centers for Disease Control and Prevention (CDC). Prevalence of self-reported arthritis or chronic joint symptoms among adults--United States, 2001. *MMWR* 2002;**51**:948-50.
3. Picavet HSJ, van Gils HWV, Schouten JSGA. *Klachten van het bewegingsapparaat in de Nederlandse bevolking. Prevalenties, consequenties en risicogroepen* (Musculoskeletal complaints in the Dutch population: prevalences, consequences and risk groups). Bilthoven, Netherlands: Rijksinstituut voor volksgezondheid en milieu (RIVM), 2000.
4. Picavet HS, Hazes JM. Prevalence of self reported musculoskeletal diseases is high. *Ann Rheum Dis* 2003;**62**:644-50.
5. De Zwart BCH, Broersen JP, Frings-Dresen MH, *et al* . Musculoskeletal complaints in The Netherlands in relation to age, gender and physically demanding work. *Int Arch Occup Environ Health* 1997;**70:**352-60.
6. Ekman A, Andersson A, Hagberg M, *et al.* Gender differences in musculoskeletal health of computer and mouse users in the Swedish workforce. *Occup Med* (Lond) 2000;**50**:608-13.
7. Leino-Arjas P, Hänninen K, Puska P. Socioeconomic variation in back and joint pain in Finland. *Eur J Epidemiol* 1998;**14**:79-87.
8. Krause N, Ragland DR, Greiner BA, *et al.* Psychosocial job factors associated with back and neck pain in public transit operators. *Scand J Work Environ Health* 1997;**23**:179-86.
9. Hemingway H, Shipley MJ, Stansfeld S, *et al.* Sickness absence from back pain, psychosocial work characteristics and employment grade among office workers. *Scand J Work Environ Health* 1997;**23**:121-9.
10. Leijon M, Hensing G, Alexanderson K. Gender trends in sick-listing with musculoskeletal symptoms in a Swedish county during a period of rapid increase in sickness absence. *Scand J Soc Med* 1998;**26**:204-13.
11. IJzelenberg W, Molenaar D, Burdorf A. Different risk factors for musculoskeletal complaints and musculoskeletal sickness absence. *Scand J Work Environ Health* 2004;**30**:56-63.
12. Brage S, Nygard JF, Tellnes G. The gender gap in musculoskeletal-related long-term sickness absence in Norway. *Scand J Soc Med* 1998;**26**:34-43.
13. Punnett L, Herbert R. Work-Related musculoskeletal disorders: Is there a gender differential, and if so, what does it mean? In Goldman MB, Hatch MC, eds: *Women and health.* San Diego, CA: Academic Press, 2000:474-92.
14. Strazdins L, Bammer G. Women, work and musculoskeletal health. *Soc Sci Med* 2004;**58**:997-1005.
15. Musgrave DS, Vogt MT, Nevitt MC, *et al.* Back problems among postmenopausal women taking estrogen replacement therapy: the study of osteoporotic fractures. *Spine* 2001;**26**:1606-12.

16. Brynhildsen JO, Björs E, Skarsgård C, *et al.* Is hormone replacement therapy a risk factor for low back pain among postmenopausal women? *Spine* 1998;**23**:809-13.
17. Lindbeck L, Kjellberg K. Gender differences in lifting technique. *Ergonomics* 2001;**44**:202-14.
18. Van der Beek AJ, Kluver BDR, Frings-Dresen MHW, *et al.* Gender differences in exerted forces and energetic workload during pushing and pulling of wheeled cages by postal workers. *Ergonomics* 2000;**43**:269-81.
19. Bellman S, Forster N, Still L, *et al.* Gender differences in the use of social support as a moderator of occupational stress. *Stress Health* 2003;**19**:45-58.
20. Hooftman WE, van Poppel MN, van der Beek AJ, *et al.* Gender differences in the relations between work-related physical and psychosocial risk factors and musculoskeletal complaints. *Scand J Work Environ Health* 2004;**30**:261-78.
21. Hoogendoorn WE, Bongers PM, de Vet HCW *et al.* Flexion and rotation of the trunk and lifting at work are risk factors for low back pain: results of a prospective cohort study. *Spine* 2000;**25**:3087-92.
22. Ariëns GAM, Bongers PM, Douwes M *et al.* Are neck flexion, neck rotation and sitting at work risk factors for neck pain? Results of a prospective cohort study. *Occup Environ Med* 2001;**58**:200-7.
23. Kuorinka I, Jonsson B, Kilbom A *et al.* Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. *Appl Ergon* 1987;**18**:233-7.
24. Hildebrandt VH, Bongers PM, van Dijk FJ, *et al.* Dutch Musculoskeletal Questionnaire: description and basic qualities. *Ergonomics* 2001;**44**:1038-55.
25. Hildebrandt VH. *Prevention of work related musculoskeletal disorders: setting priorities using the standardized Dutch Musculoskeletal Questionnaire.* Doctoral thesis. Hoofddorp: TNO Work and Employment, 2001.
26. De Jonge J, Reuvers MMEN, Houtman ILD, *et al.* Linear and nonlinear relations between psychosocial job characteristics, subjective outcomes and sickness absence: Baseline results from SMASH. *J Occup Health Psychol* 2000;**5**:256-68.
27. Bongers PM, Miedema M, Douwes M. *et al. Longitudinaal onderzoek naar rug-, nek en schouderklachten. Deelrapport 1: Opzet en uitvoering van het onderzoek.* (Longitudinal study on low back, neck, and shoulder complaints. Sub report 1: Design and execution of the study). Hoofddorp (The Netherlands): TNO work and employment, 2000
28. Altman DG, Bland MJ. Interaction revisited: the difference between two estimates. *BMJ* 2003;**326**:218.
29. Leino-Arjas P. Men-the weaker sex? Unexpected results of a systematic review on work exposures and musculoskeletal disorders. *Scand J Work Environ Health* 2004;**30**:257-9.
30. Ekman I, Boman K, Olofsson M, *et al* . Gender makes a difference in the description of dyspnoea in patients with chronic heart failure. *Eur J Cardiovasc Nurs* 2005;**4**:117-21.
31. Vodopiutz J, Poller S, Schneider B, *et al.* Chest pain in hospitalized patients: cause-specific and gender-specific differences. *J Womens Health (Larchmt)* 2002;**11**:719-27.
32. Kennedy AM, Koehoorn M. Exposure assessment in Epidemiology: Does gender matter? *Am J Ind Med* 2003;**44**:567-83.
33. Green CA, Pope CR. Gender, psychosocial factors and the use of medical services: a longitudinal analysis. *Soc Sci Med* 1999;**48**:1363-72.
34. Hansson GA, Balogh I, Bystrom JU *et al.* Questionnaire versus direct technical measurements in assessing postures and movements of the head, upper back, arms and hands. *Scand J Work Environ Health* 2001;**27**:30-40.
35. Leijon O, Wiktorin C, Harenstam A, *et al* Validity of a self-administered questionnaire for assessing physical work loads in a general population. *J Occup Environ Med* 2002;**44**:724-35.
36. De Zwart BCH, Frings-Dresen MHW, Kilbom A. Gender differences in upper extremity musculoskeletal complaints in the working population. *Int Arch Occup Environ Health* 2000;**74**:21-30.
37. Coury HJCG, Portcatti IA, Alem MER, *et al.* Influence of gender on work-related musculoskeletal disorders in repetitive tasks. *Int J Ind Ergon* 2002;**29**:33-9.
38. Hooftman WE, van der Beek AJ, Bongers PM, *et al.* Gender differences in the prevalence of musculoskeletal symptoms are not caused by exposure differences. Submitted
39. Fillingim RB, Ness TJ. Sex-related hormonal influences on pain and analgesic responses. *Neurosci Biobehav Rev* 2000;**24**:485-501.
40. Gijsbers van Wijk CMT, Kolk AM. Sex differences in physical symptoms: the contribution of symptom perception theory. *Soc Sci Med* 1997;**45**:231-46.

7

Am I too sick to work? What makes men and women with musculoskeletal complaints decide to call in sick?

Submitted as:
Hooftman WE, Westerman, MJ, Van der Beek AJ, Bongers PM, Van Mechelen W.
Am I too sick to work? What makes men and women with musculoskeletal complaints decide to call in sick?

Abstract

Objective: To find out what makes men and women with musculoskeletal complaints decide to call in sick for work.

Design: Qualitative, face-to-face interviews with employees on sick leave.

Setting: Two branches of an occupational health service in the Netherlands.

Participants: 16 men and 14 women who had called in sick due to a musculoskeletal complaint, and expected to be absent from work for at least two weeks.

Results:

The participants fell into two main groups: those who were off sick because of a diagnosed medical condition, such as a fracture, and those who were off sick because of an unidentifiable complaint, such as low back pain. Employees in the former group called in sick because they were in hospital or because they reckoned that their condition was too serious to warrant a continuation of work. Employees in the latter group felt hesitant and insecure and found it hard to judge whether absenteeism was justified. They decided either to play it safe, and stay off work to prevent the complaints from worsening, or to seek advice from medical professionals. Their advises did not include explicit instructions to stay at home, but were usually interpreted as such. Finally, women, but not men, were likely to call in sick if they felt that their home situation was being negatively affected by attempts to keep working while suffering physical complaints.

Conclusion

The decision to call in sick is not taken lightly. Employees with non-specific disorders base their decision on several factors, including advice from medical professionals. A factor found only in women was work-home interference.

Introduction

Sick leave is generally recognized as a major problem in modern society. However, different groups of employees display quite distinct differences in patterns of sick leave; for example, younger employees tend to be off sick more often than older employees, and women more often than men[1,2]. In the Netherlands the frequency of sick leave is also higher for women than for men, though the average duration is equal in both cases[3]. Similar findings have been recorded in other countries[1,4]. However, data on the average duration of absenteeism are ambiguous[2,4]. Recent Scandinavian studies showed that the frequency of sickness 'presenteeism' (i.e. working when sick leave should be taken) was also greater among women[5,6]. This suggests that the pattern of absenteeism (i.e. frequent short-term leave, versus infrequent long-term leave) differs between the genders. This might be caused by differences in the reasons for calling in sick. Although legally, absenteeism is justified only when a person is unable to perform his or her usual tasks because of a health problem, previous research[7-11] has shown that this is not the only determinant factor in the decision to call in sick. Practical issues such as getting paid, finding a replacement, and the extent to which a person 'wants' to be off work also play a role. For example, Donders et al.[12] showed that work-family interference (but not family-work interference) influences the sick leave patterns of both men and women. However, whereas women attach more importance to private circumstances (child care, domestic help) when taking sick leave, men pay more attention to work-related factors (taking work home, support from superiors). Although it is known that these factors influence the decision to call in sick, it is not clear *how* they operate. The aim of this study was therefore to explore how men and women with musculoskeletal complaints decide to call in sick for work.

Subjects and Methods

The participants were recruited through two branches of an occupational health service (OHS) in the Netherlands. As a part of the standard procedure, all the employees received a telephone call from the OHS to confirm their absenteeism two days after they called in sick. They were asked why they had called in sick and how long they expected to be absent from work. Those who said that they suffered from a musculoskeletal complaint and that they would probably be absent for at least two weeks were asked to participate in the study. Forty-nine agreed to have information about the study sent to their home address, 30 of them (16 men and 14 women) agreed to be interviewed (see Table 1 for data on the participants).

The participants were interviewed at their home, except for one who, upon request, was interviewed at a workplace conference room. They were interviewed alone, except for three cases, when another person was present (spouse (n=1), young children (n=1), son/translator (n=1)). The interviews were open-ended and conducted with an interview guide. They lasted 45-90 minutes. The interview was geared to allowing the participants to speak freely about their reasons for being off sick. Each interview opened with the question “Why did you call in sick for work?”. Possible follow-up questions/prompts were: “Were there additional factors that caused you to call in sick?”; “Describe your work at the time you called in sick”; and “Describe your personal life at the time you called in sick”. After the interview, the participants completed a short questionnaire on socio-demographics. The interviews were recorded and a verbatim transcript was made. Unfortunately, in two interviews the quality of the tape was too poor to make a transcript.

Table 1: general data on the participants

		Men (n=16)	**Women (n=14)**
Age (years)	Mean	34.1	41.0
	Range	22.4-50.8	21.0-52.9
Complaint region	Shoulder/neck	8	3
	Hand/arm	1	0
	Back	2	10
	Leg/foot	4	1
	Several regions	1	0
Nature of complaint	Specific disorders	7	0
	Non-specific disorders	9	14
Duration of complaint prior to absenteeism	0 days	5	4
	<1 week	0	1
	1 week-6 months	3	6
	6-12 months	2	2
	>12 months	6	1

The interviewer (WH) conducted the analyses according to the constant comparison method[13]. First, the 10 most informative interviews were selected on the basis of the impression gained by the interviewer. These were then open-coded to identify themes. Interviews were read and reread several times to ensure that all the themes were identified. Similar themes were grouped into categories, and preliminary conclusions were discussed with a second member of the research team (MW). Then, a second set of interviews was read during which conscious efforts were made to detect further examples of the identified themes, new themes, and contradictions to the identified themes. After analyzing the second set of interviews, the themes and conclusions were updated and again discussed with the second team member. The final set of interviews was then used to either confirm or question the results.

Results

Two groups of employees emerged, each with a different decision-making process: those who were off sick because of a diagnosed medical condition, such as a fracture (specific disorders), and those who were off sick because of an unidentifiable complaint (non-specific disorders), e.g. low back pain.

Box 1: Specific disorders

<u>*Surgery*</u>
Man (32) has had knee complaints for a year, but has not been off sick until now. Reason for absenteeism: knee surgery.

I had an operation on the fourteenth. And well, I've had surgery before, and in my experience, when they start messing with your bones, you're in a fair amount of pain for at least a couple of weeks. So, I thought, I'm just going to stay off work and give my leg some rest. I have to walk with crutches for two weeks anyhow, and crutches at work, that's not much good.

<u>*Complaint too serious*</u>
Man (40), off sick due to a ruptured Achilles tendon

I've been forbidden from putting any weight on my leg for the first two weeks. I'm walking with crutches, and I usually have to walk a lot at work, so that's no use. I was emphatically told not to use my leg too much. And, if I walk with crutches, and I fall, the tendon will rupture again. So I just have to get some rest.

<u>Specific disorders</u>

For participants with specific disorders the decision to call in sick was easily made, and based on only a few factors. They were absent from work either because they were in hospital, or because they rated their disorder too serious to continue work. The latter was sometimes influenced by advice from medical professionals, or by previous experience of the consequences of surgery (Box 1).

Box 2: Insecurity

<u>*Judging complaints*</u>
Woman (49), complaints for 9 months. Has continued working until now. Considers herself incapable of judging whether she should call in sick. Feels this has aggravated her complaints.

When you have 'flu, you stay at home. But symptoms that can't be seen on the outside, that's when I find it hard to take a decision. Maybe I should have acted sooner. I find it difficult, taking that decision.

<u>*Views from others*</u>
Woman (41) has had back complaints for 9 months.

You don't need to stay in bed all day, you have to keep moving. And then you run into someone from work, and you think, maybe they think "Well, she's able to do that". It's just an idea you get, you know what I mean. After all, people talk.

Man (22) has had shoulder complaints for 6 months and has been off work with the same complaints before.

When I want to go out I just go, but, well, then people say you can go to work as well. When I go out I wear a sling, purely to show the outside world: "He's got something is wrong with his shoulder, so watch out."

Non-specific disorders

Insecurity

Employees with non-specific disorders wrestled with the decision to call in sick. The fact that their complaints were often not visible to others and that no diagnosis had been drawn made them feel insecure (Box 2). These participants indicated that the main reason for their absenteeism was the imbalance between (physical) work demands and reduced physical capacity. However, they found it difficult to judge their symptoms. Considerations ranged from whether they were serious enough to call in sick, up to whether they might get worse through continuation of work. In addition, they were afraid that friends/family/neighbors would see them as 'skivers' if they were off work but still able to walk around without visible discomfort.

Two strategies for coping with insecurity emerged: (1) play it safe, and (2) seek advice (Box 3). The first strategy was usually chosen because there was no diagnosis or prognosis for the complaints; it was believed that staying off work would prevent the complaints from worsening. The reason for choosing this strategy was that the sufferer had worked with the same symptoms in the past, and they had not diminished (Box 3).

Box 3: Strategies

Play it safe

Man (29) has had wrist complaints for 2 years. Hasn't yet called in sick.

I'm trying hard to fight it. It takes so much energy, I just can't handle it anymore. Last time I thought 'just keep going', but this time, I felt I shouldn't be doing that anymore. This time I first want to make sure it gets a bit better, and get some straight answers. I want to know what the problem is, if anything's been damaged, if I can keep working like this. I first want to find out what it is and how serious it is.

Seeking advice

Woman (49), complaints for 9 months. Has continued working until now. Considers herself incapable of judging whether to call in sick. Feels this has aggravated her complaints

Six weeks ago my physiotherapist said how are things at work? I told him not good. Well, he said, then you'll have to stay home for a while and see whether it gets a bit better instead of worse. And that's what I told them at work. At least I could then tell my boss that my physiotherapist doesn't understand why I'm still working.

Man (44) has had neck complaints for 10 months. Has always continued working.

I've called in sick now because my physiotherapist gave me an ear-bashing. Are you still working? Nobody told me to call in sick. They just told me not to use my arm too much. Well, I reckon that if I can't use my arm, I have to stay at home.

Employees who adopted the second strategy believed that they did not have enough expertise to decide whether they needed to stay off work. They therefore (un)consciously sought advice from medical professionals such as their GP or physiotherapist. The aim was twofold: (1) to help them decide on the seriousness of the complaint in relation to their work, and (2) to legitimize their absenteeism to their employer and their friends. According to the participants, medical professionals hardly ever instructed them explicitly to call in sick, but advised them to rest or to avoid over-exerting their arm/leg/back. Such advice was regarded as highly significant, because it came from experts. The employees concluded that in order to obey to these experts, they needed to call in sick. Advice from other sources, such as friends and family, was rarely sought. Spontaneous advice was appreciated, because it showed general interest, but was not pursued. The rationale was that this advice was given by people who were incompetent and should therefore stay out of it. Advice from friends and family was therefore usually ignored, while advice from medical experts directly influenced and legitimized the absenteeism, even if it did not include explicit instructions to stay off work.

Private life

Women with small children reported that they were more likely to call in sick if the combination of work and symptoms was having a negative effect on their private life (Box 4). They did not mind working while suffering pain or discomfort, but if it proved so draining that they had no energy left for their domestic tasks, they found it self-evident that they needed to change the situation. They felt that at work someone else could, and would, fill in for them, while at home they were ultimately responsible and could not be missed. Consequently, these women decided to call in sick for work.

Box 4: private life

> *Woman (41), back complaints for 9 months. Feels that working with back complaints is causing so many problems that it is hard to do anything at home.*
>
> Calling in sick is difficult enough. Will I or won't I? I always just kept going until the work caused so much discomfort that I had no energy left when I came home. That's when you start thinking "What am I doing?" I have a family at home that needs taking care of, and I feel it's important to be there for them. I don't want to be incapable of doing anything at home just because I want to keep working. That's not what it's about.

Discussion

The results indicate that the decision to call in sick for work is not taken lightly. Employees with non-specific disorders base their decision on several factors. One factor that was found in women alone was work-home interference. The double workload of women has often been associated with better health, but is usually mentioned in the light of the higher prevalence of complaints in women[14-18]. Work-family interference has also been shown to affect sick leave (through perceived health)[12]. Our results indicate that work-home interference is indeed a factor in absenteeism, but only for women, and that this is influenced by the responsibility women feel towards the home.

Our results corroborate those of Hansson et al.[19], who found that for persons with new (diagnosed) spinal related pain (SRP) all that mattered when deciding to call in sick for work was the disorder. Persons with long-term (undiagnosed) SRP tried to strike a balance between the factors that prompted them to keep working and those that prompted them to call in sick. Their strategy was to call in sick in order to get a diagnosis, re-adjust the work arrangements, and to recover from their complaints. This approach closely resembles our 'play it safe' strategy. Our 'advice-seeking' strategy was not, however, found by Hansson et al[19]. Insecurity about whether absenteeism was justified made workers with non-specific disorders seek advice from medical professionals. This advice seldom answered the dilemma of whether or not to call in sick. However, the general advice to take rest, was interpreted as instructions to stay at home. Hussey et al.[20] found that GPs experience a similar quandary when deciding whether to issue a doctor's certificate if the patient has no objective clinical diagnosis. In the Netherlands employees do not need a doctor's certificate to stay off work, so GPs are not forced to take a decision on the matter. This may allow them to evade the issue altogether, and offer non-specific advice. The incidence of potentially work-related ailments is, however, high and musculoskeletal complaints are the primary reason for work-related visits to a GP[21]. Hence, the influence of the GP on absenteeism may be fairly high. This suggests that GPs may need more training on work-related matters in order to be able to give appropriate advice. At the same time, however, GPs should be aware that non-specific advice is not interpreted as such, and that they do directly influence sick leave. Their advice should therefore be more explicit. When a GP means, "take rest, *but keep working*" he should say so.

What is already known on this topic

- There are distinct differences in reasons for sick leave between groups of workers.
- Other factors besides health problems play a role when deciding to call in sick.

What this study adds

- Workers with non-specific disorders are insecure about whether they are too sick to work.
- Two strategies are adopted when deciding to call in sick for work: (1) play it safe (2) seek advice.
- Non-specific advice from medical professionals is interpreted as advice to stay off work and thus influences sick leave.
- Women are more likely to call in sick if working with complaints has too many consequences for the home situation.

References

1. Gluck JV, Oleinick A. Claim rates of compensable back injuries by age, gender, occupation, and industry. Do they relate to return-to-work experience? Spine 1998;23.(14):1572-87.
2. Sharp C, Watt S. A study of absence rates in male and female employees working in occupations of equal status. Occup Med 1995;45(3):131-6.
3. Cuelenare B, Jetten B, Kooten D van. Differences in sickness absenteeism between men and women [in Dutch: Verschillen in ziekteverzuim tussen mannen en vrouwen? Verklaringen onderzocht]. Tijdschrift Voor Arbeidsvraagstukken 1996;12(1):43-55.
4. Hensing G, Brage S, Nygard JF, Sandanger I, Tellnes G. Sickness absence with psychiatric disorders--an increased risk for marginalisation among men? Soc Psychiatry Psychiatr Epidemiol 2000 Aug;35(8):335-40.
5. Aronsson G, Gustafsson K. Sickness presenteeism: prevalence, attendance-pressure factors, and an outline of a model for research. J Occup Environ Med 2005 Sep;47(9):958-66.
6. Aronsson G, Gustafsson K, Dallner M. Sick but yet at work. An empirical study of sickness presenteeism. J Epidemiol Community Health 2000 Jul;54(7):502-9.
7. Johansson G, Lundberg I. Adjustment latitude and attendance requirements as determinants of sickness absence or attendance. Empirical tests of the illness flexibility model. Soc Sci Med 2004 May;58(10):1857-68.
8. Voss M, Floderus B, Diderichsen F. How do job characteristics, family situation, domestic work, and lifestyle factors relate to sickness absence? A study based on Sweden Post. J Occup Environ Med 2004 Nov;46(11):1134-43.
9. Voss M, Floderus B, Diderichsen F. Physical, psychosocial, and organisational factors relative to sickness absence: a study based on Sweden Post. Occup Environ Med 2001 Mar;58(3):178-84.
10. Dew K, Keefe V, Small K. 'Choosing' to work when sick: workplace presenteeism. Soc Sci Med 2005 May;60(10):2273-82.
11. Philipsen H. Absenteeism due to sickness, a study of causes of sickness absenteeism in 83 companies [in Dutch: Afwezigheid wegens ziekte een onderzoek naar oorzaken in ziekteverzuim in 83 middelgrote bedrijven]. Groningen: Wolters-Noordhof, 1969.
12. Donders NCGM, van der Gulden JWJ, Furer JW, Bor JHJ, Tax B, Roscam Abbing EW. Does combining work and family issues form a risk factor for sick leave? Antecedents and outcomes of work-family interference in Dutch university employees. Submitted .
13. Pope C, Ziebland S, Mays N. Qualitative research in health care. Analysing qualitative data. BMJ 2000 Jan;320(7227):114-6.
14. Hall E. Double exposure: The combined impact of the home and work environments on psychosomatic strain in Swedish women and men. Int J Health Serv 1992;22(2):239-60.
15. Krantz G, Ostergren PO. Double exposure. The combined impact of domestic responsibilities and job strain on common symptoms in employed Swedish women. Eur J Public Health 2001;11(4):413-9.
16. Strazdins L, Bammer G. Women, work and musculoskeletal health. Soc Sci Med 2004 Mar;58(6):997-1005.
17. Martikainen P. Women's employment, marriage, motherhood and mortality: a test of the multiple role and role accumulation hypotheses. Soc Sci Med 1995;40(2):199-212.
18. Mastekaasa A. Parenthood, gender and sickness absence. Soc Sci Med 2000;50:1827-42.
19. Hansson M, Bostrom C, Harms-Ringdahl K. Sickness absence and sickness attendance-What people with neck or back pain think. Soc Sci Med 2006 May;62(9):2183-95.
20. Hussey S, Hoddinott P, Wilson P, Dowell J, Barbour R. Sickness certification system in the United Kingdom: qualitative study of views of general practitioners in Scotland. BMJ 2004 Jan;328(7431):88.
21. Weevers HJ, van der Beek AJ, Anema JR, van der Wal G, van Mechelen W. Work-related disease in general practice: a systematic review. Fam Pract 2005 Apr;22(2):197-204.

8

General Discussion

The main objective of this thesis was to explore to what extent gender differences in the risk of (sickness absence due to) musculoskeletal symptoms can be explained by differences in (work-related) exposures differences. Furthermore, based on interviews with absent workers, the process that leads to the decision to call in sick for work was explored, and gender differences in this decision process were described. In this final chapter a summary of the results will be given, and discussed in a broader perspective. At the end of the chapter an overall conclusion and recommendations will be given.

Summary of the results

In the chapters 2-4 gender differences in the exposure to (work-related) risk factors were examined. Given the gender differences in symptoms it was expected that exposure to risk factors for neck and upper extremity symptoms would be higher for women, while exposure to risk factors for back pain would be about equal for men and women. Chapter 2 describes the exposure of men and women with the same job title to work-related risk factors. For most risk factors gender differences in exposure were found, but the direction of this difference was depended on the type of work performed. While among desk workers women indeed reported more exposures to risk factors for neck and upper extremity problems, among assembly workers men often reported higher exposures. Male assembly workers reported more exposure to physical risk factors for back symptoms, while among desk workers exposure was sometimes higher for women. In chapter 3 differences in exposure to awkward postures between men and women performing the same task were examined. The results show that there were no gender differences in the duration or frequency of exposure to postural risk factors, although it seemed as if men and women had slightly different exposure patterns. In chapter 4 it was examined whether gender differences in musculoskeletal symptoms, as well as absenteeism, could be explained by gender differences in socio-demographic variables, exposures at work and in private life. Given the gender segregation of the labor market and the gender division in household chores, with the corresponding gender differences in exposures, it was expected that after correction, the odds ratio for neck and upper extremity symptoms would diminish, while for back symptoms there would be no change or the odds might become larger for men. Surprisingly, however, neither for neck and upper extremity symptoms, nor for back symptoms the gender difference in musculoskeletal symptoms changed after correction. All in all, based on the results of the chapters 2-4, the conclusion is that gender differences in (sickness absenteeism due to) upper extremity musculoskeletal symptoms are most likely not solely caused by differences in exposure to (work-related) risk factors.

Chapter 5 and 6 describe differences between men and women in the effect of work-related exposures. In chapter 5 a literature review was conducted, while in chapter 6 gender differences in the effect of exposure were examined using SMASH data. Both studies showed gender differences in the effect of exposure for some risk factors. When the results of these chapters are combined, only for the relation between lifting and back complaints evidence of a gender difference was found, with men having a higher risk. For the relation between job demands and job control and neck-shoulder symptoms, and for the relation between social support and both neck-shoulder and arm-hand symptoms no evidence for a gender difference was found, while for the remaining risk factors there was inconclusive evidence. Altogether the combined results of chapter 5 and 6 show that there is hardly any evidence for gender differences in the effect of work-related exposures, and that women are probably not more vulnerable for exposure. Gender differences in the effect of exposure to work-related risk factors therefore do not explain the female excess in musculoskeletal symptoms.

In chapter 7 a qualitative approach was used to explore how workers make the step from having complaints (but working at the same time) to being absent from work. It appeared that both male and female workers weigh several factors when deciding to call in sick for work, and that especially workers with non-specific complaints are insecure about whether their sickness absenteeism is justified. The same factors were found to be of influence for men and women, except for work-home interference, which only seemed to be of influence for women.

Comparison with literature

In chapter 1 several hypotheses are introduced that might explain the gender differences in musculoskeletal symptoms. The first hypothesis is the exposure hypothesis, which coincides with the first two boxes in model 1a ('situation' and 'performance'). Differences in work situation are often believed to explain part of the gender difference in musculoskeletal symptoms. To a large extent the labor market is still gender segregated. Statistics Netherlands showed that in 2004, especially for low-level and medium-level occupations, there still are many occupations that are solely held by men or women[1]. A pattern that has been consistently found for many years,[2] and in many countries (e.g. [3-7]). Construction, truck driving, and engineering are typical male professions, while women more often hold clerical and caring occupations. This also seems to have implications for the physical and psychosocial load workers are exposed to. Male occupations are predominantly physically heavy and characterized by exposures to risk factors such as manual material handling, while typical exposures in female occupations are repetitive movements, sitting work, and low autonomy[8-11].

Differences in work performance are another possible source of gender differences in exposures to work-related risk factors. Several authors have investigated gender differences in exposures within jobs, and the results show that when men and women are employed in the same job, they still have different tasks[4,10,12-16] , and because of that different exposures. Again, men are more often exposed to tasks that require more physical strength, while women perform the more repetitive tasks[4,12-15]. These results are in agreement with the results of chapter 2, where it is found that especially among desk workers women are more often exposed to risk factors for upper extremity symptoms, while among assembly workers men are more exposed to risk factors for back symptoms. Furthermore, gender differences in exposures to work-related risk factors may occur due to gender differences in task performance. When task performance of men and women was studied in a laboratory situation, they were found to perform the same task differently, resulting in differences in external[17-21] as well as internal exposure [20-25]. However, when task performance was studied at the work place (e.g. with video recordings) no significant differences in external exposure were found[26,27]. This is in agreement with the results of chapter 3, where no significant gender differences in exposure to awkward postures were found among men and women with the same tasks. It thus seems as if men and women perform specific isolated tasks in a slightly different way, but in the larger picture of 'a days work' these differences disappear.

Hence, there are indications that there are gender differences in exposure to risk factors due to the gender difference in the labor market, and to a lesser extent due to gender differences in tasks and task performance. These differences in exposure to risk factors are often believed to explain the gender difference in short term and long term musculoskeletal consequences (among which symptoms) to a large extent. However, so far, this hypothesis had not been tested. It is therefore surprising to see that the results of chapter 4 show that gender differences in musculoskeletal symptoms could not be explained by (work-related) exposures.

The second hypothesis that was introduced was the vulnerability hypothesis. As shown in the model in chapter 1 sickness absenteeism (due to musculoskeletal complaints) is not only caused by health complaints, but more factors are of influence. Women have more complaints than men, which seems to indicate that the *need* to be absent might also be higher for women than for men. However, the need to be absent is based on two factors, (1) the (seriousness of the) complaint, and (2) the work situation. Therefore, the proposition that women have a higher need to be absent is only true when two additional conditions are met. First that the seriousness of the complaints is equal for men and women, and second that work situation is also equal. However, women generally make more use of health care for their complaints, which may indicate that the complaints of women are more serious, or at least perceived as more serious. On the other hand, based on a literature review, Vinke et al[28] conclude that men more often have serious complaints, such as fractures, which are associated with operations and hospitalization, causing a higher need for absenteeism. In addition, working situations are not equal for men and women. As stated before, men and women have different occupations, and men tend to occupy the more physically strenuous jobs. Therefore, even when a man and a woman have the same complaint, it might be more difficult for a man to work with this complaint, and the need to be absent might be higher for men. All in all this means that, although the higher prevalence of complaints in women indicates a higher need for absenteeism, the reality might be more complicated, and the gender difference in need for absenteeism might be smaller than expected.

Furthermore, the gender difference in the prevalence of complaints seems to be larger than the gender difference in the prevalence of absenteeism (chapter 6, table 1). Presenteeism, defined as going to work while the complaints are valued as too serious to work with, also seems to be higher for women than for men[29,30], indicating that the opportunity and/or desire for absenteeism are also different for men and women. The *opportunity* for absenteeism is determined by formal and informal regulations regarding absenteeism. In the Netherlands, issues as getting paid when sick are often arranged in collective labor agreements. Therefore, for the majority of workers there are no major differences between men and women in formal regulations. However, De Rijk et al[31] examined gender differences in return to work, and showed that the work situation was different for men and women, women were more often temporarily employed and less often had an executive function. This was found to be the main factor to explain the gender differences in return to work. Furthermore, informal regulations also seem to differ between men and women. Men are more stimulated by their occupational physician to return to work[28], while women more often received an advise regarding return to work from their general practitioner (GP). Unfortunately, it was not examined whether the GP advised them to return or to remain sick[31]. In addition, attitudes from the social environment (friends/family) also seemed to differ between men and women. Men more often thought that the social environment estimated it as important that they returned to work. This might cause men to be more prone to return to work, but the results from de Rijk et al[31] show that this was not the case. These results, however, all concern the decision to return to work, and not the decision to be absent from work. Although factors that influence the decision to start sickness absenteeism may resemble the factors that influence the opportunity to return to work, they are not necessary the same. Unfortunately, research on factors that constitute the opportunity to be absent for work is scarce, and not aimed at explaining gender differences.

Women often take up the majority of the household work, and combine this with a (part-time) job. It has therefore been argued that women experience the housework as their main responsibility, and the paid job as additional. This should cause women to experience less work commitment than men. This lower motivation for women to perform paid work (which is associated with the *desire* to be absent), could be one of the factors that influence the higher absenteeism of women. However, in their study on return to work, De Rijk et al[31] found that the motivation to work did not differ between men and women. Furthermore, studies on sickness presenteeism[29,30] also show higher frequencies for women, which indicates that women in fact have a high motivation to work. However, the desire to be absent does not only depend on work commitment. Recently Hansson et al[32] described how men and women with musculoskeletal complaints decide to call in sick for work, and found that women with undiagnosed spinal pain sometimes used their absenteeism as a way to force their employer to change their working conditions. This shows that the *desire* for absenteeism can also be caused by different factors in men and women. Women desired to be absent in order to put pressure on their employer, but men did not feel such a desire. In chapter 7 we found that, although the decision to call in sick for work was mainly based on the imbalance between work demands and physical capacity, for women work-home interference also played a role. Work-home interference (WHI), and home-work interference (HWI) are caused by the fact that workers have to combine their work duties with their duties in private life. Since the majority of tasks regarding household and childcare are still performed by women, this so-called double workload and the associated WHI/ HWI have often been mentioned in light of the higher complaint level of women, but has seldom been investigated in relation to sickness absenteeism before.[33]. Donders et al[33] showed that WHI influenced absenteeism, through perceived health complaints, both in men and in women. Our results showed that the fact that WHI influenced the decision to call in sick for work was mainly due to the fact that women feel a high level of responsibility towards the housework. They felt responsible towards their work (indicated by the fact that they kept working while having complaints), but when they could no longer combine work and home duties and felt like they needed to choose between the two, they choose for the home responsibilities, since they felt they could not be replaced there.

Limitations of the study

Study on Musculoskeletal disorders, Absenteeism Stress and Health (SMASH) was one of the first studies to longitudinally examine the effect of exposure to physical as well as psychosocial risk factors on the development of musculoskeletal symptoms. However, in order to study such relations several choices have been made, which may have influenced the results.

First of all, because of the criteria used while selecting the population, selection bias may have occurred: to facilitate the follow-up measurements only companies where the workforce was relatively stable were eligible for participation in the study, and only workers who worked in their present job for at least one year and worked more than 20 hours per week could participate. This, however, may have strengthened the healthy worker effect. Workers who have complaints, may be more prone to change jobs, or to work less hours a week. Therefore, the effect of exposure on the development of symptoms may appear to be smaller than it in fact is. Furthermore, women more often work part-time, with a substantial number of women working less than 20 hours per week[34]. Therefore, a relatively large proportion of female workers may have been excluded. Reasons for working part-time may differ, but one reason why women may work part-time is that they cannot combine their work and home responsibilities, this would mean that in the SMASH population a relatively strong population of female workers is represented, and the healthy worker effect may have been larger in women than in men, which may have disguised the gender differences.

Selection bias may also have occurred due to the fact that, in order to make the video observations possible, workers in occupations with strongly varying work tasks, or work places could not participate in the study. Because of this a number of occupations that are often held by men (such as construction and transport) or women (such as nursing) were not represented in our population, meaning that our population worked in relatively gender integrated occupations. On the one hand, this means that the exposure differences between men and women in this population are relatively small, which may explain why they do not explain gender differences in the prevalence of symptoms. On the other hand, considering the results of Leijon et al[35], who found that sickness absenteeism due to musculoskeletal symptoms is higher in gender segregated than in gender integrated professions, this may mean that in our population the gender difference in sickness absenteeism may have appeared smaller than in the working population as a whole.

A further limitation of the present study is that the results of the chapters 2, 4 and 6 are based on self-reports. Although self-reports are widely used in large epidemiological studies, they are not considered to be the most precise and accurate measurements[36], since they are prone to several forms of bias. In the present study the use of self-reports may have been specifically problematic, since the various forms of bias may be linked to the gender factor. If either men or women would systematically differ in the way they experience (information bias), remember (recall bias), or report (reporting bias) their exposure or their symptoms this may not only influence the results, but may in fact be an explanation for the gender difference in the prevalence of musculoskeletal symptoms. In chapter 3 both self-reported and observed exposures were used, and the results showed that when higher exposures (duration and/or frequency) were observed for women compared to men, women also reported higher exposures. However, both men and women reported exposure more often than it was observed, and the difference between observed and reported exposure seemed larger for women than for men. A number of studies compared self-reported exposure with objective measures. The results showed that persons with complaints (more often women) tend to rate their exposure higher than persons without complaints[26,37,38]. However, these results have been contradicted in other studies[39,40]. Only few studies directly compared self-reports of exposures between the genders. When questionnaires were compared with an interview, no gender difference was found[39], but when questionnaires were compared with direct measurements, women over-reported exposure compared to men[37]. Although the results of these studies are not consistent as to whether self-reported data are influenced by gender, the results of chapter 3 indicate that at least in our population both men and women tended to over-report their exposure, and that this was probably slightly higher in women than in men.

The second problem with self-reports, namely over-reporting of symptoms, is more difficult to solve. Women do not only report more musculoskeletal symptoms, but they tend to report more complaints in general. They therefore are the most likely gender to be over-reporting. However, the problem is that it is very difficult to objectively measure pain, and therefore it is almost impossible to distinguish between feeling pain and reporting pain. Many laboratory studies have been performed to examine gender differences in pain perception. Independent of the exact stimulus (e.g. thermal stimuli (hot and cold)[41-43], electrocutaneous stimulation[44], and pressure [45]) women were found to have a lower pain threshold (the moment one indicates that the stimulus causes pain) as well as a lower pain tolerance (the moment one indicates that the pain is no longer sustainable)[46]. However, only one study was found that used an objective measure as an indicator of pain. Ellermeier and Westphal[45] used pupil reactions to measure pain intensity resulting from a high-pressure stimulus. Pupil reactions are related to pain, but are unlikely to be biased by attitude or culture, and therefore are considered to be an objective measure of pain. Their results showed that women did not only report more pain, but also showed more pupil dilation. This indicates that part of the gender difference in pain is due to the fact that women indeed feel more pain. However, reporting of pain also seems to be influenced by social expectations. Robinson and colleagues have examined the influence of gender role expectations (GREP) on pain. They found that women are viewed to be more willing to report pain[47], and that ,while women have a lower pain threshold, tolerance and temporal summation of pain, this could be (partly) explained by GREP[48]. It was also shown that pain rating behavior could be influenced, and that when a gender specific expectation of pain tolerance was given before the test, there no longer was a significant gender differences in pain tolerance[49]. Combined with the results of Ellermeier and Westphal[45] this shows that women do not only detect pain at an earlier stage, but are also more willing to report a stimulus as being painful. For our study this implies that women probably indeed experienced more pain, but were also more prone to report pain. Therefore, women have at least slightly over-reported their pain compared to men.

A limitation of the interviews is that only workers who were absent, and expected their absenteeism to last for a few weeks, were interviewed. Workers who had considered to be absent, but in the end decided to keep working, and workers who indicated that their absenteeism would only last for a few days were not interviewed. This means that we only explored part of the decision-making process regarding work absenteeism. However, for most of the workers in our populations the decision to call in sick for work was not made instantaneously, but the result of a constant weighing of factors that influence the decision to call in sick. It is therefore believed that the results of chapter 7 give a good indication of how the decision making process of sickness absenteeism takes place, although the factors that we describe are not necessarily an exhaustive list of factors that influence this decision.

Implications

Since, contrarily to our expectations, gender differences in (sickness absenteeism due to) upper extremity musculoskeletal symptoms could not solely be explained by differences in the exposure to, or the effects of exposure to (work-related) risk factors, alternate explanations should be explored. Differences in pain experience (both feeling and reporting) could be of more importance when explaining gender differences in musculoskeletal pain than expected in advance. This raises several questions. Firstly whether this is a problem, and secondly whether this can or needs to be solved. In our questionnaire it was asked whether workers had experienced pain or discomfort in the past 12 months. It was not asked whether this pain or discomfort had any consequences. If women detect or report pain at an earlier moment than men do, it can be expected that upon request women would indeed more often answer 'yes' to this question. However, as long as they merely detect that something is going on, but do not put any consequences to this, like restricted home or work activities, or increased medical consumption, this might not be a problem at all. Many musculoskeletal complaints are non-specific, meaning that upon examination no physical damage to structures can be found. This also implies that there often is no need for restriction of activities. In fact performing normal activities, while having pain is the core concept of the graded activity therapy, which has been shown to reduce sickness absenteeism in workers with low back pain[50,51]. In table 1 of chapter 6 it is shown that equal percentages of men and women report pain or discomfort in the back region, but women report about twice as many neck, shoulder and arm-hand problems. If this is due to gender differences in pain experience, it could be hypothesized that for pain with consequences this gender difference would lessen. Table 1 also shows that for sickness absenteeism, the only measure of pain with consequences in our study, the gender difference indeed declined. Women actually were less often absent for work due to back problems, and for neck-shoulder-arm-hand absenteeism the gender difference declined from twice as often to less than 1.5 times as often. This seems to indicate that there is at least some truth in our hypothesis, but it should be kept in mind that there is a big step between having complaints and being absent for work. The hypothesis that gender differences in musculoskeletal problems are the largest for complaints, smaller for complaints with consequences, and the smallest for sickness absenteeism was tested in a population of about 1500 office workers, 50% of whom were female (PROMO study). In this study three categories of pain could be distinguished: pain, pain with consequences (such as restricted activities, and medical consumption), and sickness absenteeism. The preliminary results from this study (personal communication) showed that prevalence as well as the incidence of neck-shoulder symptoms, and arm-wrist-hand symptoms was found to be higher among women for all outcome measures (range gender ratio 1.25 –4.5), indicating that women put as much consequences to their pain as men do. Wijnhoven et al[52] also found higher prevalences of pain with consequences for women, and found that this difference decreased when examined in a population with complaints compared to the general population. For the neck, shoulder and higher back the gender difference in prevalence seemed to disappear almost completely. This implies that gender differences in musculoskeletal pain with consequences are largely due to differences in general prevalence, and women do not experience more or less consequences as a result of their pain. It thus seems that women feel/report more pain than men, but put just as many consequences to this perceived pain as men. And, although pain without consequences might be considered to only be problematic for the individual, pain with consequences could be considered a problem for society as a whole. Therefore, it should be attempted to resolve these gender differences in pain.

Gender differences in the perception of pain are probably to a substantial extent caused by biological differences between men and women. It is beyond of the scope of this thesis to extensively discuss the relation between gender-related biological differences and pain, but it seems to be related to hormonal differences between men and women, and has an effect both in the central nervous system as well as in the peripheral nervous system. Furthermore, men and women seem to have different nocioceptive receptors, and process pain in a different way[46,53-55]. Biological differences in pain perception are probably hard to influence, and for the near future the emphasis should therefore, most likely be on resolving gender differences in pain reporting, and minimizing the consequences of pain. Although it has been suggested that one day pain killing drugs may be developed that take into account biological differences between men and women, and work solely, or better, in men or women[55].

Gender differences in reporting of pain, are to a large extent caused by social differences between men and women, and originate at an early age. In modern western societies boys and girls are, or at least have been, raised differently, and are learned different values regarding the expression of pain. While boys are taught not to show pain and emotions ('big boys don't cry'), girls might be even encouraged to show emotions associated with pain, causing them to be more inclined to report pain[47,48,56]. Gender difference in pain reporting behavior therefore seem to be acquired habits that might be broken again. As said before, it has been shown that GREP influence pain reporting, and that GREP in its turn can be influenced as well[49]. Furthermore, men and women have been found to use different coping strategies for dealing with pain. When the literature on gender, pain and coping was reviewed[54] it was found that men and women use different coping strategies when dealing with pain. Women used a larger variety of coping strategies than men. While women relied on active behavioral and cognitive coping, avoidance, emotion-focused coping, seeking support, relaxation and distraction, men relied on problem-focused strategies, talking problems down, denial, looking at the bright side of life and tension reducing activities such as alcohol consumption, smoking and drugs abuse. Keogh and colleagues[41,42,57] examined the effect of different coping strategies on the perception of pain and found that when men used a sensory focused coping strategy they felt less pain, while for women the pain perception did not change[42,57]. When instructed to use an emotion-focused strategy the pain perception for women in fact got worse[42]. They furthermore found that when instructed to use an acceptance-based coping strategy this resulted in lower pain reporting, for sensory pain (described in words like throbbing/shooting), but for affective (descriptions as sickening, fearful) pain this was only true for women[41]. It thus seems that men and women use different coping strategies and that, especially the emotion focusing strategy women use does not benefit their pain experience. The results from Keoch et al[41,42,57] furthermore showed that coping strategies can be influenced, and that this in its turn can lead to a reduction of pain, especially in women. This combined with the results of Thastum et al[41,42,57,58], who found that coping strategies in children are related to the coping strategies of their parents, indicate that changing the way women cope with pain may have a large influence on the pain perception now, of women of the present generation and those of future generations.

Conclusion

In chapter 1 several hypotheses were introduced that might explain the gender differences in musculoskeletal symptoms. The first hypothesis is the exposure hypothesis, which was examined in the chapters 2-4. Based on the results of these chapters it can be concluded that gender differences in (sickness absenteeism due to) musculoskeletal pain, are most likely not solely caused by gender differences in (work-related) exposures. The gender segregation of the labor market seems to be of influence, but gender differences in tasks, or task performance have only little explanatory value. The second hypothesis, the vulnerability hypothesis, was examined in the chapters 5 and 6. The conclusion of these chapters is that women are not more vulnerable for the effect of exposure to work-related risk factors than men. Based on the literature, it was concluded that that biological differences between men and women, might explain why women generally experience more pain. Furthermore, differences between men and women in social values might explain why women more often report pain, and have different coping strategies for dealing with pain. Influencing these coping strategies seems possible, and might have a beneficial effect on the pain perception of women. However, it should be noted that the differences between men and women in social values might already be changing. In the past century, society has changed from a almost strictly gender segregated world where men worked and women stayed at home, into a society where men and women are more and more equal. Nowadays men and women both have paid jobs outside of the house, and seem to have more and more equal life styles. Results from cancer research have shown that with more equal life styles (e.g. smoking) gender difference in disease prevalence also became more equal[59]. Although for the prevalence of cancer this did not benefit the women, for musculoskeletal symptoms this might resolve part of the problem.

Recommendations

- Epidemiological studies focusing on work-related risk factors should continue to include both male and female workers in their populations. However, researchers should be aware that gender should not be a priori treated as a confounder. More gender sensitive analyses might be needed, since gender can also be an effect modifier, interact with other potential confounders, as well as act as a proxi for other factors related to musculoskeletal symptoms.
- It is recommended to perform further research, both epidemiological studies and laboratory based experimental studies, to examine to what extent gender differences in pain perception as well as pain reporting can explain the gender difference in musculoskeletal symptoms.
- It should be determined to what extent gender differences in patterns of exposure to work-related risk factors, in which intensity, duration and frequency are combined, influence the gender difference in musculoskeletal symptoms.
- Research should not only focus on which factors are related to absenteeism, but more, especially qualitative, studies should be performed that explore the process by which workers decide to call in sick for work, and (not) to return to work. Insight in these processes would allow the occupational physician to give absent workers more specific guidance.
- To resolve, and prevent gender differences in musculoskeletal symptoms the focus should not primarily be on the reduction of exposure among women, but broader social issues, such as coping behavior, should be addressed.
- To prevent the occurrence and/or recurrence of musculoskeletal symptoms interventions often aim at the reduction of exposure to work-related risk factors. No specific attention to the presumably weaker sex (i.e. women) is justified. The focus should rather be on those working situations that cause high exposures among workers in general.
- Employers should be aware that especially female workers attempt to balance work and home responsibilities, and that this influences absenteeism. To prevent

sickness absence, and corresponding costs for the company, employers should therefore try to offer flexible working arrangements in order to facilitate this balance.

- Considering the limitations of the SMASH study it should be examined whether the results of the current study also hold in a different, more gender segregated working population.

References

1. CBS (Statistics Netherlands). Top ten Male and Female dominated occupations . CBS Web Magazine November 21st 2005; http://www.cbs.nl/en-GB/menu/themas/dossiers/vrouwen-en-mannen/publicaties/artikelen/2005-1825-wm.htm?languageswitch=on.
2. Centraal Bureau voor de Statistiek. Separate labour markets [in Dutch: Gescheiden Arbeidsmarkten]. Index 1999;6:12.
3. De Zwart BC, Frings-Dresen MH, Kilbom A. Gender differences in upper extremity musculoskeletal complaints in the working population. Int Arch Occup Environ Health 2001; 74(1):21-30.
4. Josephson M, Pernold G, Ahlberg-Hulten G, Harenstam A, Theorell T, Vingard E, et al. Differences in the association between psychosocial work conditions and physical work load in female- and male-dominated occupations. Am Ind Hyg Assoc J 1999;606:673-8.
5. Lindqvist K, Schelp L, Timpka T. Gender aspects of work related injuries in a Swedish Municipality. Safety Science 1999;31:186-96.
6. Stellman JM. Where women work and the hazards they may face on the job. J Occup Med 1994;36(8):814-25.
7. Stellman JM. Women workers: the social construction of a special population. Occup Med 1999;14(3):559-80.
8. De Zwart BCH, Broersen JP, Frings-Dresen MH, van Dijk FJ. Musculoskeletal complaints in The Netherlands in relation to age, gender and physically demanding work. Int Arch Occup Environ Health 1997;70(5):352-60.
9. Mergler D, Brabant C, Vezina N, Messing K. The weaker sex? Men in women's working conditions report similar health symptoms. Journal of Occupational Medicine 1987;29:417-21.
10. Messing K, Reveret JP. Are women in female jobs for their health? A study of working conditions and health effects in the fish-processing industry in Quebec. Int J Health Serv 1983;13(4):635-48.
11. Vezina N, Courville J. Integration of women into traditionally masculine jobs. Women Health 1992;18(3):97-118.
12. Fransson-Hall C, Bystrom S, Kilbom Å. Self reported physical exposure and musculoskeletal symptoms of the forearm-hand among automobile assembly line workers. J Occup Environ Med 1995;37(9):1136-44.
13. Messing K, Chatigny C, Courville J. 'Light' and 'Heavy' work in the housekeeping services of a hospital. Appl Ergon 1998;29(6):451-9.
14. Messing K, Doniol-Shaw G, Haëntjes S. Sugar and Spice and everything nice: Health effects of the sexual division of labor among train cleaners. Int J Health Serv 1993;23(1):133-46.
15. Nordander C, Ohlsson K, Balogh I, Rylander L, Palsson B, Skerfving S. Fish processing work: the impact of two sex dependent exposure profiles on musculoskeletal health. Occup Environ Med 1999;56(4):256-64.
16. Messing K, Dumais L, Courville J, Seifert AM, Boucher M. Evaluation of exposure data from men and women with the same job title. J Occup Med 1994;36:913-7.
17. Johnson PW, Hagberg M, Hjelm EW, Rempel D. Measuring and characterizing force exposures during computer mouse use. Scand 2000;6(5):398-405.
18. Kerrigan DC, Todd MK, Della Croce U. Gender differences in joint biomechanics during walking: normative study in young adults. Am J Phys Med Rehabil 1998;77(1):2-7.
19. Lindbeck L, Kjellberg K. Gender differences in lifting technique. Ergonomics 2001;44(2):202-14.
20. Van der Beek AJ, Kluver BDR, Frings-Dresen MHW, Hoozemans MJM. Gender differences in exerted forces and energetic workload during pushing and pulling of wheeled cages by postal workers. Ergonomics 2000;43(2):269-81.
21. Wahlstrom J, Svensson J, Hagberg M, Johnson PW. Differences between work methods and gender in computer mouse use. Scand J Work Environ Health 2000;26(5):390-7.
22. Bejjani FJ, Gross CM, Pugh JW. Model for static lifting: Relationship of loads on the spine and the knee. J of Biomech 1984;17(4):281-186.
23. Bhambhani Y, Maikala R. Gender differences during treadmill walking with graded loads: biomechanical and physiological comparisons. European Journal of Applied Physiology 2000;81:75-83.
24. Garg A, Saxena U. Physiological stresses in warehouse operations with special reference to lifting technique and gender: a

case study. Am Ind Hyg Assoc J 1985;46(2):53-9.

25. Nordander C, Hansson GA, Rylander L, Asterland P, Bystrom JU, Ohlsson K, et al. Muscular rest and gap frequency as EMG measures of physical exposure: the impact of work tasks and individual related factors. Ergonomics 2000;43(44):1904-19.
26. Balogh I, Orbaek P, Ohlsson K, Nordander C, Unge J, Winkel J, et al. Self-assessed and directly measured occupational physical activities--influence of musculoskeletal complaints, age and gender. Appl Ergon 2004;35(1):49-56.
27. Dahlberg R, Karlqvist L, Bildt C, Nykvist K. Do work technique and musculoskeletal symptoms differ between men and women performing the same type of work tasks? Appl Ergon 2004 Nov;35(6):521-9.
28. Vinke H, Andriessen S, Van den Heuvel SG, Houtman IDL, Reinders S, Van Vuren CV, et al. Vrouwen en Reintegratie. Onderzoek naar de verschillen tussen vrouwen en mannen bij WAO intreden en Reintegratie. Samenvattende Rapportage. Hoofddorp: TNO Arbeid, 1999.
29. Aronsson G, Gustafsson K. Sickness presenteeism: prevalence, attendance-pressure factors, and an outline of a model for research. J Occup Environ Med 2005;47(9):958-66.
30. Aronsson G, Gustafsson K, Dallner M. Sick but yet at work. An empirical study of sickness presenteeism. J Epidemiol Community Health 2000;54(7):502-9.
31. De Rijk A, Van Lierop B, Janssen N, Nijhuis F. Geen kwestie van motivatie maar van situatie. Een onderzoek naar man/vrouw verschillen in werkhervatting gedurende het eerste jaar na ziekmelding (Situation not motivation. An investigation of gender differences in work resumption during the first year of sickness absenteeism). Doetinchem / 's Gravenhage (The Netherlands): Ministry of Social Affairs and Employment, 2002.
32. Hansson M, Bostrom C, Harms-Ringdahl K. Sickness absence and sickness attendance-What people with neck or back pain think. Soc Sci Med 2006;62(9):2183-95.
33. Donders NCGM, van der Gulden JWJ, Furer JW, Bor JHJ, Tax B, Roscam Abbing EW. Does combining work and family issues form a risk factor for sick leave? Antecedents and outcomes of work-family interference in Dutch university employees. Submitted .
34. Centraal Bureau voor de Statistiek. Available at http://statline.cbs.nl/StatWeb/start.asp?LA=nl&DM=SLNL&lp=Search%2FSearch Assessed June 20 2006.
35. Leijon O, Bernmark E, Karlqvist L, Harenstam A. (2005) Awkward work postures: association with occupational gender segregation. Am J Ind Med 47:381-93.
36. Van der Beek AJ, Frings-Dresen MH. Assessment of mechanical exposure in ergonomic epidemiology. Occup Environ Med 1998;55(5):291-9.
37. Hansson GA, Balogh I, Bystrom JU, Ohlsson K, Nordander C, Asterland P, et al. Questionnaire versus direct technical measurements in assessing postures and movements of the head, upper back, arms and hands. Scand J Work Environ Health 2001;27(1):30-40.
38. Viikari-Juntura E, Rauas S, Martikainen R, Kuosma E, Riihimaki H, Takala EP, et al. Validity of self-reported physical work load in epidemiologic studies on musculoskeletal disorders. Scand J Work Environ Health 1996;22(4):251-9.
39. Leijon O, Wiktorin C, Harenstam A, Karlqvist L. Validity of a self-administered questionnaire for assessing physical work loads in a general population. J Occup Environ Med 2002;44(8):724-35.
40. Toomingas A, Alfredsson L, Kilbom Å. Possible bias from rating behavior when subjects rate both exposure and outcome. Scand J Work Environ Health 1997;23(5):370-7.
41. Keogh E, Bond FW, Hanmer R, Tilston J. Comparing acceptance- and control-based coping instructions on the cold-pressor pain experiences of healthy men and women. Eur J Pain 2005;9(5):591-8.
42. Keogh E, Herdenfeldt M. Gender, coping and the perception of pain. Pain 2002;97(3):195-201.
43. Lowery D, Fillingim RB, Wright RA. Sex differences and incentive effects on perceptual and cardiovascular responses to cold pressor pain. Psychosom Med 2003;65(2):284-91.
44. Mitchell S, Reading I, Walker-Bone K, Palmer K, Cooper C, Coggon D. Pain tolerance in upper limb disorders: findings from a community survey. Occup Environ Med 2003;60(3):217-21.
45. Ellermeier W, Westphal W. Gender differences in pain ratings and pupil reactions to painful pressure stimuli. Pain 1995;61(3):435-9.
46. Wiesenfeld-Hallin Z. Sex differences in pain perception. Gend Med 2005 Sep;2(3):137-45.
47. Robinson ME, Riley JL 3rd, Myers CD, Papas RK, Wise EA, Waxenberg LB, et al. Gender role expectations of pain: relationship to sex differences in pain. J Pain 2001;2(5):251-7.
48. Wise EA, Price DD, Myers CD, Heft MW, Robinson ME. Gender role expectations of pain: relationship to experimental pain perception. Pain 2002;96(3):335-42.
49. Robinson ME, Gagnon CM, Riley JL 3rd, Price DD. Altering gender role expectations: effects on pain tolerance, pain threshold, and pain ratings. J Pain 2003;4(5):284-8.

50. Hlobil H, Staal JB, Twisk J, Koke A, Ariens G, Smid T, et al. The effects of a graded activity intervention for low back pain in occupational health on sick leave, functional status and pain: 12-month results of a randomized controlled trial. J Occup Rehabil 2005;15(4):569-80.
51. Staal JB, Hlobil H, Twisk JW, Smid T, Koke AJ, van Mechelen W. Graded activity for low back pain in occupational health care: a randomized, controlled trial. Ann Intern Med 2004;140(2):77-84.
52. Wijnhoven HAH, de Vet HCW, Picavet HSJ. Sex differences in consequences of musculoskeletal pain. submitted
53. Rhudy JL, Williams AE. Gender differences in pain: do emotions play a role? Gend Med 2005;2(4):208-26.
54. Unruh AM. Gender variations in clinical pain experience. Pain 1996;65(2-3):123-67.
55. Wilson JF. The pain divide between men and women. Ann Intern Med 2006;144(6):461-4
56. Gijsbers van Wijk CMT, Kolk AM. Sex differences in physical symptoms: the contribution of symptom perception theory. Soc Sci Med 1997;45:231-46.
57. Keogh E, Hatton K, Ellery D. Avoidance versus focused attention and the perception of pain: differential effects for men and women. Pain 2000;85(1-2):225-30.
58. Thastum M, Zachariae R, Herlin T. Pain experience and pain coping strategies in children with juvenile idiopathic arthritis. J Rheumatol 2001;28(5):1091-8.
59. CBS (Statistics Netherlands). Cancer number one cause of death in male population. CBS Web Magazine May 16 2006; http://www.cbs.nl/en-GB/menu/themas/mens-maatschappij/gezondheid-welzijn/publicaties/artikelen/2006-1953-wm.htm?languageswitch=on.

Summary

In spite of their longer life expectancy women generally report more health complaints, and make more use of medical care for health problems, especially for relatively minor and subjective complaints. One of the conditions that is more prevalent among women than among men are musculoskeletal symptoms. Musculoskeletal symptoms are, in general, one of the most prevalent causes of pain and discomfort, with about 75% of the Dutch population suffering from these complaints on a yearly base. When gender differences in musculoskeletal symptoms are reviewed it is found that, especially for the neck and upper extremities, women report more symptoms, and are more often absent from work because of these symptoms. A phenomenon that is not only found in the Netherlands but seems to be a worldwide problem. Although musculoskeletal symptoms are multifactoral in origin a large role is played by exposure to both physical and psychosocial risk factors in the work place. The main objective of this thesis is therefore to find out to which extent gender differences in the risk (sickness absence due to) musculoskeletal symptoms can be explained by differences in (work-related) exposures.

In chapter 2 and 3 it was examined whether men and women, are equally exposed to work-related risk factors. Data from the Study on Musculoskeletal disorders, Absenteeism Stress and Health (SMASH) were used. In this study, which focused on the determination of risk factors for musculoskeletal complaints, nearly 1800 employees in 34 companies participated. Data on sociodemographic variables, exposures and symptoms were collected at baseline (1994), and during three annual follow-up measurements. Furthermore, a selection of workers was video recorded at their workplace

For chapter 2 the baseline questionnaires of 491 men and 342 women, who worked in a job with at least 10 male and 10 female workers, were analyzed, to see whether men and women with the same job report equal exposure to work-related physical and psychosocial risk factors. The results showed that exposure to physical risk factors for back symptoms was more common for male assembly workers, while among desk workers exposure was sometimes higher for women, and sometimes for men. Exposure to physical risk factors for upper extremity complaints on the other hand was reported more often by female desk workers, while among assembly workers some risk factors were reported more by men and others by women. Regarding exposure to psychosocial risk factors men were found to report more job control, while female assembly workers reported more job demands. However, both among assembly and among desk workers women reported higher job satisfaction. In conclusion this seems to implicate that men and women with the same job do not have equal exposure to work-related risk factors, however, it is not so clear as to who has higher exposure.

In chapter 3 exposure differences between men and women were further investigated, and differences in exposure between men and women performing the same task were examined. Six task groups, in which at least 2 men and 2 women worked, were selected and video recordings of 37 male and 43 female workers were observed. From these video observations data on the frequency and duration of exposure to awkward postures were derived. The results showed that men and women did not significantly differ on either the duration or frequency of exposure. However, when Exposure Variation Analyses (EVA) matrixes, which combine the three core dimensions of exposure, i.e. intensity, duration and frequency at the same time, were calculated, it seemed as if men and women had slightly different exposure patterns. Furthermore, when the observed exposures were compared with self reported exposures, workers more often reported to be exposed than they were observed to be exposed. This difference between reported and observed exposure seemed to be larger in men than in women. The final conclusion is that the differences in exposure were, at the most, very small and it is therefore unlikely that they have a large influence on the gender difference in musculoskeletal symptoms.

The effect of gender differences in socio-demographic variables, exposures at work and in private life on the prevalence of sickness absence due to symptoms was examined in chapter 4. Again, data form the SMASH study were used, but for these analyses all follow-up measurements were included, and Logistic Generalized Estimation Equations (GEE) regression analyses were performed to determine the relation between musculoskeletal symptoms, gender, and exposures one year before the symptoms. The results showed significant higher odds for women of self-reported neck (Odds Ratio (OR)=2.70), shoulder (OR=2.30) and hand-arm (OR 1.61) symptoms, and for sickness absence due to neck-shoulder-arm-hand symptoms (OR 1.60). However, no significant difference was found for (sickness absence due to) back symptoms. Surprisingly, however, these differences generally did not change after the addition of sociodemographic and exposure variables. And it was concluded that at least some of the gender difference in this population is due to factors other than exposure differences between male and female workers.

In the chapters 5 and 6 gender differences in the effect of exposure to work-related risk factors were examined. In chapter 5, the existing literature was examined, to determine the level of evidence for a gender difference in the relation between selected exposures and musculoskeletal symptoms. Based on a systematic search of the literature snowball search, reference check and personal databases 14 studies on back symptoms, 9 studies on neck-shoulder symptoms, 4 studies on hand-wrist complaints and 4 studies on lower extremity complaints were used in the analyses. The results showed that men have a higher risk of back symptoms due to lifting, and a higher risk of neck-shoulder symptoms because of exposure to hand-arm vibration. Women on the other hand have a higher risk for neck-shoulder complaints because of exposure to awkward arm postures. For social support, no evidence for a gender difference was found for either neck-shoulder or back complaints, while for the remaining risk factors inconclusive evidence was found.

In chapter 6 gender differences in the effect of exposure to work-related risk factors were examined within the SMASH data. Gender ratios (GR) were calculated to determine differences in effect. Gender ratios higher than 1.33 (women having a higher risk) or lower than 0.75 (men having a higher risk) were regarded as relevant. For the relation between exposure and symptoms no relevant gender differences were found for the majority of the risk factors (16 out of 22). When a difference was found men generally had a higher risk of symptoms (GR range 0.50-0.68), except for bending the wrist and bending the neck backwards (GR 1.52-2.55). For sickness absence women had a higher risk due to twisting the upper body, working in uncomfortable postures, twisting the wrist, bending the neck backwards, coworker and supervisor support (GR range 1.66-2.63). While for driving vehicles, hand-arm vibration, squeezing, working above shoulder or below knee level, reaching, twisting the neck, job demands and skill discretion men had a higher risk. For job satisfaction a GR of 0.50 was found for absence due to back symptoms and a GR of 1.78 for sickness absence due to neck-shoulder-hand-arm symptoms. When the results of chapter 5 and 6 are combined only for the relation between lifting and back complaints there remains evidence of a gender difference, but with men having a higher risk. For the relation between job demands and job control and neck-shoulder symptoms, and for the relation between social support and both neck-shoulder and arm-hand symptoms there is no evidence for a gender difference, while for the remaining risk factors there is inconclusive evidence. Altogether the combined results of chapter 5 and 6 show that there is hardly any evidence for gender differences in the effect of work-related exposures, and that women are certainly not more vulnerable for exposure.

The step from having complaints (but working at the same time) to being absent for work was examined in chapter 7. Thirty workers (16 men and 14 women) who had called in sick for work due to a musculoskeletal complaint, and expected their absenteeism to last for more than 2 weeks were interviewed about their reasons for absenteeism. The results showed that the participants fell into two main groups, each with a different decision-making process: those who were off sick because of a diagnosed medical condition, such as a fracture, and those who were off sick because of an unidentifiable complaint, e.g. low back pain. Employees in the first group were absent from work either because they were in hospital, or because they rated their disorder too serious to continue work. The latter was sometimes influenced by advice from medical professionals, or by previous experience of the consequences of surgery. Employees in the second group wrestled with the decision to call in sick. They felt hesitant and insecure and found it hard to judge whether absenteeism was justified.

Because of this they decided either to play it safe, and stay off work to prevent the complaints from worsening, or to seek advice from medical professionals. Advises from these professionals usually did not include instructions to stay at home, but were often interpreted as such. Finally, women, but not men, were likely to call in sick if they felt that their home situation was being negatively affected by attempts to keep working while suffering physical complaints.

Finally, in chapter 8, the results are summarized, and discussed in a broader perspective. It is concluded that, based on the results of this thesis, it is unlikely that gender differences (sickness absenteeism due to) musculoskeletal symptoms can be solely explained by gender differences in (the effect of) work-related exposures. However, based on the literature it seems that biological differences between men and women, might explain why women experience more pain. Furthermore, differences between men and women in social values might explain why women more often report pain, and have different coping strategies for dealing with pain. Furthermore it seems possible to influence these coping strategies, which might have a beneficial effect on the pain experience of women. Further research should therefore focus the relation between social values and coping behavior, and the possibilities to influence this behavior. Although it should be noted that differences between men and women in social values, and therefore coping behavior, might already be changing, which, in time, may resolve part of the gender difference in musculoskeletal symptoms on its own.

Samenvatting

Ondanks dat vrouwen een langere levensverwachting hebben dan mannen hebben zij over het algemeen meer gezondheidsklachten en een hogere medische consumptie. Iets wat vooral geldt voor alledaagse en subjectieve klachten. Eén van de klachten die vaker voorkoment bij vrouwen dan bij mannen zijn klachten aan het bewegingsapparaat. Ongeveer 75% van de Nederlandse bevolking heeft jaarlijks last van het bewegingsapparaat Dit is dan ook één van de meest voorkomende oorzaken van pijn en ongemak. Als er wordt gekeken naar man-vrouw verschillen in deze klachten blijkt dat vrouwen, vooral voor de nek en de bovenste extremiteiten, meer symptomen rapporteren, en vaker vanwege deze klachten verzuimen van hun werk. Dit verschijnsel is niet specifiek voor Nederland, maar lijkt een wereldwijd probleem te zijn. Hoewel klachten aan het bewegingsapparaat door (een combinatie van) meerdere oorzaken kunnen ontstaan is een grote rol weggelegd voor de blootstelling aan risicofactoren op het werk. Het doel van dit proefschrift is daarom om uit te zoeken in hoeverre man-vrouw verschillen in de prevalentie van (ziekteverzuim vanwege) klachten aan het bewegingsapparaat worden veroorzaakt door verschillen in blootstelling aan (werkgerelateerde) risicofactoren.

In de hoofdstukken 2 en 3 is gekeken of mannen en vrouwen in gelijke mate worden blootgesteld aan risicofactoren op het werk. Hiervoor is gebruik gemaakt van gegevens van de Study on Musculoskeletal disorders, Absenteeism Stress and Health (SMASH). Aan deze studie, die was opgezet om risicofactoren voor klachten aan het bewegingsapparaat te bepalen, deden ongeveer 1800 werknemers uit 34 bedrijven mee. Van deze mensen werden op de baseline (1994) en tijdens drie jaarlijkse follow-up metingen gegevens over hun sociaaldemografische situatie, blootstelling en klachten verzameld. Bovendien werd van een deel van de deelnemers video-opnames op het werk gemaakt.

Voor hoofdstuk 2 werden de baseline vragenlijsten van 491 mannen en 342 vrouwen, die in een baan met minimaal 10 mannelijke en 10 vrouwelijke werknemers werkten, geanalyseerd om te kijken of mannen en vrouwen met *dezelfde baan* ook dezelfde blootstelling aan werkgerelateerde risicofactoren rapporteerden. De resultaten lieten zien dat blootstelling aan risicofactoren voor rugklachten bij assemblagemedewerkers vaker voor kwam bij mannen, terwijl bij kantoorpersoneel de blootstelling soms hoger was voor vrouwen en soms voor mannen. Blootstelling aan risicofactoren voor klachten aan de bovenste extremiteiten werden daarentegen vaker gerapporteerd door vrouwelijke kantoormedewerkers, terwijl bij de assemblagemedewerkers soms de mannen en soms de vrouwen een hogere blootstelling rapporteerden. Blootstelling aan fysieke risicofactoren voor de bovenste extremiteiten werd tenslotte vaker door vrouwelijke kantoormedewerkers gerapporteerd, terwijl bij de assemblagemedewerkers sommige risicofactoren vaker door vrouwen en andere vaker door mannen werden gerapporteerd. Ten aanzien van de psychosociale risicofactoren gaven mannen aan meer regelmogelijkheden te hebben, terwijl vrouwelijke assemblagemedewerkers meer taakeisen rapporteerden. Maar vrouwen gaven ook aan vaker tevreden te zijn met hun werk, iets wat zowel bij kantoorwerkers als assemblagemedewerkers werd gevonden. Concluderend leek dit te betekenen dat mannen en vrouwen met dezelfde baan niet in gelijke mate worden blootgesteld aan werkgerelateerde risicofactoren, maar in het algemeen was het niet duidelijk wie er nu precies een hogere blootstelling had.

In hoofdstuk 3 werd verder gekeken naar blootstellingsverschillen tussen mannen en vrouwen. In dit hoofdstuk werden verschillen tussen mannen en vrouwen die *dezelfde taak* uitvoerden bekeken. Hiervoor werden zes taakgroepen, waarin minimaal 2 mannen en 2 vrouwen werkzaam waren, geselecteerd, en video-opnames van 37 mannelijke, en 43 vrouwelijke werknemers geobserveerd. Op basis van deze video observaties werd de duur en frequentie van blootstelling aan belastende houdingen berekend. De resultaten lieten zien dat mannen en vrouwen niet significant verschilden in duur of frequentie van blootstelling aan belastende houdingen. Hoewel ook blijkt dat als de gegevens werden geanalyseerd aan de hand van Exposure Variation Analyses (EVA) matrices, waarin duur, frequentie en intensiteit van de blootstelling gelijktijdig werden meegenomen, mannen en vrouwen wel iets verschillende blootstellingspatronen leken te hebben. Als de geobserveerde blootstelling daarnaast werd vergeleken met de zelfgerapporteerde blootstelling bleek bovendien dat werknemers een hogere blootstelling rapporteerden dan werd gemeten. Dit verschil tussen gerapporteerde en gemeten blootstelling leek groter te zijn bij mannen dan bij vrouwen. De uiteindelijke conclusie van dit hoofdstuk was dan ook dat als er al verschillen in blootstelling aan belastende werkhoudingen zijn, deze uiterst klein zijn, en dat het onwaarschijnlijk is dat deze verschillen van grote invloed zijn op het man-vrouw verschil in klachten aan het bewegingsapparaat.

De invloed van man-vrouw verschillen in zowel sociaal demografische variabelen, werkgerelateerde blootstelling als privé blootstelling op het ontstaan van (ziekteverzuim wegens) klachten aan het bewegingsapparaat werd bekeken in hoofdstuk 4. Ook nu werden data van de SMASH studie gebruikt, maar voor deze analyses werden alle follow-up metingen gebruikt, en werd door middel van een logistische Generalized Estimation Equations (GEE) regressieanalyse de relatie tussen klachten, geslacht, en blootstelling één jaar voor het ontstaan van de klachten bekeken. De resultaten lieten zien dat vrouwen een significant hogere kans hadden op zelfgerapporteerde klachten van de nek (Odds Ratio (OR)=2,70), schouder (OR=2,30) en hand-arm (OR 1,61). Bovendien hadden zij een grotere kans om te verzuimen van het werk wegens nek-schouder-arm-hand klachten (OR 1,60). Voor (verzuim wegens) rugklachten werd daarentegen geen enkel significant verschil gevonden. Deze resultaten bleken over het algemeen niet te veranderen als in de analyse werd gecorrigeerd voor verschillen in sociaaldemografische kenmerken of blootstelling aan risicofactoren. De conclusie was dan ook dat in ieder geval een deel van het man-vrouw verschil in deze populatie aan andere factoren dan verschillen in blootstelling tussen mannelijke en vrouwelijke werknemers te wijten moet zijn.

In de hoofdstukken 5 en 6 werd onderzocht of het effect van werkgerelateerde risicofactoren verschillend is voor mannen en vrouwen. In hoofdstuk 5 werd aan de hand van de bestaande literatuur bekeken hoeveel bewijs er was voor een man-vrouw verschil in het effect van blootstelling aan een selectie van risicofactoren op het ontstaan van klachten. Door middel van elektronische databases, checken van referenties en persoonlijke literatuurbestanden werd de literatuur doorzocht, en werden 14 studies over rugklachten, 9 over nek-schouder klachten, 4 over hand-pols klachten en 4 over klachten van de onderste extremiteiten en in de analyses gebruikt. Uit de resultaten bleek dat mannen vaker dan vrouwen rugklachten kregen door te tillen, en vaker hand-arm klachten vanwege blootsteling aan hand-arm trillingen. Vrouwen hadden daarentegen een grotere kans dan mannen op het krijgen van nek-schouder klachten als gevolg van blootstelling aan oncomfortabele arm houdingen. Er werd geen bewijs gevonden voor een man-vrouw verschil voor het effect van steun uit de sociale omgeving op het ontstaan van rug- en nek-schouder klachten, terwijl voor alle overige risicofactoren de resultaten uit de literatuur niet eensluidend genoeg waren om te kunnen concluderen of er een man-vrouw verschil is.

In hoofdstuk 6 werden man-vrouw verschillen in het effect van blootstelling aan werkgerelateerde risicofactoren bekeken in de SMASH data. Hiervoor werden gender ratio's (GR) berekend, waarbij een GR hoger dan 1,33 (groter risico voor vrouwen) of lager dan 0,75 (groter risico voor mannen) als een relevant verschil werd beschouwd. Voor het merendeel van de risicofactoren (16 van de 22) werd geen relevant man-vrouw verschil gevonden voor de relatie tussen blootstelling en klachten. Als er al een verschil werd gevonden was de kans op klachten meestal hoger voor mannen dan voor vrouwen (range GR 0,50-0,68). Alleen het buigen van de pols, en het achterover buigen van de nek was een groter risico voor vrouwen (GR 1.52 respectievelijk GR 2,55). De kans op verzuim was groter voor vrouwen als gevolg van het draaien van het bovenlichaam, werken in oncomfortabele houdingen, draaien van de pols, achterover buigen van de nek, het (niet) krijgen sociale steun van collega's en chef (GR range 1,66-2,63). Voor het effect van blootstelling aan het besturen van voertuigen, hand-arm trillingen, knijpen, werken met de handen boven schouder of onder kniehoogte, rijken, draaien van de nek, hoge taakeisen en beperkte vaardigheidsmogelijkheden gold echter dat mannen hiervan vaker klachten kregen dan vrouwen. De resultaten voor het effect van werktevredenheid waren niet duidelijk met een GR van 0,50 voor verzuim wegens rugklachten, en een GR van 1,78 voor verzuim vanwege nek-schouder-hand-arm klachten.

Als de resultaten van de hoofdstukken 5 en 6 worden gecombineerd blijft er alleen voor de relatie tussen tillen en rugklachten bewijs dat mannen een grotere kans hebben op het ontstaan van rugklachten als gevolg van tillen. Zowel voor het effect van blootstelling aan taakeisen als regelmogelijkheden op het ontstaan van nek-schouder klachten, als voor de relatie tussen sociale steun en zowel nek-schouder als hand-arm klachten werd geen bewijs voor een man-vrouw verschil gevonden, terwijl voor de overige risicofactoren er geen eensluidend antwoord gevonden werd. Samen laten hoofdstuk 5 en 6 dan ook zien dat er nauwelijks bewijs te vinden is voor een man-vrouw verschil in het effect van blootstelling aan werkgerelateerde risicofactoren, en dat vrouwen niet of nauwelijks kwetsbaarder zijn voor het effect van blootstelling.

Hoe werknemers de stap van werken (met bewegingsapparaatklachten) naar verzuimen vanwege die zelfde klachten nemen werd in hoofdstuk 7 onderzocht. Dertig werknemers (16 mannen en 14 vrouwen) die verzuimden wegens een klacht aan het bewegingsapparaat, en verwachtten dat het verzuim meer dan 2 weken zou duren, werden geïnterviewd over de redenen waarom zij waren gaan verzuimen. De resultaten lieten zien dat er twee groepen werknemers, elk met een ander besluitvormingsproces, waren te onderscheiden. Ten eerste, werknemers die verzuimden vanwege een gediagnosticeerde klacht, zoals een botbreuk. En ten tweede, werknemers die verzuimden vanwege aspecifieke klachten, zoals lage rugpijn. Werknemers uit de eerste groep verzuimden óf omdat zij in het ziekenhuis lagen, óf omdat ze hun klacht te ernstig vonden om mee te werken. Dit laatste werd soms beïnvloed door adviezen van medici of eerdere ervaringen met operaties. Werknemers in de tweede groep vonden het moeilijker om te beslissen om zich ziek te melden. Zij twijfelden vaak, voelden zich onzeker, en vonden het moeilijk om te beoordelen of verzuim gerechtvaardigd was. Zij besloten daarom óf om op zeker te spelen, en zich ziek te melden zodat de klachten niet zouden verergeren, óf om medisch advies in te roepen. En hoewel dit advies zelden een specifieke instructie om te verzuimen bevatte, werd het over het algemeen wel als zodanig geïnterpreteerd. Tenslotte werd bij vrouwen, maar niet bij mannen, gevonden dat zij zich ziek meldden als ze het gevoel hadden dat hun thuissituatie negatief beïnvloed werd wanneer zij ondanks hun klachten probeerden te blijven werken.

Tenslotte worden in hoofdstuk 8 alle resultaten samengevat en in een breder perspectief bediscussieerd. De conclusie is dat, op basis van de resultaten uit dit proefschrift, het onwaarschijnlijk is dat man-vrouw verschillen in het risico op (ziekteverzuim vanwege) klachten aan het bewegingsapparaat, volledig verklaard kunnen worden door man-vrouw verschillen in blootstelling aan werkgerelateerde risicofactoren of het effect van deze risicofactoren. Op basis van de literatuur lijkt het mogelijk dat biologische verschillen tussen mannen en vrouwen kunnen verklaren waarom vrouwen meer pijn ervaren. Bovendien kunnen verschillen tussen mannen en vrouwen in sociale waarden mogelijk verklaren waarom vrouwen vaker pijn rapporteren, en op een andere manier met de pijn om gaan dan mannen. Tenslotte lijkt het mogelijk om de manier waarop iemand met pijn omgaat te beïnvloeden, hetgeen een positief effect zou kunnen hebben op de pijn ervaring van vrouwen. Toekomstig onderzoek zou daarom gericht moeten zijn op de relatie tussen sociale waarden en coping gedrag ten aanzien van pijn, en de mogelijkheden om dit te beïnvloeden. Hierbij moet echter wel worden opgemerkt dat verschillen in sociale waarden tussen mannen en vrouwen al aan het veranderen zijn. Het zou kunnen dat man-vrouw verschillen in klachten aan het bewegingsapparaat hierdoor op termijn vanzelf verminderen.

Dankwoord

" Er is geen moeilijkere taak dan goed te bedanken "
Gilles Ménage

Na 5 jaar, en ruim 150 pagina's proefschrift zou het schrijven van een dankwoord toch niet zo moeilijk moeten zijn. Maar is minder waar, want met de vraag wie te bedanken volgt ook automatisch de vraag en wie dus niet. Daarom zonder te pretenderen volledig te zijn, en in alfabetische volgorde:

Bedankt

Allard – Annemieke – Bonne – Bregje – David – Deelnemers – Dirk Knol – dr. A.De Rijk – dr. S.Geurts – Familie – Han – Hidde – Ilja – Ivan – Laura Punnett – Lex Burdorf- Marjan – Martijn – Monique – Myrthe – Oma – Pake – Paul – Paulien – prof.dr. J.W. Groothoff – prof.dr. M.H.W.Frings-Dresen – prof.dr. T.Lagro-Janssen – prof.dr.ir. H.C.W de Vet – Robin – SG Collega's – Stefan – Vrienden - Willem

Bedankt voor

Aandacht – Altijd weer krantenknipsels – Belangstelling – Een schouder om op uit te huilen – Even vragen hoe het er mee gaat – Geduld – Inhoudelijke steun – Inspiratie – Jullie tijd – Kletspraatjes – Knuffeltjes in de ochtend – Kopjes thee – Kritische correcties – Lachjes midden in de nacht – Leesbaar commentaar – Meedenken – Mogelijkheden zien – Motivatie – Niet zeuren als ik weer een afspraak afzeg – Onbegrijpelijke statistische analyses – Onleesbaar commentaar – Onvoorwaardelijk in me geloven – Paranimf zijn – Praktische steun – Samen mopperen – Steeds weer dezelfde spelfouten verbeteren – Sturing – Telkens weer oppassen – Uitleg – Verbeteringen – Vertrouwen – Wijze woorden – Zinnige gesprekken – Zorgen dat ik niet té veel op ga in het werk.

Bedankt voor alles

Zonder jullie had het nooit zo'n mooi boekje geworden.

Wendela

About the Author

Wendela Hooftman (1977) was born and raised in Haarlem, the Netherlands. After finishing grammar school at the Stedelijk Gymnasium in Haarlem, she went abroad, and spend a year in Mississippi, USA. Upon return in 1996 she started to study at the Faculty of Human Movement Sciences of the Vrije Universiteit in Amsterdam. She obtained her Masters in 2001, after which she started working as a PhD student at the Institute for Research in Extramural medicine (EMGO institute), where she conducted a study on gender differences in work-related risk factors for musculoskeletal symptoms and absenteeism. During her PhD studentship she attended courses in statistics and epidemiology at the Postgraduate Epidemiology Programme (POE) of the EMGO institute, and the Netherlands School of Primary Health Care. Furthermore she attended courses on qualitative research at the Radboud University in Nijmegen.