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Low back pain in a general population

Care seeking behaviour, lifestyle factors and methods of exposure assessment

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Original papers

This thesis is based on the following papers, which will be referred to in the text by their Roman numerals (I-V)

I. Mortimer M, Ahlberg G, and MUSIC-Norrtälje study group. To seek or not to seek, care seeking behaviour among people with low-back pain. (Submitted)

II. Vingård E, Mortimer M, Wiktorin C, Pernold G, Fredriksson K, Alfredsson L, Németh G and MUSIC-Norrtälje study group. Care-seeking for low-back pain in a general population a two-year follow-up study. (Submitted)

III. Mortimer M, Wiktorin C, Pernold G, Svensson H, Vingård E and MUSIC-Norrtälje study group. Sports activities, body weight and smoking in relation to low- back pain, a population-based case referent study. *Scandinavian Journal of Medicine & Science in Sports*, 2001, 11:178-184.

IV. Mortimer M, Wigaeus Hjelm E, Wiktorin C, Pernold G, Kilbom Å, Vingård E and MUSIC-Norrtälje study group. Validity of self-reported duration of work postures obtained by interview. *Applied Ergonomics* 1999; 30:477-486.

V. Wiktorin C, Vingård E, Mortimer M, Pernold G, Wigaeus Hjelm E, Kilbom Å, Alfredsson L and MUSIC-Norrtälje study Group. Interview Versus Questionnaire for Assessing Physical Loads in the Population-Based MUSIC-Norrtälje Study. *American Journal of Industrial Medicine* 1999; 35:441-455.

Abbreviations

BMI	Body mass index
LBP	Low-back pain
MET	Metabolic unit
OR	Odds ratio
RR	Relative risk
SLR	Straight leg raising
VDU	Visual display unit
WHO	World Health Organisation

Contents

Introduction

Magnitude of the problem

Low-back pain (LBP) is a common condition affecting most people sometime during their life. The lifetime prevalence reported in different studies from different countries varies from 10 per cent to 80 per cent. In surveys from Statistics Sweden in 1997, 32 per cent men aged 16-84 years reported current low-back pain and the corresponding figure for women was 38 per cent. Similar figures are reported in other studies (Svensson & Andersson 1982, Biering-Sörensen et al. 1983, Svensson et al. 1988, Brattberg et al. 1989, Heliövaara et al. 1989, Skovron et al. 1994, Carey et al. 1996, 1999, 2000, Hillman et al. 1996, Leboeuf-Yde et al. 1996, Linton et al. 2001). Low-back disorders cause pain and disability and have an enormous economic impact, mainly in indirect costs, as they are so common. Costs of low back and neck pain in Sweden have been calculated to be approximately 1.7 per cent of the Swedish gross national product (Norlund & Waddell 2000). The prevalence of LBP has remained high for some decades and there are also reports on increased prevalence (Croft & Rigby 1994, Waddell 1998, Persson 2001).

Anatomy

The spinal column contains of seven cervical, twelve thoracic and five lumbar vertebrae held together and stabilised by ligaments and muscles, which support and protect the spinal cord. A spinal segment consists of two vertebrae, an intervertebral disc, and two nerve roots that leave the spinal cord, one from each side. The inter-vertebral disc is composed of the annulus, a ring of collagenous fibres that surrounds the nucleus pulposis, a gel-like substance that absorbs the pressures transmitted throughout the spine. The discs are held in the disc space by longitudinal ligaments as well as fibres attached to the vertebral endplate. The posterior part of the vertebra consists of two transverse processes, two facet joints and a spinous process. The facet joints, with a synovial lining and joint capsule, allow the vertebrae to be linked like a chain. They also prevent rotation in the lumbar spine. The transverse processes of the vertebrae provide attachments for muscles to the spine.

Spinal nerves leave the spinal cord from each side and contain both sensory and motor fibres. There are four major groups of muscles. 1) the erector spinae muscles of the back and the lumbar region, a very large muscle mass 2) the transversospinalis (multifidus and the rotatores) group which lie deep to the erector spinae muscle 3) the interspinalis muscles and 4) the intertransversalis muscles. All the muscles in the spine work in synergy to move and to stabilise the spine and the trunk.

Low-back pain

Low-back pain as diagnosis only states that a subject suffers from pain localised in the lower back region. The pain can be concentrated to the lower back region or radiate. Primarily, most surveys define *lumbago* as pain occurring between the costal margins and the gluteal folds, sometimes with radiating pain in the buttock and thigh but not below the knee.

Sciatica is defined as radiating pain following a dermatomal pattern. The pain radiates below the knee and often down to the foot and toes. There may also be signs of numbness and reduced muscle strength. There could also be pain in or from the lumbar region.

Secondly, depending on the duration of the pain, low-back pain can be classified as acute back pain, 0-3 weeks duration, sub-acute back pain 4-12 weeks duration and chronic back pain, more than 12 weeks duration (Deyo et al. 1998, Nachemson et al. 2000).

The natural course of back pain varies from transient, recurrent or chronic (von Korff et al. 1994, 1996). Low-back pain recurs in as many as 60-85 per cent of patients (Shelerud 1998). It can therefore also be classified into acute, recurrent or chronic (Wadell 1998).

Pain in the low-back region may be caused by diseases or functional disorders of any of the structures – vertebrae, discs, facet joints, nerves, ligaments tendons and muscles – within or associated with the spinal column. The pain may arise from any structure that contains nerve endings (nociceptors) i.e. *nociceptive* pain. However, these receptors require noxious intensities of stimulation in order to inform the central nervous system (Carlsson & Nachemson 2000). *Neurogenic* pain is a result of injury or damage in the peripheral or central nervous system. Pressure on a nerve root such as from a herniated disc is considered as common neurogenic pain.

Only 15 per cent of patients seeking care for low-back pain get a diagnosis based on pathology. The main diagnoses based on pathology are herniatied discs, spinal stenosis, severe degenerative discs, spondylolisthesis, inflammatory diseases such as Mb Bechterew, fractures, osteoporosis, infections and tumours.

Although serious spinal diagnoses are rare, as many as 40 per cent of patients with low-back pain worry that they may become crippled or that they have a serious disease (Waddell 1998).

Pain and disability are subjective personal experiences, and cannot be measured objectively. By definition, pain is an unpleasant and emotional experience associated with actual or potential tissue damage, or described in terms of such damage (Merskey 1979).

Patients seeking care for low-back pain also often report disability. Disability is any restriction or lack (resulting from impairment) of ability to perform an activity in the manner or within the range considered normal for human beings (World Health Organisation 1980). However, disability also depends, on the individual’s effort to perform activities, which in turn depends on psychological and social processes (Fordyce 1997).

Care-seeking behaviour

Of all people experiencing low-back pain, some do and some do not seek care for their problems. A positive relationship between high pain intensity with or without disturbed daily activities and seeking care are noted in some studies (Carey et al. 1995, 1996, 2000, Hillman et al. 1996, van den Hoogen et al. 1997, Molano et al. 2001) but not in others (Cameron et al. 1993). In some studies, subjects with either numerous previous pain episodes or suffering from chronic low-back pain were reportedly less likely to seek care (Carey et al. 1996, 2000). In contrast, Hillman et al. (1996) noted that the longer the duration of LBP the greater the likelihood of consulting. Stressful work, strain, and individual psychological factors were positively related to health-care use in some studies (Croft et al. 1995, Manning et al. 1996, van den Hoogen et al. 1997). However, physical workload, was not important for seeking care for LBP in a study by Carey et al. (1996). Financial position may also be of importance. In one study by Elofsson et al. (1998), nearly every fourth person had forgone seeking care due to the cost. In contrast, Carey et al. (1996) noted that care is often sought regardless of income. Life-style factors such as sports activities, smoking, and overweight have been less studied in relationship to consulting for low-back pain.

Many types of treatment to alleviate low-back pain are given by various kinds of caregivers. Some caregivers, e.g. physicians and physiotherapists, work in public or in private practice, and are all licensed and evaluated by the official authorities. Among the chiropractors and naprapaths some are licensed and some not. There are also therapists whose methods are not described, controlled or licensed by anybody, but who still attract a substantial number of patients. Our knowledge of where patients seek care and how many visits they use for recovery is incomplete.

Molano et al. (2001) noted that chronicity, pain intensity, perceived disability, sciatic pain and back pain with sickness absence prompted workers to visit their general practitioner. A similar pattern was observed for visiting a physiotherapist. These authors also noted that age, years at work, education, physical or psychosocial working conditions were not associated with care seeking.

Etiology

Several models have been developed to present possible pathways to the development of musculoskeletal disorders. Some models focus mainly on biomechanical loads other on more psychosocial aspects. The National Research Council (1999) outlined a broad conceptual model (Figure 1), indicating possible factors that might affect the development of musculoskeletal disorders.

There is clear evidence that low-back pain disorders are related to certain physical and psychosocial working conditions as well as to individual factors (Putz-Anderson et al. 1997, Burdorf & Sorock 1997, Vingård & Nachemson 2000, Hansson & Westerholm 2001). For low-back pain most published studies on physical loads report an association between whole-body vibrations and low-back pain (Vingård & Nachemson 2000, Hansson & Westerholm 2001). A positive association between work in strenuous postures has also been reported (Punnett et al. 1991, Riihimäki 1991, Burdorf 1992a, b, Holmström et al. 1992, Burdorf 1993, Liira & Shannon 1996).

Not only work-related factors but also lifestyle factors and individual factors outside work may be of interest when studying risk factors for low-back pain in the general population. The effect of individual factors outside work and sports activities has been less studied in comparison with studies on working conditions.

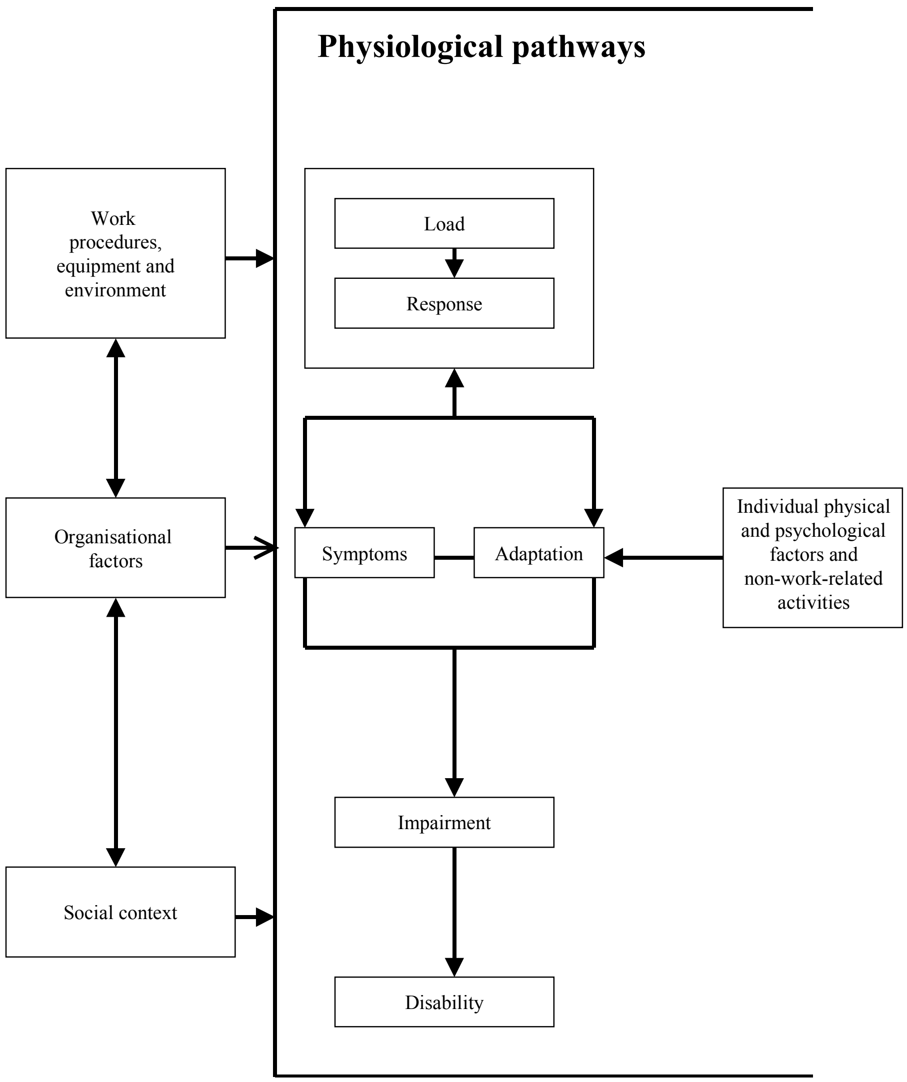

Figure 1. Conceptual framework of physiological pathways and factors that potentially contribute to musculoskeletal disorders (Adapted with permission fromWork Related Musculoskeletal Disorders. Copyright 1991 by the National Academy of Sciences. Courtesy of the National Academy Press, Washington).

Lifestyle factors

Sports activities

Health care providers often recommend sports activities for the prevention of low-back pain. The intention is to increase muscle strength and endurance in the structures stabilising the spine and also to enhance the metabolism in order to facilitate the healing of injured structures. However, results conflict regarding the preventive effect of sports activities on low-back pain (Plowman 1992, Campello et al. 1996, Mälkiä & Ljunggren 1996, Hoogendoorn et al. 1999, Hildebrandt et al. 2000). Positive effects of leisure-time activities in relation to low-back pain have been reported in some studies (Cady et al. 1979, Leino 1993, Videman et al. 1995, Harreby et al. 1997) whereas no such effects have been reported in others (Saraste & Hultman 1987, Kujula et al. 1996, Barnekow-Bergkvistet al. 1998).

Results also conflict as to whether subjects who exercise will recover from low-back pain more rapidly than those who do not (Evans et al. 1987, Lindström et al. 1992 a, b, Malmivaara et al. 1995, Macfarlane et al. 1996, Waxman et al. 2000). In Table 1, the findings from studies on sports activities and low-back pain are summarised.

Body weight

A possible relationship between high body weight (obesity) and low-back pain is reasonable since the spine must support a larger amount of fat, which may increase pressure on the discs and/or other structures. In a recent review on body weight and low-back pain, the author noted that thirty-two per cent of all the studies reported a significant positive weak association between body weight and LBP (Leboef-Yde 2000).

However there are conflicting results on the relationship between high body weight and low-back pain (Table 2). Thus, despite several studies, further research is necessary before a possible link between high body weight and low-back pain can be demonstrated.

Smoking

Smoking as a risk factor for low-back pain and sciatica has been extensively discussed. One plausible mechanism to explain the association between smoking and low-back pain is diminished blood flow affecting the nutrition to the disc (Holm & Nachemsson 1984, Ernst 1993). Another is lowered pH of the disc (Hambly & Mooney 1992). Further, decreased mineral content leading to osteoporosis (Daniell 1976, Hansson 1981) and altered fibrinolytic activities leading to reduced blood flow and increased degenerative changes of the spine have been discussed (Kelsey et al. 1984, Battié et al. 1991).

A positive association between smoking and low-back pain has been reported in some studies but not in others (Table 3). Any association between smoking and low-back pain must be interpreted with caution since most studies are cross-sectional. In a recent review, Goldberg et al. (2000) noted that the majority of cross-sectional studies showed positive association between low-back pain and current smoking but the association in the prospective studies was not consistent. More prospective studies are needed to investigate a possible link between smoking and low- back pain.

Table 1. Epidemiological studies on the effects of sports activities on low-back pain

Study	Design	Population and gender study	Outcome	Exposure	Confounders adjusted for	Results (OR, RR, p-value)
Cady et al. 1979	Prospective	1652 fire-fighters	Subsequent back injuries	Fitness		Graded and significant protective effect for increasing levels of fitness and conditioning
Saraste and Hultman 1987	Cross-sectional	2872 men and women 30-59 years of age	Low back pain	Physical exercise during leisure time	Age and sex	No association
Burton and Tillotson 1991	Cross-sectional	958, age 10-84	Low back trouble	Leisure sport		Sport/leisure time do not represent major risk factor for low back trouble
Leino 1993	Cohort 5 year follow up	Metal industry blue-white collar 607 men and women	Low back disorder	Leisure time physical activity, exercise	Age sex, occupational class	Modest inversely linear association between leisure time and LBP
Croft et al. 1993	Cross-sectional	4504 18-75 years of age	Low back pain	Sports		No association with specific activities
Riihimäki et al. 1994	Prospective cohort	Male machine operators, Carpenters, office workers	3-year incidence of sciatic pain	Weekly physical exercise more than once a week	Age, smoking occupation, history of low back problems	RR 1.3 (1.0-1.6) p-value 0.6
Niedhammer et al. 1994	Prospective cohort	465 nurses	LBP last year	Sports activities	Age, smoking, children, work,	Non- significant
Videman et al. 1995	Historical cohort	937 former athletes (men) 620 controls	Back pain, sciatica, disability, spinal pathology	Physical loading, exercise lifestyle	Age, occupational physical loading	1) LBP ORs were all below 1.0 2) Sciatica 1.54 (0.94-2.48)
Kujula et al. 1996	5-year prospective study	456 adults	Back pain past 5 yr Sciatica past 5 yr	Leisure time physical activity, aerobic power, muscle strength	Age, sex	Not predictive of future back pain
Harreby et al. 1997	Cohort	38 year old men and women	LBP	Physical activity 3h/week	Sex, pain history social class, school education	Reduced risk of LBP measured as lifetime, and point prevalence
Barnekow-Bergkvist et al. 1998	Combined cross-sectional longitudinal	148 men 90 women 16, 34 years	Low back Symptoms (pain) ≥ month	Physical activity ≥ once/week	Socio-economic, stress factors, lifestyle factors physical capacity	OR 1.4 (0.5-3.4) men 3.1 (0.8-12.6) women

Table 2. Epidemiological studies on the effects of weight on low-back pain

Study	Design	Population and gender study	Outcome	Exposure	Confounders adjusted for	Results (OR,RR,p-value)
Deyo and Bass 1989	Retrospective cohort	10 404 men and women > 25 years of age	Pain in the low back > 2 weeks last year	BMI quintiles	Age and sex	Increasing prevalence back pain with increasing obesity
Rihhimäki et al. 1989	5-year follow- up	167 construction workers, 161 painters	Sciatica	BMI >= 28 21 % BMI >= 28	Age	No association
Heliövaara et al. 1991	Mini- Finland cross-sectional health survey	Randomised sample of Finnish men and women 30-64 years old 3156 men and 2946 women	1. Sciatica 2. Low back symptoms	BMI Or per increase of 10 kg/m^2	Sex, age, BMI, trauma, occupational, physical and mental stress, vehicle driving, alcohol consumption, number of births for women	1. OR 1.1 (0.8-1.4) 2. OR 1.1 (0.9-1.3)
Pietri et al. 1992	Cross-sectional	1376 men, 343 women commercial travellers	1.LBP last 12 months 2. 1-year cumulative incidence	BMI	Gender, age,carrying, psychosomatic score, occupation by design	1.4 (1.1-1.7)
Bigos et al. 1992	Prospective study	3020, Aircraft industry	Back injury, reporting at work	Weight	Height	No association
Zwerling et al. 1993	Case control	Postal workers	Low-back injuries	BMI >= 30	Height	1.4 (0.9-2.1)
Leino 1993	Prospective study industrial cohort	607 men and women from metal factories followed at year 0, 5 and 10	Low-back morbidity in clinical Examination 4-graded scale	BMI	Exercise. Low back findings at year 0, age, occupational class, BMI, stress symptoms	Non significant

Table 2. continued

Study	**Design**	**Population and gender study**	**Outcome**	**Exposure**	**Confounders adjusted for**	**Results (OR, RR, p-value)**
Niedhammer et al. 1994	Cross-sectional	465 nurses	LBP last year	BMI	Age, children, smoking, symptoms of psychological disorder, psychosocial and physical factors at work	Non significant
Croft et al. 1994	Cross-sectional	9003 >= 18 years of age	Self-reported back pain last months	BMI	Age	BMI >27.3 versus ≤ 21.0 1. Women OR 1.4 (1.2-1.8) 2. Men OR 1.2 (0.9 –1.7)
Wright et al. 1995	Cross-sectional	General population Adults >= 18 yr	LBP past year Consultations for LBP	BMI	Age, sex, BMI, psychiatric morbidity, alcohol, living alone, daily activities	Obesity 1.6 (1.4-1.8)
Manninen et al. 1995	Prospective cohort	366 farmers followed for 12 years	One-year prevalence of 1. Sciatic pain 2. LBP	BMI	Age, height, BMI, type of farm production, mental stress score, joint pain	1. 0.98 (0.55 -1.77) 2. 0.96 (0.64-1.43)

Table 2. continued

Study	Design	Population and gender study	Outcome	Exposure	Confounders adjusted for	Results (OR, RR, p-value)
Shekelle et al. 1995	Prospective	Population-based study, 3105	Episodes of back-pain care	BMI		No association
Liira et al.1996	Cross-sectional	38 540, 16-64 years of age	Long-term back problems	BMI	Age, sex, occupation and physical exposure index	1.6 (1.2-2.0)
Magnusson et al. 1996	Cohort 365 men	1. truck drivers 2. bus drivers 3. sedentary workers (ref group)	Low-back pain	Brocas index		No association
Kujula et al. 1996	5-year prospective study	456 adults	Back pain past 5 yr Sciatica past 5 yr	BMI (mean value)	Age, sex	No association
Skov et al. 1996	Cross-sectional	1306 Sales people	LBP last year	Weight	Driving, sedentary work, social contact, height, age, tendency to feel overworked	No association
Han et al. 1997	Cross-sectional	5887 men and 7018 women 20-60 years of age	1.Low-back pain last 12 months 2. Sciatica	BMI	Age, smoking and education	1. 1.2 (1.1-1.4) women 1.1 (1.0-1.3) men 3. 1.4 (1.2-1.6) women 1.2 (1.0-1.5) men
Matsui et al. 1997	Cross-sectional	2517 men 525 women	Low-back pain	BMI > 25 men BMI > 24 women	Age, job classification, family history	OR men 1.0 (0.8-1.2) women 1.3 (0.8-2.2)
Smedley et al. 1997	Prospective cohort	961 female nurses	Incidence of new LBP during a 2 year follow up	1.Weight 2. BMI	Age, height, pain history	No association No association
Barnekow-Bergkvist et al. 1998	Combined cross-sectional longitudinal	148 men 90 women 16-34 years of age	Low back symptoms (pain) >=1/month	BMI ≥ 20 (at the age of 16)	Socio-economic, stress factors, lifestyle factors physical capacity	OR 0.5 (0.2-1.6) men 0.3 (0.1-1.2) women

Table 3. Epidemiological studies on the effects of smoking on low-back pain

Study	Design	Population and gender study	Outcome	Exposure	Confounders adjusted for	Results (OR,RR,p-value)
Rydén et al. 1989	Case-control	84 cases of occupational back injury and 168 controls	Occupational injury of LBP	1. Cigarette smoking or not 2. Cigarette smoking in increasing doses	Matched on age, sex and hospital departments	1. 0.82 (0.04-1.70) 2. No trends
Deyo and Bass, 1989	Retrospective cohort	10 404 men and women > 25 years of age	Pain in the low back > 2 weeks last year	Pack-years of smoking in seven categories	BMI, chronic cough, currently employed or not, education, usual daily activity	1. OR 1.05 for each pack year category 2. OR 1.36 for non-smokers versus 50 pack years
Heliövaara et al. 1991	Mini- Finland Cross-sectional health survey	Randomised sample of Finnish men and women 30-64 years old 3156 men and 2946 women	1. Sciatica 2. Low back symptoms	Smoking $\geq$ 20 cig/day	Sex, age BMI, trauma, occupational physical and mental stress, vehicle driving, alcohol consumption, number of births for women	1. 1.1 (0.7-1.06) 2. 1.5 (1.1-2.1)
Battié et al. 1991	Matched twin study	20 pairs of twins	Disc degeneration on MRI, disc signal intensity, disc height	One twin smoker the other one non-smoker	Occupational exposure, leisure time activities, chronic bronchitis, blood pressure, blood lipids, weight	p= < 0.02
Holmström et al. 1992	Cross-sectional	1773 construction workers	1. LBP 2. severe LBP	Smokers	Age-adjusted	PRR 1.07 (0.97-1.18) PRR 2.67 (2.0-3.4)

Table 3. continued

Study	Design	Population and gender study	Outcome	Exposure	Confounders adjusted for	Results (OR,RR,p-value)
Pietri et al.1992	Cross-sectional	1376 men, 343 women commercial travellers	1.LBP last 12 months 2. 1-year cumulative incidence	Smokers and ex - smokers Smokers and ex- smokers	Gender, age, carrying, psychosomatic score, occupation by design	1.OR 1.4 (1.1-1.7) 2. OR 1.3 (0.8-2.1)
Leino 1993	Prospective study industrial cohort	607 men and women from metal factories followed at year 0,5 and 10	Low back morbidity in clinical examination 4-graded scale	Average number of cigarettes each day	Exercise. Low-back findings at year 0, age, occupational class, BMI, stress symptoms	NS
Boshuizen et al.1993	Cross-sectional health survey	4054 men 25-55 years old in 13 occupations (at least 100 p in each group)	Regular pain or stiffness in the back	Non-smokers , ex-smokers, current smokers	Working conditions, physical exercise, mental health, age	No significant difference between smokers and non-smokers in the 13 occupational groups
Riihimäki et al. 1994	Prospective cohort	Male machine operators, carpenters, office workers	3-year incidence of sciatic pain	Smokers versus non-smokers and ex-smokers	Age, occupation, car-driving, physical exercise, occupational exposure, history of low back problems	RR 1.3 (1.0-1-7)
Croft et al. 1994	Cross-sectional	General population 5098 women 3905 men	Low back pain previous month	Current smokers versus non smokers	Age-adjusted	OR Women 1.4 (1.1-1.5) Men 1.3 (1.1-1.7)

Table 3. continued

Study	Design	Population and gender study	Outcome	Exposure	Confounders adjusted for	Results (OR,RR,p-value)
Bovenzi & Betta, 1994	Cross-sectional	1155 tractor drivers	Chronic LBP	Smoking no/yes	Age	1.0 (0.75-1.31)
Leboeuf-Yde 1995	Cross-sectional	30-50 year old men and women from the Danish population	1. LBP > 30 days last year 2. LBP < 30 days	Smokers /non smokers	Age, BMI, sex, marital status, physical activity at work	1. OR 2.3 (1.6-3.) unclear if adjusted 2. OR 1.0 (0.7-1.3)
Manninen et al. 1995	Prospective cohort	366 farmers followed for 12 years	One-year prevalence of 1. Sciatic pain 2. LBP	Current smokers versus never smokers	Age, height, BMI, type of farm production, mental stress score, joint pain	1. 9.6(1.7-53.0) 2. 0.71(0.24-2.11)
Toroptsova et al. 1995	Cross-sectional	339 men and 362 women from a machine building factory	LBP lifetime	Smoking > 10 cigarettes per day		OR 1.2 (0.8-1.9)
Wright et al. 1995	Cross-sectional	General population ≥ 18 year, 38.011	LBP past year Consultations for LBP	> 15 cigarettes/day	Age, sex, BMI, psychiatric morbidity, alcohol, living alone, daily activities	OR 1.4 (1.3- 1.6) OR 1.5 (1.4-1.7)
Niedhammer et al. 1994	Prospective cohort	465 nurses	Lumbar pain	Tobacco (yes/no)	Age, children, smoking, symptoms of psychological disorders, psychosocial and physical factors at work	NS

Table 3. continued

Study	Design	Population and gender study	Outcome	Exposure	Confounders adjusted for	Results (OR,RR,p-value)
Smedley et al. 1995	Cross-sectional	2405 nurses	Back pain	1. Smokers 2. Ex smokers	Age, height, non-musculoskeletal symptoms	1. OR 1.2 (0.9-1.5) 2. OR 1.0 (0.8-1.4)
Skov et al. 1996	Cross-sectional	1306 salespeople	LBP past year	1.Exsmokers 2.Current smokers	Driving, sedentary work, social contact, height, age, tendency to feel overworked	1. OR 1.51(1.1-2.1) 2. OR 1.3 (0.9-1.8)
Brage et al. 1996	Cross-sectional	6681 subjects 16-66 years of age national interview survey	Musculoskeletal pain (cervical/upper limbs, back, lower limbs)	1. Smokers, 2. Ex-smokers, versus never smoked	Age, gender, non-musculoskeletal disease, mental stress, workplace factors	1. OR 1.69 (1.45-1.97) 2. OR 1.22 (1.02-1.97)
Liira et al. 1996	Cross-sectional	16-64 years of age 18920 men and women	Long-term back problems	Smoking versus non-smoking	Sex, age, physical work exposure, BMI, occupation (white-collar, blue-collar)	OR 1.55 (1.20-2.00)
Harreby et al. 1997	Cross-sectional	578 38 year old men and women investigated 24 years earlier	Severe LBP	Smoking 16 cig/day for men and 13 cig/day for women	Gender, familial occurrence of back disease, radiological changes in the spine,	Tendency of increased risk of severe LBP for men who smoke more than 16 cig /day among
Erikssen et al. 1997	Cross-sectional	Norwegian health Survey 4490 ≥ 18 years	Intense musculo-skeletal pain last 14 days	Smokers/non smokers	Age, gender, socio-economic status, physical exercise, workplace factors	OR 1.58 (1.24-2.00) $p < 0.001$
Leboeuf-Yde et al. 1998	Cross-sectional	Identical twins	LBP >= 30 days past year	Currently smoking> 10 cig/day sibling versus never smoking sibling	Age, gender, BMI	OR 0.6 (0.3-1.4)
Barnekow-Bergkvist et al. 1998	Combined cross-sectional longitudinal	148 men 90 women 16, 34 years	Musculoskeletal symptoms (pain) >=1/month	Smoking (yes)	Socio-economic, stress factors, lifestyle factors physical capacity	OR Men 1.7 (0.6-5.0) Women. 0.3 (0.1 – 1.2)
Scott et al. 1999	Cross-sectional	General population, 1130 men, 620 men	LBP currently and in past year	Never smokers versus current smokers	Occupation, age, BMI, physical activity,etc	OR Women 1.3 (0.9-1.9) Men 0.9 (0.6- 1.5)
Thorbjornsson et al. 2000	Retrospective nested case control study	General population 484 men and women	Excess risk of low -back pain	Smoking >10 years	Age, work, leisure time	OR 1.3 (0.8-2.0) women

Methods of exposure assessment

The methods for assessing physical exposure should involve quantification of both intensity and time dimensions of potential risk factors (Winkel & Mathiassen 1994). In most studies, exposure has been assessed by classifying the subjects by job titles (Burdorf, 1992, Winkel & Westgaard 1992). The job title has been assumed to be an overall proxy for the occurrence of e.g. strenuous work postures such as forward bending or work with hands above shoulder level. However, exposure levels can vary more between individuals within a certain job title than between different job titles (Burdorf 1992). In these circumstances, the job title is too crude to reflect the exposure. Several methods have been developed during the past few years for quantifying individual physical exposures.

The most commonly used methods for quantifying exposure in epidemiological studies are 1) self-reports 2) observations and 3) technical instruments. The most cost-effective and feasible method to assess exposure in population-based studies is probably self-reports. However, questionnaires designed to quantify the duration of work postures in proportions of a day seem to offer poor or moderate validity (Baty et al. 1986, Rossignol et al. 1987, Dallner 1991, Burdorf & Laan 1991,Wiktorin et al. 1993, Van der Beck et al. 1994, Wiktorin1996 c, Viikari-Juntura et al. 1996, Hansson et al. 2001). On the hypothesis that an interview may give more valid exposure information than a self-administered questionnaire, an interview method for quantitative measurement of physical exposures was developed (Wiktorin et al. 1996a).

When using different observation methods or direct measurements, it is necessary to observe an individual several times or during a longer period, to be able to get representative data over time. The optimal length of each measurement and the number of measurements per subject depend on the variation of the actual exposure for the subject (Burdorf 1992, Winkel & Mathiassen 1994, Burdorf 1995).

The MUSIC-Norrtälje study

The Musculoskeletal Intervention Center (MUSIC)-Norrtälje study was started to investigate different aspects of low back and neck/shoulder pain in a general working population. The design was a case-referent study. The study population of about 17,000 persons comprised all men and women of ages 20 to 59 years, who were living in the municipality and rural district of Norrtälje and not working or studying outside the municipality. The cases consisted of all persons from the study base who sought care or treatment for low back or neck/shoulder pain from any of the approximately 75 caregivers in the area between November 1993 and November 1996. The participation rate of the cases is not known. The caregivers asked their patients if they wanted to participate and according to interviews with the caregivers few subjects refused. The caregivers may have forgotten to ask patients if they wanted to participate, but such forgetfulness would hardly have been selective towards persons with special exposures. The reasons for refusal were usually lack of time, problems with childcare or scepticism to research.

Referents were men and women from the study base, randomly selected in 5-year age intervals. In the referent group, 69 per cent among the women and 68 per cent among the men took part in the entire investigation. Another ten per cent of the women and ten per cent of the men filled out all the questionnaires, but were unable to attend to the clinical examination and interviews. The cases and referents were excluded if they had sought any care for low back or neck/shoulder pain during the previous six months. The study subjects were in total 791 LBP cases, 439 neck/ shoulder cases, and 1,700 referents (Figure 2).

All the cases were followed with a postal questionnaire 3, 6 and 24 months after the baseline investigation.

Results from the MUSIC-Norrtälje study on work-related physical and psycho-social risk factors in association with a new episode of low-back pain and neck/ shoulder pain have recently been reported (Vingård et al. 2000, Wigaeus Tornqvist et al. 2001).

	Total number of subjects in the MUSIC-Norrtälje study									
	LBP cases 342 men 449 women				**Neck/shoulder cases** 125 men 314 women			**Referents** 716 men 984 women		
	Paper									
	I Cross sectional study		II Follow up study		III Case referent study		IV Validity study		V Validity study	
Selection criteria for the different papers	**LBP cases**	**Referents**	**LBP cases**	**Referents**	**LBP cases**	**Referents**	**LBP + N/S cases**	**Referents**	**Cases**	**Referents**
	men/ women	men/ women	men/ women	men/ women	men/ women	men/ women	men/ women	men/ women	men/ women	men/ women
Subjects with self-reported LBP previous 6 months in combination with disability	317/410	287/434								
Subjects who sought care for LBP			342/449							
All subjects who sought care for LBP and LBP referents					342/449	662/948				
Subjects who reported they worked at least 10% of the working day with their hands above shoulder level or below knuckle level								9/11		
Subjects working at least 2 months the preceding 12 months									421/632	610/813

Figure 2. The subjects participating in the MUSIC-Norrtälje study.

Aims of the studies reported in this thesis

The specific aims of the studies were:

- to identify potential differences between subjects who seek care for their low-back pain problems and those who don't with respect to pain intensity, grade of disability, physical or psychosocial working conditions, individual physical and physiological factors, and lifestyle factors,
- to describe patients seeking care for a new episode of low-back pain and to follow them during a two-year period, with respect to pain, disability, care-seeking behaviour and sick leave,
- to study whether sports activities, body weight or smoking in a general population influenced the risk of a new episode of low-back pain,
- to validate interview data concerning duration of work in a stooped position and work with the hands above shoulder level,
- to validate self-administered questionnaire data concerning duration of work in a stooped position, and work with the hands above shoulder level.

Subjects

In all five studies the subjects were individuals from the whole or parts of the study population in the MUSIC- Norrtälje study (Figure 2).

Paper I

The inclusion criteria were: low-back pain cases and referents with self-reported low disability (1-2-disability points) in combination with a low pain intensity score (< 50), i.e. pain grade I according to von Korff et al. (1992). Seven hundred and twenty-seven subjects (cases) who had sought care and 721 subjects (referents) who had not sought care despite their low-back pain fulfilled the inclusion criteria. Thus, 64 cases and 979 referents in the base study did not fulfil the inclusion criteria and were excluded from the study.

Paper II

In this study 449 female cases and 342 male cases that had sought care for LBP were followed by postal questionnaires three months, six months and two years after the baseline investigation. The case ascertainment period was from November 1993 to November 1996, and the follow-up period ended in November 1998. Of all cases in the main study, 83 per cent answered at the two-year follow up and 72 per cent participated in all three follow-ups. For those who did not participate in the two-year follow-up, the mean age was 43.9 (SD 10.21) compared to mean age 41.5 (SD 10.3) among those who participated. There were equally many men and women in the non-responding group.

Paper III

In this study all 449 female and 342 male cases as well as 948 female and 662 male referents were included.

Paper IV

Interview data concerning the duration of work postures was validated in 20 referents recruited from MUSIC-Norrtälje study. The subjects were selected to cover as wide a range as possible of time spent in two strenuous working positions**.** Therefore, subjects who reported working at least ten per cent of the working day in a stooped position or with their hands above shoulder level were asked to participate. The selection to the study lasted from January 1996 to October 1996. Initially 32 subject were asked and agreed to participate. When this study started six subjects declined to participate, three subjects could not be reached in spite of several attempts, one subject was unemployed at the time, one subject was excluded due to night shift, and one subject was participating in another study at the time.

Paper V

The validity of parts of the self-administered questionnaire concerning physical loads was examined in 632 female and 421 male cases and 813 female and 610 male referents. All subjects with a job for least 2 months during the preceding year and with working time exceeding 17 hours per week were included.

Methods

Care-seeking behaviour and lifestyle factors (Papers I-III)

All caregivers in the region, even very untraditional ones, reported their patients to the MUSIC-Norrtälje study. At baseline, each subject completed a questionnaire about background data, disorders, pain intensity level, grade of disability and psychosocial factors before the visit to the MUSIC centre in Norrtälje. At the MUSIC Centre, the subject underwent a clinical examination, a work-task-oriented interview about present physical loads, a self-administered questionnaire about physical loads at present and in the past, and an interview about psychosocial factors. The whole session took 3 - 3.5 hours. The cases were also followed by a postal questionnaire 3, 6 and 24 months after the baseline investigation.

Dependent variables
In papers I and III, the dependent variable was “seeking care for low- back pain”.

In paper II, the dependent variables were pain intensity score, disability score and pain grades according to von Korff et al. (1992), see below.

Independent variables
Demographic data. Information about age and socio-economic status was elicited with a questionnaire. The following socio-economic groups were registered; blue-collar workers, white collar workers in lower positions, white-collar workers in middle or higher positions, self-employed/employer and unemployed.

Caregivers. The type of caregiver was registered both at baseline and at the two-year follow-up investigation. General practitioners, occupational physicians, hospital physicians, and physiotherapists were called “traditional caregivers”. Chiropractors, naprapaths, homeopaths, massage therapists, herbal therapists et cetera were called “alternative caregivers”.

At the two-year follow up the subjects were asked about the number of visits to the different caregivers since the baseline investigation.

Pain and disability. Three questions about pain intensity and four about disability were asked in a self-administered questionnaire both at base line and at the three follow-ups (von Korff et al. 1992). To rate the pain intensity score the questions concerned 1) current pain in the low back, 2) the worst pain experienced during the previous 6 months and 3) an average of the pain during the previous 6 months. The ratings were on an 11-point scale, where 0 meant no pain at all and 10 meant worst conceivable pain.

The three questions for rating disability covered the previous 6 months and were phrased 1) “how much has low-back pain interfered with your daily activities”? 2)

“How much has low-back pain changed your ability to take part in recreational, social and family activities”? and 3) “how much has low-back pain changed your ability to work (including housework)”?

The ratings were on an 11-point scale, where 0 meant “not affected at all” and 10 meant “impossible to continue with these activities”.

For each person the score for pain intensity and disability was defined by the sum of the three figures multiplied by 10 and divided by three.

In paper I the pain intensity score and the disability score were dichotomised into exposed /non-exposed. Subjects with a pain intensity score > 50 (von Korff et al. 1992) were defined as exposed and those with a disability score > 10 (arbitrarily chosen) were exposed.

The fourth question concerning disability concerned the number of days (disability days) in the previous 6 months on which the subject had been unable to carry out usual activities (work, school, and housework) due to the low-back pain.

Disability points were calculated as described below:

Disability days		**Disability score**	
0-6 disability days	= 0 points	0-29	= 0 points
7-14 disability days	= 1 points	30-49	= 1 points
15-30 disability days	= 2 points	50-69	= 2 points
>30 disability days	= 3 points	70+	= 3 points

The responders were then pooled into five hierarchical classes according to their scores (von Korff et al. 1992)

Grade 0 Pain free	No pain problem last 6 months
Grade I Low disability-low intensity	Pain-intensity < 50 and < 3 Disability points
Grade II Low disability-high intensity	Pain-intensity ≥ 50 and < 3 Disability points
Grade III High disability-moderately limiting	3-4 Disability points, regardless of pain-intensity
Grade IV High disability-severely limiting	5-6 Disability points, regardless of pain-intensity

Due to few numbers of subjects in Pain Grade 0 and Pain grade IV (paper II) this grading of pain and disability was performed

	Pain Grades according to von Korff et al. 1992
Grade I	Grade 0 and Grade 1
Grade II	Grade II
Grade III	Grade III and Grade IV

At the two year follow up the subjects were also asked if the their low-back pain had become better, become worse or was unchanged since the baseline investigation. The ratings were on a 9-point scaling where -4 to -1 meant “worse”, 0 meant “unchanged”, and +1 to + 4 meant “much better”.

Previous pain history. Information about previous periods of acute/sub-acute pain lasting at least seven days consecutively, and previous periods of chronic pain lasting at least three months consecutively was obtained from the self-administered questionnaire. Five response alternatives were given: “never”, “once”, “twice”, “3-5 times ” and “more than 5 times”.

In paper 1, subjects who answered “never” were defined as unexposed.

Clinical signs. The clinical examinations were performed by seven registered physiotherapists. The examination consisted of inspection, range of motion, test of muscle strength, neurological tests, soft-tissue palpation for pain, and pain provocation tests. The range of motion (in degrees) of the lumbar spine, from neutral position to flexion and from neutral to extension, was measured in a standing position with a kyphometer (Model CN 4802; AZB, Geneva, Switzerland). The cut-off point for defining those with reduced range of motion was based on the distribution in the referent population (median values).

Women with a total range of motion ≤ 70 and men with a total range of motion ≤ 62 degrees were defines as exposed to reduced range of motion.

Psychosomatic complaints. The sum index for psychosomatic complaints included 17 questions concerning general psychological symptoms, headache, stomach troubles, psychosomatic heart troubles, and somatic anxiety. The cut-off point for defining those with psychosomatic complaints was based on the distribution in the referent population. The median value was used for classifying subjects into exposed and non-exposed.

Physical work load. Information regarding amount (duration and intensity level) of physical load during occupational work the preceding 12 months was collected by interview (Wiktorin et al. 1999). From that interview an average level of energy expenditure during occupational work was calculated and expressed in multiples of the metabolic rate (MET) at rest. High physical workload was defined as an average energy expenditure ≥ 3.0 METs for women and ≥ 3.5 METs for men These figures represent > 30-35 per cent of maximal aerobic capacity in an average trained 45-year old Swedish women and men (Åstrand & Rodahl 1986, Jorgensen 1985).

Job strain. Job strain is a combination of high psychological demands and low decision latitude (skill utilisation and authority over decisions) according to Karasek and Theorell (Karasek 1979, Karasek & Theorell 1990). The Swedish version of the Job Content Questionnaire scale was used for measuring job strain. The scale included 11 items covering the dimensions psychological demands, skill utilisation and authority over decisions.

Job satisfaction and social support at work. From the baseline questionnaire, four items concerning a sense of meaningfulness in work and job satisfaction were added together to form an index for “job satisfaction” (Waldenström et al.in press).

The index “Social support ” seeks to tap social climate at the workplace (Ahlberg-Hulthén 1995). The index consists of six items: “there is a calm and pleasant atmosphere at my work”, “there is a good sense of fellowship”, “my workmates support me, if I have a bad day”, “I’m met with acceptance”, “I get on well with my superiors” and “I get on well with my workmates.” The cut-off points for both these indices were based on the distributions in the referent population. The median values were used for classifying subjects into exposed /non-exposed.

Passive coping. A group of questions concerned “avoiding ways to react toward workmates and superiors when in conflict or when feeling one has been treated unjustly”. These items concerned both immediate reactions and reactions a while after the actual incident. Psychometric properties and results from factor analysis have been presented by Ahlberg-Hultén et al. (1995). The index “passive coping” was measured with four items; ”let it pass without saying anything”, ”goes away”, ”feels bad (headache, stomach pain etc.)” and ”get angry and irritated at home”. Four response alternatives were possible: “no, never”, “no, seldom”, “yes, sometimes”, and “yes, most often”. The cut-off point was based on the distribution in the referent population. The median values were used for classifying subjects into exposed and non-exposed.

Functional economy. The general attitude to the private economic situation was captured in the baseline questionnaire. The answer to the question “In general what do you say about your economic situation?” was rated on a 7-point scale where 1 meant “functioning very badly” and 7 meant “functioning very well”. The cut-off point was based on distribution in the referent population. Median values were used for classifying subjects into exposed and non-exposed.

Lifestyle factors. At base line, information regarding amount (duration and intensity level) of sports activities was collected by interview. During the interview, the subject described each specific sports activity and the hours spent weekly on each activity (Wiktorin et al. 1999). Directly afterwards, the interviewer estimated the level of energy expenditure needed to perform each specific activity.

The estimations were quantified in multiples of the resting metabolic rate (MET) with the help of MET values chosen from a table of about 153 different sports activities. The table was modified from Mälkiä et al. (1988), and Ainsworth et al. (1993). Most of the sports activities could get 4 different intensity levels; 1) light recreational level 2) more stressing recreational sports 3) condition sports and 4) competition sports.

In papers I and II we used information about sports activities at a dichotomous level (yes/ no).

For each subject in paper III, all sports activities were pooled into two intensity levels, "low-intensity" (MET = 4) and "high-intensity" (MET ≥ 5) level. The total time each subject spent at each of the two levels was categorised into four classes: (0, 1-2, 3-4, ≥ 5 hours/week).

Four different combinations of the two intensity levels and their durations were analysed:

1. Long-time ≥ 5 hours/week) "low-intensity" training in combination with no "high- intensity" training.
2. Short-time (1-2 hours/week) "high-intensity" training irrespective of the amount of "low- intensity" training.
3. Medium-time (3-4 hours/week) "high intensity" training irrespective of amount of "low- intensity" training.
4. Long-time (≥ 5hours) "high-intensity" training, irrespective of amount of "low-intensity" training.

Body mass index (BMI) was calculated from body weight (kg) and height (m) according to the formula $[kg/(m)^2]$ and categorised according to the recommendations of the World Health Organisation (WHO 1985). A BMI for women ranging from 18.7 to 23.8 was defined as normal, a BMI ranging from 23.9 to28.6 was defined as overweight, obesity was defined as a BMI >28. Corresponding BMI values for men were; normal 20.0 – 25.0 overweight 25.1-30 and obesity >30.

Smokers, ex-smokers, and non-smokers were identified from the baseline questionnaire.

Methods of exposure assessments (Paper IV-V)

The interview covered occupational work during the previous twelve months and focused on work tasks performed during "a typical working day". A work task was primarily defined by the postures sitting and standing/walking and, secondly, by energy expenditure. The interviewer systematically asked if the work task was performed sitting or standing/walking. The standing/walking work tasks were subdivided into subtasks performed 1) standing/walking with hands above shoulder level 2), standing/walking with hands between shoulder and knuckle level, and 3) standing/walking with hands below knuckle level i.e. standing/walking in a stooped position. The subjects were asked about time spent in the different work postures involved in the respective tasks. The assessment of time was reported in minutes per day and per cent of the work shift.

Validity of interview data

Interview data concerning duration of four work postures was compared with systematic observations during two whole working days. The time spent in each of the four different work postures was continuously registered with a small hand-held computer (Psion Organiser II mod XP). The observations were made by two physiotherapists who did not participate in the collection of interview data concerning "a typical work day" in the main study.

Two of the work postures: 1) trunk flexion, and 2), upper-arm elevation was also compared with technical measurements during the two whole working days. For measuring the position of forward bending of the back, the subjects were equipped with a trunk flexion analyser. The trunk flexion analyser registers the sagittal angle between the trunk and the reference trunk position. For this the subject stood upright with the arms hanging by the sides.

For measuring the positions of the arms during the day, the subjects were equipped with an arm position analyser, Abduflex (Ericson et al. 1994). The Abduflex registers the angle between the upper arm and the vertical in seven 15-degree intervals.

Before the work-shift started the worker was equipped with the technical instruments and then one of the physiotherapists observed the four work postures continuously during two working days. At the end of the first working day the worker was interviewed by the physiotherapists, who observed, and estimated the duration of each work posture during that specific day. At the end of the second day the subjects were interviewed and estimated the total duration of work postures performed during the two days.

Interview data concerning "a typical work day, " "one working day" and "two working days" were then compared with the results from the observations and with the technical measurements.

Validity of questionnaire data

Seven occupational physiotherapists, with at least two-weeks´ training in the interview technique, performed the interviews about physical loads without knowing if the respondent was a case or a referent. The interview comprised three different parts: I. Work, a typical working day, II. Leisure time, a typical working day, and III. Sports activities. Physical workloads were described in terms of work postures, energetic load, and manual materials handling (Wiktorin et al. 1999). To qualify an interview about occupational physical loads the subjects should have been in job for at least two months during the preceding year and the working time should exceed 17 hours per week. If the work had lasted less than two months, the interview only covered parts II-III.

Directly after the interview, the respondent also filled in a questionnaire regarding physical loads. The questionnaire comprised 18 questions about occupational work, leisure time and sports activities. The answers to eight of the questions about current conditions were compared with the corresponding interview responses.

Continuous scales were used for the proportion of the day spent sitting, working at VDU, motor vehicle and leisure time activities such as domestic work. An ordinal scale was used for the work postures "time spent in a stooped position" and "hands above shoulder level". Six response alternatives were possible: "Not at all", "1-3 days per month", "one day per week", and "2-4 days per week ", "every work day", and " not working".

Data treatment and statistical analysis

The potential relationship between the independent variables and seeking care for low-back pain was estimated by calculating the odds ratio (OR) with 95 per cent confidence intervals (Paper I).

Ninety-five per cent confidence intervals (CI) were calculated for proportions as well as difference between proportions. The median values and ranges were used for describing continuous scales. In order to study the predictability of recovery, relative risks with 95 per cent confidence intervals were calculated with multiple regression using the Cox proportional hazards (Paper II).

For testing differences between pain-intensity and disability values, the t-test and the Mann-Whitney U test were used (Paper II)

The odds ratio (paper III) was interpreted as an estimate of the incidence rate ratio (RR) since this was a population-based case referent study (Miettinen 1976). Initial analysis was calculated with the Mantel-Haenszel odds ratio for single factors and adjusted for age.

The correlation between self-reports and observation/ technical measurements as well as between interview data and questionnaire, was examined with Pearson´s product moment correlation coefficient and by the parameters for the regression line, $y = \beta_0 + \beta_1 x$ (Glantz & Slinker 1990). Questions with ordinal-scale answers were examined by using Spearman´s rank correlation coefficient (papers IV-V).

Results

Care-seeking behaviour (Papers I-II)

In a population of about 17,000 persons, 449 women and 342 men during a three-year period sought care for a new episode of low-back pain. About 60 per cent of the women initially consulted either a physician or a physiotherapist, the corresponding figures for men were 40 per cent (Table 4).

Table 4. Number (n) and percentage (%) of consultations to caregivers among female and male cases.

	Women		Men	
	n	%	n	%
Physician	120	31	68	22
Physiotherapist	125	32	62	20
Alternative caregiver	147	36	177	58

About 25 per cent of the people who sought care for LBP reported pain grade III (high disability moderately limiting) or pain grade IV (high disability, severely limiting). Of the men and women who did not seek care for their low-back pain problems only 2 per cent were in those pain grades (Table 5).

Table 5. Numbers (n) and percentages (%) in different pain-grades among care seeking and non-care seeking men and women.

	Women				Men			
	Care-seekers		Non-care seekers		Care-seekers		Non-care seekers	
	n	%	n	%	n	%	n	%
Pain grade I. Low disability-low pain intensity	173	42	358	83	168	53	237	83
Pain grade II. Low disability-high pain intensity	136	33	67	15	79	25	44	15
Pain grade III. High disability-moderately limiting	73	18	9	2	56	18	5	2
Pain grade IV. High disability-severely limiting	28	7	0	0	14	4	1	0

A high disability score and a high pain-intensity score were strongly related to care seeking among men and women with low-back pain. The odds ratios for a high disability score and seeking care were 7.4 (CI 5.0-11.0) for women and 4.9 (CI 3.3-7.1) for men. The odds ratios for a high pain-intensity score and seeking care were 3.7 (CI 2.2-6.0) for women and 1.7 (CI 1.1- 2.8) for men (Table 6,7).

A strained economic situation and use of passive coping strategies was associated with not seeking care OR 0.6 (CI 0.4-0.9) among women (Table 6).

Reduced range of motion remained a significant factor for men OR 1.8 (CI 1.2-2.7) in the multiple analysis (Table 7). Neither previous pain history, physical or psychosocial working conditions, nor lifestyle factors or psychosomatic complaints were associated with seeking care for low-back pain.

Table 6. Numbers (n) and percentages of exposed female care- and non-care-seekers, odds ratios (OR) with 95% confidence intervals (95% CI), estimated odds ratios in a multiple logistic regression analysis (OR) for seeking care for low-back pain.

Women

			Univariate analysis		Multiple Logistic Regression Analysis	
	Care seekers n= 410 %	Non-care seekers n= 434 %	OR	95 % CI	OR	95 % CI
Pain intensity score ≤ 50	58	89	1.0		1.0	
Pain intensity > 50	42	11	**5.9**	**4.1-8.4**	**3.7**	**2.2-6.0**
Disability score ≤1 0	25	71	1.0		1.0	
Disability score >10	75	29	**7.3**	**5.4-9.9**	**7.4**	**5.0-11.0**
Total range of motion > 70°	33	39	1.0			
Total range of motion ≤ 70°	67	61	1.3	1.0-1.8		
No previous sub-acute pain	29	40	1.0		1.0	
Previous sub-acute pain	71	60	**1.6**	**1.2-2.2**	0.8	0.5-1.3
No previous chronic pain	64	75	1.0		1.0	
Previous chronic lasting pain	36	25	**1.7**	**1.2-2.3**	0.9	0.6-1.4
Passive coping ≤ 18	56	46	1.0		1.0	
Passive coping > 18	44	54	**0.7**	**0.5-0.9**	**0.6**	**0.4-0.9**
Functional economy >5	52	44	1.0		1.0	
Functional economy ≤ 5	48	56	**0.7**	**0.5-0.9**	**0.6**	**0.4 – 0.9**

Table 7. Number (n) and percentage (%) of exposed male care-and non-care-seekers, odds ratios (OR) with 95% confidence intervals (95% CI), estimated odds ratios in a multiple logistic regression analysis (OR) for seeking care for low-back pain.

Men

			Univariate analysis		Multiple Logistic Regression Analysis	
	Care-seekers n= 317 %	Non-care-seekers n= 287 %	OR	95 % CI	OR	95 % CI
Pain intensity score ≤ 50	67	87	1.0		1.0	
Pain intensity > 50	33	13	**3.4**	**2.2-5.1**	**1.7**	**1.1-2.8**
Disability score ≤ 10	28	70	1.0		1.0	
Disability score >10	72	30	**6.0**	**4.2-8.5**	**4.9**	**3.3-7.1**
Total range of motion > 62°	33	50	1.0		1.0	
Total range of motion ≤ 62°	67	50	**2.0**	**1.4-2.8**	**1.8**	**1.2-2.7**
No previous sub-acute pain	22	32	1.0		1.0	
Previous sub-acute pain	78	68	**1.6**	**1.1-.2.4**	1.2	0.8-1.8
No previous chronic pain	68	76	1.0		1.0	
Previous chronic lasting pain	32	24	**1.5**	**1.1-2.2**	0.9	0.5-1.3
Passive coping ≤ 16	57	54	1.0			
Passive coping >16	43	46	0.9	0.6-1.3		
Functional economy >5	51	45	1.0			
Functional economy ≤ 5	49	55	0.7	0.6-1.1		

At the two-year follow-up, 224 (59 %) female cases who participated at baseline and at the two-year follow-up paid in total 4,511 visits to caregivers (mean 20, MD 10, range 1-232) since the base-line study. The corresponding figure for 162 (58 %) men was 1.746 visits (mean 11, MD 6, range 1-112), (Table 8). Forty-seven per cent of the women and 59 per cent men consulted the same type of caregiver during this period. A minority, 15 per cent women and 12 per cent men, consulted 3 to 5 different types of caregiver.

Table 8. Numbers, median and range of visits at different caregivers during a period of two years for cases.

	Men (n = 162)			**Women (**n = 224)		
Type of caregivers consulted	Number of visits	Md	range	Number of visits	Md	range
Physician	176	2	(1-15)	337	2	(1-25)
Physio-therapist	931	8	(1-112)	2,856	10	(1-208)
Chiropractor	311	4	(1-12)	363	3	(1-35)
Naprapath	240	4	(1-28)	435	4	(1-104)
Other caregiver	88	4	(1-26)	520	10	(1-52)
Total	**1,746**	6	(1-112)	**4,511**	10	1-232

Cases who sought care during the follow-up period reported a higher pain intensity score than cases who did not seek care. The pain intensity score was higher both at base line and at all three follow-ups (p-values were all below 0.01). The trend was similar for the disability score.

Improvements concerning pain and disability were reported for all cases after three months, but less so after 6 and 24 months (Figure 3).

The average reduction in pain intensity was less for consulting cases (mean reduction =10) than for non-consulting cases (mean reduction =16) during the first 3 months after the base-line investigation (p-value < 0.001). The average reduction in disability score during the first 3 months was also less for consulting cases (mean reduction =11) than for non-consulting cases (mean reduction = 18), p-value < 0.01.

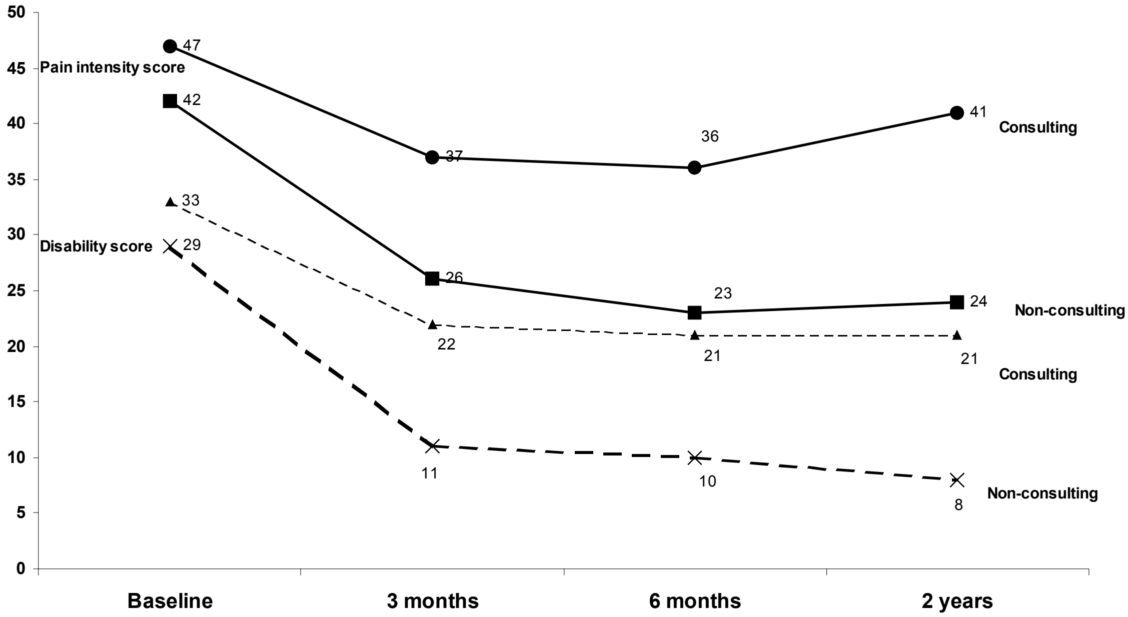

Figure 3. The pain and disability scores (mean values) at baseline, 3, 6 and 24 months for 324 cases consulting and 246 cases not consulting a caregiver since the base-line investigation.

For those cases who consulted a caregiver, the mean pain intensity scores after two years were rather similar irrespective of what type of caregiver they visited (p-value 0.517) (Figure 4).

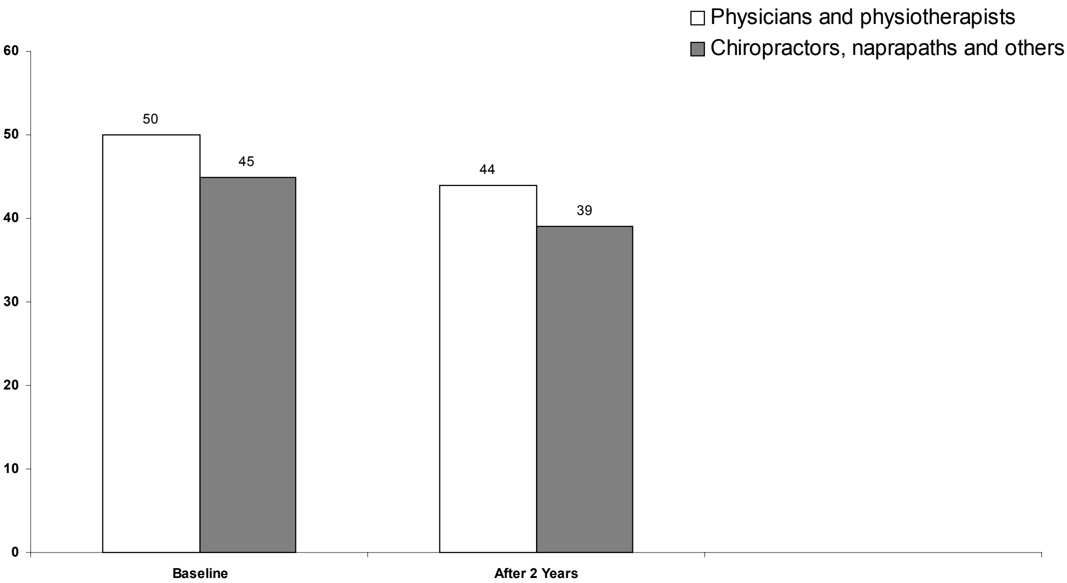

Figure 4. The pain intensity score (mean values) at baseline and at two-year for cases who consulted physicians/physiotherapists or alternative caregivers during the follow up period.

The majority of the individuals reported that they felt much better after two years than at baseline, but a substantial number also reported no recovery, or that they had become worse. More persons who had had treatment of any kind during the two-year period reported that they had become worse compared to those who had not been treated (Table 9).

Table 9. Proportions (in %) of women and men in different pain grades that reported that their low-back pain had become worse better or unchanged after two years.
Consulting yes = those persons who had sought care or treatment during the two- year follow-up period. Consulting no = those persons who had not sought care or treatment during the two-year follow-up period

	Women						**Men**					
	Worse		No change		Better		Worse		No change		Better	
	Consulting		Consulting		Consulting		Consulting		Consulting		Consulting	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Grade I	19	10	25	25	56	65	23	5	31	31	47	64
Grade II	26	10	25	23	49	67	24	18	29	27	48	54
Grade III	8	9	17	12	75	78	18	5	27	24	54	71

There were only 10 per cent of low-back pain cases who reported being free from pain two years after the baseline investigation.

During the whole follow-up period, 45 women (12 %) and 28 men (10 %) had changed job or work tasks because of low-back pain, and a few, four women (1%) and four men (1%), had been given early retirement.

During the period 12-24 months after baseline, 12 per cent (95 % CI 9-15) of the women and 13 per cent (95 % CI 9-17) of the men had been on sick leave at least one day because of low-back pain. About 70 per cent of the cases had not been on sick leave one single day during the follow-up. The subjects with the longest sick leave were those reporting high disability at baseline (Table 10).

Table 10. Median values and range for days of sick leave due to low-back pain during the last 12 months and at 24-month follow-up

	Women			**Men**	
	Days of sickleave			**Days of sickleave**	
	Md	Range		Md	Range
Grade 1 n=12	14	4-190	n=11	7	3-365
Grade 2 n=18	20	3-365	n=13	7	3-364
Grade 3 n=14	65	10-365	n=11	40	2-365

Lifestyle factors (Paper III)

Neither low-intensity training for many hours/week nor high-intensity training for few or many hours per week affected the men's risk of a new episode of low-back pain. Few (1-2) hours with high-intensity training increased the relative risk of low-back pain among women, RR 1.6 (1.1-2.4). An increased risk of low-back pain was found for men with high body weight, RR 2.2 (CI 1.2-3.9) but not for women. Smoking did not influence the risk of low-back pain (Table 11, 12).

For those who were active in sports at baseline, the odds ratio for changing from pain grade III or IV at baseline to pain grade I (low pain intensity and low disability) at the two-year follow-up was 1.3 (CI 0.9 – 1.9).

Table 11. Number of exposed female cases and referents, the relative risks with 95% confidence intervals (95% CI), estimated by the Mantel-Haenszel method (RR[1]) and the estimated relative risks in a multiple logistic regression analysis (RR[2]) for seeking care for low-back pain and sports activities, body mass index and smoking.

	Women					
			Univariate analysis, age adjusted		Multiple Logistic Regression Analysis	
	Number of cases	Number of referents	RR[1]	CI	RR[2]	CI
Sports activities						
No sports activities	69	179	1.0		1.0	
≥ 5 hours/week with low-intensity and no hours with high intensity	113	222	1.3	0.9-1.8	1.3	0.9-1.9
1-2 hours/week with high-intensity training irrespective of the amount of low-intensity training	103	199	1.4	0.9-1.9	1.6	1.1-2.4
3-4 hours/week with high-intensity training irrespective of the amount of low-intensity training	25	82	0.8	0.5-1.4	1.0	0.5-1.7
≥ 5hours/week with high-intensity training irrespective of the amount of low-intensity training	20	40	1.4	0.8-2.6	1.5	0.8-2.9
BMI						
Normal	199	447	1.0		1.0	
Obesity >28.6	57	117	1.1	0.8-1.6	1.0	0.6-1.4
Overweight 23.9-28.6	175	337	1.1	0.9-1.5	1.1	0.8-1.4
Underweight < 18.7	3	18	0.5	0.2-1.3	0.3	0.1-1.2
Present smoking status						
Non-smokers	300	607	1.0		1.0	
Smokers	147	337	0.8	0.6-1.1	0.9	0.7-1.2
Lifelong smoking history						
Never smoked	160	326	1.0			
Pack-years 1-10	48	99	1.0	0.7-1.5		
Pack-years 11–20	40	99	0.8	0.5-1.2		
Pack-years > 20	38	88	0.9	0.6-1.3		

RR[1] adjusted for age <45 and ≥ 45 by the Mantel Haentzel method
RR[2] adjusted for age, high physical workload, previous pain > 3 months and socio-economic status.

Table 12. Number of exposed male cases and referents, the relative risks with 95% confidence intervals (95% CI), estimated by the Mantel-Haenszel method (RR^1) and the estimated relative risks in a multiple logistic regression analysis (RR^2) for seeking for low-back pain and sports activities, body mass index and smoking.

Men

	Number of cases	Number of referents	Univariate analysis, age adjusted RR^1	CI	Multiple logistic regression analysis RR^2	CI
Sports activities						
No sports activities	105	205	1.0		1.0	
≥ 5 hours/week with low- intensity and no hours with high-intensity	41	86	1.0	0.6-1.5	0.9	0.6-1.6
1-2 hours/week with high-intensity training irrespective of the amount of low intensity training	68	105	1.2	0.8-1.8	1.3	0.8-2.0
3-4 hours/week with high-intensity training irrespective of the amount of low-intensity training	38	65	1.1	0.7-1.8	1.3	0.8-2.2
≥ 5 hours/week with high-intensity training irrespective of the amount of low-intensity training	27	77	0.6	0.4-1.0	0.7	0.4-1.3
BMI						
Normal	164	349	1.0		1.0	
Obesity >30	25	27	2.2	1.2-3.9	2.2	1.2-4.1
Overweight 25.1-30	114	235	1.0	0.9-1.3	1.1	0.8-1.5
Underweight < 20.1	14	36	0.8	0.5-1.4	0.8	0.4-1.6
Present smoking status						
Non-smokers	235	478	1.0		1.0	
Smokers	106	181	1.2	0.9-1.6	1.2	0.9-1.7
Lifelong smoking history						
Never smoked	138	292	1.0			
Pack-years 1-10	26	41	1.4	0.9-2.4		
Pack-years 11–20	24	41	1.2	0.7-2.1		
Pack-years > 20	27	57	1.2	0.7-2.1		

RR^1 adjusted for age <45 and ≥ 45 by the Mantel Haentzel method
RR^2 adjusted for age, poor job-satisfaction, forward bent position, previous pain > 3 months and socio-economic status

Methods of exposure assessment (Papers IV-V)

Validity of inteview data

Self-reported data versus observation. The relationships between self-reports covering ”a typical day” (from the MUSIC-Norrtälje study) and observations covering two days were all lower than the relationships between self-reports and observations covering one or two working days, (Table 13).

The correlation coefficient between self-reports covering “a typical day” and observations was 0.79 for work in a stooped position and 0.65 for work with hands above shoulder level (Table 13, figure 5 A, B).

Table 13. Median duration, in per cent of one working day, two working days and “a typical working day”, of different work postures, as measured by observations and self-reports in 20 subjects. Correlation coefficients (r), the intercepts (β_0), and, the slopes (β_1) of the linear regression lines between observed time as independent variable and self-reported time as dependent variable are presented.

Work postures	Observations % time		Self-reports % time		r	β_0	β_1
One working day	Md	range	Md	range			
Sitting	16	(1-63)	14	(2-53)	0.86	2	0.80
Work with hands above shoulder level	3	(0-23)	8	(1-49)	0.67	4	1.33
Work in stooped position	14	(0-37)	30	(0-68)	0.86	7	1.33
Two working days							
Sitting	18	(3-51)	20	(3-55)	0.74	6	0.90
Work with hands above shoulder level	2	(0-16)	8	(1-42)	0.76	3	1.90
Work in stooped position	14	(0-41)	21	(0-52)	0.83	6	1.0
“A typical day” during preceding 12 months							
Sitting	18	(3-51)	16	(2-62)	0.39	12	0.50
Work with hands above shoulder level	2	(0-16)	10	(0-43)	0.65	6	1.75
Work in stooped position	14	(0-41)	15	(0-43)	0.79	3	0.71

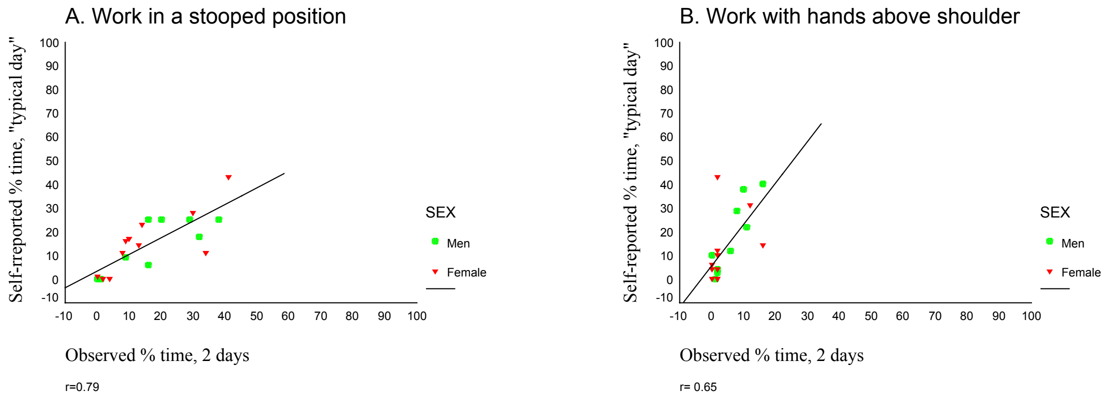

Figure 5 A-B The linear regression between self-reported duration, in per cent of two working days for A: work in a stooped position B: work with hands above shoulder level, (n= 20).

Self-reported data versus technical instruments. The correlation coefficients between the self-reported time spent in a stooped position and measured time with trunk flexion angles > 20° ranged from 0.61-0.67 and for angles >40° the correlation coefficients ranged from 0.60-0.73 (Table 14).

Corresponding correlation coefficients between self-reports concerning work with hands above shoulder level and measured upper arm elevation > 60° ranged from 0.46-0.66. For upper-arm elevation angles > 75° they ranged from 0.58- 0.62 (Table 14).

Table 14. Median duration, in per cent of one working day, two working days and "a typical working day", spent with the trunk flexed > 20° and > 40°, as registered with a trunk position analyser. Correlation coefficients (r), intercepts (β_{0}) and, slopes (β_1) of linear regression lines between different trunk flexion angles as independent variables and self-reported time spent in a stooped position as dependent variables, are presented.

Trunk flexion angle	Trunk flexion % time		r	β_0	β_1
One working day (n=16)	Md	range			
> 20°	30	(4-60)	0.61	10	0.71
> 40°	12	(0-37)	0.60	16	1.11
Two working days (n=16)					
> 20°	29	(6-58)	0.67	5	0.64
> 40°	10	(0-39)	0.73	11	1.10
" A typical day" during preceding 12 months (n=16)					
> 20°	29	(6-58)	0.66	2	0.46
> 40°	10	(0-39)	0.62	7	0.68

Table 15. Median duration, in per cent of one working day, two working days and "a typical working day", spent with the upper arms elevated > 60° and > 75°, as registered by an arm position analyser. Correlation coefficients (r), the intercepts (β_{0}), and the slopes (β_1) of the linear regression lines between different upper arm elevation angles as independent variables and self-reported time spent with hands above shoulder level as dependent variable, are presented.

Upper arm elevation	Abduflex time		r	β_0	β_1
One working day (n =19)	Md	range			
> 60°	12	(2-40)	0.66	1	0.71
> 75 °	7	(1-24)	0.62	2	1.14
Two working days (n =18)					
> 60°	12	(2-40)	0.46	4	0.56
> 75 °	7	(2-25)	0.61	1	1.30
" A typical day" during preceding 12 months (n=18)					
> 60°	12	(2-40)	0.66	1	0.87
> 75 °	7	(2-25)	0.58	2	1.36

Validity of questionnaire data

The correlation coefficients between interview and questionnaire responses were higher for tasks performed at work than for leisure tasks. The correlation coefficient was higher for time spent sitting at work (r=0.82) than for the awkward postures work in a stooped position (r_s=0.66) and hands above shoulder level (r_s= 0.63) (Table 16). The time spent sitting at work was somewhat underestimated in the self-administered questionnaire compared to the interview (Table 17).

The correlation was lower for leisure-time activities such as “domestic work” (r=0.55), “time for own activities” (r=0.39), and “sitting during leisure time” (r=0.38) (Table 17).

In the six exposure variables with ratio scales the correlation coefficients, the intercepts, and the slopes for the regression lines between the interview and the self-administered questionnaire responses were similar for the referent group, the low-back pain group and the neck/shoulder group (Table 17). The rank correlation coefficient between questionnaire and interview answers concerning work in a stooped position was 0.66 in the referent group, 0.63 in the low-back pain group, and 0.68 in the neck/shoulder group. The corresponding rank correlation for work with the hands above shoulder level was 0.63 in the referent group, 0.59 in the low-back pain group, and 0.62 in the neck/shoulder group.

At a dichotomous level, when high exposure to “sitting” was defined as > 75 per cent of the time spent in this position and the same cut-off point (>75%) was chosen for the questionnaire responses, the sensitivity was 0.44 and the specificity 0.98 (Figure 6 A). If instead the underestimation of sitting time in the questionnaire responses was taken into consideration and the cut-off point was set to ≥ 25 per cent of the questionnaire time, the sensitivity increased to 0.96 and the specificity decreased to 0.57 (Figure 6 B). In a population where sitting > 75 per cent of the objective (interview) time is common (50%) this change of cut-off point would decrease the dilution of an RR of 4.00 from 1.9 to 2.6 (Table 16).

Table 16. Comparison of interview and questionnaire responses with the interview used as reference method. The table illustrates how the sensitivity (sens) and specificity (spec) in the referent group (n=1421) were affected by choosing different cut-off points regarding the questionnaire responses. The dilution of a true relative risk of 4.00 in a population with high (50%) and with lower (10%) prevalence of exposure is given as an illustration.

	Cut-off point		Referents		Prevalence of exposure	
Questionnaire variable	**Reference method, Interview**	**Self-administered questionnaire**	**Sens**	**Spec**	**50% R^R***	**10% R^R**
Sitting (% time)	0-75% 76-100%	0-75% 76-100%	0.44	0.98	1.9	2.7
$r^{\dagger} = 0.82$		0-24% 25-100%	0.96	0.57	2.6	1.6
		0-75% 76-100%	0.46	0.99	1.9	3.0
VDU work (% time)	0-49% 50-100%	0-49% 50-100%	0.92	0.94	3.1	2.8
$r^{\ddagger} = 0.87$		0-24% 25-100%	1.00	0.86	3.6	2.3
		0-75% 76-100%	0.52	0.99	2.0	3.1
Motor vehicle (% time)	0-49% 50-100%	0-49% 50-100%	0.93	0.96	3.2	3.1
$r^{\S} = 0.80$		0-24% 25-100%	0.97	0.89	3.4	2.4
Hands above shoulder level > 30 min/day	≤ 30 > 30 min/day	Never >Never	0.86	0.74	2.2	1.7
$r_s^{**} = 0.63$		<Every day Every day	0.43	0.95	1.7	2.1
Hands below knee level > 30 min/day	≤ 30 > 30 min/day	Never >Never	0.79	0.73	1.9	1.6
$r_s = 0.66$		<Every day Every day	0.38	0.94	1.6	2.0

* R^R = observed relative risk

† r = the product moment correlation coefficient

‡ r = the product moment correlation coefficient

§ r = the product moment correlation coefficient

** r_s = Spearman´s rank correlation coefficient

Table 17. Comparison of interview and self-administered questionnaire responses concerning estimated percentage of time spent on specific tasks or sitting at work and during leisure time in the referent, low back, and neck/shoulder groups. The product-moment correlation coefficients (r), the intercepts (β_0) and slopes (β_1) of the linear regression lines with interview data as the independent and questionnaire data as the dependent variable.

Exposure variable	**Referent group** n=1421	**Low back cases** n=694	**Neck/ shoulder cases** n=358	**Referent group**		**Low back cases**		**Neck/shoulder cases**	
	r	r	r	intercept β_0	slope β_1	intercept β_0	slope β_1	intercept β_0	slope β_1
Work, typical working day									
Sitting (% of work time)	0.82	0.80	0.82	-2	0.8	-1	0.8	-1	0.8
VDU (% of work time)	0.87	0.85	0.89	3	1.0	3	1.0	3	1.0
Motor vehicle (% of work time)	0.80	0.83	0.92	3	1.0	3	1.0	1	1.0
Leisure time, typical weekday									
Domestic work (% of leisure time)	0.55	0.52	0.62	21	0.7	22	0.7	19	0.8
Time for own act.(% of leisure time)	0.39	0.31	0.35	8	0.5	14	0.4	12	0.5
Sitting (% of leisure time)	0.38	0.34	0.38	14	0.5	17	0.4	16	0.4

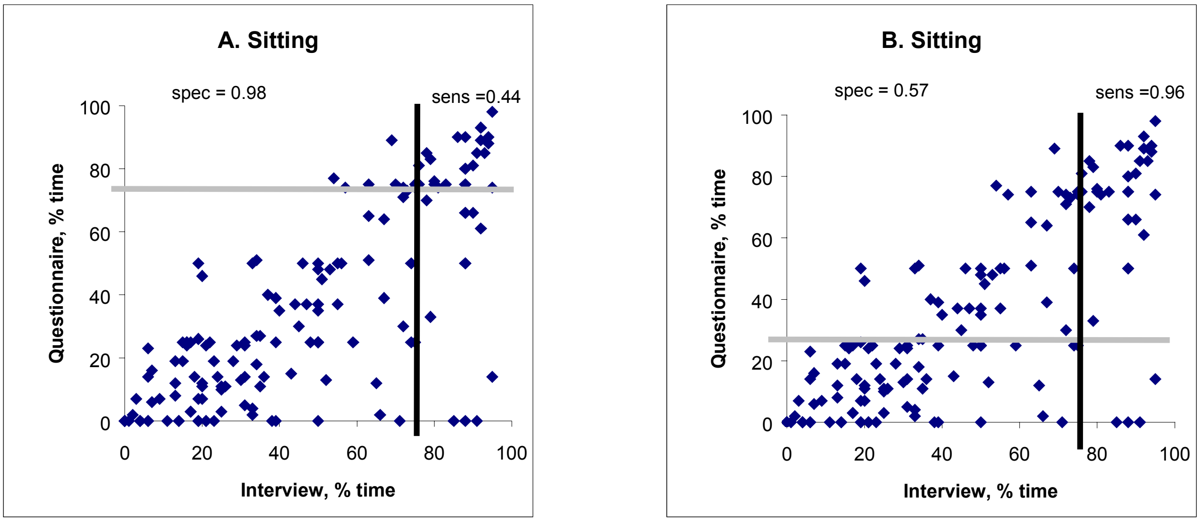

Figure 6 A-B. Plots of percentage of time per day spent in sitting in a 10 per cent random sample of referents in the MUSIC Norrtälje study reported by interview versus by questionnaire. The subjects to the right of the black vertical lines represent those who were defined as highly exposed (> 75% of the time) according to the interview responses (= truly exposed). The subjects to the right of the black vertical and above the grey horizontal lines are those who are correctly classified as exposed according to the questionnaire responses. A. When the cut-off point according to the questionnaire was set to >75 per cent of the time (grey horizontal line), the sensitivity was 0.44 and the specificity was 0.98 in the questionnaire responses. B. When the cut-off point was set to ≥ 25 per cent instead, the sensitivity was 0.96 and the specificity was 0.57 in the questionnaire responses.

Discussion

This study has focused on care-seeking behaviour, lifestyle factors, and aspects of exposure assessment in relation to low-back pain in the general population.

The main findings were that disability and pain were the most decisive factors for seeking care for low-back pain. Women reporting a less good economic situation were more likely to forego care-seeking for their low-back pain problems than women reporting a better economic situation. Pain and disability were still present after two years for many of those who had sought care because of LBP. Surprisingly, irrespective of caregiver, the pain-intensity scores and the disability scores were less improved for cases that consulted a caregiver during the two-year follow-up period.

Sports activities were neither a risk nor a health factor for men seeking care for low-back pain. For women there was a slightly increased risk when sport activities were performed only 1-2 hours at high-intensity. High body weight increased the relative risk of low-back pain among men but not among women. Smoking did not influence the risk of getting low-back pain.

The self-reports concerning work postures such as work in a stooped position and, work with hands above shoulder level may be accurate enough for studying these work postures in epidemiological studies.

Care-seeking behaviour

Low-back pain is common and more the rule than the exception, regardless of age, sex, and occupation. Somewhat more women than men sought care. Older people did not report more new episodes of pain or more problems than younger. Whether this means that older persons do not have more pain than younger ones, or that they have more problems that are chronic and were therefore excluded from this study is difficult to tell.

As many as 46 per cent of the women and 43 per cent of the men among the referents in the MUSIC-Norrtälje study reported present low-back pain in combination with disability, without consulting for their problems. This tallies with some other studies (Hillman et al. 1996, Carey et al. 1996). Among those non-care-seekers, the majority had previously suffered from low-back pain for seven consecutive days or more. In concordance with our results, Papageorgiou et al. (1996) noted that the experience of previous pain did not influence the decision on seeking care or not for a new episode of LBP.

A high disability score and a high pain-intensity score were strongly related to care- seeking among both men and women with self-reported low-back pain. To seek care for pain especially in combination with disability is reasonable, since this interfere with one's job, the housework, or social activities. This accords with a previous study by McPhillips-Tangum et al. (1998) who conducted depth interviews with 54 patients citing difficulty in performing normal activities. Thus, the determining factor for seeking care is the pain intensity and disability and not duration or previous pain history.

Seeking care for low-back pain is sometimes assumed to coincide with high levels of psychological distress (Jackson et al. 2001). However, when psychological distress was measured in terms of psychosomatic complaints, this was not found in our study.

Our results agree fairly well with results from other studies, showing that psychological distress and negative emotional feelings was equally common among those consulting as among those non-consulting for LBP (Croft et al. 1995, Cameron et al. 1993).

However, it is reasonable to hypothesize that subjects with long-lasting low-back pain may suffer also from psychological distress. This was not analysed in the present thesis since cases and referents were excluded if they had sought care or were on treatment during the six months preceding the investigation.

As expected, women who reported frequent use of passive coping strategies sought care to a lesser extent than those who did not, which is consistent with the results by Cameron et al. (1993) who noted that passive coping was more common among those who did not seek medical care. Although the questions concerned ways to react towards workmates and superiors at work, they may to some extent also reflect more general ways of coping.

It was interesting to find that women who reported a strained economic situation did not seek care for low-back pain as much as those reporting a better economic situation. The same pattern was noted among men although here it was not statistically significant. Even if the self-reported "functional economy" is not the same as an actual low income, the results mirror the fact that economy plays a role in one's decision to seek care. Patient charges for consulting tripled in real terms from 1979 to 1995 (Elofsson et al. 1998). The fact that economic factors seemed to be of importance shows that costs for health care must be kept low if the goal is health care on equal terms.

All caregivers in the region, also very untraditional ones, sent their patients to the MUSIC-Norrtälje study. Going to an alternative caregiver for treatment was more common than had been known before. About 70 per cent of the women and 80 per cent of the men both initially as well at the two-year follow-up sought care for their low back pain problems from others than a physician. This indicates that the majority seek care for other reasons than for medical prescriptions or sick leave.

Treatment by alternative caregivers is not subsidized in Sweden, it costs about twice as much as seeing a doctor, and 5-6 times the cost of a visit to a physiotherapist. However, alternative caregivers usually offer prompt treatment compared to doctors and physiotherapists, who generally have much longer waiting lists and a delay of treatment for weeks. Men went to alternative caregivers more frequently than did women, and maybe the time aspect is important for men. Generally men also have higher incomes than women do and therefore they better can afford to seek care from alternative caregivers.

Irrespective of pain and disability at baseline, the pain-intensity scores were improved for both sexes at the three months follow up but remained rather stable during the rest of the follow-up period.

The pain-intensity scores of the cases never reached the values for the referents at baseline at any point. Although most patients will improve and go back to work within one month (Nachemson 1991, 1992) pain may persist which has been shown here and in other studies as well (Lloyd & Troup 1983, Von Korff & Saunders 1996, Croft et al. 1998).

About 60 per cent of the low-back cases paid a substantial number of visits to their caregivers because of low-back pain during the follow-up period, women generally more than men. Why women are more inclined to seek care than men is hard to tell. Some of the women received continuous treatment during the whole two-year period. There is no evidence that such long treatment periods are beneficial for recovery from low-back pain (van Tulder & Waddell 2000).

Surprisingly, the cases who sought care during follow up did not improve as much as those who did not seek care. The lack of improvements did not depend on the choice of caregiver, which was an interesting result per se.

It is possible that visiting a caregiver preserves the symptoms and hamper improvement. However, those cases who sought care during follow-up reported higher pain intensity at base line than those who did not seek care. The underlying causes to the pain may be different in the groups. Therefore, we can not compare the prognosis among those cases who sought care with those who did not.

Most diagnoses for describing low-back pain are based on symptoms and the patho-anatomic cause is unknown. Consequently, it is difficult to give appropriate treatment to each patient, which may mirror the fact that treatment seemed to be of limited value for some patients. A challenge for further studies would be to find better methods for making a diagnosis in order to give the correct treatment to each patient.

Sick leave due to low-back pain was not very frequent although pain and disability still were present for most of the cases. As expected, among those on sick leave, persons in pain grade III (high disability) had significantly more days off than any other group. Even if the sick-leave rate for this group was low, low-back pain has an enormous economic impact on society, mainly in indirect costs, as it is so common (Norlund & Nachemson 2000). Most people continued to work regardless of pain intensity and disability. Trying to continue life as normally as possible is often said to be the best cure for low-back pain (van Tulder & Waddell 2000) and obviously most people in this low-back pain group followed this advice.

Lifestyle factors

Sports activities

The main findings were that sports activities were neither a risk nor a health factor for low-back pain among men. For women there was a slightly increased risk when sports activities were performed 1-2 hours with high-intensity training.

Our results partly agree with some other studies (Saraste & Hultman 1987, Barnekow-Bergkvist et al. 1998, Kujula et al. 1996).

It is interesting that sports activities performed few hours/week with high-intensity training increased the relative risk of low-back pain among women. The majority (68%) of these women performed sport activities at MET level of 6.0, half of them one hour per week and half of them two hours. Few (n= 9) performed sports activities at MET level of 8.0 and none above. This group of women more than others had children living at home, and reported less time for their own activities. One explanation of the increased relative risk could be that the combination of occupational work, household activities, care of children and few hours with high-intensity training may fatigue the structures stabilising the spine and therefore cause low-back pain.

Some of the sports activities may be protective and some may be harmful to the low back. The association between specific sports activities and low-back pain was impossible to analyse due to too few exposed cases in each sporting activity.

Sports activities at base line had a weak tendency to be a positive predictive factor for recovery at the two-year follow-up. This is in accordance with some other studies showing that people who exercise recover from low-back pain more rapidly than those who do not (Evans et al. 1987, Lindström et al. 1992, Malmivaara et al. 1995, Macfarlane et al. 1996). However, our limited number of study persons weakened the power in the analyses of predictors for recovery from pain and disability grades III to I with wide confidence limits. In contrast, in a recent longitudinal study over three years no individual, occupation, pain, or treatment-related factors predicted recovery from low-back pain (Waxman et al. 2000).

High body weight

An increased risk of low-back pain was found for men with a high body weight but not for women. Boström and Diderichsen (1997) reported that women underestimated their weight more than men did. This could be one reason for not finding an increased risk of low-back pain among obese women in the study. The women who underestimated their body weight will become classified as unexposed and thus dilute the risk estimates (Rothman 1986).

The lack of association between high body weight and low-back pain has been shown earlier (Riihimäki et al. 1989, Heliövaara et al. 1991, Manninen et al. 1995, Magnusson et al. 1996, Barnekow-Bergkvist et al. 1998).

Deyo and Bass (1989) and Liira et al. (1990) reported in two different cross-sectional studies that high body weight was related to a higher prevalence of back pain. However, the results from different studies are difficult to compare since different classifications of BMI and different outcome definitions are used.

Smoking

In contrast to our results, Deyo and Bass (1989) found a slightly increased risk (OR =1.36) among those with 50 or more pack-years of smoking. However, such extremely heavy smokers probably have somewhat different risk profiles in many respects.

Heliövaara et al. (1991) found no increased risk of sciatica among smokers but a moderate one for unspecific low-back pain. One prospective study on Finnish farmers (Manninen et al. 1995) showed an inverse picture, with increased risk of sciatica but not for low-back pain. The cases were few however, and exposure to high physical load or to strenuous work postures was not adjusted for. In a recent review on smoking and low-back pain Goldberg et al. (2000) pointed out that 18 of 20 studies showed positive association between smoking and LBP. However, most of those studies were cross sectional and therefore difficult to interpret. Further studies are needed for better knowledge of whether smoking causes low-back pain or not.

Methods of exposure assessment

The relationship between self-reports and observations was higher for the posture standing/walking in a stooped position than for work with hands above shoulder level.

There was a positive relationship between self-reported time in a stooped position and measured time spent with the trunk flexed. There was also a positive relationship between self-reported time spent with hands above shoulder level and measured time spent with the upper arms elevated even though an upper-arm elevation is by definition not the same as hands above shoulder level. The upper-arm can be raised to 90° relative to the vertical without the hand being positioned above shoulder level.

The accuracy of the self-reports was similar when the estimations covered one and two working days. This indicates that the subjects seemed able to estimate the average time spent in these postures during two days although it can vary from day to day, as it did for “sitting”. However, when self-reports concerning “a typical day” were compared with observations for two days, the correlation decreased more for “sitting” than for the two strenuous postures work in a stooped position and hands above shoulder level. For some subjects the reference measurements probably not represented for a “typical day”.

The high correlation between self-reported and observed durations in sitting, during one day and two days, in the present study agrees with the results of other studies (Wiktorin et al. 1993, 1996, Viikari-Juntura et al. 1996). The accuracy of self-reported time spent in the other two work postures corresponded with the results of a study of selected blue-collar workers by Wiktorin et al. (1996). Most of the subjects in the present thesis overestimated the duration of work postures with hands above shoulder level. Overestimation of strenuous work postures has also been reported by Viikari-Juntura et al. (1996) and by Wiktorin et al. (1996*)*. In contrast to this, the subjects of Burdorf and Laan (1991) underestimated time spent with the trunk in a flexed position. This may be due to very short observation periods or to their definition of a flexed position (only 20°).

Misclassification of exposure is always a problem in epidemiological studies. A differential misclassification, i.e. when it depends on the outcome causes serious problems in case-referent studies. A non-differential misclassification i.e., when the misclassification is independent of the outcome dilutes the RR towards unity (Rothman 1986, Norell 1992, Ahlbom et al. 1990).

Both types of misclassification reduce the sensitivity and specificity, i.e. the probability that a truly exposed individual is classified as "exposed" and a truly unexposed individual is classified as an "unexposed", respectively. Some truly exposed subjects may be falsely included in the "unexposed" group and vice-versa. In a population where the prevalence of exposure is low, high specificity in combination with low sensitivity has very little influence on dilution of the relative risk (RR) compared with the diluting effect of low specificity in combination with high sensitivity.

Differential misclassification

No substantial differential misclassifications were noted in the present work. With pooled data from Paper IV and a study by Wiktorin et al. (1996) testing the self-reported durations of work postures in relation to observations, the correlation coefficients between self-reports and reference measurements were high and ranged from 0.70 to 0.92. Subjects with musculo-skeletal complaints overestimated the time spent in awkward postures and underestimated time spent sitting, as much as subjects without those symptoms did (Wiktorin et al. 1996).

Subjects seeking care for low-back or neck/shoulder disorders (Paper V) estimated their current exposures similarly to subjects not seeking care for such symptoms i.e. there was no differential misclassification. Contradictory results were found by Viikari-Juntura et al. (1996). In their study, the correlation coefficients between self-reports and observations were higher in subjects without low-back pain than in those with pain. The problem with differential misclassification needs further research.

Non-differential misclassification

The high correlations found between the interview method and the questionnaire responses for estimated time spent "sitting at work", work with "VDU" and "motor vehicle driving" could be because the subjects answered the questionnaire only a few minutes after the interview and hence may have remembered their earlier responses. Probably this is not the only explanation, because the time estimations in the interview were made task-by-task and not as total time per day as in the questionnaire. It could be that subjects really are able to make these time estimations, even though the perceived time scale they use may differ slightly from the objective time scale (systematic errors) e.g. as was made for time spent "sitting". The high accuracy in self-reported time spent "sitting" tallies with previous studies (Burdorf & Laan, 1991, Wiktorin et al. 1993, van der Beek et al. 1994, Viikari-Juntura et al. 1996).

In the two questions concerning awkward postures, the rank correlation coefficients were moderately high. One explanation of this could be that the response scales differed and thus, the questions were not comparable.

Another explanation could be that the questionnaire questions were too complex ("more than 30 minutes/day" and "number of days for this exposure"). It may also be too difficult to recognise the position of the hands and the trunk when performing a job without the help of structured questions directly related to the actual job tasks, as in the interview.

Not even a high product-moment correlation or rank correlation coefficient between the reference and the proxy instruments is a guarantee for avoiding dilution of RR when the questionnaire is used in epidemiological studies. Thus, systematic under- or overestimation of exposure can still be present and dilute the RR if not adjusted for.

It is especially important to correct for underestimation of exposure in populations with high exposure prevalence, and it is important to correct overestimation in populations where exposure is low. Thus, it is important to know both if systematic errors in the proxy instrument are present and if the prevalence of exposure is common or uncommon.

To increase the chance of detecting moderately increased risks in epidemiological studies, subjective instruments such as self-reports should preferably be validated against more objective instruments on a sample of subjects from the actual study group.

Conclusions

Care-seeking behaviour

As expected, the most decisive factors for seeking care were high disability and high pain intensity. However, the results also show that many individuals with considerably less pain and disability also seek care for their problems. Economic factors seem to be of importance and costs for using health care must be kept low if the goal is health care on equal terms. The majority of people seek care for pain without wanting medical prescriptions or sick leave certificates. Among subjects seeking care for LBP, the pain and disability lasted for the whole two-year follow-up period, but sick leave was uncommon. During the follow-up the majority (60 %) of the low-back pain cases paid a substantial number of visits to different caregivers and for some treatment was of limited value.

Lifestyle factors and LBP

Among women, few hours with high intensity training increased the relative risk of a new episode of low-back pain. No degree of low intensity training or high intensity training affected the risk of a new episode of low-back pain among men.

An increased risk of low-back pain was found for men with high body weight but not for women. Smoking did not affect the risk for getting low-back pain.

Methods of exposure assessment

Interview data concerning time per day spent in a stooped position and time per day spent with hands above shoulder level may be accurate enough for studying health effects in epidemiological studies. Although interview data are preferable, questionnaire data may also be useful.

Summary

Mortimer M (2001) *Low back pain in a general population. Care seeking behaviour, life style factors, and methods of exposure assessment*. Arbete och Hälsa 2001:15, National Institute for Working Life, Stockholm. Department of Public Health Sciences, Division of Occupational Medicine, Karolinska Institute, Stockholm.

This thesis is based on the MUSIC- Norrtälje study, a population-based case-referent study of low-back pain with a two-year follow-up. Included in the study were 449 female and 342 male cases. The specific aims were to study their reasons for seeking care for low-back pain and to describe and follow the development of pain, disability, choice of caregiver and sick leave during the two-year period. A further aim was to study whether sports activities, body weight, and smoking influenced the risk of a new episode of low-back pain. Finally the present study thesis aimed at validating interview and questionnaire data concerning the physical exposures, work in a stooped position work and work with hands above shoulder level.

High disability (OR 7.4 for women and OR 4.9 for men) and high pain intensity (OR 3.7 for women and OR 1.7 for men) were strongly related to seeking care for low-back pain. Women not seeking care despite pain reported a more strained economic situation than those who sought care did. Physical or psychosocial working conditions, life style factors, and psychosomatic complaints did not affect care-seeking behaviour.

Some improvements regarding pain and disability were reported after three months but not much after six and 24 months. During the follow-up, about 60 per cent of the cases paid a substantial number of visits to caregivers. The majority (70%) of the cases had not been on sick leave one single day during the two-year period.

Sports activities did not affect the risk of low-back pain among men. High intensity training 1-2 hours per week increased the relative risk of low-back pain for women (RR 1.6) compared to women who did not do sport. An increased risk of low-back pain was found for men with BMI > 30 (RR 2.2) but not for women. Smoking did not influence the risk of low-back pain.

Regarding validation of the interview, the correlation coefficients between interview responses concerning a “typical day”and observations during two working days was 0.79 for work in a stooped position and 0.65 for hands above shoulder level.

The correlation coefficients between interview and questionnaire responses were 0.66 for work in a stooped position and 0.63 for hands above shoulder level.

In conclusion, the studies demonstrate that the most decisive factors for seeking care due to low-back pain were high disability and high pain intensity. Economic factors seemed to be important for women. Few of the cases became pain-free during the follow-up, but sick leave was rare. A certain amount of sports activities had a negative association with low-back pain for women. Smoking did not influence low-back pain. Interview data concerning work in a stooped position or work with hands above shoulder level are valid for exposure assessments. In addition, questionnaire data for those postures may be sufficiently accurate, at least at a dichotomous level.

Sammanfattning (Summary in Swedish)

Mortimer M (2001) *Low back pain in a general population. Care seeking behaviour, life style factors, and methods of exposure assessment*. Arbete och Hälsa 2001:15, National Institute for Working Life, Stockholm. Department of Public Health Sciences, Division of Occupational Medicine, Karolinska Institute, Stockholm.

Avhandlingen baseras på MUSIC-Norrtälje studien, en befolkningsbaserad fall-referent studie. I studien deltog 449 kvinnor och 342 män med ländryggsbesvär. Ett syfte med avhandlingen var dels att studera orsaker till att man söker vård dels att följa dem som sökt vård med avseende på smärta, funktion, val av vårdgivare samt sjukskrivning under en tvåårsperiod. Ett annat syfte var att studera om motion, övervikt eller rökning påverkar risken att få ländryggsbesvär. Det tredje syftet var att validera intervju- och enkätdata vad beträffar skattad tid i arbete med framåtböjd rygg samt arbete med händer ovan axelhöjd.

Nedsatt funktionsförmåga (OR 7.4 för kvinnor och 4.9 för män) samt hög smärt-intensitet (OR 3.7 för kvinnor och 1.7 för män) var starkt relaterade till att söka vård. Kvinnor med ansträngd ekonomi hade en hög benägenhet att avstå från att söka vård. Varken fysiska eller psykosociala arbetsfaktorer, livsstil eller psykosomatiska besvär hade något samband med att söka vård eller ej.

Efter basundersökningen sökte cirka 60 procent av fallen ytterligare vård. Smärtan minskade och funktionen förbättrades efter 3 månader men därefter skedde inga stora förändringar. Högintensiv motion 1-2 timmar i veckan ökade risken för kvinnor att få ländryggsbesvär (RR 1.6). Kraftig övervikt (BMI >30) var relaterat till ländryggs-besvär hos män (RR 2.2) men inte för kvinnor. Rökning påverkade inte risken för ländryggsbesvär.

Korrelationskoefficienten mellan svaren från intervjun ”en typisk dag”och observationer under två hela arbetsdagar, var 0.79 för arbete med framåtböjd rygg och 0.65 för arbete med händer ovan axelhöjd. I studiegruppen var variationen i exponeringstid låg enligt observationerna.

Korrelationskoefficienten mellan svaren från intervjun och svaren från enkäten var 0.66 för arbete med framåtböjd rygg och 0.63 för arbete med händer ovan axelhöjd.

Sammanfattningsvis visar studierna att nedsatt funktionsförmåga och hög smärt-intensitet är av avgörande betydelse för att söka vård. Kvinnor med ansträngd ekonomi avstår i hög grad från att söka vård. Få personer blev helt smärtfria efter två år men sjukskrivning var ovanligt. Generellt var motion varken risk- eller friskfaktor för ländryggsbesvär. Intervjudata angående tid med arbete med framåtböjd rygg och arbete med händer ovan axelhöjd var tillräckligt precisa för bedömning av expo-neringar. Intervjudata är att föredra, men enkätdata kan vara tillräckligt precisa, åtminstone på dikotom nivå.

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