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Work factors and musculoskeletal disorders

– An epidemiological approach focusing on female nursing personnel

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List of papers

This thesis is based on the following papers, which will be referred to by their Roman numerals.

- I Lagerström M, Josephson M, Pingel B, Tjernström G, Hagberg M, The Moses Study Group. Evaluation of the implementation of an education and training programme for nursing personnel at a hospital in Sweden. *International Journal of Industrial Ergonomics* 1998;21:79-90.
- II Josephson M, Lagerström M, Hagberg M, Wigaeus Hjelm E. Musculoskeletal symptoms and job strain among nursing personnel: a study over a three year period. *Occupational and Environmental Medicine* 1997;54:681-685.
- III Josephson M, Hagberg M, Wigaeus Hjelm E. Self-reported physical exertion in geriatric care - a risk indicator for low back symptoms? *Spine* 1996;21:2781-2785.
- IV Josephson M, Vingård E, MUSIC-Norrtälje Study Group. Workplace factors and care seeking for low back pain among female nursing personnel. *Scandinavian Journal of Work, Environment & Health* 1998;24:465-472
- V Josephson M, Pernold G, Ahlberg-Hultén G, Härenstam A, Theorell T, Vingård E, Waldenström M, Wigaeus Hjelm E and MUSIC-Norrtälje study group. Differences in the association between psychosocial work conditions and physical workload in female and male dominated occupations. *American Industrial Hygiene Association Journal* (In press)
- VI Josephson M, Gustafsson H, Ahlberg-Hultén, G, Härenstam A, Theorell T, Wiktorin C, Vingård E and MUSIC-Norrtälje study group. Paid and unpaid work; and its relation to care seeking for low back and neck/shoulder pain among women. (Submitted)

Definitions of terms as they are used in this thesis

Assistant nurses

Umbrella term for State enrolled nurses and Auxiliary nurses

Musculoskeletal Disorders

Umbrella term for symptoms, diseases and illness in the neck, shoulders and the back

Symptoms

Self-reported pain, aches and discomfort

List of abbreviations

CI	Confidence Interval
LB	Low Back
MET	Metabolic Rate
MSD	Musculoskeletal Disorders
NS	Neck/Shoulder
OR	Odds Ratio
RPE	Rating of Perceived Exertion
RR	Rate Ratio
TWA	Time Weighted Average

Contents

Introduction	1
Focus of this thesis	1
Women and work	1
The prevalence of musculoskeletal disorders	2
Assessment of musculoskeletal disorders	3
Epidemiology and musculoskeletal disorders	4
A model of psychosocial work factors and musculoskeletal disorders	5
Perceived physical exertion	7
Interventions	7
Aim	8
Methods	9
Included studies	9
The Moses program (<i>Study I, II</i>)	9
The Upp program (<i>Study III</i>)	11
The MUSIC-Norrtälje study (<i>Study IV, V, VI</i>)	11
Assessments of musculoskeletal disorders	13
Assessments of exposure	14
Data treatment	16
Results	18
The Moses program (<i>Study I</i>)	18
Musculoskeletal symptoms (<i>Study II</i>)	18
Job strain and perceived physical exertion (<i>Study II</i>)	19
The Upp program (<i>Study III</i>)	20
Risk factors for seeking care for low back disorders (<i>Study IV</i>)	21
Exposure factors (<i>Study IV, V</i>)	22
Paid and unpaid work (<i>Study VI</i>)	24
Discussion	25
Job strain	25
Perceived physical exertion	26
Additional work factors and musculoskeletal disorders	27
The interplay between work factors and musculoskeletal disorders	28
Occupation category, disorders and exposure	28
Musculoskeletal disorders	30
Unpaid and paid work	32
Interventions	32
The implementation of the transfer technique	33
Training of physical exercises and stress management	34
Methodological considerations	34
Conclusions	36
Summary	37

Sammanfattning (Summary in Swedish)	38
Acknowledgements	39
References	40

Introduction

Focus of this thesis

Episodes of low back and neck/shoulder disorders are common in the entire population. Many factors contribute to musculoskeletal disorders (MSD), and there is epidemiological evidence for a relation between work demands and MSD (74). The focus of this thesis was to examine the association between job factors and the occurrence of MSD, and in particular low back disorders, among female nursing personnel. Physical demands, perceived physical exertion, psychosocial work factors and the number of work hours, both for paid work at the workplace and unpaid work in the home, are considered.

Women and work

Approximately 20 percent of the employed women in Sweden work as registered nurses, assistant nurses, attendants in psychiatric care, home care workers or as assistants for the mentally retarded; approximately 136, 000 women in Sweden were employed as assistant nurses in 1997 (100).

The labor market is strongly sex segregated in Sweden, as in most industrial countries. About 90 percent of those employed in the health care and social sector are women (96). Furthermore, previous studies have indicated that men and women in the same occupation do not perform the same work tasks. Being a woman or a man can be a proxy for a special work tasks and exposure pattern (71). The studies in this thesis consider the female nursing personnel, their work conditions and occurrence of MSD. However, it should be pointed out that male nurses do not necessarily have better work conditions and less MSD than female nurses (72).

Several studies report a positive association between employment and health among women. Different social roles as spouse, parent, and paid worker induce independence and well being. However, daily domestic work and child care, daily care of relatives and other family duties include both physical and psychological demands and may lead to time pressure and work overload (6). It is reasonably to assume that the health of employed women is influenced both by the paid and the unpaid work and the balance between professional work, family and leisure time (7).

The prevalence of musculoskeletal disorders

In the Nordic countries, in population based questionnaire studies, approximately 50 percent report episodes of low back pain the previous year (65). No significant differences in prevalence between women and men or between different ages in the interval between 30 and 50, were observed (65). In an English population study from 1996 the annual prevalence was around 40 percent (45). Sick leave at least one day the previous year due to low back problems was reported by 6 percent (45).

In a review over low back pain among nurses, published 1987 (17), the annual prevalence of symptoms was approximately 40-50 percent. An additional review, published 1988, pointed out that assistant nurses were at higher risk than registered nurses (55). More recent studies have not shown a consistent tendency of changes in the prevalence (Table 1). However, Leighton et al. (66) compared the observed prevalence 1993 with those obtained from a similar study published 1983 (97). The annual prevalence was 43 percent 1983 and 59 percent 1993. The number of nurse taking sick leave due to back symptoms, approximately 9 percent, remained constant.

Table 1. The prevalence of low back symptoms among nursing personnel.

Country and Year	Study group	Prevalence of low back symptoms
France, 1990 (31).	1505 female nurses	47% during the previous 12 months
New Zealand, 1994 (22)	3425 female nurses	37% during the previous 12 months 12% point prevalence
China, 1994 (21)	3159 female nurses	70% during the previous 12 months 14% point prevalence
Sweden, 1995 (64)	688 female nurses	56% point prevalence
United Kingdom, 1995 (66)	1134 nurses, 90% females	59% during the previous 12 months 24% point prevalence
United Kingdom, 1995 (93)	1616 female nurses	45% during the previous 12 months
Greece, 1995, (108)	407 female nurses	67% during the previous 6 months 63% during the previous two weeks
The Netherlands, 1996 (29)	890 nurses, 90% females	36% complaints regularly
The Netherlands, 1996, (59)	355 female community nurses	67% during the previous 12 months 21% during the previous seven days
Sweden, 1998 (16)	1 100 female home care workers	40% during the previous seven days

The present studies mainly focused on low back disorders. However, in a Swedish population-based epidemiological study of 305 women, 53 percent reported symptoms in the neck and 40 percent in the shoulders the previous six months (28). For neck/shoulder symptoms a higher prevalence has been reported for female employees compared with male employees (23). In nursing work, the observed prevalence for neck and shoulder symptoms is at approximately the same level as for low back symptoms (16, 29, 64).

There is no consensus MSD are more frequent among nursing personnel compared with the general female population. In a study of Leighton et al. (66), no significant difference in prevalence of low back symptoms between nurses and the female population was observed. On the other hand, in the study of Pheasant et al. (82), the point prevalence and the annual prevalence was higher for nurses compared to the general population. In Sweden, in a representative sample of about 17,000 of the inhabitants for 1995/1996, assistant nurses and home care workers reported a higher prevalence of low back symptoms, and registered nurses the same prevalence, compared with the general working population (99). Furthermore, according to the Swedish occupational injury register, home care workers and assistant nurses had a higher risk for back injuries compared with other women (30, 76).

Assessment of musculoskeletal disorders

There is no “golden standard” for estimating the prevalence of MSD among the population. Self-reported data in questionnaire concerning episodes of pain is common method for estimating the magnitude of the problem. Furthermore, health care consultations or sick leave can be used as a proxy for the problem. Health outcomes as symptoms, care-seeking and sick leave overlap, but to a high degree, they give different pictures of the extent of the problem (4, 33).

Many people are healthy enough to work, although they report symptoms in questionnaire studies. The symptoms reported may not have been known to the occupational health care service, the employers or may not have lead to sick leave. In the literature there are different views of the importance of self-reported symptoms. One discussed issue is whether studies about symptoms help us to understand causes of musculoskeletal disorders, which lead to sick leave and early retirement (33). A hypothesis is that a common continuum of the disorders is first the development of symptoms, followed by reporting the symptoms and seeking health care, and then sick leave and disability (89). Thus, studies of risk factors for self-reported symptoms can help us understand the causes of more severe cases (33). However, most individuals with back symptoms do not develop chronic symptoms and long periods of disability (49). According to an English study, around 50 percent of those with low back symptoms the previous year consulted a caregiver for their problems (45). Besides the severity of the disorder, care-seeking is probably influenced by the family situation, occupation and activities during leisure time (45).

Epidemiology and musculoskeletal disorders

Epidemiological studies attempt to identify and quantify factors that are associated with health problems. Identification and quantification of contributing factors for MSD in nursing work have been the objective in a number of epidemiological studies (2, 15, 17, 29, 31, 40-42, 44, 50, 55, 75-77, 82, 85, 92-94, 97, 110, 118). A variety of individual factors, job factors and living conditions have been assessed and scrutinized.

The majority of the conducted studies have a cross-sectional study design. Cross-sectional studies can be used for describing the prevalence of disorders and exposure, and also to examine the association between variables. The prevalence of a disorder, estimated in cross-sectional studies, is dependent both on the incidence and the duration of the disorder. Factors related to the incidence of the disorders and factors related to the duration of the disorders could not be separated. In studies of MSD it is reasonable to assume that the same job exposure, for example heavy lifting, both increases the risk of getting the disorders and also extends the duration of it. If there are opportunities, individuals with MSD may move to physically lighter occupation (122). Thus, the observed prevalence of symptoms decreases.

In case-referent studies and in follow-up studies the objective is to establish that the exposure precedes the disorder. In a case-referent study all cases that occurs in the study population during a defined time period are compared with a representative sample selected from the study population. Ideally the exposure distribution among the selected referents is representative for the study population. A drawback of the case-referent study is that the retrospective exposure information can introduce recall bias. The cases and referent differ in respect to their experience of the disorder being studied and this differ may influence the recall of previous exposure (87).

In the follow-up study people are followed over a period of time in order to describe the incidence of the disorder and to identify risk factors and risk indicators. A risk factor must precede the disorder and the occurrence of the disorder should be lower in the absence of the risk factor. A risk indicator precedes the disorder but is not necessarily causal for the disorder (3). However, there are problems in incidence studies of MSD. The definition of incident new disorders is not obvious. Is an incident case someone who has experienced the first episode of musculoskeletal symptoms in their life? Alternatively, is it someone who has been free from symptoms for a defined period of time before the incidence; or does it refer to the first episode of sick leave or of seeking professional care for the symptoms? The high frequency and the episodic events of MSD make it difficult when designing and interpreting epidemiological studies, both cross-sectional and prospective studies (43, 87).

In occupational health epidemiology, exposure factors are usually defined as factors in the work environment outside the individual, for example work tasks demanding heavy lifting (39). In this thesis, the term exposure was used in a broader sense, exposure factors refer to variables considered as potential risk

indicators for MSD. An exposure can refer to a behavior (e.g. working in forward-bent positions), to the work demands (e.g. lifting a weight of 30 kg), to the perception of the work (e.g. perceived exertion) or to a potential causal characteristic (e.g. individual capacity) (87). Covariance between exposure factors, i.e. the degree to which exposure factors changes together, causes problems in determining the relative influence of each. A confounding situation, when the effect of the exposure being studied is distorted by another exposure factor, is likely in epidemiological studies of multifactorial health problems as MSD (87).

A model of psychosocial work factors and musculoskeletal disorders

Psychosocial work factors in the epidemiological studies have been attributed to psychological, social and organizational conditions (69, 89). Psychosocial factors are associated with job tasks, with work environment and with characteristics of the individual worker. An association between psychosocial job factors and musculoskeletal disorders has been shown in a number of epidemiological studies (2, 8, 10, 11, 16, 27, 47, 51, 52, 60, 64, 67, 68, 78, 91). In a review which is frequently referred to, Bongers and co-workers presented a model of possible pathways between psychosocial work factors and MSD (11) (Figure 1).

One possible pathway is that psychosocial factors at work influence physical load. Adverse psychosocial conditions may lead to an increased frequency of strenuous work postures, unexpected movements and a decrease in pauses and variability.

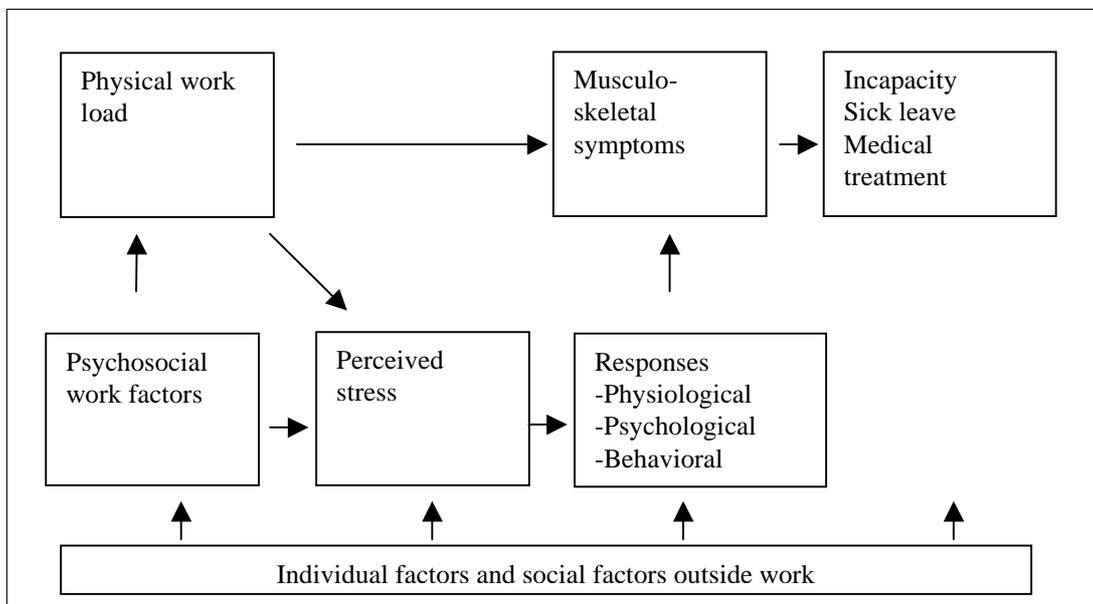


Figure 1. A simplified model of the association between psychosocial factors at work and MSD, slightly modified from Bongers et al. (11)

Furthermore, the individual experiences the work demands (environmental factors), both physical demands and psychosocial demands. The experience is perceived as stressful, depending on the demands and on individual factors. The environmental factors can partly be separated in physical and mental demands, but the perception of the demands and the physiological response are often connected. An imbalance between the requirements and the individual capacity may lead to perceived stress."Psychological and psychosocial stress can be defined as an interactional process between environmental demands and the individual's ability to meet those demands." (Lundberg, page 117 (70)).

A job situation reported as psychologically demanding, and at the same time with low influence over decisions, has been described as a job strain situation (56, 102). In the job strain model, the psychological demands involve both quantitative and qualitative demands and the influence over decisions includes two dimensions: possibilities to influence decisions regarding what to do and how to do the work and opportunities to use and develop skills which enable individual control in the work. A job strain situation has been pointed out as an important factor for stress and negative health outcomes (56, 61).

The responses of perceived stress can be psychological (e.g. tenseness and anxiety), physiological (e. g. muscle tension and organic changes) and/or behavioral (e.g. deteriorated work technique). As a result of the interplay between environmental factors, individual psychological, social and physical factors, the same environmental demands do not have the same effect on everyone. The responses to physical load, as the responses to psychosocial conditions, influenced by individual factors, e.g. physical capacity, work technique, competence and coping behavior (5).

Increased muscle tension can be the response of a physical load but also the response of perceived psychological demands. Tenseness and anxiety may increase the perception, the awareness and reporting of musculoskeletal symptoms and reduce the capability to cope with them. Increased muscle tension may by itself lead to musculoskeletal symptoms and/or increase the sensitivity for physical load. Furthermore, the increased muscle tension give rise to a new response, for example tissue damage and a possible process is a cascade of responses that give rise to disorders (5). One theory is that stress creates physiological changes that increase the vulnerability of the musculoskeletal system (102). When musculoskeletal symptoms arise, the symptoms may increase and result in seeking health care, sick leave and disability.

Besides the influence of job factors on MSD, it is reasonable that MSD influence the work situation. Pain, disability and reduced capability to cope with work demands may partly direct the work tasks, pace of work, work technique and social relations at work. Furthermore, changes in behaviors, as an effect of perceived stress, can be a deteriorated work technique and less communication and cooperation with work mates. A more extended model of the interplay between psychosocial factors and disorders most include two-way arrows and feedback loops between the included factors.

Perceived physical exertion

The physical load at work can be caused by the demands of strenuous working positions, lifting, carrying and pushing. The prevalence of MSD among nursing personnel can partly be explained by the physical load (31, 44, 93). Transferring patients has been reported as the most physically exerting work task for nursing personnel (36).

“Perceived exertion is the feeling of how heavy and strenuous a physical task is.” (page 8, Chapter 1, (12)). The most frequently used scale for measurement of perceived physical exertion during physical work is the RPE scale (Rating of Perceived Exertion) (12). The scale has been developed on the basis of empirical data from work on bicycle ergometers. A high correlation of ratings and heart rate for short-time work on bicycle ergometers has been reported (12).

Furthermore, the RPE scale has been used in several studies on tasks representative of actual job performance (34). The rating of the perceived exertion reflected the kind of work tasks, duration and frequency of the tasks and the intensity of the activities. In a previous study, 38 assistant nurses ranked different patient-handling tasks for perceived physical exertion to the back, shoulders and whole body (36). Transferring a patient from toilet to a chair was perceived as most physically exerting task. The greatest amount of exertion was felt in the lower back.

In many epidemiological studies of work and MSD the information on the physical workload is assessed by job title (18). However, within the same occupation the work tasks and the work condition vary. Job title is a crude method of assessment of workload (18). The RPE scale applied as an item in a self-reported questionnaire was first used in a methodological study which aimed to develop effective methods for physical load assessments in large population studies (113). Perceived physical exertion was used a proxy for the general physical workload and was considered as dependent on the external requirements and on individual factors. One individual factor in nursing work that may influence physical exertion is the work technique used at patient transfers.

Interventions

The importance of a good patient transfer technique in order to reduce physical load has been pointed out in previous studies (111, 119). Training in patient-handling technique has been regarded as effective not only in improving the patient-handling skills among the staff, but also in decreasing back injuries (36, 111). On the other hand, a review published 1996, of interventions to reduce low back disorders among nursing personnel, concluded that patient transfer training has little, if any influence on low back disorders (44). There are several possible explanations for the negative results: the taught technique do not decrease the physical load; the implementation and the compliance of the technique is low; the follow-up time is short; the total workload and changes in workload are not considered and/or the assessment of MSD is too rough.

Introducing and implementing a patient transfer technique at a hospital is a resource-consuming project. Generally, when a work technique has been introduced, 1-2 nursing personnel at one ward have been trained in the technique in order to keep costs low. It has been difficult for these persons in their turn to introduce and maintain the new technique at their wards. An outcome of the training programs is to evaluate the implementation, and the compliance and sustainability of the change of behavior (57, 109). Also, attitudes to the program can be seen as an intermediate outcome.

Aim

The overall aim of this thesis was to examine the association between job factors and musculoskeletal disorders among nursing personnel.

The specific aims were:

- to examine the association between a job strain situation and musculoskeletal symptoms
- to examine the association between perceived physical exertion and musculoskeletal symptoms
- to identify risk factors for seeking care for low back disorders
- to examine the turnover from no musculoskeletal symptoms to symptoms, and vice versa, in yearly repeated surveys
- to examine whether there is a relation between high physical workload and adverse psychosocial work factors
- to examine the influence of the amount of paid and unpaid work on seeking care for low back and neck/shoulder disorders
- to evaluate the implementation of a training program in patient transfer technique

Methods

Included studies

This thesis is based on three separate projects. Two training programs for nursing personnel, called the Moses program and the Upp program and one population-based case-referent study, called the MUSIC¹ - Norrtälje study.

The Moses program (*Study I, II*)

A new patient transfer technique, Stockholm Training Concept (53) was introduced to the nursing personnel at a regional hospital during a period of approximately four years. This is a dynamic and flexible work model that is focused on preventing work related over-exertion disorders among the nursing personnel, and on meeting the need for care and rehabilitation of the patient. Two important concepts, "natural movements" and "basic knowledge of ergonomic principles" formed the basis for the collaboration with the patient. All 40 physical therapists at the hospital were trained by external experts in the Stockholm Training Concept. Thus, the physical therapists became experts in this technique and in turn trained all nursing personnel. The physical therapists were each assigned to a specific ward where they were responsible for the rehabilitation of patients. From now on they also became responsible for the training of the nursing personnel at "their" wards in this work technique.

While all nursing personnel at the hospital were taking part in the training of the new transfer technique the idea of a further training program was raised. Thus, a program called Moses, consisting of three courses; additional courses in patient transfer technique, physical fitness exercise and stress management was designed (Figure 2).

The courses lasted one day and there was an average of nine to twelve participants in each course. The personnel from one ward attended together in the same course during working hours. Every participant attended one of the three courses each year. The order of courses was different for personnel at different wards.

The number of female nurses who participated in the yearly courses were 581, 570, 577, respectively. The participants in the program completed a self-administrated questionnaire once a year over a period of four years. At the first three assessments this was done before the yearly course day, at the fourth assessment, the subjects filled in a questionnaire without a subsequent course. The yearly assessments are referred as the first, second, third and fourth survey. The first cross-sectional survey is referred as the baseline assessment in the follow-up analysis.

¹ MUSIC = Musculoskeletal Intervention Center

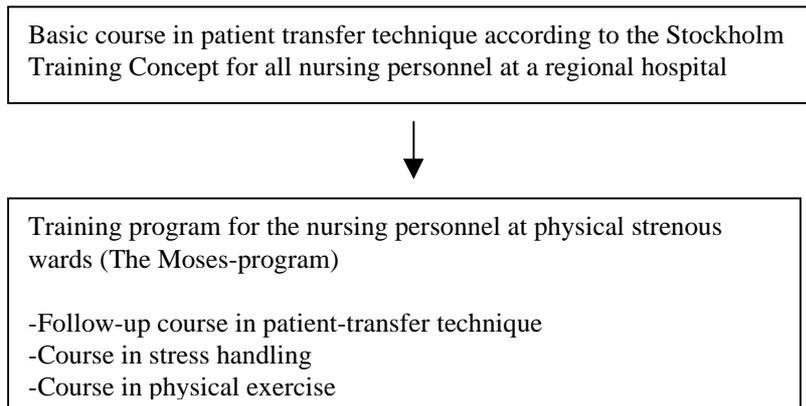


Figure 2. The Moses program

In the repeated cross-sectional analysis the study group was dynamic, i.e., all participants answering the questionnaire on each occasion were included in the analysis. In the follow-up analysis the study group was a closed cohort; no new participants were added to the study group (Table 2). The drop-out was mainly because of maternity leave, personnel turnover and staff cuts.

More participants, totally 348 participants (*Study I*) were included in the study about the implementation of the patient transfer technique, than in the analyses of the closed cohort in *Study II*, which involved 285 participants. The difference in number of nursing personnel depended on time limits in the data collection and missing out questions.

Table 2. The number of participants included in the analyses of job strain, perceived physical exertion and ongoing musculoskeletal symptoms (The Moses program- *Study II*). Distribution of occupation and age.

Repeated cross-sectional surveys	n	Registered nurses (%)	Assistant nurses (%)	Other ¹ (%)	Mean age (years)	Frequency ≥ 45years (%)
First survey	565	39	60	2	40	37
Second survey	553	41	57	2	42	43
Third survey	562	42	56	2	42	45
Fourth survey	419	44	52	5	43	49
Closed cohort						
Baseline (First survey)	285	47	51	2	43	49

¹ Assistants and pupils

The Upp program (*Study III*)

The main objective of the program was to examine the effect of physical training on musculoskeletal disorders. The program included three different intervention activities. One group performed aerobic training, a second group muscular training. The third group had courses in occupational health and stress management and was planned to serve as a control group. The participants enrolled individually but were randomly selected for one of the intervention activities. All the activities took place in the hospital during working hours. The work loads for the physical training were adjusted individually before the training started and after one and three months. The activities were performed for 40 minutes, twice a week, during a period of six months. Employed instructors supervised the intervention sessions.

In *Study III*, 131 female assistant nurses, working in geriatric care, participated. In the six- months follow-up, 91 nursing personnel remained in the study. The reduction of the study group was mainly due to personnel turnover, maternity leave, redundancy notices and staff cuts. The drop-outs did not differ in age, in exposure variables under control or in prevalence of low back symptoms.

Assessments by questionnaires and physical capacity tests were performed twice, before the intervention program and after six months.

The MUSIC-Norrtälje study (*Study IV, V, VI*)

The study took place in the municipality and rural district of Norrtälje, a part of Stockholm county in central Sweden. The source population comprised of about 17,000 persons, 20-59 years old, living within the municipality. The data collection took place from November 1993 to June 1997. The cases had sought health care from any of the around 70 professional caregivers in the region during the study period. The referents were randomly selected from the same source population and went through a similar investigation.

In the presented studies the inclusion criteria varied. In *Study IV*, female referents and low back cases, collected between 1993 and 1996 were included. The respondents, 333 female cases and 733 female referents, had been employed for at least two months during the previous year. They were not self-employed; were not taking part in labor market measures, and did not have an occupation requiring at least six years of education after compulsory school.

In *Study V*, the referents collected between 1993 and 1996, 797 women, all employed for at least two months the previous year, were included.

In *Study VI*, all female cases and referents during the whole study period, 1993 and 1997 704 cases and 984 referents, were included, (Table 3).

Table 3. Number of currently employed and non-employed low back cases (LB), neck/shoulder cases (NS), combined LB and NS cases and referents in *Study VI*.

	LB Cases	NS Cases	Combined LB and NS cases	Referents
Full-time employed (≥ 35 h/week)	182	123	23	495
Par-time employed (18-34h/week)	120	84	24	278
Unemployed	30	14	10	77
Student	17	11	2	29
On maternity leave	22	10	-	54
Housewife	8	4	1	24
Other	11	5	3	27
Total	390	251	63	984

The classification in occupation sectors was based on the Nordic Occupation Classification (95). Health and social work were most frequent for the women. About 35% of the women were employed in health and social work, 15% in educational work, 15% in clerical work, 10% in service work and about 10% in sales work. When comparing the present study base with the general working population in Sweden the agricultural sector was somewhat over-represented and assembly work relatively infrequent in the municipality of Norrtälje (96). Nursing occupations included registered nurses, assistant nurses, attendants in psychiatric care, home care workers and assistants for the mentally retarded. In the presented studies the inclusion criteria and the number of nursing personnel varied (Table 4).

Table 4. Number of female nursing personnel (assistant nurses, attendants in psychiatric care, home care workers and assistants for the mentally retarded) in the MUSIC-Norrtälje study (*Study IV, V, VI*). LB cases: those who had sought care for low back disorders. NS cases: those who had sought care for neck/shoulder disorders. Combined LB and NS cases: those who had sought care for low back and neck/shoulder disorders.

Nursing personnel	<i>Study IV</i>	<i>Study V</i>	<i>Study VI</i>
LB cases with current employment ¹	71	-	71
LB cases with no current employment ²	3	-	3
NS cases with current employment	-	-	42
NS cases with no current employment	-	-	5
Combined LB and NS cases with current employment	6	-	7
Combined LB and NS cases with no current employment	1	-	1
Referents with current employment	169	169	180
Referents with no current employment	19	19	19

¹ Employed the two months prior the examination

² Not employed the two months prior the examination but at least two months during the previous year

The registered nurses, the assistant nurses and the attendants in psychiatric care were mainly working in a hospital setting: in medical, surgical, psychiatric or geriatric wards. The home care workers were employed by the local municipal authority and worked with elderly people in their private homes or in blocks of service flats. Assistants for the mentally retarded were also employed by the local municipal authority and took care of the mentally retarded in nursing homes. Comparing nursing personnel with occupations requiring the same level of education, the categorization was based on the Swedish socio-economic index classification (95).

The study persons took part in a clinical examination, an interview about physical exposures by a physical therapist and an interview about psychosocial factors by a behavioral scientist. Furthermore, the participants filled in questionnaires about living conditions, work exposure and general health. The physical therapist and the behavioral scientist did not know if the study subject was a referent or a case during the interviews.

Assessments of musculoskeletal disorders

The Moses program (Study I, II)

Musculoskeletal symptoms were assessed by a modified version of the Nordic Musculoskeletal Questionnaire (63). The items were "Have you had any symptoms the last 12 months?" and "Do you have any ongoing symptoms?" The question about symptoms the last 12 months had two response alternatives: yes and no. Ongoing symptoms were assessed by means of a 10-point (0-9) scale with the verbal endpoints "no symptoms" and "very intense symptoms". Cases were defined as nursing personnel reporting intensive ongoing symptoms, score ≥ 6 , from at least one of the body regions neck/shoulders/upper back/lower back.

The Upp program (Study III)

The outcome variable was ongoing low back symptoms. The question was "Do you have any symptoms right now?" A 100 mm Visual Analogue Scale (VAS), from "no symptoms" to "very intensive symptoms" was used. A mark at 11 mm or more on the scale was defined as ongoing low back symptoms. The 11 mm limit for ongoing symptoms was based on the fact that it was common to report no symptoms during the last 12 months and mark between 0-10 mm on the VAS scale for ongoing symptoms. Reporting the same intensity, more intensive or new symptoms from the low back was defined as a negative outcome in the follow-up analysis.

The MUSIC-Norrtälje study (Study IV, V, VI)

The definition of a case was that they had sought care for low back or neck/shoulder disorders from the caregivers in the region, such as physicians, physical therapists, chiropractors and osteopaths, during the study period. They were defined as cases independent of the outcome of the clinical examination in the study. People who had sought care for low back and neck/shoulder pain

during the previous six months prior the study occasion were excluded. The objective was to identify incident cases.

Assessments of exposure

Job strain

In the present studies a Swedish version of the job strain questionnaire was used (103). The index of psychological demands included five items: excessive work; conflicting demands; not enough time to do work; fast work and hard work. The score variation was 5-20; the higher the score the higher the demands. The index of decision latitude included six items. There were four items about intellectual discretion: learning new things; high levels of skills; high levels of creativity; repetitious job, and two items concerning authority over decisions: influence over what to do at work and how to perform the work. The possible score variation was 6-24; the lower the score the less the decision latitude.

The indices were divided based on the distribution among the respondents. In the Music-Norrtälje study the division based on the distribution among female and male referents. In the Moses-program (*Study II*) and in Music-Norrtälje-study (*Study IV, V,*) the score was divided approximately in tertiles; a score of ≥ 14 for high psychological demands and ≤ 16 for low decision latitude were the cut-off points. In the Upp program (*Study III*) the score was divided approximately in quartiles. A score ≥ 16 was defined as high psychological demands, score ≤ 14 for low decision latitude.

The Cronbach alpha coefficient was used for estimating the internal consistency among the included questions. The coefficient can be interpreted as a correlation coefficient, it ranges in value from 0 to 1. The internal consistency of the index concerning psychological demands was between 0.69 to 0.76, for decision latitude between 0.51 to 0.72. The internal consistency for decision latitude in *Study II* can be considered as low ($\alpha=0.51$). This may led to an underestimation of the association between the items included in the index and musculoskeletal symptoms.

Perceived physical exertion

Perceived physical exertion was assessed by an RPE scale (13). The scale was used as an item in the questionnaires. In the Moses-program (*Study I, II*) and the UPP-program (*Study III*) the range was modified to 0-14. High physical exertion was defined as an RPE rating ≥ 10 , corresponding to between "hard" and "very hard" (Figure 3).

In the MUSIC-Norrtälje study (*Study IV*) the original scale was used with a range from 6-20 (Figure 3). The cut-off point for high perceived physical exertion was based on the exposure distribution in the referent group. Nursing personnel who reported physical exertion higher than "somewhat hard" (score ≥ 14), approximately the highest tertile among the female and male referents in the Norrtälje study, were categorized as exposed.

Original Scale	Modified Scale	
6	0	
7	1	Very, very light
8	2	
9	3	Very light
10	4	
11	5	Fairly light
12	6	
13	7	Somewhat hard
14	8	
15	9	Hard
16	10	
17	11	Very hard
18	12	
19	13	Very, very hard
20	14	

Figure 3. The original (13) and the modified (113) RPE scale for assessment of perceived physical exertion.

Individual physical capacity (Study III)

The maximal aerobic capacity was estimated by a sub-maximal bicycle ergometer test, -with correction for age(120, 121). The individual's aerobic capacity was defined as low if the estimated maximal capacity was ≤ 27 mlO₂*min⁻¹*kg⁻¹ (lowest quartile). All participants defined as having a low aerobic maximal capacity had lower capacity than normal for their age (120).

Back endurance was estimated by a test developed by Biering-Sørensen (9). The subject was placed prone with the buttocks and legs fixed to the couch and the upper part of the body unsupported. The numbers of seconds the participant was able to keep the unsupported upper part of the body horizontal with the legs and buttocks was measured. Short low back endurance was defined as ≤ 110 seconds (lowest quartile).

Additional exposure assessments (Study IV, V, VI)

The psychosocial factors treated in the present studies focused on individual's description and perception of the job. Besides the job strain model, the interview and questionnaires took into account work involvement, social relations, demands and opportunities for problem-solving and planning, opportunities to learn and develop, and questions concerning monotony-variation (103, 106, 107). In the interview, the time spent on: routine work, active knowledge and problem-solving for a typical workday was estimated (106). The underlying hypothesis was that work requiring little thinking and planning has negative consequences on the health over a long-term perspective (117). "Mainly routine work" was defined as 50% or more of the working hours spent on routine work, and no working tasks requiring problem-solving. The opportunities for social support

and satisfying social relations at work were assessed both in the interview (two questions) and by questionnaire (six items) (103, 107).

In the interview with the physical therapists, awkward work postures, manual materials handling and energy expenditure in work were assessed (73, 79, 116). Based on the description in the interview of a typical workday, the energy expenditure was estimated and quantified in multiples of the resting metabolic rate (MET) for each work task. In a previous method study the inter-rater and inter-method reliability of the assessment of the energy expenditure during an ordinary workday were considered to be high (79). A time-weighted average of MET (TWA-MET) for a typical workday was calculated. The level of TWA-MET was used as a proxy for the physical load. For an 8-hour workday consisting of mixed physical work, the use of around 30% of the maximal aerobic power has been recommended as a general upper limit (54). An energy expenditure of 2.9 MET for average middle-aged women represents around 30% of the maximal aerobic power (120). Thus a TWA-MET of 2.9 or more for the women was considered as high physical workload. Manual lifting of 10 kg or more during at least five minutes of a typical workday, lifting at least 30 kg once a week, and working in forward-bent positions with the hands below knee level were and high physical workload were considered as potential risk factors.

For unpaid work the women described a typical weekday and the time spent on domestic work and child care. Additional duties at home, such as care of elderly parents and maintenance work, were also considered. The time for different activities was divided into unpaid work and time for own relaxation without any special demands and duties. The total work hours were the sum of paid work and unpaid work for a typical week, excluding the weekend.

The interview also included questions about; who in the family performed the main part of the daily domestic work; support with the daily domestic work. The women were asked to evaluate the balance between paid work, unpaid work and leisure time activities, i.e. if paid work, domestic work, and time for their own recreation took up the amount of time that was “just the right”; if they would like to have more time for it, or if it took up too much time. The hypothesis was that an imbalance between the desired time and the real time spent in paid work, unpaid work and other activities may led to stress reactions and health problems. A five-point scale, from “far too little time” (1) to “far too much time”(5) were the response alternatives.

Education and social background, temporary or permanent employment and working schedule were also considered.

Data treatment

The analyses were performed with EPI-INFO, SAS and CIA computer programs (24, 35, 88). Differences in the proportion exposed were presented 95% CI of the mean difference (CI 95%). The difference was considered as significant when the 95% CI for the mean difference did not cover zero.

In *Study II*, age (≥ 45 years), occupation (not registered nurse), patient transfers ($3 \geq$ per working day), high physical exertion and job strain were considered as potential risk factors or confounding factors. In the cross-sectional analysis the rate ratio (RR) was used to describe the relative occurrence of case between exposed and unexposed. In the follow-up analysis RR was used to describe the relative occurrence of cases at the time for the follow-up between exposed and unexposed nurses at baseline. In the follow-up analysis all nurses defined as cases at baseline were excluded. The data were divided into subgroups to consider effect modification and to control for potential confounding. Mantel-Haenszel weighted statistics were calculated to combine the estimates of the subgroups specific into a single overall estimate (87)

In *Study III*, age (≥ 45 years), high psychological demands, low decision latitude, high perceived physical exertion, low aerobic capacity (lowest quartile among the participants), and estimated short low back endurance (lowest quartile among the participants) were considered as potential risk factors or confounding factors. In the cross-sectional analysis, RR was used to describe the relative occurrence of low back symptoms between exposed and unexposed. In the follow-up analysis RR was used to describe the relative occurrence of a negative outcome (i.e. the same intensity, more intensive or new symptoms) between exposed and unexposed nurses at baseline. Differences between the three intervention groups were estimated by one-way variance analysis and chi-square analysis.

In *Study IV* and *VI*, Odds Ratio (OR) was calculated as the odds of being exposed among cases divided by the odds of being exposed among referents. The OR with test-based 95% CI were interpreted as an estimate of the relative risk (87)

In *Study V*, OR with test-based 95% CI was used as an estimate of the association between psychosocial work factors and high physical workload. The probability for employees exposed to adverse psychosocial conditions having a high general physical workload, as compared with those without adverse psychosocial work conditions, was calculated.

In *Study IV, V and VI*, multivariate logistic regression analyses were conducted. By considering several factors in the same analysis it was possible to estimate whether a factor was related to the outcome when additional variables were taken into account. The stability of the logistic regression analysis was tested by the Hosmer and Lemeshow test (46). The observed and estimated expected frequencies were compared and, the calculated p-value was dependent on the estimated expected frequencies being large enough for a stable model (46).

In the MUSIC-Norrälje study the data was frequency-matched for age, in order to increase the efficiency of the study. In the analyses, age was considered as a potential confounding factor or effect modifier. The univariate analyses and the multivariate analysis in *Study V* were stratified for age in two groups, 20-44 years and 45-60 years. In *Study IV* and *Study VI*, in the multivariate logistic model, age was classified in four 10-year intervals.

Results

The Moses program (*Study I*)

During the entire program 89% to 93% of the nursing personnel reported that they used the transfer technique during most of the patient transfers and 97% to 99% reported that they appreciated the technique.

Musculoskeletal symptoms (*Study II*)

The prevalence of musculoskeletal symptoms did not decrease during the years of the program (Table 5). In the closed cohort, 13% were defined as cases at all four assessments, 46% varied between cases and not cases, 41% were defined as non-cases at all four assessments. The frequency of turnover from case to non-case or vice versa, from non-case to case, was 10% to 14% between baseline and the one, two and three-year follow-ups, respectively (Table 6).

The symptoms from neck, shoulder and the back overlapped to some extent. At the baseline, 13% reported intensive ongoing symptoms only from the neck/shoulders, 10% reported only back symptoms and 10% reported both neck/shoulder and back symptoms.

Table 5. Prevalence of cases¹ in the yearly repeated cross-sectional surveys (*Study II*).

Yearly repeated cross-sectional surveys	Number of subjects in the repeated surveys	Prevalence of cases in the repeated surveys	Prevalence of cases in the closed cohort (n=285)
		%	%
First survey	565	33	34
Second survey	553	35	35
Third survey	562	36	35
Fourth survey	419	36	35

¹Cases were defined as nursing personnel reporting ongoing symptoms, score ≥ 6 , from at least one of the body regions: neck/shoulder/upper back/low back.

Table 6. Frequency of those who were cases¹ both at baseline and at the follow-up, frequency that became cases, and frequency that became non-cases at the one, two and three years follow-up, respectively. n=285

	Frequency who were cases both at baseline and at the follow-up assessment	Frequency that became cases at the follow-up assessment	Frequency that became non-cases at the follow-up assessment
Baseline and	%	%	%
1 year follow-up	24	12	10
2 year follow-up	21	14	13
3 year follow-up	23	13	12

¹Cases were defined as nursing personnel reporting ongoing symptoms, score ≥ 6 , from at least one of the body regions.

Job strain and perceived physical exertion (*Study II*)

In the repeated cross-sectional surveys the RR for being a case was between 1.1 and 1.5 when comparing the job-strain group with the non job-strain group (Table 7). When comparing the high-exertion group with the non high-exertion group, the adjusted RR was between 1.4 and 1.8 (Table 7). For the combination of job strain and exertion the estimated RR was between 1.5 and 2.1 (Table 7).

In the follow-up analysis the RR for becoming a case was between 1.4 and 2.2 when comparing the job-strain group with the non-job-strain group. When comparing the high-exertion group with the non high-exertion group, the estimated RR was between 1.3 and 1.6. The precision was low; the lower limits of 95% CI of the RR were between 0.5 to 0.8.

Table 7. Yearly repeated cross-sectional surveys. Estimated adjusted RR for being a case.¹ *Study II*

Potential risk factor				
Job strain (Demands score ≥ 14 , Decision latitude score ≤ 16)				
Yearly repeated cross-sectional surveys	n	Frequency exposed %	Frequency exposed cases %	RR(95% CI) ²
First survey	505	10	17	1.5 (1.1-2.1)
Second survey	506	11	15	1.1 (0.8-1.6)
Third survey	506	16	24	1.5 (1.2-2.0)
Fourth survey	372	18	21	1.1 (0.8-1.6)
Physical exertion (>Hard)				
				RR(95% CI) ³
First survey	505	12	19	1.5 (1.1-2.1)
Second survey	506	15	23	1.5 (1.2-2.1)
Third survey	506	16	24	1.4 (1.1-1.8)
Fourth survey	372	20	31	1.8 (1.4-2.4)
Job strain and Physical exertion				
				RR(95% CI) ⁴
First survey	505	4	8	2.1 (1.4-3.3)
Second survey	506	4	8	2.0 (1.3-3.0)
Third survey	506	6	9	1.5 (1.0-2.3)
Fourth survey	372	6	10	1.6 (1.0-2.5)

¹Cases were defined as nursing personnel reporting ongoing symptoms, score ≥ 6 , from at least one of the body regions.

²Adjusted for age, occupation and physical exertion by the Mantel Haenszel method.

³Adjusted for age, occupation and job strain by the Mantel Haenszel method.

⁴Adjusted for age and occupation by the Mantel Haenszel method.

The Upp program (*Study III*)

In the Upp program, ongoing low back symptoms were reported by 47% of the participants before the intervention activities, and by 50% after six months.

In *Study III*, in the cross-sectional analysis, high physical exertion, reported by 38%, tended to be positively associated with an increased occurrence of low back symptoms (RR 1.3 95% 0.9-2.1). Of the 91 assistant nurses who participated both in the initial assessment and in the follow-up, 30% reported a negative outcome, i.e. the same intensity, more intensive or new symptoms. A rating of high perceived exertion in the initial assessment indicated an association with a negative outcome (Table 8). Of the seven nursing aides who perceived high exertion and were ≥ 45 years, four reported a negative outcome. Their estimated RR for a negative outcome was 3.0 (95% CI 1.1-8.2), compared with the nursing aides who were younger than 45 and who not reported high perceived exertion.

No association between changes in reported physical exertion and changes in the physical capacity tests, was observed. In the initial assessments, the variable which was highest correlated (Pearson correlation coefficient=0.4) with perceived physical exertion was psychological demands. Of the 26 assistant nurses who reported high psychological demands, 50% reported high physical exertion. Of those who did not report high psychological demands 23% (21/90) reported high physical exertion.

Table 8. RR for reporting a negative outcome, i.e. the same intensity, more intensive or new symptoms from the low back in the six-month follow-up. Because of missing data, numbers varied according to the studied variable. The RR was adjusted for age (≥ 45 years) by Mantel Haenszel the method. Analyses based on *Study III*.

Exposure Initial assessments	Frequency of exposed	Frequency exposed of those reporting a negative outcome	RR (95% CI)	n
Age ≥ 45 years	26	12	2.0 (1.1-3.7) ¹	91
Physical exertion (Rating >Hard)	29	11	1.5 (0.8-2.9)	89
Aerobic capacity (lowest quartile) ²	26	10	1.1 (0.6-2.2)	91
Back endurance (lowest quartile) ³	20	7	1.3 (0.6-2.6)	91
Job strain ⁴	7	4	2.2 (0.6-5.4)	80

¹Crude RR. ² ≤ 27 mlO₂*min⁻¹*kg⁻¹. ³ ≤ 110 seconds

⁴Psychological demands ≥ 16 score, Decision latitude ≤ 14 score

Risk factors for seeking care for low back disorders (*Study IV*)

In *Study IV*, the highest relative risk for seeking care for low back disorders, was found for those highly exposed to work in forward-bent positions (Table 9). High perceived physical exertion (>somewhat hard) was associated with an increased relative risk. The relative risk remained when the general physical load and work in forward-bent positions were considered (Table 9).

Insufficient social support at work indicated an increased relative risk (Table 9). However, few reported insufficient social support and the precision of the relative risk estimate was low. No association between job strain and seeking care for low back disorders was observed. However, low intellectual discretion, a part of the job strain concept, was associated with an increased relative risk in the univariate analysis (Table 9).

Table 9. Number of exposed among referents and cases. The estimated OR with 95% CI, adjusted for age by the Mantel-Haenszel method, and the estimated OR in a multiple logistic regression analysis for seeking care for low back disorders. In the logistic regression, besides age and smoking, factors with a crude risk estimate of 1.5 or greater were included. Age, in four 10-year intervals, was examined as a potential confounder. (Hosmer and Lemeshow Goodness-of-fit test p-value=0.13).

Exposure factors	Exposed referents	Exposed cases	OR (95% CI) ¹	OR (95% CI) ²
Working in forward-bent positions	154	77	4.3 (1.6-12)	.
Forward-bent positions =>60 min day	15	17	.	8.7 (2.1-46)
Forward-bent positions 1-59 min day	139	60	.	2.2 (0.7-10)
High general physical workload	23	18	2.1 (1.1-4.2)	2.3 (1.0-5.3)
High perceived physical exertion ⁴	51	40	2.7 (1.6-4.7)	2.3 (1.2-4.5)
High psychological demands	46	12	0.5 (0.3- 1.0)	.
Low intellectual discretion	61	40	2.0 (1.2- 3.4)	1.2 (0.6-2.2)
Low authority over decisions	69	30	1.1 (0.6 -1.9)	.
Job strain	12	6	1.2 (0.4 -3.3)	.
Insufficient social support/social relations	11	16	1.7 (0.8-3.8)	2.4 (0.9-6.4)
Temporary employment	37	21	1.9 (0.9 -4.2)	1.6 (0.7-3.4)
Working hours between 18 to 29 hours/week	53	35	2.0 (1.1- 3.4)	1.6 (0.8-3.5)
Night-shift	22	15	1.7 (0.8 -3.4)	1.5 (0.5-4.4)
Current smoking	50	24	1.2 (0.6- 2.0)	1.0 (0.5-1.9)

¹OR adjusted for age (<45, =>45) by the Mantel-Haenszel method

²OR according to the multivariate logistic regression

³92 study persons lifted 10-20kg at least once a week

⁴> somewhat hard

In the univariate analyses, combined exposure of forward-bent working positions and low intellectual discretion gave a relative risk of OR= 9.0 (95% CI 2.5 - 33). Nursing personnel with insufficient social support in combination with forward-bent working positions had a relative risk estimate of OR= 6.2 (95% CI 1.7 - 22). Comparing nursing personnel with other occupational groups did not show any increased relative risk of consultation for low back disorders. On the contrary, the relative risk was lower for registered nurses compared with women in occupations requiring the same level of education (OR 0.2 95% CI 0.1-0.5). When assistant nurses, attendants in psychiatric care, home care workers and assistants for the mentally retarded were compared with registered nurses and the relative risk was OR=7.2 (95% CI 2.5 –21). 4.6.

Exposure factors (*Study IV, V*)

Registered nurses had to a large extent different work tasks compared with assistant nurses. Assistant nurses spent on average 71% of the working hours in patient-handling tasks, compared with 41 % for the registered nurses. High general physical work load, working in forward-bent positions, low intellectual discretion, low authority over decisions, part-time, temporary employment and night-shift work were less frequent among the registered nurses compared to the other nursing occupational groups (Table 10). However, high psychological demands were more frequent among the registered nurses.

Comparing nursing work with other occupations work in bent positions were less frequent. On the other hand, perceived high physical exertion was more frequent among nursing personnel than among the women in other occupations (Table 10). Part-time work and night-shift were more common among nursing personnel than in other occupations (Table 10).

In the analyses of women with professional jobs in different occupational sectors, self-employment, mainly routine work and job strain increased the probability of having a high general physical workload (Table 11). The probability of having a high physical workload was six times higher for women with mainly routine work, and four times higher for the women reporting a job strain situation compared with other working women (Table 11).

Table 10. Distribution of exposure factors among the referents; female registered nurses and other nursing personnel (assistant nurses, attendants in psychiatric care, home care workers and assistants for the mentally retarded) and for females employed in other occupations. The figures are based on the study group in *Study IV*.

Exposure factors	Registered nurses n=41	Other nursing personnel n=147	Employed women besides nursing personnel n=609	Difference between Registered nurses and other nursing personnel	Difference between nursing personnel and other employed women
	%	%	%	%	%
Working in forward-bent positions =>1 hour/day	2	10	16	-8	-8*
High physical workload	0	16	16	-16	-4
High perceived physical exertion	18	32	20	-14	+9*
High psychological demands	41	20	30	+21*	-4
Low intellectual discretion	7	39	34	-32*	-1
Low authority over decisions	24	39	27	-15	+10
Job strain	0	8	9	-8*	-2
Insufficient social support/ social relations at work	12	7	14	+5	-4
Night-shift	7	13	1	-6	+11*
Part-time work (<35h/week)	39	53	33	-14	+17*
Temporary employment	5	24	20	-19*	0

*The 95% CI of the mean difference did not include zero

Table 11. Factors related to a high physical workload¹ according to a multivariate logistic regression analyses. The probability of having a high physical workload for women with adverse psychosocial working conditions. The analyses involving women in different occupational sectors. Age (20-44 years and 45-60 years) was considered in the multivariate analysis. (Hosmer and Lemeshow Goodness-of-fit test p-value=0.69)

Exposure	OR for high physical workload for employed women
Temporary employment	1.4 (0.8-2.3)
Part-time (18-34h/week)	1.4 (0.9-2.2)
Self-employed	2.7 (1.2-5.9)
Solitary work	1.2 (0.6-2.7)
Mainly routine work	6.4 (3.6-12)
No requirements of further training	1.3 (0.7-2.4)
High psychological demands	1.0 (0.5-2.0)
Low decision latitude	0.9 (0.5-1.6)
Job strain	4.1 (1.6-11)

¹=>2.9 TWA-MET

Paid and unpaid work (Study VI)

There was no increased relative risk of seeking care for gainfully employed women compared with non-employed women (OR 0.9 95% CI 0.7-1.2). Having at least 60 hours of paid work, or at least 40 hours of unpaid work resulted in a relative high risk of seeking care for MSD. Those with long hours of unpaid work, and those who perceived far less paid work than they wanted, ran the highest relative risk of seeking care for low back disorders. For neck/shoulder disorders, long hours of paid work was the strongest risk factor. The risk estimates were diluted when low back and neck/shoulder cases were taken together in one case group (Table 12). However, a total of 70h/week or more did not result in further increase in risk of seeking care. Most of the women did the main part of the daily domestic work in the family, 69% of the cases and 70% of the referents. Nineteen percent of the cases and 20% of the referents had care duties for relatives outside the family. The frequency of long hours of work and unpaid duties did not differ substantially between nursing personnel and other occupations. In separate univariate analyses, nursing personnel who perceived far too much daily domestic work, ten cases, had an increased relative risk of seeking care (3.0 95% CI 1.0-8.4).

Table 12. Multivariate logistic regression analyses of seeking care for low back disorders and/or neck/shoulder disorders among gainfully employed women. LB cases: those who had only sought care for low back disorders. NS cases: those who had only sought care for neck/shoulder disorders. The model was adjusted for physical workload, psychosocial work conditions, motherhood, socio-economic position, previous symptoms and age. Answering “far too little time” (1) and “far too much time”(5) were considered as potential risk factors in the multivariate analysis. The other response alternatives were considered as non-exposure. The p-value for the Hosmer and Lemeshow Goodness-of-fit test is presented (HL p). *Study VI*

Exposure	Exposed cases	OR for LB and/or NS cases (HL p =0.56)	OR for LB cases (HL p =0.24)	OR for NS cases (HL p =0.39)
Paid work =>60h/w	14	2.2(0.8-5.9)	2.0(0.7-6.2)	3.9(1.1-13)
Unpaid work =>40h/w	20	2.1(1.0-4.8)	2.6(1.1-6.4)	1.7(0.5-5.3)
Far too much paid work	64	1.0(0.7-1.5)	1.1(0.6-1.7)	0.8(0.5-1.4)
Far too little paid work	8	2.0(0.6-7.0)	3.6(1.1-13)	0.7(0.0-4.6)
Far too much daily domestic work	36	1.4(0.8-2.4)	1.3(0.7-2.5)	1.2(0.6-2.3)
Far too little daily domestic work	8	1.5(0.5-5.4)	1.4(0.3-6.7)	1.0(0.2-5.0)

Discussion

Job strain

In *Study II*, the association between job strain and symptoms was clear in the baseline assessment and in the survey two years later. In the second and fourth surveys the association was more uncertain. If we had only performed the first survey, the conclusion would have been a rather strong association between job strain and ongoing symptoms. On the other hand, if we had only done the study a year later, our conclusion would have been more uncertain. The cross-sectional surveys were repeated once a year in order to examine the consistency. Although the risk estimates differed between the different years, the direction of the association was stable. The different point estimate of the association between job strain and musculoskeletal symptoms was probably partly due to random errors. In the follow-up, the analyses indicated that job strain was a risk indicator for musculoskeletal symptoms. The association between job strain and low back symptoms observed in the analysis based on *Study III* supported the result in *Study II*.

In the MUSIC-Norrköping study, job strain was less frequent among the registered nurses compared with nursing occupations with a relatively increased risk of seeking care for low back disorders. On the other hand, in the analyses on the individual level, when nursing personnel who reported job strain were compared with nursing personnel not reporting job strain, no increased relative risk was shown.

Finding the same association in different population and with different research method strengthens the assertion that there is a real association. The studies in the thesis comprise of three independent study populations. Nursing personnel at a regional hospital, assistant nurses in geriatric care and a sample of nursing personnel in different occupations in another region of Sweden. If seeking care for low back symptoms was an expression for more severe disorders than self-reported symptoms, and job strain preceded MSD, the non-relation between job strain and seeking care was unexpected. It is possible that a job strain situation, with low control and high demands, not encourage active measures, such as seeking professional care. This may mask a possible association between job strain and MSD, assessed as utilization of health care.

Psychosocial job conditions for nursing personnel involve more dimensions than just demands and decision latitude (80). Working with human suffering and sickness implies special psychological work factors and requirements. A previous methodological study of psychosocial work quality provided support for six different factors: 1) competence and work engagement, 2) work strain, 3) organizational climate, 4) possibilities of satisfying demands from patients, relatives and staff members, 5) goal clarity; the sixth factor estimated the difference between ideal and perceived workload (81). The work strain factor included five questions from the psychological demand index in the job strain model (56) and also questions about perceived efficiency. However, the internal consistency of the factor, or the work demand questions alone, were not

satisfactory (81). Working “to hard” in nursing work probably includes both physical and mental demands. Transferring a patient, maybe an old, confused and anguished patient, involves a mixture of physical demands, quantitative mental demands, and qualitative and emotional demands. It has been proposed that specific index constructions for assessing psychological demands and control may be necessary for the health care sector (98, 101).

In a study of Fox et al. (32), the job strain model was tested with a group of 136 nurses. Work demands were assessed by asking the head nurse of the ward to report patients’ requirements, and also by asking the nurses themselves about the amount and pace in the work and about stressful events. Furthermore, the nurses were asked about the level of control over the variety of task performed, order of tasks, pacing, breaks procedures and policies in the work place, and the physical work environment. The measured physiological outcomes were job satisfaction, blood pressure and salivary cortisol levels. An interaction effect was observed between workload and self-reported control, in their influence on the physiological stress responses and job satisfaction. High levels of perceived workload were associated with physiological stress responses under low control conditions. When the nurses reported high levels of control, high workload was not associated with physiological responses. The study supported the use of the job strain concept in nursing work; it was the combination of high demands and low control that increased the risk for a negative outcome (56).

At least three different methods of assessing job strain can be used in epidemiological studies (62). First, as in the present studies, by means of questionnaire assessing the perceived job strain for every individual (62). A possible bias was that nurses with somatic symptoms reported adverse psychosocial conditions to a higher degree than the nurses without symptoms, even if the work conditions were the same (62). The individual biasing factors become stronger when comparing individuals in the same work sector, and the contrasts in work exposures are low (56, 62).

The job method takes the average perceived job strain of all individuals in an occupation as a proxy for the exposure. If the average rating for a specific occupational group is used, the importance of individual biasing factors decreases. However, a problem is that nurses with the same job title did not do the same job tasks, or were working in the same psychosocial work conditions (62).

In the third method, measurements are independent of the individual under study, for example number of patients required supervision or help being fed as a measure of demands. A difficulty is to find independent measures that reflect the job situation (62).

Perceived physical exertion

In *Study II*, the cross-sectional analyses were consistent; high perceived exertion was associated with musculoskeletal symptoms. In the follow-up analysis, high perceived exertion reported one, two or three years ago was associated with

ongoing musculoskeletal symptoms. In *Study III*, all participants worked as assistant nurses in geriatric care and the variation in external work demands was low. Thus, the perceived physical exertion reflected to a great extent individual perception of the work. The cross-sectional analysis and the follow-up demonstrated a weak tendency towards higher prevalence of low back symptoms among assistant nurses, who reported a high level of physical exertion at work. When *Study III* was considered separately, perceived physical exertion could not be established as a risk indicator for reporting low back symptoms. In *Study IV*, among the nursing personnel, high perceived physical exertion was associated with care-seeking for low back pain. The relation was consistent after adjustment for the general physical load and psychosocial factors. The fact that several studies indicated an association supported the probability that high perceived physical exertion was a risk indicator for MSD.

Presumably, in contrast to the original use of the scale, the intervals between the 15 grades of rating levels were not equal, and the scale could not be considered as an interval scale. In *Study II, III and IV* the ratings were dichotomized into two categories; high/not high perceived physical exertion. For the first two studies the categories were based on the verbal expressions in the scale. The nurses who rated more than "hard" physical exertion were defined as exposed. In the MUSIC-Norrtälje study the distribution of the rating defined the categories; the criterion for high physical exertion was a rating higher than "somewhat hard". In the studies on only nursing personnel, the RPE scale was used for identifying nurses with higher physical exertion than their colleagues, although they had about the same work tasks. In the population-based study, when nursing personnel was compared with other occupational groups, high physical exertion was a tool for identifying physical loading work. The merging of the rating to two categories, high/not high perceived exertion, may diluted the effect. Probably, there was almost no difference in perceived physical exertion between those who rated one grade under the cut-off point compared with those who rated one grade above.

In the MUSIC-Norrtälje study, initial analyses of the interplay between the energy expenditure in the work and RPE rating were conducted among the referents. When using the RPE rating as a method for identifying women with work requiring high energy expenditure, independent of the cut-off point, the misclassification was extended. This is in accordance with a previous study among women in different occupation (113).

Additional work factors and musculoskeletal disorders

The result provided support for the assertion that general work-related risk factors also are valid for nursing personnel (19, 86). Working in forward-bent positions and high general physical load were associated with an increased relative risk of seeking care for low back disorders. Several studies on nursing personnel have shown an association between the amount of patient-handling in the work and the risk of low back disorders (44). Patient-handling involves work

in forward-bent positions, lifting, and also manual handling such as pushing and pulling.

The results indicated evidence for a direct association between insufficient social support and increased risk of seeking care for low back disorders. The dimension social support was a mixture of instrumental support and sufficient social relations at the workplace. Insufficient social support is strenuous in itself and may well also increase the negative effect of other strenuous working conditions (20). Studies concerning the influence of social support on MSD are not consistent. One study showed that nursing personnel who reported LB symptoms were more satisfied in their relation with work mates (92). In a previous survey, conducted at the same hospital as the Moses program, low support from superiors was related to LB symptoms (64). In a study of Ahlberg-Hultén et al. (2), low support was related to NS symptoms, but not with symptoms from the LB. In a study concerning home care workers, social support had no main effect on LB symptoms but modified the effect of physical and psychological workload (51).

Working short hours (18-29/h week) seemed to imply an increased risk of seeking care for low back disorders. In a previous cross-sectional study on female hospital staff, full-time and part-time workers did not differ in prevalence of low back symptoms. However, a multiple analysis indicated that psychosocial job factors were associated with the intensity of symptoms for full-time but not for part-time personnel (15). In order to test the same hypothesis, the univariate analyses were stratified for working hours, but no differences in risk factors were observed.

The interplay between work factors and musculoskeletal disorders

As pointed out in the model (Figure 1), there are different possible explanations for the pathways between work factors and MSD.

For the nursing personnel, work tasks requiring forward-bending positions were related to MSD. The relation remained after considering for perceived physical exertion and psychosocial conditions. According to the model (Figure 1), physical demands directly influenced the tissues and caused physiological disturbances and MSD.

Perceived physical exertion can be seen as an effect on physical demands and be on the causal pathway between work, physiological disturbances and disorders. However, the same physical demands are perceived as exerting for some but not for others. The experience of exertion in it self may cause physiological, behavioral or psychological responses (Figure 1).

Psychosocial factors may modify the perception and the experience of physical demands and also modify the effect of physical exertion. It is possible that the risk involved in the physical demand decreases if it is not perceived as exerting.

In the multivariate analyses, external demands and perceived physical exertion remained as risk factors for MSD. Not adjusting for perceived exertion in the multivariate analysis could have led to an overestimation of the effect of the

environmental demands if perceived exertion were both associated with the environmental demands and a cause of disorders (87).

The same argumentation can be applied for psychosocial conditions and stress. A job situation with high demands and low control leads to perceived stress for some but not for others. If stress is on the causal pathway between adverse psychological, organizational and social conditions and disorders, the risk involved in adverse conditions may decrease or disappear if it is not perceived as stressful.

In *Study IV*, a relation was found in the univariate analysis between self-reports of low opportunities to use and develop skills and MSD, but when other risk indicators were considered, the risk estimate decreased. If conditions such as low opportunities to use and develop skills led to increased physical load, the physical load was on the pathway between psychosocial conditions and disorders (Figure 1). It is possible that psychosocial conditions must interact with physical loading factors, to give rise to MSD. Thus, if the psychosocial conditions improved, the risk of the external physical demands might be reduced. Adjusting for the physical load in analysis of the relation between psychosocial work factors and disorders may result in an underestimation of the effect of the psychosocial conditions (87).

In the studies, some support for an association between psychosocial factors and MSD, independent of physical load, was observed. In *Study II*, the data indicated that job strain, independent of perceived physical exertion, was associated with musculoskeletal symptoms. In *Study IV*, data indicated that insufficient social support, independent of physical load and perceived physical exertion, was related to seeking care for low back disorders.

In *Study IV*, physical load and perceived physical exertion gave a higher relative risk of MSD than the psychosocial factors. The nurses who were exposed to the combination of high physical demands and adverse psychosocial conditions had the highest relative risk of MSD. However, when trying to determine the relative influence of physical load, psychosocial conditions, the combination of the two or job status (i.e. assistant vs. registered nurses), a covariation creates problems. Compared with registered nurses, assistant nurses spent more of their working hours in patient-handling work, involving heavy lifts and high general physical work load. Furthermore, assistant nurses more often reported job strain, low decision latitude and a work situation with no requirements of further training.

In the case-referent study and in the cross-sectional analyses the interpretation of the result involved assumptions considering temporality. It was reasonable to assume that high physical exertion, job strain and insufficient social support led to perceived stress, physiological changes and MSD (Figure1). On the other hand, it was not unreasonable that MSD influenced the work situation, the perception of the work situation and the reporting of physical exertion, job strain and social support. An additional possibility was that MSD, perceived physical exertion and self-reports of adverse psychosocial conditions occurred at

approximately the same time, and had a common underlying cause, i.e. work overload.

Occupation category, disorders and exposure

Working as a registered nurse, seemed to decrease the relative risk of consultation for low back disorders.

Compared to the registered nurses, the nursing personnel with a lower level of education than the registered nurses had a higher physical workload, a higher prevalence of adverse psychosocial work factors and an increased risk of seeking care. No registered nurses had a high general physical load, corresponding to an average of approximately 30% of the maximal aerobic capacity, as compared to 16% of other nursing personnel. A study in 1974 (26), where heart rate during continuous work on a ward was registered, found that the average demands on circulation and energy for assistant in geriatric care were approximately 25% of their maximum aerobic power, which is about the same as in domestic work. In a more recent study there was no support for a decline in the physical demands for nursing personnel. The mean oxygen consumption of home care workers aged 45-65 approximately was at approximately the same level as in the 1974-year study (104). The heavy, relatively brief work tasks, such as patient transfers, were probably not reflected in the average aerobic demands.

According to a study by Pheasant et al. (82) nurses had fewer days of sick leave in total, but more days of sick leave due to back pain, compared to the population. It is possible that the prevalence of symptoms in survey studies is underestimated. The nurses with symptoms are on sick leave or have left their nursing work due to low back symptoms and may therefore not be included in the prevalence studies (82). In relatively heavy physical work, as nursing work, the requirements may not permit work during periods of intensive low back symptoms.

In a cross-sectional questionnaire study among home care workers, the prevalence of low back and neck/shoulder symptoms was higher among the home care workers compared with the reference group of municipal employees (52). The difference in prevalence increased when only symptoms regarded as work-related by the respondents were considered (52).

In MUSIC-Norrköping study the cases were restricted to those who had not sought care or been treated because of low back or neck-shoulder disorders during the previous six months in order to study "new" incident cases. Persons with chronic disorders and with ongoing treatment were excluded. The associations between risk factors and disorders would probably have been quite different if the study had also included those persons.

Musculoskeletal disorders

According to *Study I* and *Study II* the majority of the nursing personnel have had episodes of neck, shoulder or low back symptoms. For most of the nurses, the

symptoms were not always ongoing. The case group was not stable in the yearly repeated surveys, neither if the definition of cases was ongoing symptoms nor if the definition was episodes of symptoms during the previous 12 months.

Studies examine work factors and symptoms highlight the magnitude of the problem but if the intention is to find groups with increased risk for musculoskeletal disability, the outcome can be questioned. Not all, even not a majority of those with ongoing symptoms, will presumably become disabled and get sick leave due to musculoskeletal problems.

To define the case as in the MUSIC-Norrtälje study, as those who received professional care for the problem was an attempt to identify the more severe cases. It was not the diagnosis or the intensity of the pain; just the fact that they sought care for the problem that was the definition of a case.

A conceivable selection bias could have arisen if demands permitted pain and reduced working capacity. Furthermore, it is possible that the health care personnel, especially registered nurses, did not seek care for their pain. However, among the female referents, 34% reported current low back pain. Of the registered nurses, 22% of the referents reported current pain; the corresponding figures were 32% of the assistant nurses and 38% of the home care workers. The data did not support the hypothesis that health care personnel suffer from low back disorder without seeking care to a greater extent than other employed women. On the contrary, a possible selection bias could be that nursing personnel seek medical treatment for disorders more often than other occupational groups (105). Maybe nursing personnel rely more on professional care than women employed outside the health care sector.

The fact that around one third of the referent group had low back symptoms might diluted the estimated relative risk for different exposures. In a previous population-based case-referent study of work factors and diagnosed disorders in the neck/shoulders, two referent groups were established (27). One group consisted of a random population sample of those both with and without symptoms. The other referent group included only those free from musculoskeletal symptoms in all parts of the body: about 40% of the first referent group. In general, the risk estimates were higher when cases were compared with the referent group included only those free from musculoskeletal symptoms (27). In the MUSIC-Norrtälje study (*Study IV*), in analyses where the referents with ongoing low back symptoms were excluded, the same tendency was observed. For the nursing personnel, the identified risk exposures were the same, the relative risk estimates did in general increase and the statistical precision decreased. In studies, where the outcome is intensive symptoms, seeking care for symptoms or diagnosed disorder the group with light symptoms may dilute the result. On the other hand, if those with light symptoms are excluded, the referents only represent a subset of those under risk of becoming cases.

In *Study II* and partly in *Study VI* those with neck/shoulder disorders and those with back disorders were included in the same risk analyses. The results may mask that there were different risk factors for back and neck/shoulder disorders.

In a previous questionnaire study on nursing personnel from different kinds of wards, job strain was associated with low back symptoms, but not with symptoms from the neck and shoulders (2). The opposite tendency was observed in a cross-sectional study among home care workers (51). Psychological workload was associated with neck/shoulder symptoms, not with back symptoms. In a cross-sectional study among home care personnel, insufficient cooperation with superior was associated with both neck/shoulder and low back symptoms, although the association was somewhat stronger with neck/shoulder symptoms (16). A combination of strenuous work positions and low influence on the planning of work was associated with an increased prevalence of neck/shoulder symptoms, indicating an interaction between physical and psychosocial exposure (16). No interaction effect was found for low back symptoms.

In *Study II*, those who reported back symptoms also reported neck/shoulder symptoms to a greater extent than those without any back symptoms. The coexistence of symptoms is not surprising; neck, shoulders and back are parts of the musculoskeletal system and the body regions are close to each other. In questionnaire studies can it be uncertain to draw conclusions about separate risk factors for neck/shoulders or back disorders, at least in studies of occupational groups with a variation in work postures, such as nursing personnel.

Unpaid and paid work

Nursing work involves high physical and psychological demands. Besides this, many nurses have the main responsibility for domestic work, for care of children and for elderly dependent relatives. Our results indicate that the frequency of duties outside paid work does not differ between nursing personnel and women in other occupations. There was no support for the assumption that women with nursing work continue with care duties in the family to a greater extent than other women. However, those who perceived far too high an amount of daily domestic work had an increased relative risk of seeking care. The majority of those who perceived far too high amount of daily domestic work had short hours of part-time work. The analyses showed that 18-29 hours of paid work /week was related to an increased relative risk of seeking care for low back disorders. Nursing personnel with temporary employment, often with short hours of paid work, have experienced deterioration in their psychosocial work conditions during the last years (1). Presumably, changes in work conditions and demanding domestic work have influenced the risk of seeking care.

Interventions

The interventions presented in this thesis were focused on the individual. In the Moses program the nurses were trained in patient transfer technique, physical fitness or stress management. Training in patient transfer technique may reduce mechanical load. Physical exercises aim to increase the capacity to meet physical demands. Training in handling stress may protect for strenuous work situation.

There are several possible explanations as to why no decrease in the prevalence of MSD was observed. The symptoms were assessed by self-reported questionnaires. No information on work capability, days of sick leave or duration of symptoms was recorded. Secondly, the personnel were followed over a period of three years. The change in work technique and physical training behavior may protect from disorders in the long run, not in a period of some years. Furthermore, considering the decrease in the number of nursing personnel due to dismissals at each ward, it is realistic to suppose that the workload has increased. Interventions including the combination of individual training and physical and organizational improvements seemed to have a greater chance to reduce musculoskeletal disorders (48).

Several studies have indicated that low physical fitness increases the risk of work-related low back symptoms and that physical training is important for the individual's well-being, for prevention of musculoskeletal disorders and for rehabilitation (37, 38). In the Upp program, when cleaning personnel were added to the study group, there was a clear indication that there were more participants with a positive effects on the intensity of the symptoms in the groups with physical training compared with the control group (112). However, for the assistant nurses the prevalence of current symptoms had not decreased at the six-months follow-up. The result is in accordance with a previous study on the effect of physical training and ergonomic instruction in a group of female assistant nurses (25). The influence on the low-back symptoms was negligible, although the physical capacity of the training group had increased.

The implementation of the transfer technique

Introducing and implementing a patient transfer technique at a hospital is a resource-consuming project. To carry out the program, the management of the hospital applied for money from a regional foundation that promoted development within working life. When the program started, the studied hospital was already well equipped with transfer devices, which could be seen as one organizational prerequisite for the use of a good work technique. The importance of maintaining the knowledge of the transfer technique, and also of providing space for this in the organization has been pointed by the project leader, managers and the nursing personnel (83).

The nurses stated in self-reports that they used what they had trained. In spite of the fact that there is no common agreement on what constitutes a good work technique (58), it was evident from the questionnaires that the work technique chosen for use at the hospital was appreciated by the nurses. However, they did know what transfer technique the employers supported and wanted them to use. No independent structural assessment of the use of the patient transfer technique was done.

Training of physical exercises and stress management

In the Moses program the participants had one day of learning an exercise program and one-day course in stress handling. Directly after the course the majority of the nurses had a positive attitude to the content. However, there were no observation periods with follow-up assessments concerning how the training program was carried out. The courses in stress management were partly focused on handling pressure of time and to use long-term planning. Considering the decrease in the number of nursing personnel due to downsizing at each ward, it is realistic to suppose that the time pressure increased and possibilities for planning of the work were reduced during the studied time period. The frequency of nurses who reported job strain and high perceived physical exertion increased during the study period.

In the Upp program, after the intervention period ended, there was no follow-up concerning if the participants conducted the physical training during working hours or leisure time.

The positive attitudes to the training might partly be explained by that the programs were mainly directed towards assistant nurses, a personnel category that usually receives little or no competence development (84). Furthermore, the positive attitudes to the training can be explained by the opportunity to participate in the programs during working hours.

Methodological considerations

Study groups

The study groups in *Study I, II and III* consisted of nursing personnel who took part in interventions, an important fact when generalizing from the results. In *Study I and II* all personnel in the selected departments participated. Nursing personnel on long-term sick leave and nursing personnel employed in less physically strenuous departments did not participate. In *Study III* the participants individually volunteered to take part in the intervention activities. Probably it was nursing personnel with positive attitudes to physical training and to having training programs during working hours, who chose to participate. The nurses included in the studies were healthy enough to work. From the study no conclusion about rehabilitation can be drawn.

The included intervention studies support the fact that work environment is not constant during a study period (57, 90). The layoffs, threat of layoff and reorganizations may have influenced the prevalence of reported symptoms and the association between job factors and symptoms. In order to control for background variables, the use of a reference group has been recommended (57). Use of a reference group in another hospital introduces differences in background; different hospitals have different training programs and make different reorganizations in health-care. The Moses program and the Upp program were attempts to assign the nursing personnel to different groups to be able to make comparisons between the groups. In the presented programs the participants took the courses in different orders or went on different training programs. The transfer of knowledge and attitudes between the nursing personnel

introduces difficulties when interpreting differences and similarities between the groups.

In the Moses program all the participants had a basic course in patient transfer technique. In the continuing courses they were in three different training groups, with different programs every year. After three year all the participants had had the same training program but in different order. There were no effects observed within a year of the training programs on the prevalence of symptoms. Effects arising after a longer period of time could not be compared between the groups, since in the three-year period all participants had gone through the same training programs. Furthermore, the courses in basic patient transfer had been given about one year earlier than the first questionnaire survey. If there was a decrease in symptoms due to the transfer technique it might already have happened before the questionnaire investigation.

In the Upp program several in the theoretical training group, influenced by their work mates in the physical training groups, began with regular physical training during the intervention period.

Recall bias

In *Study II* and *Study III* both the exposure and outcome were assessed by questionnaire. The observed associations were between the self-reported exposures and symptoms. Maybe the nurses with symptoms perceived their work conditions in another way compared to those without health problems. An additional possible biasing factor could be that persons with negative emotionality tend to report high exertion and health problems (14). Thus, an association mainly shows that people who have symptoms have an increased probability of reporting adverse conditions (61).

In the MUSIC-Norråälje study, the assessments were based on interviews and questionnaires. The interview methods were developed based on the statement that an interview gives more descriptive information than self-reported questionnaires (106, 115). However, recall-bias is a validity problem; maybe the cases recalled the exposure with better accuracy or exaggerated the exposure compared with the referents (114).

Strength of association

The cut-off points between exposed and unexposed were decided by results in previous studies, experience and knowledge of risk factors and working conditions and based on the exposure distribution in the samples. The data analyses started with more categories of every exposure, often three categories; unexposed, medium exposed and highly exposed. Mostly the exposure variables were dichotomized in two categories. The difference in association was generally between unexposed/exposed or between medium /highly exposed. The observed individual risk estimates were rather low, most of them under a two times higher risk for the exposed compared with the unexposed. Non-differential miss classification presumably diluted the estimated associations.

When the association in a study is weak it is more likely that it can be explained due to bias factors. The greater the estimated RR or OR are, the more likely that the observed association is real.

Conclusions

The included studies showed that the environmental work demands and the interaction between the demands and the nurses were related to musculoskeletal disorders.

- The repeated cross-sectional surveys and the follow-up analyses of job strain and musculoskeletal symptoms among female nursing personnel indicated an association. However, job strain was not associated with a high relative risk for seeking care for low back disorders.
- In nursing work, high perceived physical exertion was associated with musculoskeletal symptoms. Furthermore, high perceived physical exertion was associated with seeking care for low back disorder, after adjustment for the physical workload and psychosocial conditions.
- Among the female nursing personnel, those who worked in forward-bent positions had the highest relative risk of seeking care for low back disorders.
- Among nursing personnel, even if the prevalence of symptom was rather stable, there was a considerable turnover between reporting ongoing musculoskeletal symptoms or not.
- For employed women, self-reported adverse psychosocial conditions were related to a high general physical workload. Compared with registered nurses, assistant nurses spent more of their working hours in patient-handling work, involving heavy lifts and high general physical work load. Furthermore, assistant nurses more often reported job strain, low decision latitude and a work situation with no requirements of further training.
- For employed women, long hours of paid work, or long hours of unpaid work, separately, indicated a risk of seeking care for low back and/or neck/shoulder disorders. The nursing personnel who perceived far too high amount of daily domestic work had an increased relative risk of seeking care.
- According to the self-report of the nurses who participated in the training program, it was possible to implement a common patient transfer technique in a regional hospital.

Summary

Work factors and musculoskeletal disorders - An epidemiological approach focusing on female nursing personnel. *Arbete och Hälsa* 1998:30.

The overall aim of this thesis was to examine the association between job factors and the occurrence of musculoskeletal disorders, and in particular low back disorders, among female nursing personnel. The thesis is based on three separate projects. Two training programs for nursing personnel and one population-based case-referent study, called the MUSIC- Norrtälje study.

The specific aim of the first study was to evaluate the implementation of a patient transfer technique at a hospital. According to the nurses who participated in the training program, the patient transfer technique was used and appreciated. During the study period, four yearly repeated surveys among the nurses indicated that psychological job strain was associated with back and neck/shoulder symptoms. High perceived physical exertion showed a consistent association with musculoskeletal symptoms. The prevalence of symptoms was rather stable, even though almost half of the nurses varied between reporting intensive ongoing musculoskeletal symptoms or not.

In the second project, the study group consisted of assistant nurses in geriatric care, who took part in a program of physical training and education. The cross-sectional analysis and the follow-up demonstrated a weak tendency towards higher prevalence of low back symptoms among assistant nurses who reported a high level of physical exertion at work. Individual physical capacity was not related to perceived physical exertion.

In the Music-Norrtälje study, high physical workload and perceived physical exertion were associated with a relative risk of seeking care for low back disorders, when exposed nursing personnel were compared to unexposed. The study indicated a positive relation between low intellectual discretion, insufficient social support, terms of employment and seeking care for low back disorders. When all women with paid jobs were included, i.e. women with nursing work and other occupations, self-reported adverse psychosocial work conditions were related to a high general physical workload. Long hours of paid work, or of unpaid work, separately, indicated a relative risk of seeking care for low back and/or neck/shoulder disorders.

These studies show that in nursing work, the environmental demands, and the interaction between these demands and the nurses, were related to musculoskeletal disorders.

Keywords: Musculoskeletal symptoms, Seeking care, Women, Nursing personnel, Physical work load, Psychosocial work factors, Epidemiology

Sammanfattning (Summary in Swedish)

Work factors and musculoskeletal disorders - An epidemiological approach focusing on female nursing personnel. *Arbete och Hälsa* 1998:30.

Den övergripande målsättningen med föreliggande avhandling har varit att undersöka sambandet mellan muskuloskeletala besvär och faktorer i arbetet hos kvinnlig vårdpersonal. Avhandlingen baseras på tre projekt, två utbildning och tränings program för vårdpersonal och en populationsbaserad fall-referent studie, kallad MUSIC-Norrtälje studien.

Det specifika syftet med den första studien var att värdera införandet av en förflyttningsteknik på ett regionsjukhus. Förflyttningstekniken användes vid de flesta patientförflyttningar och uppskattades av personalen. Under studieperioden genomfördes fyra årliga enkätundersökningar som indikerade ett samband mellan å ena sidan en psykosocialt ogynnsam arbetssituation (job strain) och å andra sidan besvär i rygg, nacke, och skuldror. Hög självupplevd fysisk ansträngning i arbetet visade ett stabilt samband med muskuloskeletala besvär. Förekomsten av pågående intensiva besvär varierade inte mellan de årliga undersökningstillfällena, trots att nästan hälften av sköterskorna varierade mellan att rapportera pågående intensiva besvär eller inte.

I den tredje studien ingick undersköterskor, anställda inom långvården, som deltog i ett program med fysisk träning. Hög självupplevd fysisk ansträngning i arbetet, rapporterat vid samma tidpunkt eller sex månader tidigare, indikerade ett svagt samband med pågående ryggbesvär. Det förelåg inget samband mellan sköterskornas fysiska kapacitet och självupplevd fysisk ansträngning.

MUSIC-Norrtälje studien visade att vårdpersonal med arbetsuppgifter som krävde arbete i framåtböjd ställning, hög generell fysisk belastning och hög självupplevd fysisk ansträngning löpte en ökad relativ risk för att söka vård för ländryggsbesvär jämfört med övrig (oexponerad) vårdpersonal. Studien indikerade även att ogynnsamma psykosociala arbetsförhållanden gav en ökad risk för att vårdpersonalen skulle söka vård för ländryggsbesvär. När alla yrkesarbetande kvinnor inkluderades i analyserna, kvinnor inom vården och andra yrken, var sannolikheten att ha ett yrke som innebar hög fysisk arbetsbelastning högre för de som rapporterade ogynnsamma psykosociala arbetsförhållanden. Många timmars yrkesarbete eller många timmars obetalt hemarbete, såsom hushållsarbete och omsorg, gav en ökad relativ risk för att söka vård för besvär från nacke, skuldror och/eller rygg.

Studierna visar att både de yttre kraven i arbetet och samspelet mellan de yttre kraven och vårdpersonalen var relaterade till muskuloskeletala besvär.

Nyckelord: Muskuloskeletala besvär, Vårdpersonal, Söka vård, Kvinnor, Fysisk arbetsbelastning, Psykosociala arbetsförhållanden, Epidemiologi

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