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Work-related low-back problems in nursing

by Monica Lagerström, PhD,¹ Tommy Hansson, MD,² Mats Hagberg, MD³

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This scientific literature review focuses on the relation between nursing work and low-back problems. Its aim was to estimate the risk of physical, psychosocial, and work organizational exposure factors that may lead to low-back problems. In addition this paper reviews and evaluates reported ergonomic intervention, with the object of decreasing the prevalence and incidence of low-back problems among nurses. A considerable number of studies of nursing staff has shown the connection between lifts and transfers of patients on one hand and low-back problems on the other. Factors in nursing work that may be significant in this connection are staff density and work satisfaction. In this review the single individual factor that was indisputably related to low-back problems was "history of back problems". Prevention programs do not show unequivocally positive results. There is a great need to carry out prospective studies with preventive programs.

Key terms ergonomic intervention, nurses, physical factors, psychosocial factors, review, work organizational factors.

Background

In several respects nursing work is not comparable with other types of work. The most significant factor is patient handling (ie, close contact with another human being in need of help and support), which is considered rewarding but also demanding for the nurse. The work can be physically strenuous, but usually with less repetitive load than, for example, work on an assembly line (1) and with less frequent lifting than work in, for example, warehouses. Furthermore, work postures are often awkward, and nurses walk and stand more than warehouse workers (2). It is not unusual that nurses stand and walk for more than 6 hours a day (3).

Hospitals are high-stress employers (4, 5). The organization is hierarchical, and a nurse has to adapt to several supervisory levels, as well as to the demands of the

patients. Factors in the work situation that lead to stress on nurses are, for example, violence and threats of violence (6), close contact with suffering and death (7), role ambiguity (8), understaffing (7), and shift work (9). A large proportion of nurses suffers from moderate to severe "burn-out" (5).

It has been pointed out that the rapid rise in sick leave and early retirement from work due to musculoskeletal disorders during recent decades has not yet been explained convincingly (10). High levels of work-related low-back problems are found among nursing personnel, and, since nursing is primarily a female career and a large proportion of the female work force consists of nursing personnel, this is a prominent problem in worklife. The 1-year prevalence of low-back problems among 1616 English nurses (mean age 38 years) was 45% (11), which can be compared with the 1-year prevalence rate of 35%

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for Danish women (mean age 41 years) in the general population (12). Among the English nurses the life-time prevalence was 60%, and this figure could be compared with 45–64% for 1495 women from 8 areas in Great Britain in all age ranges (20–59 years) (11).

When different vocational groups among nurses are defined, there are often differences in the prevalence of low-back problems among the groups. Generally speaking, fewer registered nurses than state enrolled nurses, or auxiliary nurses (nurses' aides) report low-back problems. In a Swedish study of 688 nursing personnel the point prevalence of ongoing low-back problems was 52% for registered nurses, of whom 14% experienced severe problems. For state enrolled nurses the corresponding numbers were 55% and 15%, and for auxiliary nurses, they were 65% and 22%, respectively (13). The issue of low-back problems and their relation to work often arises. In a study of 348 female nurses, about 4 out of 5 (80%) considered these problems to be related to work (14). Thus the prevalence of low-back problems seems to be slightly higher for nurses than for women of a similar age range in the general population. However, the magnitude of this difference, especially among registered nurses, is smaller than is commonly perceived. A register study showed, however, that the risk for occupational accidents of the back was higher among nurses than among working women in the general population (15).

Because of the rise in sick leave due to low-back problems among nurses, several studies have focused on identifying work-related risk factors to point to the route of predicator intervention. Hence ergonomic intervention has been described and evaluated in some studies. Intervention generally focuses on the individual person and often consists of training programs in lifting and handling techniques; it has proved to be of little long-term benefit (16). There is agreement as regards the need for intervention that leads to a reduction in the prevalence and incidence of low-back problems among nurses.

Aim of the study

The aim of the review was to assess the reported knowledge on the relationship between nursing work and low-back problems, and, further, to make a risk assessment of the influence of physical, psychosocial, and work organizational factors that may lead to low-back problems.

On the basis of previous epidemiologic studies and the scientific literature on work at hospitals, the following factors were considered possible work-related risk factors for low-back problems in nursing work: (i) physical factors: lifts and transfers and "save the patient" situations, work postures, work category, and clinical area; (ii) psychosocial factors: psychological demands, authority over decisions, skill utilization, social support at work, work satisfaction, and stress; and (iii) work organization-

al factors: staff density, shift work, mode of nursing care, and work technique.

A further aim of this paper was to review and evaluate reported ergonomic intervention with the objective of decreasing the prevalence and incidence of low-back problems among nurses. A main object was to find relevant ergonomic intervention in nursing work that might result in the prevention of low-back problems.

Selection of the literature

An extensive search was made of the scientific literature published from 1988 to 1998 for studies on low-back problems among health personnel. The focus on the last 10 years was chosen because of the rapidly changing work situation at hospitals, nursing homes, and other types of nursing institutions. The key words "nurses", "nurses' aides", and "back pain" were used on computer-based bibliographic databases such as NIOSH-TIC, Medline, Arblin, and Spiline. Searches were also carried out in reference lists of review articles and other scientific "peer-reviewed" articles, via contacts with researchers within the field, as well as in the personal archives and computer-based data bases of the authors. When there were several reports based on the same study, the one or two most relevant to the purposes of this review were retained.

Included in the study were peer-review articles as follows: (i) studies of the relationship between low-back problems and exposure and (ii) intervention studies.

Most of the studies were of cross-sectional design ($N=21$) (table 1), 10 studies presented prospective data (table 2), and 11 concerned intervention programs (table 3). In the longitudinal studies and in the intervention studies at least 2 data collections had to be reported.

Quality comments

All the studies that were obtained were further reviewed for methodological quality issues and descriptive information as follows (for each study see tables 1, 2, and 3):

1. Among nursing personnel there are different occupational groups of "nurses": untrained nursing aides, state enrolled nurses, and registered nurses. Due to different tasks and exposure, the groups ought to be defined to clear the generalizability of the results.

2. Before the work situation of nurses can be evaluated, not only physical exposures, but also psychosocial exposures need to be clearly assessed. Bongers et al (17) suggested that psychosocial factors could directly influence mechanical load through changes in postures and the like, since the 2 types of exposure are not independent on each other.

3. Low-back problems must be defined. This item could be either primary data of (low) back problems reported in validated questionnaires [eg, the Nordic

Table 1. Work-related risk factors for low-back problems in nursing — cross-sectional and case-referent studies. (OR = odds ratio, RR = rate ratio, 95% CI = 95% confidence interval, OWAS = Ovako Working Posture Analysing System, NS = not significant; incomplete information: S = sample, PhE = physical exposure, PsE = psychosocial exposure, LBP = low-back problems, PR = participation rate <70%, IR = incidence density ratio)

Reference	Population	Data collection	Quality comments	Work-related risk factors	Outcome measure	Main findings
Jensen, 1990 (20)	Health care personnel from the United States, Scotland, Canada and Australia	Meta-analyses; 1 prospective cohort and 5 cross-sectional studies	PhE, PsE, LBP, PR	a) Frequent patient care, b) infrequent patient care	LBP according to the definitions of the different studies	a) prevalence rate = 3.7, b) prevalence rate = 1
Jørgensen et al, 1994 (21)	28 619 assistant nurses (40% working in hospitals and 60% in nursing homes) compared with the overall Danish female population ^a	Register data in 1988; the assistant nurses had been working as such at least 4 years prior to the study	PhE, PsE	Heavy lifting and strong physical work loads at work	Operations for herniated lumbar disc (N=1091; register data)	Risk of operation of herniated lumbar disc among assistant nurses / overall female population, OR=1.6 (95% CI 1.2—2.2, P<0.01)
Smedley et al, 1995 (11)	1659 nurses (3% men) employed in the United Kingdom	Questionnaire	PsE, PR	Frequency of occupational activities	LBP lasting >1 day	Manually move a patient on the bed 5—9 times per shift, OR=1.5 (95% CI 1.1—2.2); manually transfer a patient between bed and chair 5—9 times per shift, OR=1.7 (95% CI 1.2—2.3); transfer a patient between bed and chair with a hoist >5 times per shift, OR=NS; manually lift a patient up off the floor >1 time per shift, OR=1.3 (95% CI 1.0—1.6) (adjusted for age and height)
Cato et al, 1989 (24)	53 nurses in geriatric, orthopedic and rehabilitation wards at 1 hospital in the United States	Questionnaire	S, PsE	Availability and use of mechanical lifting aids; identification of unsafe equipment	Occupational LBP defined as LBP related to work on present unit	Differences between nurses with or without LBP, years in present unit (6.3 / 2.5, P<0.05); lifting a patient in bed and one-person transfer were activities mostly associated with LBP
Leighton & Reilly, 1995 (25)	1134 nursing staff from 6 hospitals 315 matched references among the general population in the United Kingdom	Different questionnaires to nursing and reference groups	S, PsE, PR	Use of lifting devices during patient transfers	Incidence and prevalence of back problems and sick leave	48% of 222 nurses with back problems implicated that positioning a patient in bed initiated back problems
Engels et al, 1996 (28)	846 nurses in 4 Dutch nursing homes	Questionnaire	PsE	Work pressure, postures, lifting, ergonomic layout of ward	Back problems (arm, neck and leg problems)	Physical stress: OR=1.99 (95% CI 1.30—3.04) for awkward posture, OR=2.22 (95% CI 1.46—3.40) for stooping, OR=2.20 (95% CI 1.38—3.50) for lifting heavy burdens; work pressure: OR=1.94 (95% CI 1.20—3.14) for ought to slow down (adjusted for age, gender, duration of employment, workhours per week, and having managerial tasks)
Lee & Chiou, 1994 (30)	3159 female nursing personnel in 4 hospitals in Taiwan	Questionnaire, experiment with simulated patient handling task (N=24)	PsE	Work postures	LBP during the last year	Lifting heavy objects, OR=2.81 (95% CI 1.88—4.20); work experience, OR=2.33 (95% CI 1.53—3.57); sitting habits, OR=2.13 (95% CI 1.46—3.11); age, OR=1.96 (95% CI 1.37—2.80)
Estry-Behar et al, 1990 (3)	1505 female health care workers at 26 wards in Paris	Questionnaire, medical examination, and records over number of days of illness in the previous year	PsE	Work conditions, posture and lifting index: a) low index scores, b) medium index scores, c) high index scores	Back pain in past 12 months	a) OR=1, b) OR=1.50 (P<0.01), c) OR=2.25 (P<0.001); nurses' aides or registered nurses, OR=1.32 (P=0.10); NS: home-work commute, number of years in occupation
Fuortes et al, 1994 (31)	All nurses at 1 hospital during 2 years; 100 back injuries and 197 referents (United States)	Questionnaire (case-referent)	PsE, PR	Work practices	Nurses being awarded a claim for work-related back injury; occupational back injury history	Prior nonback injury, OR=3.66 (95% CI 1.52—8.83); twisting and lifting, OR=4.84 (95% CI 1.30—18.04); NS: age, gender, job title, overweight
Larese & Florito, 1994 (32)	425 nurses at a general hospital and 198 nurses in a small oncology ward, Italy	Medical examination with an interview; selected cases had X-ray examination or orthopedic examination	S, PsE	Two hospitals with different organization	Musculoskeletal symptoms; work-related injuries, absence due to illness	Differences between general hospital and oncology ward: LBP due to work during last year 48/33% (P<0.001), ratio of nurse to patient 0.57/1.27, NS: length of employment; lifting was the factor that most nurses related to back injury (50%), bending (42%), and twisting (30%)

(continued)

Table 1. Continued

Reference	Population	Data collection	Quality comments	Work-related risk factors	Outcome measure	Main findings
Burton et al, 1997 (33)	1216 nurses from 7 hospitals in Belgium and The Netherlands	Questionnaire	S, PR	Psychosocial factors, work load (ie, time spent in nursing activities)	Current back problems, history of LBP	Prevalence of LBP was not dependent on work load; prevalence rates for LBP higher for Belgian nurses, higher work load and more positive attitudes toward work among Dutch nurses
Lagerström et al, 1995 (13)	688 female nursing personnel at 1 hospital in Sweden; registered nurses, state enrolled nurses, and auxiliary nurses	Questionnaire	PhE	Physical exposure at work and psychosocial factors at work	Ongoing LBP dichotomized into symptoms or severe symptoms	Symptoms: OR=1.80 (95% CI 1.13—2.86) for low support at work, OR=1.79 (95% CI 1.26—2.54) for low physical fitness, OR=1.70 (95% CI 1.13—2.56) for work category (registered nurse / auxiliary nurse); severe symptoms: OR=1.60 (95% CI 1.04—2.46) for low physical fitness, NS for age, body mass index, smoking, work commitment, work demand, skill utilization, job control
Stobbe et al, 1988 (34) [included in (20)]	143 licensed practical nurses, 252 nurses' aides, 20 attendants at 28 wards in one hospital in the United States	Discussions with nursing supervisors, register data from the hospital	PsE	a) High lifting frequency, b) low lifting frequency	Back injuries during 40 months (reported by 23 licensed practical nurses, 44 nurses' aides, and 5 attendants)	IR of back injuries by frequency of lifting exposure (a/b): IR=7.54 for licensed practical nurses, IR=2.11 for nurses' aides, IR=1.07 for attendants; length of employment and lifting frequency related to back injuries
Owen, 1986 (37)	32 nurses with back injuries and 32 referents from a university hospital in the United States	Questionnaire, interview and physical tests and accident reports	PR	Workplace factors, lifting style, and psychological stress	Back injuries reported in accident reports	Most important factors related to LBP in multivariate analyses: a sense of overload, muscle flexibility, proprioception, family history of LBP, difference in leg length, years of risk in nursing practice, and smoking
Bru et al, 1996 (38)	586 female health care workers at 1 regional hospital in Norway	Questionnaire	PhE	Psychosocial and work organizational factors	LBP	Age, work overload, institutional policy, social relations at work related to LBP among nurses with high ergonomic load; responsibility related to LBP among nurses with low ergonomic load
Ryden et al, 1989 (9)	84 cases with low-back injuries during 4 years and 168 matched referents at 2 hospitals in San Diego, United States	Data obtained from the Employee Health Service (case-referent)	S, PhE, PsE	Records of the personnel department	Reported low-back injuries (to Employee Health Service)	History of previous back injury at work, OR=2.13 (95% CI 1.07—4.24); workday shift, OR=2.23 (95% CI 1.28—3.89); 55% of injuries from lifting; NS: history of previous injury at work, working evening or night shift, smoking
Ljungberg et al, 1989 (2)	24 nurses' aides from 2 geriatric care units in Stockholm, a modern ward with team-care and a ward with traditional care of nursing	Observation (OWAS), health check with muscle strength, patient capability scores, official records	LBP	Work organization, lifts, space, work load, mode of nursing care	Reported strain injuries of the back per 1000 employed during 4 years	Differences between traditional and modern ward (mode of nursing care; traditional/ team-care), number of back injuries per 1000 nurses: 50 and 25; mean age: 35 and 24 years ($P<0.05$); total number of lifts per hour: 30 and 14 ($P<0.01$); total time for lifts in seconds per hour: 309 and 68 ($P<0.001$); NS: total number of steps per hour and percentage of time in static posture
Skrovdon et al, 1987 (39)	787 nursing staff at 2 hospitals in New York City, United States	Questionnaire	PhE, PR	Work organization factors, mode of nursing care, frequency of lifting, satisfaction with perceived autonomy, social support at work	LBP	Younger age ($P=0.03$), job category "registered nurse" ($P=0.03$), great satisfaction with co-workers (!) ($P=0.05$), NS: factors within the work organization, support from head nurse, perceived autonomy of job, mode of nursing care

(continued)

Table 1. Continued

Reference	Population	Data collection	Quality comments	Work-related risk factors	Outcome measure	Main findings
Lo et al, 1993 (41)	37 female nurses in a geriatric hospital in West Australia	Diaries and survey sheets during 7 days, questionnaire	PsE, LBP	Patient lifts: point of time, type, training in transfer technique, and data of the patients (weight, etc)	Work-related back problems	Total weight lifted not in accordance with any of the recommended methods as the main risk factor: OR=1.07 (95% CI 1.00—1.21) for each additional 100 kg lifted; factors contributing to choice of method were patient co-operation, occupational category and number of nurses carrying out the lift
Ahlberg-Hultén et al, 1995 (43)	90 female nurses and nurses aides from different types of wards in different medium-sized hospitals in the Stockholm area	Data from 2 studies: PhE group discussions, questionnaire		Psychological demands, authority over decisions, skill utilization (ie, job strain ratio), social support at work, and physical strain	LBP sometimes or daily	Job strain, high/low OR=2.00 (95% CI 1.44—2.25); factors related to LBP for both nurses and nurses aides were high psychological demands (P=0.03), low authority over decisions (P=0.05), low skill utilization (P=0.05)
Niedhammer et al, 1994 (44)	469 nurses in 10 French hospitals	Questionnaire, interview (for nurses who had left work) (cross-sectional, the prospective cohort study 1980—1990; see table 4)	S, PR	Work description, work conditions, work organization, shift work	LBP in previous 12 months and musculoskeletal disorders	Age of 40—44 / <34 years, OR=2.05 (P=0.09); 3 or more symptoms of psychological disorders/none, OR=2.64 (P=0.01); physical work load/none, OR=2.23 (P=0.04); NS: smoking, number of children, sports activities, previous musculoskeletal disorders, psychosocial factors at work

^a 1.6 million women.

Table 2. Work-related risk factors for low-back problems in nursing — prospective cohort studies. (NS= not significant; incomplete information: S= sample, PhE= physical exposure, PsE= psychosocial exposure, LBP= low back problems, PR= participation rate <70%; FR= follow-up rate <70%)

Reference	Follow-up length	Population and data collection	Quality comments	Work-related risk factors	Outcome measure	Main findings and conclusions
Smedley et al, 1997 (22)	2-year follow-up	Of 1336 nurses 961 nurses without LBP the last month in the United Kingdom; questionnaire	PsE	Frequency of occupational activities	(a) incidence of all LBP, (b) LBP leading to absence from work	Transfer of patients between bed and chair manually 5—9 times per shift (a) OR=1.6 (95% CI 1.1—2.3, (b) OR=1.9 (95% CI 1.0—3.7); transfer of patient between bed and chair with hoist >5 times (a) NS, (b) NS; lift patients in or out of bath manually >1 time per shift (a) OR=NS, (b) NS; lifting patient in or out of bath with hoist >1 time per shift (a) OR=2.1 (95% CI 1.2—3.6, (b) NS (adjusted for age, height and earlier history of back problems)
Venning et al, 1987 (23); ^a [included in (20)]	12-month follow-up	4024 nurses aides, orderlies and registered nurses from 5 hospitals in Canada; questionnaire	PsE	Ergonomic factors: work category, lifting requirements, service area, hours and type of shift, length of employment, training in back care and lifting, team lifting, availability of lifting aids and of light duty	Report on back injury during follow-up period	Service areas with the most or least lifting OR=4.26 (P<.01); lifters daily or other OR=2.19 (P<.05); nurses' aides or registered nurses and supervisory personnel OR=1.77 (P<.01); previously reported back injury yes or no OR=1.73 (P<.01); NS: availability of lifting devices and training in back care and lifting
Heap, 1987 (35)	5-year follow-up	3778 nursing staff with 180 low-back injuries in the United Kingdom, clinical examination with an interview about the accident	PsE	Nursing procedures and patient handling maneuver, type of lift, staffing level, and other ergonomic factors	Injuries in the low back reported on standard accident forms	Previous significant back injury predicted subsequent low-back injury; higher injury rate among nurses' aides than among registered nurses

(continued)

Table 2. Continued

Reference	Follow-up length	Population and data collection	Quality comments	Work-related risk factors	Outcome measure	Main findings and conclusions
Yassi et al, 1995 (36)	2-year follow-up	1645 nurses with 416 back injuries, Canada	S, PsE	Occupational history, mechanics and circumstances of injury, and ergonomic factors	Back injury reports filled out by the 416 persons with back injuries	When, where, how and why injuries occurred: work in orthopedic wards (51%); assisted lifts and transfers (46%) and unassisted lifts (11%); "save the patient" situations (7%); inadequate training (52%) and staffing (14%); 2 first hours of 8-hour shift (53%)
Harber et al, 1994 (40) ^a	18-month study with an average of 10-months of follow-up	179 nurses newly graduated from nursing school in the United States; telephone interviews and reinterviews (pilot study)	S, PR, FR	Work site factors; shift length, patient type, availability of mechanical lifting devices and human help in lifting; psychosocial factors and training	Each subject classified as an injured or a noninjured subject based on responses to questions about back problems; prior back problems	Previous significant back problem episodes associated with increased future risk; NS: training at nursing school
Josephson et al, 1997 (42)	Base line and follow-up once a year during 3 years	285 female health care workers at one hospital in Sweden; questionnaire	PhE, FR	Perceived physical exertion; job strain (combination of high mental demands and low decision latitude)	Neck, shoulder or low-back problems	High psychological demands, low decision latitude, and perceived physical exertion on the same measure occasion RR=1.5 (95% CI 1.1—2.1) — 2.1 (95% CI 1.4—3.3); high psychological demands, low decision latitude 1.2, or 3 years later RR= 1.4 (95% CI 0.5—4.0) — 2.2 (95% CI 0.8—6.0) for having musculoskeletal symptoms
Niedhammer et al, 1994 (44)	10-year	300 nurses in 6 public sector hospitals in France; questionnaire (interview for nurses who had left work)	S, FR	Work description, work conditions, work organization, and shift work	LBP in previous 12 months and musculoskeletal disorders	Commuting >1 / < 1 hour a day OR= 2.00 (P=0.008); NS: age, psychological disorders, physical work load, smoking, number of children, sports activities, previous musculoskeletal disorders, and psychosocial factors at work
Ready et al, 1993 (45) ^a	18-month follow-up	131 nurses and unit assistants at a large health care center in Canada; questionnaire, fitness assessment	S, PhE, PsE, PR	Wards: high, medium, or low risk, employment history	Back injuries reported by subjects on an employee accident report, history of back injury	Prior compensation pay, smoking status, and job satisfaction were the most important factors for back injuries, NS: fitness, life-style factors
Klaber Moffett et al, 1993 (46)	30-month follow-up	199 student nurses on entry to 2 schools of nursing in the United Kingdom; physical tests of strength endurance of the muscles; questionnaire, diaries with recordings of LBP	PhE, PsE, FR	Initial screening for physical and psychosocial factors; follow-up every 3rd month to collect diaries with recordings of problems, questionnaire, tests of strength endurance of the muscles	Back problems during at least 3 days (group 1) or back problems during 21 days (group 2)	Attitudes towards health, personal psychology factors, strength endurance of the thigh muscles, and height predicted (group 1 and 2, height not group 2)
Mostardi et al, 1992 (52) ^a	2-year follow-up	171 female nurses in a tertiary care community hospital in Ohio; isokinetic lifting test, questionnaire, injury reports	S, PsE	Isokinetic lifting test, medical history and individual data	Injury reports of job-related LBP or injury during the 2-year follow-up period, medical history	NS: low-back strength and previous significant back injury

^a Studies included in Bigos et al, 1996 (19).

Questionnaire (18)] or secondary data (ie, register data on injury reports).

4. In studies on nursing work, participation rate is often a problem.

The intervention studies were further reviewed for the following methodological quality issues (see table 3):

5. Nonrandom assignment of subjects, as random assignment prevents selection bias.

6. Lack of a reference group, as the inclusion of a reference group makes it possible to separate the effects of the intervention and the effects of confounders.

7. Description of the intervention not informative enough for other researchers to replicate the original research.

A special committee was appointed in 1995 by the American Academy of Orthopaedic Surgeons (AAOS) to clarify the scientifically proved basis of knowledge

Table 3. Prevention of low back problems in nursing — intervention studies. (I = individual level of intervention; O = organizational level of intervention; incomplete information: S = sample, PhE = physical exposure, PsE = psychosocial exposure, LBP = low-back problems, IV = intervention, PR = participation rate <70%; FR = follow-up rate <70%; R = randomization not performed, NR = no reference group)

Reference	Follow-up length	Population and data collection	Quality comments	Intervention studied	Outcome measure	Main findings
Gundewall et al, 1993 (54) ^a	13 months	32 nurses' aides (and 28 referents) with and without history of LBP in a geriatric hospital questionnaire; report card, physical tests	PhE, PsE	Group A (training): instructions on exercises for strengthening back extensors provided during 5.5-hour sessions with individual instructions followed by 13 months of exercise sessions at work; group B (reference): no exercise or training sessions provided	Isometric back muscle strength, days experiencing LBP, days absent from work because of LBP; level I	Intervention subjects demonstrated greater extensor strength than referents, less absenteeism due to LBP during 13 months (1.0 / 4.8 days) and fewer days with LBP (54 / 94 days); every hour spent by the physiotherapist on the training group reduced the work absence among the participants by 1.3 days, resulting in a cost-benefit ratio of >10
Videman et al, 1989 (55)	2.5 years	87 student nurses with extra training and 113 student nurses without extra training (referents), questionnaire, anthropometric measurements, strength and functional tests	R, PhE, PSE	Referents started 1 course and received traditional training in patient handling; students who started next year got special 40 hours of training based on ergonomic principles	Isometric strength, psychological factors and back problems; level I	The subsequent incidence of acute back injuries occurring at work was significantly lower among the skilled nurses but there was no difference between skilled and unskilled nurses in the incidence of other forms of back problems
Hellsing et al, 1993 (56)	2 years	2 nursing schools: 19 student nurses with extra education of 2 hours per week during 2 years and 33 student nurses who received the usual curriculum were referents; questionnaire	R	Extra education included theory and practice relaxation and physical, psychological and ergonomic training	Evaluation of the extra education, neck-shoulder and LBP; level I	No obvious short-time effect of the education on musculoskeletal problems (low back) could be seen; the experimental group judged their ability to analyze the work environment higher than the referents; observations showed that students from the experience group worked in physically more favorable positions
Lagerström et al, 1998 (57)	3 years intervention with 1 year follow-up	348 registered nurses, state enrolled nurses, and nursing aides; questionnaire	R, C, FR	Training and education in patient transfer technique, stress handling, and physical fitness exercise	Work and leisure-time factors, physical exertion, and musculoskeletal problems; level I	93% of the nurses used the new work technique always or mostly; nurses who did not use the work technique rated some transfers as physically more strenuous than those who used the technique; increased rate of nurses transferred patients alone when 2 were needed; no decrease in LBP
Feldstein et al, 1993 (58)	1-month follow-up; pilot study	30 nurses (and 25 referents); questionnaire, transfer forms, physical tests	R, PR	Training in lifting technique and muscle strengthening training	Back problems; technique when transferring patients, muscle flexibility, proprioceptive ability; level I	No difference in back problems between the intervention and reference groups; higher quality of patient transfer in the intervention group
Garg & Owen, 1992 (59)	8 months	38 nursing assistants at a nursing home in Wisconsin, United States; observation (data collection forms), Borg's rating of perceived exertion, accident reports, biomechanical test	C, PsE, FR	Modified toilets, showers and other devices; ergonomic training to use the devices; teaching and training in patient transfer technique	a) incidence rate of back problems, b) compressive force on the L5/S1 disc, c) hand force, d) percentage of nurses' aides capable of performing stressful patient-handling tasks, e) perceived physical exertion; level I + O	Before and after measurements: a) 83 & 47 / 200 000 workhours, b) 4751 N / 1964 N, c) 312 N / 122 N, d) 41 / 83%, e) somewhat hard and hard or very light

(continues)

Table 3. Continued

Reference	Follow-up length	Population and data collection	Quality comments	Intervention studied	Outcome measure	Main findings
Yassi et al, 1995 (60)	6 months of follow-up after return to work	250 nurses with back problems (experiment group) and 1395 referents at the same hospital; interview	S, R, PR & FR no info	Assessment treatment by a physiotherapist; if sick leave >4 days occupational therapy assessment; early return to work with individually modified work tasks; referents asked to seek care elsewhere	Incidence of back problems and absence, costs for sick leave because of back problems; level I + O	The number of reported back injuries among the nurses dropped and absence due to back problems decreased in the experimental group; in the reference group there was an increase in these factors; the costs for back injuries and absence due to this were decreased by 23% and 43%, respectively, in the wards where the experimental group worked, while the costs for the reference group increased
Wood, 1987 (61)	1 year	Employees at 1 hospital which consisted of 3 units (2 intervention and 1 referent); accident reports	S, R, PsE; PR & FR no info	a) personnel program: increase contact with newly injured nurse and hospital staff and doctor so that the injured nurse would not be lost in the system; b) back program: evaluate ability to transfer patients in a classroom and at own wards, training in how to use equipment	Wage-loss claims filed by nurses for back injuries caused by interaction with residents; level I (back program) + O (personnel program)	The back program, training in patient transfer technique, did not reduce the back injuries; the personnel program reduced the back injuries; the combination of the 2 programs lowered the number of injuries
Donchin et al, 1990 (62) ^a	3-month intervention study, 6 months of follow-up monthly and supervision for 1 year; secondary prevention	142 nursing staff with a minimum of 3 episodes of back problems annually; questionnaire, physical capacity tests	S, PhE, PsE	Group A: 45-min exercise sessions for strengthening back flexors twice weekly for 3 months; group B: 5x90-min back education sessions; group C (referents): no exercise or education sessions	Physical capacity, endurance and isometric strength, periods of LBP; level I	Group A subjects had increased trunk-flexor strength but not extensor strength compared with group B and C subjects; effect disappeared after 6 months; the number of "painful months" in subsequent year decreased in group A compared with groups B and C (4.5 / 7.3 & 7.4 months)
Linton et al, 1989 (63) ^a	5 weeks intervention program plus 6 months of follow-up; secondary prevention	36 licensed practical nurses or nursing aides (and 30 referents) currently working but with history of back problems during the 2 years before enrollment; questionnaire, diary, 3 assessments	PhE, PsE	Group I: behavior therapy, physical therapy, "low-back school", relaxation training, life-style factors, strategies for avoiding injuries at work; the program lasted 8 hours per day for 5 weeks; group C: waiting list referents; program not provided	Pain intensity, fatigue, anxiety, sleep quality, medication intake, pain behavior, activities of daily living, depression, helplessness, work absences for 2-year period prior to the study; level I	Intervention subjects showed greater improvements than C subjects in self-reported problems, anxiety, sleep quality and fatigue, and activities of daily living at 6 months follow-up; intervention subjects broke a trend for increasing amounts of problem-related absenteeism, while C subjects did not
Cooper et al, 1996 (64)	6 months	40 study ward nurses in high risk wards and 118 referents who were injured but had no lesion before the study; 2 scales (1 was a visual analogue scale)	R, PhE, PsE	Assessment and treatment by a physiotherapist; if sick leave >4 days, the injured nurse was referred for occupational therapy assessment, early return to work with individually modified work tasks; reference ward nurses were asked to seek care through their routine care givers	Subjective problems in the low back, disability of daily activity; level I	A significant decrease in perceived disability between initial and follow-up was found for nurses with problem scores of <10 and reference nurses with problem scores of <20; early intervention program led to a reduction in disability so that no relationship existed between initial disability and disability at 6 months after injury

^a Studies included in Bigos et al, 1996 (19).

concerning risk factors for the genesis of work-related low-back problems, as well as preventive strategies for the work force. Many studies were scrutinized by this work group. This scrutiny aimed at finding results which

had been received from studies with scientific methods excluding or minimizing the possibilities of bias. In 1996 the scientific committee of the AAOS [in which one of the authors (TH) is a member] published a scientific

evaluation of these prospective cohort studies of work-related back problems (19). The studies included in the evaluation are shown in tables 4 and 5.

Physical factors

Lifts and transfers and "save the patient" situations

Many studies have shown a relationship between patient-lifting frequency and low-back problems. According to Jensen (20), each stressful patient handling involves some risk of a back injury for the nurse. If the patient behaves as predicted and everything goes smoothly, the risk is minimal. However, if anything unusual happens, for example, the legs of the patient give way or the patient slides out of bed or off a chair (ie, a "save the patient" situation occurs) the risk of low-back problems for the nurse increases dramatically.

In a meta-analysis of 6 epidemiologic studies from 1985–1988 Jensen (20) summarized that the prevalence of low-back problems among the nursing personnel who more frequently handled patients was about 3.7 times that of nursing personnel who infrequently handled patients (table 1). A register study showed an increased risk of operation for herniated lumbar disc among assistant nurses who worked in hospitals or nursing homes where heavy lifting occurred compared with the overall Danish female population (21).

Smedley et al (11, 22) reported that the risk of low-back problems was less if lifting devices were used than if not. [See references 11 (table 1) and 22 (table 2).] In another study, however, the use of lifting devices had no positive effect on low-back problems (23), nor was lifting patients in or out of baths with hoists related to lower risks for low-back problems than lifting manually (22). Studies have shown that "positioning a patient in bed" more often than other patient transfer procedures leads to low-back problems among nurses (24, 25). Takala & Kukkonen (26) noted that the work postures were awkward also when lifting devices were used, and, in another study on exposure in nursing work, Vojtecky et al (27) found that whether devices were used or not was related to type of load, stress in the lifting situation, work experience, and the amount of training in the use of devices. As far as the equipment is concerned, beds which are not adjustable in height can be risk factors for low-back problems (28), and for low-back stress (29), as the height of the bed has important consequences on the postures and handling capacity of nurses (30).

Work postures

Awkward work postures and standing great parts of a day were associated with a double risk of back problems among French nurses, as was also frequent lifting, pulling, and pushing (3). Other studies have also found that

lifting and pushing, as well as walking and standing great parts of a day, are of significance for low-back problems (2, 28, 30, 31, 32). However, in a study in which nurses from hospitals in Belgium and The Netherlands were studied, it was found that, in spite of the heavier work load among Dutch nurses, the life-time prevalence of low-back problems was higher among Belgian nurses. The work load was defined as time per day spent on strenuous patient-handling tasks (turning, lifting, helping, etc) (33).

Work category and clinical area

It has been shown in some studies that nurses' aides have a higher prevalence of work-related low-back problems than registered nurses (3, 13, 23), while a study from the United Kingdom did not reach the same conclusion (11). Low-back problems were more closely related to exposure than to work category according to Stobbe et al (34). Each of the 3 work categories (licensed practical nurses, nurses' aides, and attendants) were dichotomized into those who frequently lifted patients and those who infrequently lifted patients. In all 3 work categories, those who were exposed to frequent lifting had more low-back problems than the other exposure group. Heap (35) showed that the greater amount of sick leave among nurses' aides could be explained by their more strenuous work and that they, to a greater extent than registered nurses, worked in geriatric wards with many patient transfers.

Work in orthopedic, geriatric, and rehabilitation wards with physically demanding nursing tasks has been regarded as a risk factor for low-back problems in several studies (23, 24, 33, 36).

Work organizational factors

Staff density - work overload - stress

Staff density has been found to be an important factor in work organization and has been related to low-back problems (32, 36). When the staff density is low, the nurses have to work alone frequently, and unassisted lifts were a risk factor for back injuries in a Canadian study (36). Work pressure and a need to slow down at work were related to an increased risk for low-back problems among Dutch nurses. Work disturbed by unseen events was also a risk factor (28).

An insufficient number of staff can lead to work overload, which was seen in several studies to contribute to feelings of stress among nurses (24, 37, 38). Of nurses with low-back problems, Cato et al (24) showed that 73% reported feeling overly stressed at work compared with those without low-back problems (53%). Some of the most important factors which contributed to work stress

were a feeling of overload, emotional drain, and the perception of conflicting demands and trouble with management (24, 37).

Shift work

One study reported that work on a day shift was a risk factor for low-back problems. This finding may be explained by the higher physical demands, especially in patient handling and nursing care during the days when lifting and bending requirements are higher than during the evenings or nights (9). In another study, shift work versus day work was not a risk factor for low-back problems (11).

Working full-time during a week as compared with part-time was considered a risk factor in some studies (31), but not in others (11).

Mode of nursing care

Team care as opposed to traditional nursing care means that a nurse has the responsibility to care fully for a few patients instead of shared responsibility for many patients. In a study from 2 geriatric wards the personnel in a modern ward with team care routines performed half as many lifts as the personnel in the traditional ward, irrespective of equivalent patient handling needs. The team-care routines seemed to facilitate the work since the team got to know their "own" patients well. During 4 years 2.5% in the modern ward and 5% in the traditional ward reported strain injuries in the back (2). In another cross-sectional study, however, mode of nursing care was not related to low-back problems (39).

Work technique

No effect of training in patient handling on low-back health was found by Harber et al (40). However, inadequate training was reported by 52% of the back injured nurses as the cause of the injuries (36). There exists an international controversy concerning "proper" lifting techniques (37), and there is no proof of a particular technique leading to a decrease in low-back problems among nurses. The importance of compliance was seen in an Australian study in which the total weight lifted not in

accordance with any of the recommended methods was the main risk factor for back problems. Factors contributing to choice of method were patient cooperation, occupational category, and number of nurses carrying out the lift (41).

Psychosocial factors

Psychological demands, authority over decisions, skill utilization and social support

Psychological demands, authority over decisions, skill utilization, and social support at work were related to low-back health in some nursing studies (13, 42, 43). The relative risk of low-back problems was higher for those with high job strain as compared with those with low job strain. Job strain was defined as a combination of high work demands and limited possibilities to influence work (42, 43). In another study, institutional policy (ie, conflicts between own beliefs and those of the institution, lack of power and influence), work overload, and poor social relations were related to low-back problems among full-time nurses in wards with a high perceived ergonomic load. Moreover, responsibility was related to low-back problems for full-time work in wards with low perceived ergonomic load (38). There are, however, studies in which the psychosocial factors were not considered to be risk factors (39, 44).

Job satisfaction

Job satisfaction predicted low-back health in the prospective study by Ready et al. The effect of this factor was evident when combined with earlier severe low-back problems and smoking (45). Attitudes towards health and also psychological disturbance predicted back pain among student nurses (46). In the study of nurses from hospitals in Belgium and The Netherlands that has already been mentioned, Dutch nurses had a heavier job load, but, in spite of this, they experienced higher work satisfaction, had more positive attitudes towards pain, work and activity, and used more positive coping strategies than Belgian nurses. The Dutch nurses report-

Table 4. Summary of the cross-sectional, case-referent, and prospective studies in tables 1 and 2.

Type of study	Physical factors	Work organization factors	Psychosocial factors	Combination of physical and work organization and psychosocial factors
Cross-sectional studies (N=21)	2, 3, 11, 13, 20, ^a 21, 24, 25, 28, 30, 31, 32, 33, 34, 39, 41, 44	2, 9, 13, 24, 32, 37, 38, 39, 41, 44	13, 33, 38, 39, 43, 44	2, 13, 24, 32, 33, 39, 41, 44
Prospective studies (N=10)	22, 23, ^b 35, 36, 42, 44, 45, ^b 52 ^b	23, ^b 36, 40, ^b 44,	40, ^b 42, 44, 45, ^b 46	23, ^b 36, 42, 44, 45 ^b

^a Included in Jensen 1990 (20) were 5 cross-sectional studies (34, 83, 84, 85, 86) and one prospective cohort study (23).

^b Included in Bigos et al, 1996 (19).

ed a lower life-time prevalence of low-back problems than the Belgian nurses did (33).

Summary of work-related factors in the reported studies

It is evident that, in spite of different study designs, most research points to physical factors as contributing to low-back problems, while the contribution of work organizational and psychosocial factors is not as clear. (For a summary see table 4.)

Individual factors

In spite of the focus on work-related factors in this review, the individual factors analyzed in some studies are also included. No conclusive relationships have been found between individual factors and low-back problems among nurses. Reviews of the general population or vocational groups have in general shown that low-back problems increase with age up to 50–60 years of age, after which there is a decline (47, 48). Hence high age is a risk factor mainly for women (49), a finding which was also shown in some nursing studies (30, 38, 39) but not in others (13, 23, 28, 35). At the age 40–44 years the risk of lumbar pain was twice as high as for the group <35 years of age among French nurses (44). A literature review has, on the contrary, shown that nurses with low-back problems are often younger than those without these problems (50).

Cigarette smoking as a risk factor for low-back problems also showed a contradictory outcome. Some studies found a relation between smoking and low-back problems among nurses (45, 51), while others did not (9, 13). In the general population some reviews also showed a contradictory outcome as regards smoking (47, 48).

Those who regarded their physical fitness as low, when compared with persons of their own age, had severe low-back problems in a cross-sectional study (13), while this factor did not discriminate between those with or without low-back problems (45) or low-back strength (52).

Out of 199 student nurses who were followed for 20 months, some personal psychological factors were significant in differentiating between cases of back problems and noncases. Moreover, in the more serious cases, physical factors seemed to be more important (46). Among French nurses minor psychiatric disorders were associated with an increased risk of back problems (relative risk 2.7) (3), and among English nurses frequent low mood was associated with low-back problems leading to absence from work (22).

There seems to be a consensus that a previous history of back problems is a risk for subsequent

episodes, as shown in both cross-sectional and prospective studies, and in literature reviews (3, 9, 22, 23, 35, 45, 53). However, an American prospective cohort study found that prior history of low-back pain or injury did not predict subsequent problems (52).

The issue of work-relatedness in low-back problems often arises. In 2 French studies commuting time to work was studied. In the prospective study, commuting 1 hour or more was a risk factor (44), while in the cross-sectional study commuting more than 1 hour was not a risk factor (3).

Summary of individual factors in the reported studies

No conclusive relationships have been found between individual factors and low-back problems among nurses. However, a "history of back problems" seems indisputably related to new episodes of low-back problems.

Intervention studies

Regarding the considerable costs caused by absence from nursing work due to low-back problems among nurses, surprisingly few programs with the aim of reducing such problems have been reported. Most of these studies have focused on the individual person, and in one such study from Sweden nurses and nurses' aides both with and without back problems lowered the absence from work because of low-back problems with light physical exercise during workhours (54) (table 3).

There have been several studies published that have indicated little, if any, decrease in low-back problems as a result of technique training among participants. Two studies have evaluated ergonomic training among student nurses. In the first study the effect of 40 hours of extra training in patient handling skills on subsequent back problems led to no differences in such problems between the training group and the reference group. However, improvement in patient-handling skills was seen in the training group. The subsequent incidence of acute back injuries occurring during work was lower for the skilled nurses, but there was no significant difference between the skilled and unskilled nurses in the incidence of other forms of back problems (55). The other study of student nurses also failed to show an effect of the program on low-back problems after 2 hours of extra ergonomic training each week during 2 years (56).

Another intervention program consisting of patient transfer technique, physical exercise, and stress management was conducted during 3 years, but it did not produce the expected results. At the 1-year follow up, the nurses who used a new technique (93%) rated some patient transfers as less physically strenuous than those who did not use the technique. There was, however, no

decrease in low-back problems among the nurses (57). In another program in which nurses trained in patient transfer technique, the quality of performing patient transfers improved in the study group, but there was no reduction in low-back problems (58).

A few intervention studies have focused on both the organization (work environment) and the individual person. An ergonomic intervention program of nursing assistants in a nursing home showed that training in the use of devices, modifying the toilets and shower rooms, and applying technical aides in patient care were efficient strategies to reduce low-back problems (59). Another program also resulted in a decrease in back injuries and time lost, and it was therefore considered cost-beneficial. The intervention consisted of prompt assessment, treatment, and rehabilitation through modified work for nurses from high-risk wards (60).

Wood (61) reported two programs in the same study, one focused on the individual persons and the other on the organization. The organization intervention consisted of increased contact for the newly injured nurse with the hospital staff, the physician, and persons from the Workers' Compensation Board to prevent the injured nurse from getting lost in the system. Subsequently, there was a decrease in the number of wage-loss claims filed by nurses for back injuries caused by interaction with residents. On the other hand the individual training program was not effective in that sense.

Some studies are secondary prevention programs for nurses with manifest low-back problems. In one such study, intervention consisted of physical exercise sessions and back training sessions. The number of "painful months" in the subsequent year decreased in the training group. It was suggested that this outcome was a result of increased trunk-flexor strength (62). In a Swedish study, nurses at work, but with a history of back problems, took part in a physical exercise program 1 day a week for 4 weeks. Behavior therapy techniques conducted by a psychologist were included in the program to help the subjects achieve better control of their pain. The intervention subjects showed greater improvements than did the reference group in self-reported pain, fatigue, and daily living activities (63). Another study with early intervention for nurses with low-back problems focused on

assessment and therapy by physiotherapists. The nurses with more than 4 weeks of time lost were referred to occupational therapy, which consisted of a physical exercise program until the nurse was suited for modified work. The early intervention program led to a reduction in disability in that no relationship existed between initial disability and disability at 6 months after injury. In the absence of an intervention program, disability at the time of injury predicted disability after 6 months (64). For a summary of the intervention studies see table 5.

More-detailed information about exposure and outcome has been reported in Swedish (65).

Discussion

Study design

Direct comparisons of data from epidemiologic studies are difficult. In tables 1, 2, and 3 quality comments of the studies are noted. Most of the studies have some limitations concerning study design, definition of the sample, assessment exposure or outcome variables or response rates which must be considered when the results are interpreted. Most of the studies are of cross-sectional design, and retrospective data lead to uncertainties, not only about the start of an illness but also about the assessment of earlier work load. Another problem is the recall bias which, in the retrospective studies, might explain several of the risk factors noted in the study. Case subjects may well be more likely to recall previous injuries and arduous work conditions than referents will.

In the studies of nursing personnel that have included reference groups, other groups of the same personnel category are generally used for reference. This procedure may lead to an underestimation of the risk of low-back problems, as most of them have physically strenuous work. It is probable that the risk of low-back problems would be more evident if reference groups did not have similar physically strenuous work.

Another problem which also leads to an underestimation of risk factors for low-back problems is high turnover rates, which are mainly seen among younger nurses (66). Many nurses leave their job because of back problems (66), but other factors also contribute, such as low salary and the lack of sufficient flexibility of workhours (67).

Work-related factors

A further explanation of reported contradictory results may be that different work-related factors have significance for new episodes and for the maintenance of low-back problems. It is reasonable to assume that low-back problems and their consequences in nursing work, as in any other work, are affected by physical, psychosocial,

Table 5. Summary of the intervention studies in relation to level of intervention (individual, organizational or individual and organizational) in table 3 (N=11).

Effect on low-back problems	Individual focus	Organizational and individual or organizational focus
Decrease	54, ^a 62, ^b 63 ^{a, b}	59, 60, 61, 64 ^{a, b}
No decrease	55, 56, 57, 58, 61	

^a Studies included in Bigos et al, 1996 (19).

^b Secondary prevention.

psychological, and social factors, as well as by factors related to insurance claims. In a recent review on risk factors for low-back disorders, Burdorf & Sorock summarized that job dissatisfaction and low job-decision latitude proved to be important, but the evidence was not consistent across different study designs and studies with different vocational groups (68). In another review (69), Nachemson reported, however, that psychosocial factors were the most significant factors not only for the maintenance of low-back problems, but also for new episodes.

Attitudes towards the experience of pain and also attitudes towards work, worktasks, employers, supervisors, and co-workers can be risk factors for low-back problems and for the consequences and maintenance of these problems (10). In several studies, out of which 2 were prospective cohort studies, attitudes towards pain, work, and satisfaction with work predicted low-back health (33, 45, 46).

Staff density was seen as a risk factor for low-back problems, and an insufficient number of staff was shown to lead to patient transfers being carried out by only 1 nurse when it would be appropriate for 2 nurses to transfer the patient. In the times of downsizing nursing personnel in Sweden, in the beginning of the 1990s, there was an increase from 11% to 16% for nurses who transferred patients alone when two were actually needed, and also a tendency towards an increased prevalence of low-back problems was reported (57). Another consequence of an insufficient number of staff is work overload, which, in the long run, can lead to negative stress. Bongers et al (17) suggested that psychosocial factors could directly influence mechanical load through changes in posture and the like, but it also increased stress when the personal capacity to cope with job control and social support was not sufficient. It has been indicated that lack of relaxation may be of significant importance for the development of musculoskeletal disorders. Psychosocial and psychological factors are likely to prevent relaxation when the stress exposure has terminated (70).

An insufficient number of staff must, however, not only be regarded as a risk factor for the nurse, it is highly probable that it is also related to the quality of nursing care and thus is also of importance for the patient.

From this review of nursing work it seems plausible that heavy loads and unfavorable body positions which include "save the patient" situations can be assumed to give rise to injuries to the back among nurses. Work organizational and psychosocial factors and attitudes can thus affect pain perception and injury reporting (71) and, as such, can also be of importance with respect to the return of an injured nurse to work (72). In addition, Wood has shown that the active interest of nurses' supervisors is of great importance to the return of a person to work after an attack of back pain (61). This factor seems to have been neglected in work organization.

Currently, there are 2 difficulties in determining the relative importance of the psychosocial and physical factors related to back injuries among nursing personnel. First, psychosocial factors are usually measured at the individual level, while physical factors are more often measured at the group level, and often with methods with limited precision or accuracy. Second, "objective measures" of aspects of the psychosocial work environment are difficult to develop and are thus rarely used. Objective methods to measure the physical environment are, however, more readily available. Until it is possible to measure most workplace and individual factors with more comparable techniques, it will be difficult to determine their relative importance (73).

Intervention

An English review of 10 intervention programs to reduce low-back problems among nurses from 1976 to 1992 showed little long-term benefit (16). Pheasant & Stubbs suggested that nurses were physically overloaded instead of, as widely believed, undertrained (74). When nursing staff do not benefit from training programs, it may be that intervention has lacked the intensity needed to cause the desired change (75) or it may be a matter of inadequacy on the part of the recommended work technique (16, 41, 74) or a lack of support for the intervention program from top management (61). It is also possible that the individual nurse may already use an acceptable work technique before training. In addition it is seldom evaluated whether or not a newly taught work technique is really used by nurses.

Another issue is that of compliance with the safety rules already known. Supervisors' involvement in the form of feedback has been found to create the highest compliance ratings (61), and the impact of poor supervision of staff safety in respect to handling patients has been acknowledged (76). If the problem is not related to a skill deficiency, the issue becomes supervisory and organizational rather than educational.

One question is whether ergonomic intervention alone is sufficient to decrease low-back problems among nurses. It is probable that psychosocial factors, attitudes, and beliefs, as well as work organizational factors, influence sick leave because of low-back problems, as seen in industry (77, 78). Takala & Kukkonen (26) proposed that back problems in nursing should be ameliorated as follows: nurses should be given training, including recommendations for lifting techniques and body positions, wards must be equipped with lifting devices, and new comprehensive plans should be made for the whole hospital environment, architecture, and work organization. This proposal highlights the importance of the level of intervention, which may focus on the individual nurse or on the organization or on both. As seen in tables 3 and 5, most intervention programs focus on individual

nurses. To decrease low-back problems nurses are usually offered training and education meant to lead to behavior modification or a change in attitudes, abilities, or coping strategies. The organizationally focused types of intervention are aimed at improving the nurses' health by means of imposing changes in the work environment. In this review only 4 studies focused on the work environment (59, 60, 61, 64). Wood (61) stressed the importance of combining the 2 types of programs to reach the best possible outcomes. Kilbom (79) also pointed out that, in order to decrease musculoskeletal problems, intervention programs ought to be multidisciplinary because of the complex and multifaceted etiology involved.

It is, however, questionable whether a reduction in low-back problems can really be expected as a direct effect of improved work conditions and work technique. It can also be considered whether ergonomic intervention can lead to a reduction in low-back problems in the short-term (80). In an English training program the injury rates were initially reduced, but after 18 months the injury rates climbed back to their original level, where they remained, with apparent random fluctuations (74). Perhaps other effects of a program should be studied, for example, satisfaction with changes in the work situation, and, as suggested by Wallace & Buckle, preventive activities may instead provide opportunities to continue employment despite a low-back problem (80, 81).

In future research on low-back problems among nurses, there is a great need to carry out prospective studies with preventive programs that identify and evaluate risk factors; more cross-sectional studies are hardly necessary. However, without increased methodological rigor of these studies, it will not be possible to identify effective intervention methods and confidently encourage their use (82), which would improve the ability to make comparisons both between different study groups and across studies. Most studies in this review have used quantitative methods. A broadening of this perspective and also the use of participative or interview methods to obtain qualitative data might identify factors that contribute to low-back problems among nurses. Wickström (10) also suggested that, to reach an understanding in intervention studies, it is necessary to adopt methods used in research on education.

Concluding remarks

Nursing work in close contact with patients often involves both heavy loads and unfavorable body positions. It also often includes elements such as "save the patient" situations, for example, those in which the patient's legs give way or the patient is about to fall out of a bed or off a chair. Such situations can cause uncontrollable loads on nursing staff, loads that can irrefutably be assumed to give rise to injuries to the back and other parts of the body. High turnover among young nurses and the use of

medical staff as a reference group are factors that may lead to an underestimation of the risk of developing low-back problems.

A considerable number of studies of nursing staff have shown the connection between lifting and transferring patients on one hand and low-back problems on the other. To our knowledge there are no studies that show that work organizational or psychosocial factors, as such, cause low-back problems. However, these factors can be of significance to the consequence and maintenance of low-back problems, by affecting, for example, the perception of pain and the tendency to report illness. Factors in nursing work which might have significance for this connection are staff density and job satisfaction. In this review the single individual factor indisputably related to low-back problems was "history of back problems".

Prevention programs do not show unequivocally positive results. However, in most programs, the level of intervention focuses on the individual person, while low-back problems also undoubtedly need an organizational solution.

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