1997:30

Events and Factors Involved in Accidents Leading to Over-exertion Back Injuries among Nursing Personnel

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ARBETE OCH HÄLSA VETENSKAPLIG SKRIFTSERIE
ISBN 91–7045–454–X ISSN 0346–7821

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171 84 Solna, Sverige

ISBN 91–7045–454–X
ISSN 0346-7821
Tryckt hos CM Gruppen

Acknowledgements

The studies have been supported financially by the Swedish Work Environment Fund and the Stockholm County Council.

I would like to thank especially my supervisors for introducing me to Safety Research and for advising me when needed:

-Professor Mats Hagberg, previously Department for Work and Health, National Institute for Working Life, presently Department of Occupational Medicine, Sahlgrenska University Hospital, Gothenburg, my supervisor and co-writer
-Associate professor Ewa Wigaeus Hjelm, Department for Work and Health, National Institute for Working Life, my supervisor and co-writer
-Professor Karin Harms-Ringdahl, my supervisor, Section of Rehabilitation Medicine, Department of Surgical Sciences, Karolinska Institute- my academic home.

I would also like to thank everyone who contributed in any way to the work presented here and especially:

My co-writers Senior administrative officer Arvid Lindén, the Swedish Occupational Injury Information System (ISA), Associate professor Ewa Menckel, Department for Work and Health, National Institute for Working Life and Associate professor Lena Ekenvall, Department of Occupational Medicine, Karolinska Institute.

Ergonomist Ingrid Mårtensson, Occupational Health Services of the Stockholm County Council, for our work with the ergonomic checklist.

PROSA study-group, Occupational Health Services of the Stockholm County Council, for all heavy work with the interviews during the PROSA study. Especially I would like to thank the members of *The accident investigation group:* Ergonomist Mariana Bernhoff, Occupational Health Nurse Kerstin Hall, Occupational Health Nurse May-Britt Tjernberg and the deceased Ergonomist Mari-Anne Lind, for the enthusiasm and all valuable contributions during the development of the instruments.

Professor Anders Kjellberg, Department for Work and Health, National Institute for Working Life, for introducing me to the cluster analysis method, for great support in the analysis discussions and for being supportive whenever needed.

Dr Tomas Backström for acting as opponent together with Professor Anders Kjellberg at my “trial defence” of this thesis and for the important changes they proposed.

Dr Lars Lindbeck, Department for Work and Health, National Institute for Working Life, for taking valuable notes on comments given during seminars on my articles and my “trial defence” and for contributing with own advice.

Psychologist Lennart Hallsten, Department for Work and Health, National Institute for Working Life, for fruitful discussions concerning cluster analysis.

Senior research engineer Björn Sköldström, Research engineer Robert Gloria and Licentiate of Technology Nils “Ocka” Pettersson, Department for Work and Health, National Institute for Working Life, for guiding me through all computer technique problems and for always being helpful.

All members of *The interest group for accident research at the National Institute for Working Life* for being a resource during my personal development in the safety area.

Professor Jorma Saari, Department of Occupational Safety, Finnish Institute of Occupational Health, Helsinki, for all good advises given during continuously discussions through the years and for all valuable support regarding the development of my conceptual model for safety research.

Dr Ragnar Andersson, Department of Public Health Science, Karolinska Institute, for all valuable comments during the development of my conceptual model for safety research.

Professor Tore Larsson, Occupational Hazard Management (VIOSH) University of Ballarat, Australia, for inspiring discussions over e-mail concerning definitions and concepts in the safety area.

Professor Dinesh Mohan, Transportation Research and Injury Prevention Program, Indian Institute of Technology, Dehli, India, for valuable discussions over e-mail, concerning concepts and Haddons matrix.

The librarians at the Swedish National Resource Library on occupational Safety and Health for always giving an excellent service and with a special thanks to Birgitta Ahlberg and Peter Lindgren.

Tim Crossfield, my language examiner, who never gives up despite how badly I treat his mother language.

And to YOU,
ALL my good friends and colleagues who have been supportive all through the years

Gun-Britt Hultner, my very good friend, for taking care of my home so I could concentrate on my work.

My family Jan-Erik, Johan and Anna with her family, who give me the courage to go on.

My mother Adéle Wennergren, who taught me to never say die.

List of abbrevations

AIIR	Annual Injury incidence Rate
CI	Confidence Interval
RR	Relative Risk

List of papers

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

I Engkvist I-L, Hagberg M, Lindén A, Malker B. Over-exertion back accidents among nurses' aides. *Safety Science*, 1992; 15, 97-108.

II Engkvist I-L, Hagberg M, Wigaeus Hjelm E, Menckel E, Ekenvall L, PROSA Study Group. Interview protocols and ergonomic checklist for analysing over-exertion back accidents among nursing personnel. *Applied Ergonomics* 1995; 26, 213-220.

III Engkvist I-L, Hagberg M, Wigaeus Hjelm E, Menckel E, Ekenvall L, PROSA Study Group. Investigation of the accident processes preceding over-exertion back injuries in nursing personnel (*submitted for publication*).

Contents

Introduction

Nursing personnel have a relatively high prevalence of back pain and occupational back injuries compared to other occupational groups (14, 31, 55, 60). Work posture, incorrect lifting of objects or persons, and similar physical strains, are some of the factors which are associated with back injuries and disorders. Lifting combined with twisting is considered to constitute a great risk of injury (37, 83). Several studies show that reported back injuries are related to patient transfers (10, 16, 35, 64, 66, 77).

Occupational injuries entail great costs both for the community and for the individual worker (74, 75). They lead to loss of income as well as physical and mental suffering. For the workplace they lead to sickness benefit, overtime, recruitment of new personnel, etc. And for the community they entail sick pay, medical care, insurance, sickness pension, etc.

Injury reports provide statistics about accidents and the injuries they cause, but are seldom used to initiate preventive changes. Statistics on the incidence of accidents give some insight into the magnitude of the problem as it appears nationally but little or no information about the causes of accidents or suggestions for preventive measures. The data rely on reports from individuals who are unlikely to be trained in accident investigation (84). The information on an accident report is therefore often inadequate both for understanding the factors and events involved in the accident process and for giving a base for initiating preventive measures. According to Troup (84), most published reports dealing with the causes of back accidents have tended to focus on a single causative factor, for which the selective basis is often quite arbitrary, and other contributory factors are thus ignored. Hignett hinted that studies using interview methods to obtain qualitative data may identify factors contributing to the onset of occupational back pain (32).

For an accident report to have an impact on the safety work, the report ought not to be the termination, but the initiation, of an investigation; and a way of assessing knowledge of preventive strategies. Only through careful investigation of the circumstances involved in the accident process and an analysis of how a risk situation is created is it possible to suggest preventive measures to avoid a risk situation, or block a process once started, and to create a safer work place.

Theories and concepts

The Swedish Occupational Injury Register (ISA)

In Sweden, all working persons are compulsorily insured for occupational injuries. The Work Injury Insurance Act of 1976 requires employers to report all occupational injuries on an injury form. The form is sent by the employer to the social insurance office with one copy to the Labour Inspectorate and one copy to the occupational health care unit serving the company. At the Labour Inspectorate specialised staff examine, codify and register the information given. Occupational injuries are divided, according to type of injury, into three groups: occupational accidents, commuting accidents and occupational diseases. The criterion used for classification of “accident” is sudden onset of symptoms, closely related in time to a specific event. For the “disease” classification symptoms should have appeared gradually and are not to be related to a certain event. Occupational accidents are registered

only if they have led to absence for at least one day, or to a dental injury. All occupational diseases are registered. All information is collected in the Swedish Occupational Injury Register (ISA). (34)

The variations of the use of definitions and concepts

The literature concerning accidents shows variation in the use and definitions of the concepts *accident* and *injury* among researchers, This has also been pointed out by several authors (1, 23, 48, 53). Epidemiological research takes diseases as its point of departure. For this reason, it naturally focuses on the injury and attempts, for descriptive or analytic purposes, to relate injuries statistically to various individual and environmental factors. In this view, the accident event itself is often reduced to a mere parenthesis between the injury and a variety of conceivable causal factors (1). Hagberg emphasises that some of the confusion and controversy in occupational injury research may be attributed, in part, to the lack of clearly defined terms and concepts. Consensus definitions of injury terms and concepts are rare, perhaps due to the traditional epidemiological focus on chronic and infectious diseases (23).

The terms *accident* and *injury*, are often used interchangeably and there is an increasing confusion concerning their implications (2). It has even been proposed to use *injury* as a concept including both the accident (event) and the outcome (the injury) (67, 70). This impedes comparison of statistics and obstructs understanding of the literature.

The association of accidents with randomness have been discussed (1). Some researchers have suggested avoiding the word *accident* as having connotations of randomness, referring to the Oxford Dictionary as including in its definition of accident, unforeseen contingency, chance, and fortune (51,33); also as having the connotations of inevitability and lack of apparent cause (67). These assertions have been questioned by Andersson (1). No one has so far suggested a synonym for accident, covering the same concept, and which the other researchers in the area have accepted.

Accidents may be unwanted, but they are not or should not be unexpected (85). Random factors no doubt are a part of the factors and events leading to an accident and it is therefore generally not possible to predict *when* an accident will occur. However, this randomness does not mean that it is impossible to analyse the accident process after the accident has occurred, and to explain how and why it happened. Even if some contributing factors will still remain unknown, it may be possible to eliminate the risk of future accidents of similar type by eliminating a necessary condition for them (e.g., by changing how the task is performed or automating a critical part of the work process).

While dictionaries differ in the definitions of accident, the following two citations highlight another topic for discussions in this area. The disagreement here concerns using the term accident when there is no injury as an outcome; “an unplanned and uncontrolled event that is not necessarily injurious or damaging to an individual, property or to an operation. Any unplanned event that interrupts or interferes with the orderly progress of a production activity or process” (13) p 3. “Any unplanned occurrence which results in damage to property or equipment, causes injury or illness to one or more persons, and/or

adversely affects an activity or function" (79) pp 5-6. Another question discussed in the literature is whether the event has to be unintentional to be called an accident (5, 51, 70).

Models

Several models exist for investigating occupational accident processes.
Laflamme has found three commonalties in different accident models (48);

1) a distinction ought to be established between an injury and an accident
2) there might be similar accidental sequences of events in the genesis of accidents, these sequences being initiated by disturbances in the production flow or process
3) disturbances and accident sequences are influenced by factors related not only to the immediate working situation but also to work organisation, in a broader sense (48).

The OARU-model (Occupational Accident Research Unit) distinguishes between the *accident process* as two preinjury phases –*initial* and *concluding*-followed by the *injury phase* as the pathogenic outcome of physical damage in a person. (42-44). The *initial phase* starts when there are deviations from the planned or normal process. The *concluding phase* is characterised by loss of control and the ungoverned flow of energy. The *injury phase* is where energies meet the human body and cause physical harm.

Injuries result as a culmination of a set of circumstances and pre-existing conditions which may best be understood as a chain of events (67). Haddon's matrix provides a conceptual framework on which schematically represents this chain of events. It also consists of three phases: pre-event, event and post-event plotted against the three factors human, vehicle (product) and environmental (Figure 1) (70). Haddon also developed ten basic strategies for injury prevention to apply in different phases and to the different factors in the matrix (22). Some recommended strategies are to separate in time or space, and to protect by a material barrier between the hazard and that which is to be protected (22). The model has been particularly useful in determining appropriate points for intervention to prevent or alleviate injuries. The point of intervention is not necessarily early in the chain of events, it should be where the intervention is possible or ideally where it will be most effective (67). Haddon remarks that the larger the amounts of energy involved in relation to the resistance to damage of the structures at risk, the earlier in the countermeasure sequence the strategy must lie (22).

When it comes to prevention Gjerstland introduced the concept of primary, secondary and tertiary prevention (21). Primary prevention is given before the person meets the hazard e.g. use of vaccine. Secondary prevention is used to reduce the symptoms and tertiary prevention to rehabilitate the person. Ozanne-Smith notes that the three phases in Haddon's matrix are generally equated with primary (pre-event), secondary (event) and tertiary prevention (post-event) (67).

		Factors		
		Human	**Vehicle**	**Environment**
Phases	**Pre-event**			
	Event			
	Post-event			

Figure 1. Haddon's matrix (67)

Conceptual model for safety research

A review of the literature prompted the following question:

Why are there such different opinions on the concepts *accident* and *injury*?

Some explanations can be that investigation of the accident process is multidisciplinary territory (54). When one also considers the injury phase and post injury, the complexity is compounded. Researchers and practitioners from different fields and disciplines have focused on different parts of this phenomenon depending on their profession and their specific interest. The variation in the use of the concepts reflects the differences in starting point, but also how the user defines the concept.

One contributing factor that might explain some of the confusion over the concepts *accident* and *injury* is the short time, often just a second or less, between the accident and the injury. This means, when referring back to the occurrence of an accident (the event) or the onset of an injury (the outcome), that the *place*, the *time* and the *task* performed are identical. For example, a patient suddenly loses balance during a transfer and the nurse tries to stop the patient from falling and thereby injures her back due to over-exertion. In this case the accident occurs during a patient transfer, but so does the onset of the injury. This does not mean that accident and injury are interchangeable, as the accident is the event and the injury the outcome.

The model in figure 2 gives a schematic and general overview of how individuals with interest in the area differ in their focuses and approaches. The overview is intended to explain some of the variations in how the concepts are defined.

A): When the focus is on preventing the accident and thereby trying to find the most efficient methods, the contributing factors to the accident process will be carefully investigated. Less interest or none, will be focused on the outcome, the injury caused by the accident, which here will often be generally described, for example nature of injury (e.g. skeletal, brain) or body part (e.g. head, back, foot) (6)(Study III). The accident process has most often been seen as a technical, behavioural and social- scientific phenomenon, and has mostly been studied by the appropriate specialists (5,49,52,81,43,72).

B): medical personnel have a professional focus on the injury and the injured person. In clinical work the injury will be carefully investigated and a diagnosis made, followed by treatment. The cause of the injury is also of interest, but will seldom be carefully investigated, and the causes will be stated in general terms, e.g. over-exertion, falls, trips and slips etc. In epidemiological studies also the focus is often on the injury and its consequences e.g. type of injury, incidence and sick leave (36, 68, 78).

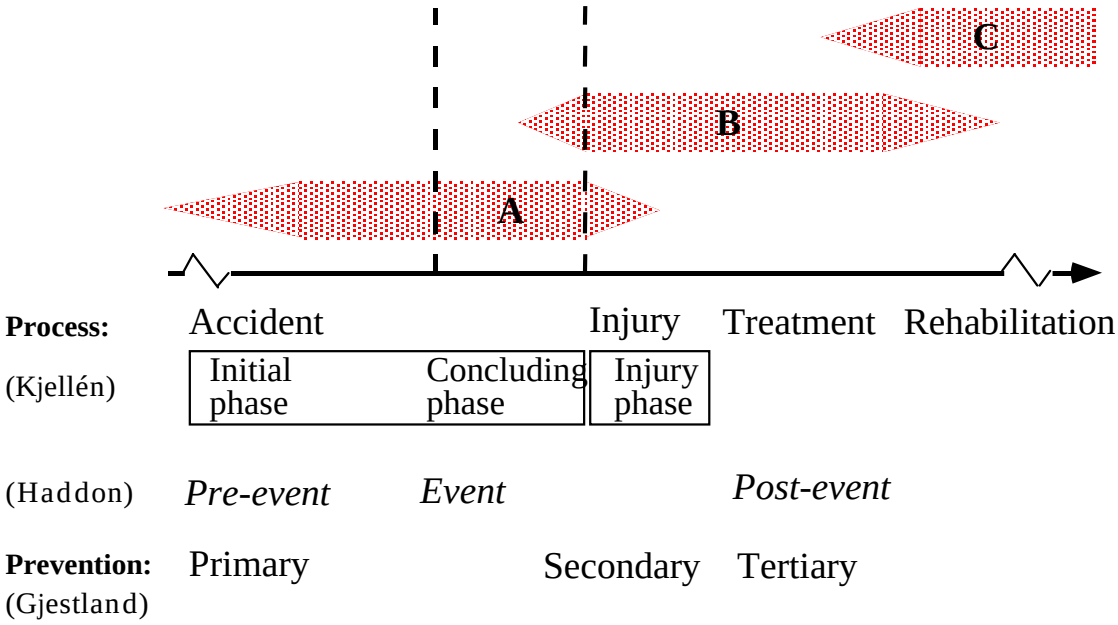

Figure 2. Schematic overview of the approaches and primary foci of different researchers and practitioners (A-C), depending on their specialities.

C): during rehabilitation there might be even less interest or none in the accident process, as the focus is now on the goal of getting the injured person back to work, or improving quality of life. Others with interest in the accident and injury area are the rescue corps, insurance company and the legal system.

The aims

The overall aim of this study was to analyse the occurrence of reported occupational over-exertion accidents leading to back injuries among nursing personnel and to identify events and factors involved in the accident process preceding the injury.

The specific aims were;
-to describe the occurrence of reported occupational over-exertion accidents leading to back injuries among female nurses' aides in Sweden during a two-year period and to identify factors and events related to these accidents (Study I).
-to develop a standardised instrument for systematic analyses of the accident process and to develop a screening tool for the physical environment that could be used quickly and easily to identify potential hazards for over-exertion accidents leading to back injuries among nursing personnel (Study II).
-to analyse factors and events involved in the accident process preceding such back injuries (Study III).

Methods and study populations

Definitions used

The present thesis is based on data from injury insurance forms for which reason the ISA definition of an occupational accident has been used. An accident is therefore defined as an (unintentional) sudden event that could be referred to a certain time and place and that has been reported on an injury insurance form. Commuting accidents are not included.

Only over-exertion accidents leading to injuries of the back were studied. In Study I, based on the ISA register, only over-exertion accidents of the back leading to sick leave of one day or more were included. In Study III all reported over-exertion accidents were included whether they led to sick leave.

In study III a similar approach as that described in the OARU model was used (se page 3). *Initial phase* refers to the deviations from the planned or normal process (se table 2), i.e. shortage of staff or lack of transfer devices. The *concluding phase* refers to loss of control, e.g. a patient is falling and a nurse makes a sudden intervention to prevent this.

The *injury phase* is where energies meet the human body and cause a physical harm, in the present study some of the tissues in the back. By *patient transfer* is meant all kinds of transfer where the nurse physically support the patient to some extent. Only reported occupational injuries are included and are defined as unintentional.

Study assumption

The assumption for the study was that several factors and events interact in the accident process leading to a back injury. In the conceptual framework below (Figure 3) these factors and events are illustrated under four headings: organisation, workplace, nurse and patient. *Organisation* refers to, factors that can be affected by organisational procedures e.g. kind of task performed, lack of information to the nurse, the co-worker, or shortage of staff.

Workplace includes the place and deficiencies in the physical environment such as lack of space, which compel the nurse to work in an awkward position. There could also be a lack of transfer devices. The *nurse* may lack experience, or she could have chosen a non-optimal way of performing the task despite her knowledge and the opportunity to perform the task in a more labour-saving way. The *patient* may have been uncooperative during the transfer due to physical or psychological handicap, may suddenly lost balance or resisted, or could be seriously overweight.

Study I

The study base in study I composed of all female nurses' aides (199,089 women) working in Sweden at any time during the period January 1, 1985 to December 31, 1986. The cases were all nurses' aides who reported an over-exertion occupational injury due to accident, involving the back (excluding the neck) and who were absent from work for at least one

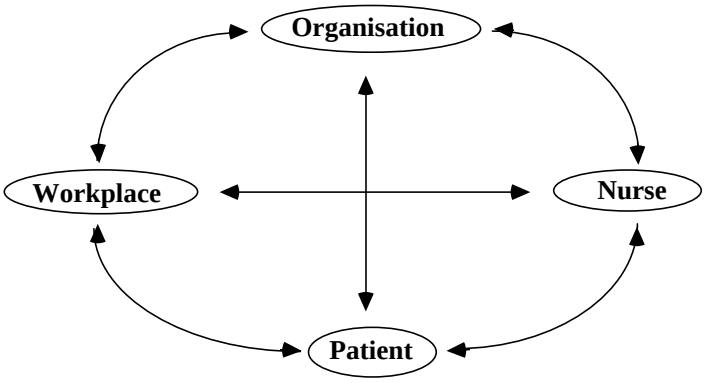

Figure 3. Conceptual framework for factors interacting in an accident process

day. The following variables were examined; age, years in present occupation, length of sick leave caused by the injury (days), place, main event and time of day.

Data processing

The incidence of occupational accidents of the back among nurses' aides was studied in relation to the total number of nurses' aides in the Swedish population. The total number was taken from the 1985 National Population and Housing Census (FoB -85). The incidence was determined for different age classes. The Annual Injury Incidence Rate (AIIR) per 1,000 workers was then calculated for each age group.

The relative risk (RR) of occupational over-exertion injuries among nurses' aides was calculated after separating them from other Swedish women, and was computed as the incidence among nurses' aides divided by the incidence among other employed women. The 95% confidence interval for the relative risk was computed by a logarithmic transformation (Gardner and Altman 1990).

Study II

The aim of study II was to develop new instruments for systematic investigation of the accident process leading to an over-exertion back injuries including a sensitive screening tool for the physical environment to identify potential hazards. For this purpose interdisciplinary co-operation was considered important for ensuring that medical, ergonomic, behavioural scientific and work-organisational views were taken into account. A task force of 24 persons was formed, including researchers from different fields and personnel from the Stockholm County Occupational Health Care, to co-operate in this study and to develop the new instruments.

Development of the three instruments

To get a good base for preventive strategies it was considered important to collect the opinions from the injured person as well as from the supervisor about the circumstances around the accident process, and to analyse the ergonomic environment objectively. Therefore three instruments were developed that could be used for discussion of preventive strategies (Table 1).

Table 1. The three instruments developed for the accident investigation

* structured interview protocol for the injured person
* structured interview for the supervisor
* ergonomic checklist

The ergonomic checklist covered the three spaces where most injuries due to accident occur; the patient's room, the corridor and the toilet (Study I). An additional part of the checklist concerned "other space" e g. rooms for X-rays, treatments, etc. The instruments were to be used to investigate reported accident processes leading to back injury, regardless of their severity.

Development of interview protocols

The task force studied available questionnaires and publications concerning interview protocols and models for investigating accident processes or hazards (7, 9, 15, 38, 39, 41, 57, 84, 86). Experience from previous back injury reports and interviews with injured persons were also discussed. The design of the instruments and the phrasing of the questions were discussed in detail and adjusted during regular meetings by the task force. The protocols were tested in two steps before the final version (Figure 4).

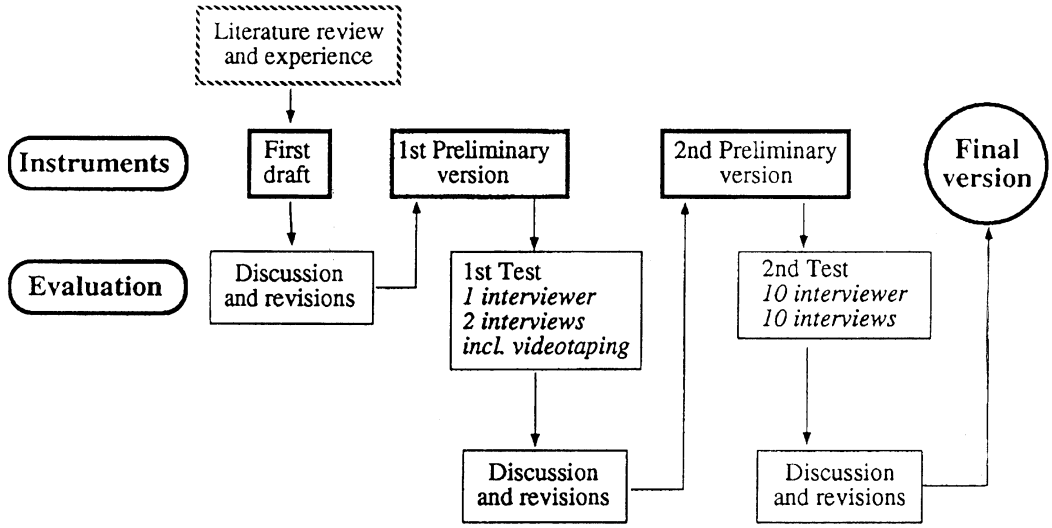

Figure 4. The outline of the process of developing standardised instruments through stepwise evaluation by the task force

Development of the ergonomic checklist

The checklist was developed as a rapid screening tool for hazard surveillance intended for identifying factors in the physical environment that may impede nursing and/or transfer of patients. Lack of space, for example may force the nursing person to work in awkward postures that constitute a risk of injury (40, 41, 83).

The Swedish norms and directive for local planning and equipment for wards and published checklists, were studied (4, 25, 26, 41, 45, 76). General instructions on how to use the checklist and a short key for each of its four parts were developed. The key consisted of guidelines for each item in the checklist.

Test of the ergonomic checklist

The checklist was tested for inter-method reliability and inter-observer reliability by ten ergonomists. The criteria used for the assessment of inter-method reliability of the checklist were based on one investigator's judgement of existing potential hazards referring to the norms and directions on which the list was based. Inter method-reliability and inter-observer reliability were calculated as percentages of full agreement. Ten ergonomists checked one patient's room, one toilet and one corridor with totally 11 hazards known only by the test leader.

STUDY III

Study III was designed as a prospective, open cohort study. The study population composed of registered nurses, state registered nurses and auxiliary nurses (henceforth all referred to nurses), totally 24 500 persons during the time of the study, employed in the Stockholm County hospitals. The study period was 12 months. To be included in the study the nurse should have been in work for at least one week during the three months preceding the reported accident. When the copy of the injury form arrived at the occupational health care unit, an investigator from the occupational health care contacted the injured person and made an appointment for an interview.

The interviews

The standardised protocols from study II were used for systematic structured interviews with the nurses who had reported over-exertion back accidents, and the head nurse of the injured person’s ward. The ergonomic checklist was used to assess possible risks in the physical environment. The interviewers were 12 ergonomists employed in occupational health care and specially trained in interview technique. The interviews were carried out at the workplaces, in privacy.

Data processing

Based on the information from the interviews with the injured nurse, a conditional probability model (11) with the categories patient work, patient transfer, planned transfer, use of transfer devices and type of patient transfer was calculated.

To identify the main types of accident process and the pattern of contributing factors concerning patient work (125 cases), 22 factors regarded as likely to be involved in the accident processes were studied. These factors were based mainly on the free description given by the injured person, but also on answers to some of the specific questions in the

Table 2. The factors assessed to contribute or not to contribute to the accident, and seven factors describing the types of patient transfer included in the cluster analyses.

Organisation

1. there was lack of staff
2. there was a lack of information to the nurse in transfer technique or how to use the transfer devices
3. there was a lack of information concerning the patient's current condition that day
4. there was a requirement for rehabilitation by the patient's physician
5. the nurse felt rushed/stressed
6. the nurse transferred the patient alone
7. the co-worker lacked training in transfer technique or lost hold of the patient

Workplace

8. there was a risk in the environment
9. there was no proper transfer devices or it was out of order.
10. the nurse was compelled to work in an awkward position when performing the task due to some external factor, e.g. lack of space

Nurse

11. the nurse herself chose an awkward position for performing the task
12. there was a misunderstanding or lack of communication between nurse and patient
13. the nurse was compelled to make a sudden movement, e.g. to save the patient from falling

Patient

14. patient weighted 80 kg or more
15. the patient suddenly lost balance or resisted

Type of patient transfer

16. in bed
17 to / from bed
18. to / from toilet
19. walking
20. from floor
21. to / from trolley / X-ray table
22. other transfer

protocol, the interview with the head nurse (staffing, weight of patient involved) and the ergonomic checklist (risks in the environment). Further, if relevant, type of patient transfer was included. By reviewing the free
description, the two interview protocols and the checklist, three ergonomic experts independently assessed whether each of the factors *directly contributed to the accident process.* Also, whether the relevant type of patient transfer were identified (Table 2). The expert's assessments were compared and in a few cases of disagreement, discussion led to consensus.

To identify groups of accident processes that were relatively homogeneous on the dichotomous factors, a cluster analysis was performed. The analyses were based on the Dice similarity measure for dichotomous data, which puts stronger weight on the joint presence of a factor than on the joint absence between two cases. Clusters were formed using the average linkage-within-groups method, which minimises the average distance between all pairs in the cluster (17). Different numbers of clusters (5-8) were tested. One-way analysis of variance (ANOVA) was calculated for all factors to get an indicator of

how clearly a variable discriminated between clusters. All the analyses were performed with the SPSS program (59). Two outliers representing unique accident processes were excluded from the analysis.

Assessment of patient transfers

In the assessment of contributing factors included in the cluster analysis, the ergonomic experts' assessments of a patient transfer differ from those of the injured persons. In contrast to the ergonomic experts, in the interviews transfers of a bed, trolley or wheelchair with a patient in it, were not reported as patient transfers; neither had all transfers in bed, such as turning the patient. Therefore, the numbers of patient transfers in the conditional probability tree, which was based on the interviews with the nurses, differs from the number in the cluster analysis where the experts' assessments were used.

Results

Study I

Accidents leading to over-exertion of the back were reported by 8,954 women in Sweden during the two-year period. Of these women, 40% (3,552 cases) were nurses' aides.

The annual injury incidence (AIIR) per 1,000 nurses' aides was 8.92. Related to number of employees in each age group, the youngest age group (18-24 years), had the highest incidence per year, with an AIIR of 12.2. Within this group, the age group 18-19 years had an AIIR of 14.5 and the age group 20-24 years 11.4 (Table 3).

The relative risk of occupational over-exertion back accidents among nurses' aides compared with other Swedish employed women was 6.00, with a 95% confidence interval from 5.75 to 6.26. The age groups 18-24 years and 35-44 years had the highest relative risk (Table 3). The mean duration of sick leave was 59 days for the whole group (median 13 days). The length of sick leave increased with age (Figure 5). Sixty-six nurses' aides made more than one report of occupational over-exertion back accidents during the study period 1985-1986. The nurses' aides who reported an accident had been working on average six years in their present occupation. Fourteen per cent of the accidents occurred among those with less than one year's experience in their present occupation.

Table 3. Total number of reported occupational over-exertion back accidents among nurses' aides in Sweden 1985-1986. Mean time (years) in present occupation, annual injury incidence rate (AIIR) per 1,000 nurses' aides and relative risk (RR) with 95% confidence intervals (CI).

Age	18-24	25-34	35-44	45-54	55-64
Total number of accidents 1985-86	1,047	731	844	593	337
Years in present occupation (mean)	1.8	5.7	7.3	16.8	12.5
AIIR	12.2	6.9	9.3	8.3	7.7
RR (95% CI)	6.9 (6.3-7.5)	5.1 (4.5-5.6)	6.8 (6.2-7.4)	4.6 (4.1-5.1)	5.7 (5.0-6.4)

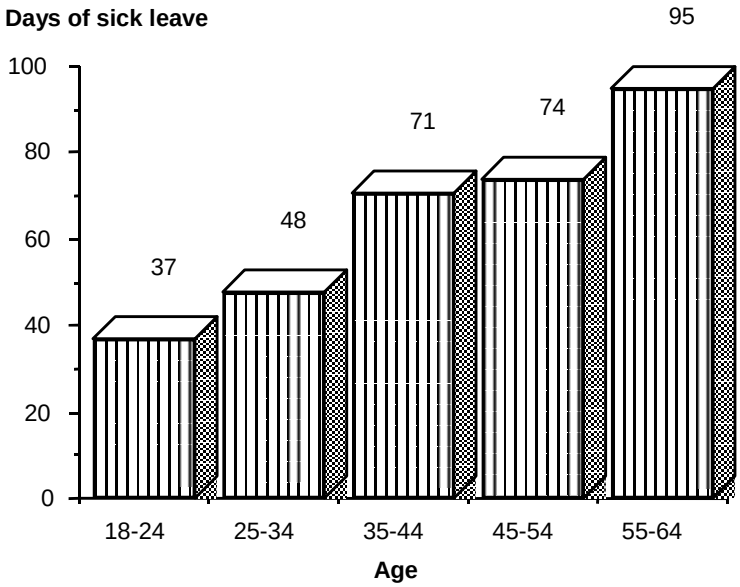

Figure 5. Average days of sick leave following occupational over-exertion back injury due to accident.

Most accidents occurred on wards and in corridors (84%). In 13% of the reported accidents, the accident occurred in the toilet room. The major risk situation was lifting, which was involved in 84% of the accidents. The distribution of the accidents varied during the twenty-four hours with a peak between 8-10 PM (Figure 6).

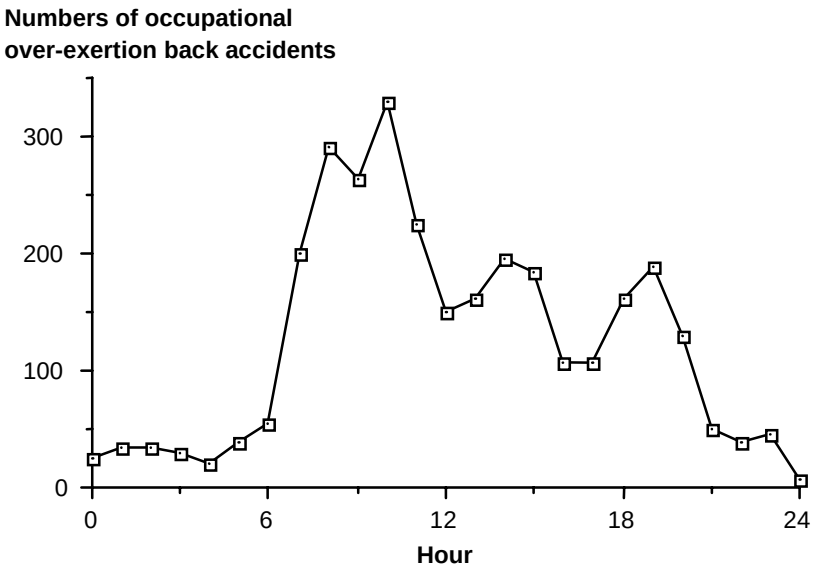

Figure 6. Distribution of the reported over-exertion back accidents during 24 hours.

Study II

Interview with the injured person

Resulting version of the interview protocols contained 83 questions to be answered by the injured nurse and three for the investigator to answer after the interview. The protocols started with a few basic questions, followed by a free description of the accident process (Table 4). Detailed questions followed about the accident and the working conditions just before the accident. Depending on whether the accident occurred while handling/transferring a patient or handling material, the injured person answered questions directed towards the situation. Most questions had closed answer alternatives, but there were also a few open questions.

Interview with the supervisor of the injured person

The interview instrument contained 38 questions to the supervisor, and started with a free description to get the supervisor's own view of the accident process (Table 5). Detailed questions followed about the working conditions just before the accident event and about work organisation on the ward. Most questions had closed answer alternatives, only a few questions were open.

Table 4. Arrangement of the interview protocol for the injured person.
Numbers of questions (q) are given in brackets.

1. Basic questions
2. Time and place of the accident
3. Unstructured interview of the accident
4. Causes leading to the accident
5. Preventive measures
6. The injured person’s history of previous over-exertion back
7. Accident in connection with handling/transferring
8. Transfer devices for handling/transferring
9. Accident in connection with handling/transferring
10. Experience
11. Instruction in safe handling
12. Consequences of the accident
13. Potential contributing factors leading to the accident
14. The investigator’s opinion about the main

Table 5. Arrangement of the interview protocol for the supervisor of the injured person. Numbers of questions (q) is given in brackets.

1. Free description of the accident process
2. Causes leading to the accident (2q)
3. Organisation of work on the ward (4q)
4. Information to ward staff (6q)
5. Physical exercise for the staff (2q)
6. The day of the accident (7q)
7. Accidents which occurred during patient care
8. Prior work-related over-exertion back accidents and suggestions for preventive measures (6q)

Ergonomic checklist

The checklist was designed as a rapid screening tool to discover potential risk factors within the physical environment for back accidents among nursing personnel. It contained general instructions for use, and three parts covering the patient's room, the toilet, and the corridor. Further, there was one part for "other space", to be used when investigating rooms for X rays, treatment etc. Each part consisted of one page. Most of the items in the key were based on the norms and directives in force for local planning and equipment for patient's room, toilet and corridor. When norms and directives were lacking, the item had to be based on a subjective ergonomic assessment. For each item, the key gave a short description of the norm or directive, or an explanation of what is considered by e.g., "unsatisfactory" or "insufficient" in the checklist. The key also gave requirements concerning minimum dimensions depending on patients' different needs for assistance and references to the relevant norm or directive were given in the key.

For all items in the checklist 1) the observer noted whether a risk factor was present, thus minimising the risk of overlooking a hazard. 2) If a hazard was observed, the observer further specified what constituted that hazard. 3) It was also considered whether the observed hazard had contributed to the reported injury and 4) whether the risk factors should be eliminated immediately or in the long run.

Inter-method reliability and inter-observer reliability

Eleven known hazards were present in the patients' room, the toilet and the corridor. Agreement was 90% in 19 of 26 items on the checklist. Inter-observer reliability had exactly the same figures as intra-method reliability for all items in the checklist (Table 6).

Table 6. Intra-method reliability and inter-observer reliability for the assessment of risk for over-exertion back accidents in the patient's room, toilet and corridor, respectively. Existing hazards according to the investigator's judgement are marked with an X in the table. Intra-method reliability and inter-observer reliability are presented as the frequency of agreement between the investigator and each ergonomist and between the ergonomists, respectively.

Patient's room	**Hazard present**	**Intra-method reliab.**	**Inter observ. reliab.**	**Toilet**	**Hazard present**	**Intra-method reliab**	**Inter-observ. reliab.**
Risk because of obstacles or lack of space which can impede care/transfer of patient In bed?	X	10/10	10/10	Risk because of -lack of space round the toilet bowl?	X	10/10	10/10
-to and from bed?	X	10/10	10/10	placement of handrails in the toilet?	X	8/10	8/10
-between bed and wheelchair?	X	10/10	10/10	placement of toilet paper holder	X	9/10	9/10
-between bed and litter?	X	10/10	10/10	-placement of wall handgrips		6/10	6/10
while lifting with a hoist?	X	10/10	10/10	placement of wash basin?		7/10	7/10
Do - the heights of the bed function unsatis.?		10/10	10/10	-door opening too narrow		10/10	10/10
-bed-head adjustment function un-satisfactorily?		10/10	10/10	-insufficient lightning?		10/10	10/10
-bed rails function un-satisfactorily?		9/10	9/10	-unusually slippery floor?		10/10	10/10
wheels of bed function un-satisfactorily?		10/10	10/10	Any other contributing factors?		8/10	8/10
ceilingmount. lift function unsatis.?		10/10	10/10				
hoist function unsatisfact.?	X	8/10	8/10	**Corridor**			
transf. devices difficult to get at?		6/10	6/10	Is the free movement in corridor impeded?	X	9/10	9/10
Is the ligtning insufficient?		9/10	9/10	ligtning insufficient?		10/10	10/10
Other contri-buting factors				Other contri-buting factors		9/10	9/10

Study III

During the study period 130 nurses (119 women and 11 men) reported occupational over-exertion back accidents. The AIIR was 5.3 (unpublished result). Nearly 60% of the accidents were reported by state registered nurses, and about 20 % by registered general nurses and auxiliary nurses (Table 7). The injured person had a mean age of 32-years (range 18-61 years) and the median working time was 5-10 years in the profession. Of the specific task they were performing, 78% had three years' experience when the accidents occurred (Table7). In 44% of the cases the nurse went on sickleave, in mean 38 days (median 14 days). Medical care was sought by half of the nurses (55%). Similar over-exertion back accidents at work had happened earlier to 39% of the nurses.

The site of the accidents was in 59 % of cases the patient's room, 12 % a toilet and 11 % a corridor. Nearly all the accidents occurred while the nurse was working with a patient, most often during patient transfer (Figure 7). Other activities were for example when washing or feeding the patient. The most frequent patient transfer was in bed and to/from the bed. The patients weighed between 33 and 180 kg, average 81 kg. The patient's possibility to co-operate during the transfers was limited. In 47% of the cases the limitation was physical, in 6% psychological, in 37% both. In 9% there were other kinds of limitation, e.g. the patient was unconscious or anaesthetised. Totally, one third of the accidents occurred with wheelchair patients, when transferring them between bed and wheelchair (20%) or between toilet and wheelchair (13%). In half of the accidents (52%) two nurses co-operated, in 13% there were three or more during the transfer and in 35%

Table 7. Occupation, approximate proportion of the study population*, mean age and experience of the specific task the nurse was performing when the accidents occurred (n=130).

Occupation	Proportion of study population %	Proportion of injured %	Age (range) Years	Experience of specific task > 1 week < 1 year %	1-2 years %	≥ 3 years %
Registered general nurse	53	20	36 (21-54)	4	17	79
State registered nurse	30	59	32 (19-59)	8	24	68
Auxiliary nurse	17	21	33 (19-61)	4	4	92

*Proportion of study population based on statistics for number of employed nurses in Stockholm County Council (Personal communication S-M Lindqvist, Federation of Swedish County Councils).

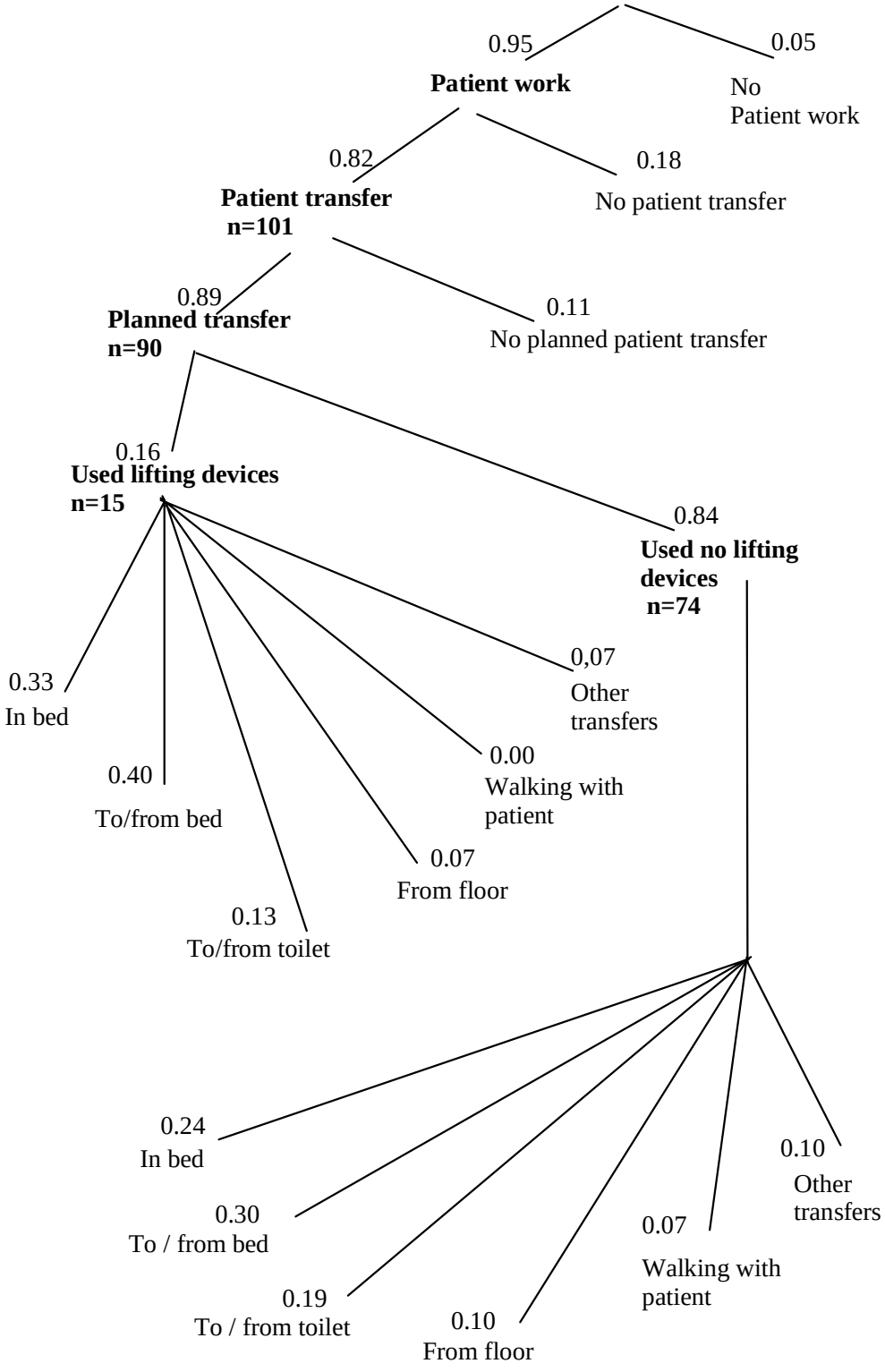

Figure 7: Probability tree for the different tasks performed when the accident occurred (n=130)

the nurse performed the task alone. Of the latter, 52% said that they usually managed alone, and 18% said there was no one else available.

Most of the accidents occurred during a “planned” activity (Figure 7), meaning that the nurse had time to consider how to perform the task and whether devices should be used, for example during an ordinary patient transfer from a bed to a chair. In 11%, the nurse had to make a sudden action, for example when a nurse came into a room and the patient was falling out of bed and the nurse tried to prevent this. As seen in figure 7 transfer devices were used in 16% of the patient transfers. The reasons most often given by the nurse for not using a transfer device were: she did not think it was necessary; there was not enough space, there was no suitable transfer device; the devices were inconveniently stored; there was an emergency, etc. The devices used were most often a walking-belt or a draw-sheet. The specific task, as during the accident, was usually performed one to several times a day by 46% of the nurses and several times per hour by 10%. Sixty-five percent of the nurses said they had enough time to plan how to perform the task.

The six clusters

Cluster 1; Patient lost control during transfer to/from bed or toilet

In most accidents in cluster 1, the largest (43 cases), the patient lost control, or resisted, during a transfer to/from bed or toilet (Table 8). Thus, the nurse had to make a sudden movement to prevent the patient from falling. In half of the cases, the nurse was compelled to work in awkward positions due to risk in the environment, most often a lack of space. Misunderstandings between nurse and patient contributed in about half of the accidents. In one third the nurse lacked information about the patient’s current condition that day. Also lack of staff and lack of information on transfer technique contributed.

Cluster 2; Nurse compelled to work in an awkward position

In cluster 2 (39 cases) most nurses were compelled to work in an awkward position either due to lack of transfer devices or a risk in the environment, most often lack of space. The nurses felt stressed. The patients who were heavy, lost control or resisted in half of the accidents. The most frequent patient transfers were in bed. In one third of the accidents the nurse lacked information on transfer technique.

Cluster 3;Nurse walked alone with patient

The accident process in cluster 3 (13 cases) often occurred when the nurses were walking alone with the patient and the patient lost control, obliging the nurses to make a sudden movement to prevent the patient from falling. In more than one-third of the accidents, there was a requirement for rehabilitation by the patient’s physician. In addition misunderstanding between the nurse and the patient contributed.

Table 8. Factors and events assessed as directly contributing to the accident process. Clusters, number of accidents and proportion of contributing factor. The five most common factors in each cluster (except cluster 5) are in bold. The p-value for F from a one way analysis of variance is an indicator of how well the clusters are differentiated by the factor.

	Cluster 1 n=43	**Cluster 2** n=39	**Cluster 3** n=13	**Cluster 4** n=14	**Cluster 5** n=4	**Cluster 6** n=10	
Factors	prop.	prop.	prop.	prop.	prop.	prop.	**p value**
Organization							
Lack of;							
-staff	.28	.21	.00	.07	.00	.10	.1390
-info. on transfer techniques	.28	.31	.15	.29	.25	.00	.4353
-info. re. patient's condition	.33	.00	.08	.00	.00	.00	.0000
Rehabilitation demands	.12	.00	**.39**	.00	.00	.00	.0002
Stressed	.14	**.54**	.08	**.50**	.00	**.90**	.0000
Transferred alone	.30	.28	**.69**	**1.00**	.00	.20	.0000
Co-worker	.12	.08	.00	.00	**1.00**	.00	.0000
Workplace							
Risk in environment	.47	**.60**	.23	.21	.00	.00	.0010
Lack of transfer devices	.14	**.62**	.23	.14	.00	.30	.0000
Compelled to work in awkward position	**.51**	**.85**	.15	.43	.00	.00	.0000
Nurse							
Chose an awkward position	.16	.03	.08	**.57**	**.50**	**1.00**	.0000
Lack of communication	**.51**	.26	.31	.07	.00	.00	.0013
Compelled to make a sudden movement	**.74**	.36	**.85**	.07	**.50**	.10	.0000
Patient							
Weight >80 kg	.28	**.56**	.15	**.57**	.00	.20	.0046
Patient lost control	**.88**	.49	**.92**	.07	.25	**.30**	.0000
Patient transfer							
In bed	.02	.31	.16	**.43**	**1.00**	.00	.0000
To / from bed	**.54**	.15	.00	.36	.00	.20	.0001
To / from toilet	.30	.08	.00	.07	.00	.00	.0060
From floor	.00	.10	.08	.00	.00	**.30**	.0122
Walking with patient	.00	.00	**.69**	.00	.00	.00	.0000
To / from trolley	.05	.08	.08	.14	.00	**.30**	.1957
Other transfer	.02	.21	.00	.00	.00	.10	.0238

Cluster 4; Unaided transfer of a patient in bed or to/from the bed

In cluster 4 (14 cases) all accidents occurred when the nurse alone transferred a heavy patient in the bed or to/from the bed. In more than half of these cases the nurses had chosen to work in an awkward position whereas the remainder were compelled to work in an awkward position. In half of the cases the nurse felt stressed. In one third the nurse lacked information in transfer technique.

Cluster 5; Co-worker lost grip of patient during transfer in bed
Cluster 5 was small, with only 4 cases. They all occurred when a patient was transferred in bed and when the co-worker lost hold of the patient during the transfer.

Cluster 6; Nurse chose an awkward position due to stress
All nurses in cluster 6 (10 cases) had chosen to work in an awkward position most often in combination with stress. The most frequent patient transfers were from the floor or to/from the trolley or the bed.

One-way ANOVA showed that the six clusters differed significantly except for lack of information in transfer technique, which contributed to the accident process in all clusters except 6, and shortage of staff, which contributed in all clusters except 3 and 5.

Discussion

The instruments

The interview protocols appear suitable for investigating over-exertion back accidents. The checklist showed good intra-method reliability and inter-observer reliability for most items. Items where the ergonomists' opinion differed from that of the investigator were items not included in the key to the checklist and which, thus, required ergonomic judgement. The checklist can also be used as a screening tool to identify hazards for back accidents in a regular preventive ergonomic workplace walk-through thereby preventing accidents (Kornberg, 1992). This basic concept could be transferred to accident investigations and preventive work in other fields.

One difficulty when developing an investigation instrument is to make it specific enough to capture the important information about the accident process in the analyses without being too comprehensive. Investigation of an accident process costs time and money. If even only one similar accident is prevented, however the cost of the investigation is small compared with the costs of an occupational back injury for the injured person, the employer and the community.

It is important to use the employee's experience to prevent accidents. The present instruments focused on systematic recording of this experience. The instruments have also formed a good basis for discussions and for co-operation among employees, supervisor and investigator leading to preventive strategies (58).

The organisation

Most accidents in both Study I and Study III involved a patient transfer, which is consistent with other studies (10, 16, 32, 35, 63, 64, 77)[Owen, 1991 #97. Owen and Garg showed that the most stressful patient handling tasks for nurses were transfers between bed and wheelchair and toilet and wheelchair (66). This is supported by Study III where one-third of the patient transfers were to/from wheelchair. A frequent patient transfer was in the bed, which is in agreement with findings of Gagnon et al., indicating that the load on the torso during pulling and turning of patients in bed was high and could partly explain the incidence of low back problems among nurses (18).

It was surprising that most of the accidents in Study III occurred during ordinary planned patient transfers where the nurse had time to prepare herself and the patient and not in emergency situations.

The nurses felt stressed to a high degree and wanted to perform the task as quickly as possible. It has been shown in another study that nurses try to work quickly to guard themselves, and to have some spare time, if something unexpected suddenly happens with any of the patients (19). It is important that there is enough staffing so the nurses do not have to feel that they always have to choose the fastest way to perform the task, but *really*

have time to plan the patient transfer, and to consider what kind of devices could be used, number of nurses included etc.

A lack of information in transfer techniques was judged to be a contributing factor in all clusters except 6. Transfer devices were seldom used. As the nurses most often said that they had performed the task as usual, this indicates that transfer devices were used seldom in daily work, which has also been found in other studies (20, 69). Two or more nurses assisted the patient in two-thirds of the accidents. This shows that two or more nurses sharing the burden do not necessarily prevent back accidents, which is similar to the findings of S:t Vincent et. al. (71). It came to light during the interviews that there is a need for training, including emergency situations, such if a patient has fallen on the floor.

To prevent back accidents among nurses it is important to give them instruction and training in how to transfer each patient in the most labour saving way and if so, what devices should be used. The nurse most also be trained for increased safety awareness e.g. to prepare themselves and the patient before the transfer. Further, based on Haddon's principle, manual lift should be avoided by always using a hoist or a ceiling lift whenever the patient needs to be *lifted* eliminating one of the necessary conditions for an accident to occur.

The workplace

The two largest clusters (1 and 2) involved mainly transfers to/from bed or toilet and transfers in the bed. Risks in the environment, most often due to lack of space, contributed in clusters 1 and 2 (as also in clusters 3 and 4). This compelled the nurse to work in an awkward position and made it impossible to use a hoist. This shows that the nurses are often *forced* to perform their tasks in a risky way even when the patients are heavy and not co-operative. Where there is too little room for a hoist, a ceiling-mounted lift should be installed. It takes a minimum of space, suits most patients, and some can carry a weights up to 180 kg.

In many cases, particularly in cluster 2 but also in 1, 3, 4 and 6, a contributing factor was lack of transfer devices, indicating that transfer devices need to be available, as well as sufficient space for their use. In a few cases the hoist on the ward was too week to carry a patient with a weight over 120 kg, thus forcing the nurses to perform the transfer manually. The study shows the need for good transfer devices that are easy to use. It is also important to train nurses in how to handle the transfer devices on their own ward, in order to make the use of devices a natural part of the job.

The explanation of why transfer devices are so seldom used in hospitals is complex. Studies have found nursing personnel to be reluctant to use transfer devices because they could not understand how to use them, or lacked experience in their use (8, 61). Nurses might also feel that their duty is to nurse patients, and that this includes manual transfers, while they find it impersonal and less human to transfer patients in a hoist. For this reasons they perhaps assume that patients prefer to be transferred manually. Sometimes the patients also express that opinion. When handling heavy goods in industry, the use of transfer devices is more natural for the workers. Compared to the industry, the nurses can not

always choose the most labour-saving way, but also both want to and have to consider the patient’s comfort and eventual pain, wishes, need for rehabilitation etc.

The Nurse

Occupation

State registered nurses had, both relatively and absolutely, more accidents than registered general nurses or auxiliary nurses. One reason may be that the general registered nurses do a smaller share of the practical nursing, and consequently fewer patient transfers. The Swedish health care organisation is changing, so in the future registered general nurses will do more of the practical nursing and thereby be at greater risk for back accidents.

Age and experience

Study I showed that nurses in all age groups had a high relative risk of over-exertion back accident compared to other Swedish women. The age groups 18-24 and 35-44 years had the highest relative risk. It might be that the younger nurses perform more patient transfers. The somewhat lower relative risk in the age group 25-34 years may be that many women because of this age can be expected to be absent from work, taking care of children at home. Hence, they where not exposed, but were nevertheless included in the 1985 census. Or it might be due to the healthy worker effect, as young women finding the work too hard and leaving for other occupations.

Ljungberg and Kilbom found that nurses' aides perform on average two lifts of 20 kg or more each per hour (Ljungberg and Kilbom, 1984). Micro-fractures may occur with repeated lifts of 20 kg (29). Bone mineral content is lower among people aged 18-19 years and among those over 50 years than among the middle-aged. This means that young and old people's lumbar motion segments can sustain less load than middle-aged people's. (28, 30). Several other back structures such as muscles, ligaments, apophyseal joint capsules, etc, can be injured. Heavy lifts combined with rotated and flexed postures constitute major risks of injury if the disk has degenerated, and rotation injuries themselves are causes of degeneration (83). However, it is seldom known from which type of structure the back pain really emanates (27).

Both studies showed that the nurses who reported an accident generally had long experience in their profession and also of the specific task they were performing when the accident occurred (Study III). This result contradicts industrial findings, where persons with short experience usually have more accidents (47, 73). It has also been found in other studies among nursing personnel that nurses with longer service had more injuries (46, 65, 80). In the present studies, only a small number of nurses had short experience.

This might indicate that the accidents reported in this study might be cumulative injury by nature, especially as quite a few of the nurses also had reported a similar accident earlier. But whether the injuries are a result of cumulative stress or of one specific peak load, the most important task is to identify the risk situations and the contributing factors where the over-exertion of tissues occurs, so the accidents leading to the injuries can be prevented.

One consequence of the changes made in health care due to the economic recession in recent years is that fewer personnel now share the same amount of work than earlier. Another consequence is that the mean age of nurses is higher today, and probably will continue to increase in the future.

Sickleave

Comparing the lengths of sickleave in Study I and III there were differences in the average value, while the median values were rather similar, indicating that there were fewer nurses with long sickleave in Study III. An indication of the severity of the injuries is that nurses in Study III sought medical care or took analgesics for the pain even if they had no sickleave. Nurses often do not take sickleave for back problems they perceive are related to work (20). Sickleaves is affected not only by the degree of injury, but also by other factors such as personal circumstances, work organisation, psychosocial work environment and the labour market. Social support from the workplace, economic factors and reduction of personnel were factors that were associated with early return to work in staff that had been on sick leave in Study III. Half of them were painfree when they returned to work (24). Since 1991, sickness benefit has been successively reduced in Sweden, leading to fewer and shorter sickleaves. In the USA, days lost increased from 1975 to 1976 in association with increases in workers' compensation (70)

The clusters

The cluster analyses were based on the assumption that the factors were judged to have directly contributed to the accident, not simply to have been present. Provided that these judgement are valid, the clusters form a good basis for a choice of effective preventive measures. Hence the most effective measure would be to improve the physical conditions, e.g., shortcomings in the environment or lack of transfer devices, that compel the nurse to work in a way unsafe both for carer and for patient. For a large group, however, organisational factors contributed to the accident process, which shows the need for better staff planning, information to and training of nurses, better planning of rehabilitation, etc. Also the nurse sometimes felt she had to perform the task in an awkward position due to stress.

The differences in the clusters showed the complexity of these kinds of accident. All accidents are determined by a multitude of factors, and it is not possible to map the whole causal network. The total complex of factors sufficient to cause the accident will remain unknown, but we may still be able to interrupt the accident process if we can only eliminate one necessary factor from that complex (87). For this reason the measures for prevention, or for blocking an accident process once started, have to be of different kinds and at several different levels in the organisation (22). Examples concern the environment, transfer devices, knowledge, instructions, safety promoting norms and safety policies.

Methodological considerations

Possible classification bias

It may often be difficult to distinguish between an occupational accident and an occupational disease, so that reported injuries may possibly be miscoded in the ISA statistics (56), which could have influenced the results. The classification is supposed to concern just the course of events. One weakness is, however, that the classification is based upon the description given in the injury reports (3).

Possible reporting bias

Compared to statistics from Stockholm County Council 1989, the numbers of reported over-exertion back accidents were lower than expected during the period of Study III. The period saw an economic recession in Sweden, the number of health care personnel decreased for the first time ever and there was little employment for which reason some nurses might have hesitated to make a claim. The willingness to report an accident could also differ between the occupational groups. Between 1992-1993 the number of registered general nurses working in County Council hospitals decreased by 17%, state registered nurses by 6% and auxiliary nurses by 42% (82). Most of the dismissed nurses changed employer from the county council to the local authorities. State registered nurses and auxiliary nurses both have much patient interaction in their work, so the differences in number of claims between the two groups might reflect the risk of dismissal. During the economic recession young people had greater difficulties to enter the labour market than when Study I was performed, at which time statistics for one Swedish county showed that 77 per cent of all those newly employed were 18-24 years of age (50).

In 1992 a sick pay period was introduced in Sweden. After a one-day waiting period the employer is responsible for compensation during the following 13 days of illness. Then the responsibility for paying cash benefits is transferred to the national health insurance scheme. Where the social insurance office gives compensation, they receive information as to whether the illness is believed to be related to work. If so, the office can request a work injury report from the employer. Since 1992, this only applies to cases lasting more than two weeks, which has led to fewer reports of short-term cases, thus mainly affecting accidents. (34).

A possible source of error could be that the amount of information given in the free description could differ depending on the nurse's ability and willingness to give very detailed information and on the skill of the interviewer, for example if the nurse blamed herself. However, the predominant attitude was very open and several respondents said they were happy that their claims were taken seriously.

Of the six persons who declined to participate in Study III, some gave as a reason that they did not want to have that much attention. The rather small number of dropouts will probably not influence the results.

The reason that only nurses who had been in work for at least one week during the three months preceding the accident were included in the study was to guarantee that the person had some knowledge of the current work and the environment. Thus, none of the accidents occurred during the first six days at work. Statistics from 1985-1986 showed that 2% of the

accidents among Swedish nurses leading to more than one day of sick leave occurred among persons with less than one week's experience of the job. Thus there is an uncertain underreporting, resulting in an underestimation known from earlier studies (80,63,12,62). In Study III, probably very few were lost of those who reported the accident on an injury form, as the study was performed in direct co-operation with the occupational health care organisation which gets copies of all injury reports.

It is possible that potential hazards have been overlooked in the instruments developed, since not all the risk factors for over-exertion accidents are known. It is likely that risk factors for back accidents among nursing personnel change with time, due to changes in type of patient care and work organisation.

Further research needed

There is a need for more studies on work-related and individual factors to find risk factors and also protective factors and such a study has been initiated. There is also a need for longitudinal cohort studies to follow the changes in the work organisation and in the society and their influence on the individuals, and to follow the reported incidence of reported over-exertion back accidents leading to injury.

Contributions to research

This thesis makes the following contribution to research:

1. The place, time of day and situations in which most over-exertion back accidents occur among nursing personnel have been identified.
2. A new method for investigation of the accident process has been developed.
3. The most common types of accident and their patterns of contributing factors to the accident process have been identified.

Conclusions

Nurses have a high relative risk for over-exertion accidents leading to back injuries compared to other Swedish women. The accidents led to long sick leave and the number of days increased with age.

The developed instruments appeared suitable for investigation of over-exertion back accidents.

Several factors contributing to the accident process were found by the developed instruments. Most reported over-exertion back accidents occurred during patient transfers in the bed or to/from the bed. During the transfers, which most often were performed without using transfer devices, the nurse had to make a sudden intervention, e.g. to prevent the patient from falling. This as the patient suddenly lost her balance or resisted during the transfer.

However, it was found when the accident process was analysed, that there were physical conditions, as lack in the working environment or lack of transfer devices that entailed performance in an unsafe way.

Six homogeneous groups and their pattern of contributing factors for the accident process were identified. The differences in the clusters showed the complexity in these kind of accidents and that the preventive measures for avoiding or for blocking an accident process once started, have to be of different kinds and at several different levels in the organisation. Examples concern the working environment (more space), more and easy to use transfer devices, training in patient transfer, more clear instructions in how to transfer each patient and improved safety policies.

Summary

Engkvist I-L. Event and factors involved in accidents leading to over-exertion back injuries. *Arbete och Hälsa* 1997;30 :pp 1-34.

The overall aim of the present thesis was to identify factors and events involved in over-exertion accidents leading to back injuries among nursing personnel. The hypothesis was that patterns of different combinations of factors and events involved determine the type of accident process leading to an over-exertion injury.

The aim of the first study (Study I) was to investigate the occurrence of reported over-exertion accidents leading to back injuries among female nurses' aides in the working population of Sweden during a two year period. The study was based on the Swedish Occupational Injury Register (ISA). The criterion for inclusion was that the injured person had reported an injury due to over-exertion of the back connected to a certain time and place. The subject's age, number of years in present occupation, experience of present work, area where the accident occurred, main event, time, and days of sick leave were studied. The nurses' aides had a relative risk of 6.0 for occupational back accidents compared to other employed Swedish women. The major risk factor was lifting, which led to 84% of the accidents. The mean duration of sick leave was 59 days for the whole group. The length of the sick leave increased with age.

To find preventive strategies, a new method for accident process investigation, was developed in co-operation between practitioners and researchers (Study II). Standardised instruments for the systematic investigation were developed, consisting of two structured interview protocols, one for the injured person and one for the supervisor. Also an ergonomic checklist was designed for the three areas where the preceding study showed most of the accidents occurred; patient's room, corridor, toilet and further one for "other space", e g. X-ray department, treatment room. The instruments were developed through frequent discussions and adjustments in a task force of 24 researchers and occupational health personnel. Inter-observer reliability was 90% or more in 19 of 26 items in the checklist. Inter-method reliability also showed the same agreement for all items in the checklist (90% or more).

The purpose of the third study (Study III) was to investigate factors involved in the accident process leading to back injury by using the interview protocols and the ergonomic checklist. The prospective, open cohort study included state registered nurses, auxiliary nurses and general registered nurses and covered all reported occupational over-exertion back accidents among nurses in the Stockholm County hospitals during one year and was. Detailed information on the accident process was obtained in interviews. The same inclusion criteria as for Study I were used in Study III, except that the case was included whether the injury led to a sick leave or not. During the study period 130 accident processes were investigated. Sixty per cent of the injuries were reported by state registered nurses, 20% by registered nurses and 20% by auxiliary

nurses. In 73 %, the injured persons had more than three years' experience of the specific working tasks they were doing when the accidents occurred. In 59 % the accident occurred in the patient's room, 12 % in the toilet and 11 % in the corridor.

Cluster analysis identified six clusters and their pattern of contributing factors for the accident process. Most over-exertion back accidents occurred during patient transfer in the bed or to/from the bed. During the transfers, which most often were performed without using transfer devices, the nurse had to make a sudden intervention, e.g. to prevent the patient from falling after suddenly losing balance or resistance during transfer.

However, there were physical conditions, such as shortcomings rendered in the working environment or lack of transfer devices that entailed performance in an unsafe way.

The differences in the clusters showed the complexity of these kinds of accident and that the measures for prevention, or for blocking an accident process once started, have to be of different kinds and at several different levels in the organisation. One example is improved working environment with more space, especially around beds and in toilet. Another example is more and easy-to-use transfer devices, more training in transfer techniques and clear instructions to the nurses. Further to avoid under staffing and time pressure on the ward. Increased safety awareness, both from the employers and among the employees is vital.

Keywords: accident investigation, cluster analysis, ergonomic checklist, interview, nurse.

Sammanfattning (summary in Swedish)

Engkvist I-L. Event and factors involved in accidents leading to over-exertion back injuries. *Arbete och Hälsa* 1997;30 :pp 1-34.

Det övergripande syftet med föreliggande avhandling var att identifiera faktorer medverkande till uppkomst av olyckor, vilka leder till ryggskador genom överbelastnings bland sjukvårdspersonal. Förliggande hypotes var att ett mönster av olika kombinationer av faktorer och händelser bidrar till en olycksfallsprocess vilken leder till en skada i rygg på grund av överbelastning.

Syftet med den första studien (Studie I) var att beräkna den kummulativa incidencen av rapporterade olyckor som lett till ryggskador genom överbelastnings bland samtliga sjukvårdsbiträden och undersköterskor i Sverige under två år. Studien baserades på rapporterade arbetsskador i ISA registret (Informations Systemet för Arbetsskador). Kriteriet för att ingå i studien var att personen rapporterat en skada i rygg pga överbelastning som kunde hänföras till en bestämd tid och plats, samt lett till en sjukskrivning på en minst dag. Den drabbades ålder, antal år i yrket och erfarenhet och vana vid det aktuella arbetet studerades. Studien visade att sjukvårdsbiträden och undersköterskor hade en relativ risk på 6,0 för överbelastnigsolycka som lett till ryggskada, jämfört med övriga förvärvsarbetande kvinnor i Sverige. De flesta olyckorna (84%) inträffade vid lyft. Medelsjukskrivnigslängden var 59 dagar. Antalet sjukskrivningsdagar ökade med ökad ålder.

En ny metod för olycksfallsutredning, med syfte att finna preventiva åtgärder, utarbetades i samarbete mellan forskare och praktiker (Studie II). Standardiserade instrument för en systematisk olycksfallsutredning arbetades fram bestående av två intervjuformulär, ett för den olycksdrabbade och ett för arbetsledaren. Vidare arbetades en ergonomisk checklista fram för de tre utrymmen där, baserat på den första studien, de flesta olyckor inträffar; patientens rum, korridoren och toalettutrymmen samt en för ”övrigt utrymme” t.ex. för röntgen, behandlingsrum etc. Instrumenten arbetades fram genom kontinuerliga diskussioner mellan forskare och Landstingshälsans personal. Intervjuformulären testades i två steg innan den slutgiltiga versionen togs fram. Checklistan testades avseende intra metod reliabilitet och interbedömmar reliabilitet, vilket var i 19 av de 26 bedömningspunkterna 90% eller högre.

Syftet med den tredje studien var att identifiera faktorer som bidragit vid olycksfallsprocessen med hjälp av de två intervjuformulären och den ergonomiska checklistan. Studiebasen bestod av sjukvårdsbiträden, undersköterskor och sjuksköterskor anställda inom Stockholms läns landsting och var designad som en prospektiv, öppen kohort studie. Studieperioden var 12 månader. Samma intagningskriterier förelåg som i studie I, med undantag för att i studie III inkluderades fallet oberoende av om olyckan lett till sjukskrivning eller ej. Detaljerad information om olycksfallsprocessen insamlades via intrvjuerna. Under studieperioden rapporterades och utreddes 130 fall. Sextio procent av olyckorna rapporterades av undersköterskor, 20% av sjuksköterskor och 20% av sjukvårdsbiträden. I 73% av fallen hade den skadade mer än tre års erfarenhet av den specifika uppgift som utfördes vid olyckstillfället. I 59% av fallen inträffade olyckan i patientsalen, 12% i toalettutrymme och i 11% i korridoren.

Sex typolyckor och deras respektive mönster av bidragande faktorer identifierades genom klusteranalys. De flesta olyckorna inträffade vid patientförflyttning i säng eller till/från säng eller toalett. Under förflyttningarna, som oftast genomfördes utan

förflyttningshjälpmedel, tvingades vårdaren ofta göra ett plötsligt ingripande, t.ex. för att hindra patienten från att falla. Detta då patienten plötsligt tappade balansen, eller stretade emot under förflyttningen. Vid analysen av olycksfallsprocessen visade det sig dock att det förelåg brister i den fysiska arbetsmiljön eller organisatoriska brister, vilka ofta tvingade vårdaren att arbeta på ett riskfyllt sätt.

Klusteranalysen visade att det är en mångfald faktorer som samverkar för att en olycka skall uppstå. Därför måste preventiva åtgärder för att förhindra att en olycka uppstår sättas in på olika nivåer i organisationen. Ett exempel är förbättrad fysisk arbetsmiljö med ökat utrymme speciellt runt sängar och i toalettutrymmen. Ett annat är fler och lättanvända förflyttningshjälpmedel, ökad utbildning i förflyttningsteknik och tydliga instruktioner till personalen. Vidare, att undvika underbemanning och tidspress på avdelningen. Samt att ha ett i övrigt ökat säkerhetstänkande både från arbetsgivare och anställd.

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Submitted for publication 1997-12-09

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Figures are placed in the text and numbered in order of appearance. The figure text is below the figure. The tables are placed in the text and numbered in order of appearance. The table text is placed above the table. Tables are normally placed at the top or bottom of a page, or immediately above a subhead.

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16 L Punnett and U Bergqvist. National Institute for Working Life – Ergonomic Expert Committee Document No 1. Visual Display Unit Work and Upper Extremity Musculoskeletal Disorders. A Review of Epidemiological Findings.

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