“Movement never lies. It is a barometer telling the state of the soul to all who can read it.”

*Martha Graham*

To Gösta
ABSTRACT

The ability to move is an important part of everyday life. Assisted transfers, at hospitals or at home, can lead to high physical load on the nurse’s musculoskeletal system, which in turn could cause musculoskeletal problems. The overall aim of this thesis, comprising five studies, was to develop methods for assessing the nurse’s work technique in patient transfers tasks, with the focus on the load on the musculoskeletal system, and to evaluate work technique after participation in training programmes. Further aims were to evaluate the patient’s safety and comfort in transfer situations, and to describe older people's experiences of transfer situations.

In Studies I-II, two observation instruments for assessment of nurses’ work technique were developed (Pate and DINO). The tests of validity and reliability for both instruments were acceptable to satisfactory, and the evaluations of work technique showed that they functioned as intended. In Study III, the video observation instrument (Pate) was used. The training programme consisted of two models of learning, traditional groups and quality circles, and was evaluated by using the video observation instrument. The patient rated perceived safety and comfort, while the participants rated their own work technique, comfort and perceived exertion during the transfer, using rating scales. The result showed that immediately after training the participants in both models of learning had improved their work technique, and that both the patient and the nurse perceived the transfer to be more comfortable. There was no difference in the effect of the two models of learning. No reduction of musculoskeletal problems was reported by the participants six months after training. In Study IV, the work technique of nursing students after proficiency training in patient transfer methods was evaluated by using the direct observation instrument (DINO). The results showed that the students improved their work technique after training. Both the patient and the students perceived the transfer to be more comfortable. There was also a positive correlation between the student’s work technique and the patient’s perceptions of safety and comfort during transfer. Study V focused on the older people’s experiences of being assisted in transfers, using a qualitative method with semi-structured interviews. The results showed that older people experienced fear of falling and fear of pain, and thus of endangering the healing process in assisted transfers. The participants considered that this fear depended both on their own inability and on the nurse’s lack of knowledge in performing safe patient transfers. This thesis indicates that the instruments showed acceptable to satisfactory reliability and validity; and that the work technique of the participants improved directly after training. Furthermore, patient ratings of perceived safety and comfort increased. Using training programmes in recommended patient transfer methods can be seen as primary prevention, since these programmes make it possible for the nurse to learn work technique that could lead to a decreased load on the musculoskeletal system. For the patient, the nurse’s acquired skills could lead to a safer and more comfortable transfer, and to improved quality of care.

Keywords: experience, musculoskeletal problems, nurses, nursing students, observation methods, older people, patient transfer, training programme, work technique.

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LIST OF ABBREVIATIONS

ANOVA  ANalysis Of VAriance
BMI  Body Mass Index
CI  Confidence Interval
DINO  DIrect Nurse Observation Instrument for assessment of nurses’ work technique during patient transfer tasks
ICC  Intraclass Correlation Coefficient
$k$  Kappa coefficient
MSP  Musculoskeletal problems
NIOSH  National Institute for Occupational Safety and Health
Pate  Video observation instrument
RPE  Rated Perceived Exertion
SD  Standard Deviation
WMSDs  Work-related musculoskeletal disorders

LIST OF DEFINITIONS

Hazard  A factor or exposure that presumably adversely affect the musculoskeletal health
Modifier  A factor that modifies the effect of a presumed risk factor and/or hazard.
Patient transfer  As patient transfer tasks
Patient transfer task  A transfer task has been defined as a work task where nurses assist or lift a patient from one location to another or from one position to another.
Patient transfer technique/transfer technique  As work technique
Risk factor  Work, individual and lifestyle factors which on the basis of epidemiological evidence are known to be associated with work-related musculoskeletal disorders
Subjective ratings  Self-ratings of for example perceived safety, comfort or exertion on rating scales.
Work technique  The concept work technique comprises two basic elements. The first element, the method, refers to generally established and recommended transfer methods learnt by nurses in training programmes. The second element, the individual performance, focuses on the nurse’s individual variations when performing a specific transfer task or using a specific transfer method.
1 BACKGROUND

Working within the health care and home care sectors is often physically demanding. Patient transfer tasks, for example when a nurse assists a patient to move from the bed to a wheelchair, are regarded as work tasks with particularly high physical load and as such constitute a problem that needs to be focused on. Elderly patients with movement disabilities often need assistance on a daily basis, and such transfer tasks are therefore frequently performed. For the patients the transfer situations involve many aspects, but being in need of assistance always creates problems. The use of a recommended work technique in a transfer task aims not only at decreasing the physical workload for health care professionals but also at increasing the patients’ safety and comfort; the patients may be afraid of getting hurt when an unsuitable method is used. In this thesis the main focus is on the nurses’ work technique in the transfer task. The aim of this thesis was to develop instruments that could be used in daily work and in research, for assessment of nurses’ work technique in patient transfer tasks. Another aim was to use these instruments for evaluating nurses’ work technique after participating in training programmes in patient transfer methods, and further to describe the patient’s experience of being assisted in transfer situations.

1.1 DEFINITIONS IN THIS THESIS

The term nurse is used for the person/caregiver who performs the transfer task and assists the patient to move, whether the person is a registered nurse, an enrolled nurse, a nursing assistant, a nurse’s aide, an orderly or other health care professional, for example a physiotherapist or occupational therapist.

The term patient is used for all persons receiving care who are assisted in transfers, whether they are patients, elderly persons living in the community or healthy persons playing the role of patients.

There is no consensus regarding the terminology used for the patient transfer task; the words handling, handling and moving, transferring and lifting are mostly used interchangeably. In this thesis the expression “patient transfer task” is used.

There is no consensus in the terminology on what patient transfer method or technique is. Here method is used as a wider concept (e.g. a whole training programme) than transfer technique, which is the way a single work task is performed, for example moving the patient higher up in bed. Patient transfer technique and work technique will be used interchangeably in this thesis.

Training programme refers here to training based on a recommended transfer method, according to a time frame with a certain form, for example 4 hours of proficiency training or 8 hours of training for newly employed personnel according to a curriculum.
1.2 THE PATIENT TRANSFER TASK
1.2.1 Definitions and performance
The patient transfer task is an encounter and interaction between the nurse and the patient. (Figure 1). A transfer task has been defined as a work task where nurses assist or lift a patient from one location to another (e.g. transfer from bed to wheelchair) or from one position to another (e.g. turning from supine to lying on one side in bed) (Kjellberg et al., 2000). Patients who are unable to manage a transfer on their own need assistance from nurses or relatives. Transfers are performed on a daily basis to accomplish activities in daily life in both health care and home care environments, for example when assisting patients in grooming, going to the toilet, dressing a leg ulcer or having an examination. In these and other daily situations the patient might have to get up and out of bed, lay down on the bed, change locations, or change positions and sit more comfortably in a chair. Transfers are performed frequently; in one study it was shown that nurses performed 98 patient transfer tasks per eight-hour shift and that in 24 of these tasks they manually lifted or carried the patients (Garg et al., 1992).

A transfer must be safe and comfortable, and cause neither pain nor discomfort to the patients or to the nurses. The nurses should choose a recommended work technique that not only is in line with the patient’s preferences and needs, but also prevents the nurses from putting excessive load on the musculoskeletal system that might lead to musculoskeletal disorders. Several methods for performing a patient transfer task have been described (Lagerstrom et al., 1999). According to one recommended method the nurses have to consider their own capabilities, the patient’s abilities, needs and preferences, as well as the possibilities and limitations of the environment, and then choose an optimal transfer technique accordingly (Lagerstrom et al., 1999).

Figure 1. The patient transfer task.
1.2.2 The nurse’s work technique and musculoskeletal health

1.2.2.1 Prevalence of WMSDs

The term work-related musculoskeletal disorders (WMSDs) has been defined as “a descriptor for disorders and diseases of the musculoskeletal system having a proven or hypothetical work-related causal component” (Kuorinka and Forcier, 1995, p 5).

WMSDs, for example low back and neck/shoulder pain/discomfort, are common among health care professionals and home care workers (Alexopoulos et al., 2003, Ando et al., 2000, Byrns et al., 2004, Karahan and Bayraktar, 2004, Maul et al., 2003, Rugelj, 2003, Smedley et al., 2003a, Smith et al., 2003, Smith et al., 2004, Violante et al., 2004, Yip, 2001, Yip, 2004) and constitute a problem in many countries, irrespective of national and cultural differences. In a Norwegian study the prevalence of musculoskeletal pain in some body region during the previous two weeks was 89 %, and the prevalence of shoulder and low back pain was 47 % and 55 %, respectively (Eriksen, 2003). In a German study the point prevalence among more than 3000 nurses was 61 % (Hofman et al., 2002). Also nursing students report musculoskeletal problems at some stage during their education (Klaber Moffett et al., 1993, Smith et al., 2003).

There is contradictory evidence concerning gender differences, and as regards manual handling injuries in a disability service setting, it was shown that female disability workers had higher injury rates than men (Ore, 2003). In another study among nurse’s aides it was shown that neck and shoulder pain was more prevalent in women (Eriksen, 2003). However, in yet another study it was shown that gender did not affect back injury (Yassi et al., 1995).

When nursing personnel were compared to another professional group, the risk of low back pain for nurses was higher than for a reference group of clerks (Hofman et al., 2002).

In two Swedish register studies from the 90s, the risk of over-exertion injuries for nurse’s aides and home care service workers was higher than for all other employed women (Engkvist et al., 1992, Ono et al., 1995). However, in a more recent Swedish study it was found that female nursing personnel had sought consultation for low back pain just as often as other employed women (Josephson and Vingard, 1998).

Statistics in Sweden from year 2003 showed that the risk of reported musculoskeletal diseases was 4.7 per 1000 employees for nurse’s aides and enrolled nurses (in Swedish: “sjukvårdsbiträden” and “undersköterskor”) and 1.4 per 1000 employees for registered nurses. This can be compared with all other professions, where the risk is 3.5 per 1000 employees in Sweden (Swedish Work Environment Authority, 2003). For women and men in these groups the risks for nurse’s aides and enrolled nurses were 4.9 and 2.4, respectively, and for registered nurses 1.5 and 0.2 respectively. Concerning reported occupational over-exertion accidents the risk was 6.6 for nurse’s aides and enrolled nurses, and 1.5 for registered nurses, as compared with all other employees, where the figure was 1.7 per 1000 employees in Sweden. In this area the risk was almost the same for women and men. This data was based on a mean of all employed persons during 2003. There were more than 175 000 nurse’s aides and enrolled nurses and more than 60 000 registered nurses, and in both groups seven per cent were men (Swedish Work Environment Authority, 2003).
1.2.2.2 The patient transfer task as one risk factor of WMSDs

Assisting patients in transfers is a work task in health and home care settings that has been considered hazardous and presumed to be a risk factor for the development of WMSDs.

Biomechanical studies (Daynard et al., 2001, Marras et al., 1999, Winkelmolen et al., 1994), often measuring the spinal load, have shown that during the patient transfer task the estimated load often exceeds the acceptable limit of 3400 N proposed by the National Institute for Occupational Safety and Health (NIOSH, 1981). In these studies, however, some transfer techniques that are no longer recommended have been evaluated (for example the Australian lift and the hook and toss method) (Corlett et al., 1992). Shibye et al. (2003) showed that when the nurses used their own self-chosen technique in two transfer tasks, “from sitting to standing” and “repositioning in the wheelchair”, the load on the back was high. When the nurses used the recommended technique, however, the load was significantly lower and did not exceed the acceptable NIOSH limit.

In other types of studies, the patient transfer task has been reported as a physically exerting task by nurses (French et al., 1997, Hui et al., 2001, Nuikka et al., 2001, Rugelj, 2003). In several studies the patient transfer task has been associated with WMSDs (Engkvist et al., 1998, Engkvist et al., 2000, Engkvist et al., 2001, Lagerstrom et al., 1998a, Retsas and Pinikahana, 2000, Smedley et al., 2003a, Smedley et al., 2003b, Yip, 2001). This has also been shown in more recent studies where Ore showed that disability services workers, assisting clients in and out of bed, had the highest injury rates of all work tasks (Ore, 2003). In a Swedish case-control study among totally 1388 home care workers, the most important risk factor for permanent work disability due to musculoskeletal problems was poor ergonomic/lifting conditions (Dellve et al., 2003). Among American registered nurses there was an increased risk of work-related low back pain when lifting or pushing patients in awkward postures (Trinkoff et al., 2003) and during frequent lifting (Byrns et al., 2004). In a study by Smedley et al. (2003a) it was shown that the physical exposures associated with the highest risks of neck and shoulder pain were in connection with patient handling. It has also been shown that when an injury occurred while lifting patients, this resulted in considerable time loss for the nurses (Tate et al., 1999).

1.2.2.3 Other risk factors for WMSDs

The development of WMSDs is complex and multifactorial, and the risk factors that potentially contribute can be divided into work-related (i.e. physical and psychosocial work conditions) and individual/lifestyle factors. How these risk factors interact is not fully understood. Several models of development and causation, where these factors and organisational factors might interact, have been proposed (Armstrong et al., 1993, Westgaard and Winkel, 1997) (described below), (Buckle and Devereux, 2002, Israel et al., 1996, Kumar, 2001, Kuorinka and Forcier, 1995, Marras, 2000).

Cumulative load, i.e. the accumulated load on the musculoskeletal system, is a particular problem for nurses who repeat patient transfer tasks and other work tasks many times during a work shift, a working week, a year and throughout their lifetime. Other care situations than patient transfer tasks, for example transportation of patients to the operating theatre, have also been reported as strenuous (Nuikka et al., 2001). Other indirect patient care activities, including manual handling tasks, have also been
The patient transfer task - methods for assessing work technique

associated with injuries (Retsas and Pinikahana, 2000). In a study by Kumar (1990) it was found that nurses aides with back pain had higher cumulative spinal compressive and shear loads compared with those without pain. Further, it was concluded that cumulative load exposure predisposes the spine to pain and/or injury and is therefore a risk factor.

Physical factors such as heavy lifting, repetitive strain, awkward postures, and stooping have been related to low back problems among nursing personnel (Engels et al., 1996, Engels et al., 1998a, French et al., 1997, Josephson and Vingard, 1998, Yip, 2004). Other work factors associated with increased prevalence of musculoskeletal pain are: increased working hours per week and working in nursing homes (Eriksen, 2003).

Physical exertion, perceived stress, and psychosocial factors, for example time pressure, emotional demands, social support and control, were studied in relation to low back pain among nursing personnel in Denmark (Gonge et al., 2002). The result showed that perceived stress was the only risk factor related to low back pain. In one study the results indicated that an interaction between physical exposure and “no possibility of influencing the work” was associated with musculoskeletal symptoms among home care personnel (Brulin et al., 1998). In an interview study with eight home care personnel it was shown that stress, related to demanding physical and psychosocial working conditions, emerged as the core variable that probably contributed to development and maintenance of musculoskeletal symptoms (Brulin et al., 2000).

Taking into account the potential effect of individual factors and physical load there was no relationship between psychosocial factors and low back pain among those working in the caring professions and other subjects in a recent study (Hoogendoorn et al., 2001). However, Ahlberg-Hulthén (1995) could show that psychosocial factors, such as psychological demands, authority over decisions, skill utilisation, and support at work, were related to symptoms from the lower back among Swedish health care personnel at two wards. It was rated that the physical strain for the personnel at one ward was heavy, while at the other ward this strain was light. Among home care personnel it was shown that limited opportunities for influencing the planning of work increased the risk of having musculoskeletal complaints (Brulin et al., 2001).

Several studies have shown a combination of contributing risk factors for WMSDs. In a study by Josephson (1997) it was shown that high psychosocial demands, low decision latitude, and perceived physical exertion on the same measurement occasion were risk factors for low back pain among nurses. In another study a combination of frequent positioning of patients in bed; perceived lack of support from the immediate superior; and perceived lack of pleasant and relaxing culture in the work unit, were associated with low back pain (Eriksen et al., 2004).

Individual/lifestyle factors, such as a history of previous back injury (Feyer et al., 2000, Lagerstrom et al., 1998a, Smedley et al., 2003a), more years worked in nursing (Byrns et al., 2004), gender (Eriksen, 2003, Ore, 2003), body mass index =25 kg/m² (Engkvist et al., 2000), below average physical fitness (Nuikka et al., 2001), have been associated with higher workload, musculoskeletal problems and injuries in some studies.
1.2.2.4  A model for musculoskeletal health in nursing work
Westgaard and Winkel (1997) have proposed a model illustrating significant issues (here mechanical exposure) for determining occupational musculoskeletal health. The model focuses on ergonomic interventions (which aim at adapting the task to the man, in order to promote a healthy working life) at three levels: community, company, and workers. The factors at the three levels determining musculoskeletal health are, for example: on the community level – legislation; on the company level – production system and external exposure; and finally on the worker level – internal exposure. It is assumed that this internal exposure results in physiological and psychological responses in the individual worker, for example discomfort and pain. The internal exposure and the individual responses can result in immediate acute physiological and psychological responses, for example discomfort, and in a long-term perspective, lead to adverse health effects such as WMSDs (Westgaard and Winkel, 1997).
Further, on the worker level, Westgaard and Winkel (1997) have suggested how “modifiers” influence the interaction between exposure and response leading to musculoskeletal health. Work technique can be a modifier in relation to the individual worker.

1.2.2.5  A model of work technique as a potential modifier
In this thesis a conceptual model for the development of WMSDs by Armstrong et al. is used (Armstrong et al., 1993). The model was modified by Kjellberg by the addition of a work technique variable as a modifier (Figure 2) (Kjellberg, 1998a). The model tries, in a simplistic way, to explain the relationship between work technique as a modifier to reduce the mechanical exposure (external factors that may give rise to forces acting on the nurse’s musculoskeletal system) when performing a transfer task. It is presumed that by decreasing mechanical exposure, work technique will contribute as one factor among others to the prevention of WMSDs. In the dose-response model four variables interact: exposure, dose, response and capacity. The exposure refers to the external factors (work environment and the patient) that produce the internal dose. Examples of factors in the work environment are: workplace design, space and equipment, as well as the stature, weight and capability of the patient. These factors give rise to mechanical exposure and thus, to forces acting on the musculoskeletal system of the nurse.
“Dose” refers to the extent to which the exposure factors interact with the organism and disturb the internal state, for example, forces acting on the musculoskeletal system (tissue loads and metabolic demands). “Response” refers to the changes that occur in the body as a consequence of the dose, for example change in temperature or in the shape of tissues. One response can in turn be a new dose that produces a new response. The effect of a dose can occur immediately, after a few hours or after longer periods of time. The capacity of the worker is influenced by the dose and responses, which in turn affect work technique.

The work technique variable (Figure 2) refers to the actions and modifications taken by the individual nurse in relation to the external mechanical exposure that produces the internal dose. The work technique is viewed as a modifier, and thus the mechanical exposure may be modified and decreased by using a recommended patient transfer method. Actions taken by the nurse can for example be adjustments of the work
environment and the work tasks, such as preparing space, using transferring aids and lifts, adjusting the height of the bed and activating the patient.

The nurse’s motor performance, i.e. the voluntary movements produced during the transfer, is also presumed to modify and decrease the exposure. The motor performance of the nurse may be described by characteristics such as balance, coordinated and efficient movements, use of legs to generate force, length of lever arms and position of the joints.

Work technique has been suggested to comprise of two basic elements: the method for carrying out a work task, and the individual performance of a work task (Kjellberg et al., 1998b). In this thesis the concept of work technique during patient transfer tasks is defined according to these two basic elements. In transfer tasks the first element, the method, refers to generally established and recommended transfer methods learnt by nurses in training programmes. The second element, the individual performance, focuses on the nurse’s individual variations when performing a specific transfer task or using a specific transfer method, for example coordination and balance. Work technique and patient transfer technique are used synonymously as regards the two elements in the above definition of work technique (unless otherwise noted).

![Figure 2](image-url) A dose-response model for the development of WMSDs where sets of cascading exposure, dose, capacity and response variables interact, modified from Armstrong et al. (1993), where a work technique variable is added as a modifier of mechanical exposure (Kjellberg 1998a).

1.2.3 Training programmes in recommended patient transfer methods

Training programmes in patient transfer methods aim at creating prerequisites for nurses to learn a recommended work technique, and thus reduce physical load on the musculoskeletal system due to mechanical exposure. Training can be held as proficiency training, as a part of a curriculum in an education programme, for
example in undergraduate programmes at universities or at nursing schools. Training programmes can also be performed as on-the-job training, where the employer arranges the training for recently employed personnel or as refresher courses. These types of training are held by employers to fulfil their responsibilities according to laws and legislation. In Sweden, according to The Swedish Work Environment Act and the Swedish Work Environment Authority’s Provisions and General Recommendations (1998, p 6) “The employer shall ensure that the employee has sufficient knowledge concerning: suitable work postures and working movements, proper use of technical equipment and aids” and “the employer shall further ensure that the employee is given the opportunity of training in a suitable work technique for the task involved”. The employer shall also ensure compliance with the instructions given.

Recommended work technique in training programmes is generally based on ergonomic principles aimed at reducing the physical load (mechanical exposure) on the nurse’s musculoskeletal system and fulfilling the patient’s need for care (Corlett et al., 1992, Experts’ Work Shop, 2002). Such principles are, for example: keeping the back in a vertical position and maintaining its natural curvature; keeping the load on the joints as low as possible by using work postures and movements with short levers; working with good balance and using the legs in weight transfers, i.e. shifting one’s own body weight from one leg to another in order to generate force (Corlett et al., 1992, Experts’ Work Shop, 2002). Further examples of these principles are: encouraging the patient to cooperate and move according to natural patterns of movement; creating space around the transfer; adjusting the working height; working in cooperation with a co-worker; using transferring aids. It is also recommended that manual lifting is avoided when assisting patients to move (Experts’ Work Shop, 2002), and nurses are advised to work calmly, plan the work, alternate and take breaks (Corlett et al., 1992, Experts’ Work Shop, 2002).

Training programmes can be viewed as primary prevention of WMSDs. Usually, prevention is divided into three categories: primary, secondary and tertiary prevention (Kaplansky et al., 1998). Primary intervention strategies directed to the healthy nurse involve taking action in advance to avoid the onset of WMSDs.

It is common that physiotherapists and/or occupational therapists – but sometimes nurses – are responsible for training programmes in patient transfer methods. These training programmes are held at hospitals, at wards, in home care, in the community or in the occupational health services. In their daily work, physiotherapists and/or occupational therapists, also instruct and guide nurses in how to assist the patient in different transfer situations, both in hospital and home care settings.

The content of a training programme is a recommended patient transfer method. In European countries, including Sweden, as well as in the USA and Australia, there are several methods for performing patient transfer tasks. The methods differ not only between countries, but also within countries, where several different methods may be used by nursing personnel (Lagerstrom and Hagberg, 1997, Experts’ Work Shop, 2002).

Usually an originator, sometimes a physiotherapist, has developed a method for patient transfer tasks and this is taught to nursing personnel in training programmes (Lagerstrom et al., 1999).
In spite of different basic principles, theories, pedagogical models, transfer techniques, and implementation approaches, the patient transfer methods have many parts in common. The effects of these training programmes concerning workload and the experience of the patient have seldom been evaluated, and there is no consensus as to which method is to be preferred.

Given the diversity of patient transfer methods, a European network of teachers and researchers, focusing on work technique in patient transfer tasks, has developed a Core Curriculum for handling and moving skills in health and social service (Johnsson et al., 1999). In this curriculum minimum basic standards for training and evaluation are proposed.

1.2.4 Evaluation of training programmes
In research projects, ergonomic interventions, including training programmes in patient transfer methods, focus on organisational and/or individual levels (compare Westgaard and Winkel’s model) with interventions at three levels: community, company, and worker (Westgaard and Winkel, 1997).

1.2.4.1 Interventions in patient transfer technique at the individual level
In a hospital in Sweden an intervention was performed during working hours focusing on the individual nurse with courses in stress management, physical activity and patient transfer method. After the programme the vast majority of the nurses stated that they used the recommended technique in a questionnaire but the self-reported low back problems did not decrease (Lagerstrom and Hagberg, 1997, Lagerstrom et al., 1998b). Two other studies have evaluated the effects of training programmes, by assessing number and percentage of harmful working postures, ergonomic and biomechanical errors and perceived exertion (Engels et al., 1998b), and ergonomic and biomechanical errors using a checklist (Engels et al., 1997). After the training the participating nurses used less harmful working postures and made fewer errors compared with a control group (Engels et al., 1997, Engels et al., 1998b). Feldstein et al. (1993) evaluated a back injury prevention project and used a transfer evaluation form that was specifically developed for this project. After the project the nurses improved the number of scores, and thus the quality of patient transfers. In another study among nursing students receiving extra ergonomic education it was shown that the students worked in physically more favourable positions with less strain on the body compared with the control group (Hellsing et al., 1993).

1.2.4.2 Interventions including patient transfer technique at organisational levels
Smedley et al. (2003b) performed an ergonomic intervention at two hospitals, of which one was a control. In the intervention hospital the manual handling policy was revised, and the lifting and handling equipment was purchased. Link nurses were established to facilitate the intervention throughout the organisation. All nursing personnel were offered a 2-day training course, which incorporated manual handling. The results showed that the self-rated prevalence of low back pain increased slightly, while among nurses in the control hospital this was not noted. Yassi et al. (2001) showed that in a 3-armed randomised control trial, which, except for control, consisted of safe lifting and no strenuous lifting. Both interventions received training in back care and handling technique. The outcome showed that in both interventions
the nurses’ self-ratings of physical discomfort, back- and shoulder pain were improved, but the no strenuous lifting intervention showed greater improvements. Musculoskeletal injury rates were not altered.

Evanoff et al. (1999) implemented a participatory worker-management ergonomics team at a medical centre among hospital orderlies. The intervention for the team was to identify job factors that contributed to injuries and to seek solutions. The interventions implemented by the team were development of standardised lifting techniques and training of all orderlies in their use. A decreased risk of work injuries, a decline in the total number of lost working days and in workers’ compensation costs were seen after the intervention.

In another study, Owen et al. (2002) evaluated the impact of ergonomic interventions. First, in the intervention hospital the most stressful patient handling task was determined; then laboratory tests were carried out to see whether assisted devices could decrease the stressfulness of the transfer task. The devices were selected for implementation at the hospital. The nurses were trained in how to used the devices and directions were placed with the chart at the patients’ bedside. Eighteen months after the intervention, back and shoulder injuries were reduced and lost working days decreased. Further, five years after the intervention both the injuries and the lost working days continued to decrease. At the control hospital the health problems remained stable.

Elford et al. (2000) has expressed a notion that – as the patient transfer task is a risk factor for WMSDs – this work task should be eliminated from daily work. In nine acute hospitals and one long-term care facility in the USA, a lift team intervention was implemented (Charney, 1997) Thus, the everyday task of patients’ transfers was taken over by professional patient movers who use lifting devices as well as personal protective equipment. The injury rates and lost working days were reduced among the nurses for several years (Charney, 1997).

As can be seen in the above-mentioned projects, injury rates, lost working days and the prevalence and/or incidence of WMSDs has often been used as one outcome when evaluating interventions, including training programmes, irrespective of level in the organisation. Other studies which have evaluated the effect of training programmes on WMSDs, have shown inconclusive results (Hignett, 2003a). It is, however, doubtful whether the learning of a recommended method will cure already established WMSDs (Kemmlert et al., 1993, Lagerstrom and Hagberg, 1997), considering the multifactorial development of WMSDs. Kristensen (2000) has also criticised this kind of study and pointed to the necessity of focusing on behaviour change in evaluating work technique. Thus, there is generally no evaluation of the effect of training programmes in patient transfer methods as regards improvement in work technique performed in daily work and in research projects. One reason for this might be the lack of suitable evaluation instruments.

1.2.4.3 Instruments for assessment of work technique

Assessment of the effects of training programmes for improving nurses’ work technique in patient transfer tasks requires valid and reliable methods for assessing work technique. It has been shown in a laboratory study of lifting tasks that there was considerable variation in individual performance between subjects who used the same lifting method (Kjellberg et al., 1998b) and this might also be the case when performing a transfer task according to a recommended method. Patient transfer
technique or compliance with recommended methods has been evaluated in different ways: by using self-report questionnaires (Lagerstrom et al., 1998b) subjective ratings (Owen et al., 2002, Schibye et al., 2003), biomechanical methods (Daynard et al., 2001, Marras et al., 1999, Schibye et al., 2003), and observational methods (Engels et al., 1998b, Feldstein et al., 1993, Hignett, 1996). To evaluate work technique, self-reported data concerning the use of a recommended patient transfer method should be complemented by observation data in order to include several aspects of the work technique. This has been commented on by Spielholz et al. (2001), as the self-reports have been found to be less precise compared with direct methods.

Several studies have used both self-rated and biomechanical methods (Garg et al., 1992, Garg and Owen, 1994, Schibye et al., 2003). Biomechanical models, however, require simplifications and equipment that is rather complicated to use, which limits the availability in the clinical field where training is held. Since the aim of the training is for nurses to learn a recommended work technique in a clinical and educational setting, an observation method that does not require extensive equipment is more accessible.

There are several observation instruments that are used in clinical and educational settings when evaluating work technique and musculoskeletal health and safety. This kind of instrument is regarded as a simple tool for studying work technique. OWAS (Ovako Working Posture Analysing System) is an observation instrument for working postures in industry (Karhu et al., 1977) but has been used in nursing work studies (Engels et al., 1994, Engels et al., 1998b, Hignett, 1996). RULA (rapid upper limb assessment) is a survey method for the investigation of work-related upper limb disorders (McAtamney and Corlett, 1993), and REBA (Rapid Entire Body Assessment) is a risk assessment tool for entire body assessment in the health care sector (Hignett and McAtamney, 2000). Further, other instruments to assess work technique have been developed by Folkert and St-Vincent (Folkerts, 1994, St-Vincent et al., 1989).

Checklists based on specific transfer methods have also been developed (Engels et al., 1997, Feldstein et al., 1990).

Another instrument, PLIBEL, the method for the identification of musculoskeletal stress factors which may have injurious effects, has been used in home care settings for assessments of ergonomic hazards in five body regions (Kemmlert, 1995).

Recently a new video observation instrument for evaluation of patient transfer technique has been developed in Denmark (Warming et al., 2004) based on several observation instruments, one of which is the Pate instrument (study I in this thesis).

The PLIBEL and the Danish instrument have been tested for validity and reliability; this is, however, a problem with some of the other instruments mentioned above.

A computer-aided instrument, PEO (portable ergonomic observation method) (Fransson-Hall et al., 1995) has been developed, where duration and number of events are calculated for postures and for manual handling. This instrument is applicable to most professions and work tasks, and has been shown to have acceptable validity and reliability (Fransson-Hall et al., 1995). However, although all the above-mentioned instruments are undoubtedly useful, they were developed for other purposes than specifically measuring work technique during transfer tasks (except for the recently developed Danish instrument mentioned above). In conclusion, when this study started, there was a need for an observation instrument, which could describe and assess nurses’ work technique in features referring to both the transfer method and the individual performance of a transfer task with regard to musculoskeletal health and safety. Further
the instrument ought to be easy to use, and the instruments should be able to apply to most transfer methods.

1.2.5 The patient’s perceptions, safety and comfort

A transfer is an encounter and interaction between patient and nurse, and as such not only the nurse’s workload but also the patient’s needs and preferences should be considered. Every patient transfer is unique and the need for nursing care and rehabilitation of the patients should be taken into account. The ability to move or transfer within the home is an important part of the activities in daily life. For elderly people this ability is often decisive as regards whether or not they can be discharged from hospital and go on living in their own home. In connection with an injury, disease or illness, the ability to transfer can be limited for a short time or a long time, even for the rest of one’s life, and thus the older person becomes dependent on assistance from others.

The transfer situation is an event for the patient to train, retrain or keep the ability to move and to use his or her body in a purposeful way (Alexander et al., 2001). For example, in retraining of motor function in the patient with neurological impairments, the treatment includes the recovery of the ability to move further up the bed, to roll, to move from the bed to a chair, to get up from a chair and so on. These basic movements, i.e. transfers, are regarded as activities in their own right, but they are also prerequisites for the performance of other activities in daily life, for example, eating, getting dressed, and going to the toilet. The ability to move is also important to the patient’s well-being and it has been shown that those who have little ability to move have lower quality of life (Hellstrom and Hallberg, 2001).

When the nurse assists the person in a transfer, this is in line with Henderson (Henderson, 1960, p 22), who stated that “the unique function of the nurse is to assist the individual, sick or well, in the performance of those activities contributing to health or its recovery that the person would perform unaided given the necessary strength, will or knowledge. And to do this in such a way as to help the individual gain independence as rapidly as possible”.

Henderson has suggested 14 components of basic nursing care, and the transfer task could be regarded as number 4: “helping the patient maintain desirable posture in walking, sitting, and lying; and helping move from one position to another” (Henderson, 1960, p 42). Further, the nurse must among other things know the principles of balance and alignment, and be able to support the person to move. (Henderson, 1960, p 55). Working together with a physiotherapist who initiates a programme that the nurse helps the patient to maintain, is a way of problem solving for the nurse (Henderson, 1960, p 56).

However, studies have shown that patients do not always have good posture. In elderly care, rehabilitation unit stroke patients spend about 26% of their time in poor positions, for example sitting in a slumped forward or sideways position (Dowswell et al., 2000). Furthermore, the nurses appeared not to notice poor positions; a routine correction of poor positions was made, for example when food was brought, as it was more common to assist patients in order for them to be able to eat – not for the transfer of just changing position (Dowswell et al., 2000). Further, Owen could show that a non-recommended transfer technique, and the so-called axilla- grip, which is not comfortable for the patient, was commonly used (Owen et al., 1999). It has also been
shown that patients with a stroke, who needed help with transfers, were more likely to suffer with hemiplegic shoulder pain than those who needed less assistance (Wanklyn et al., 1996).

Nurses are, however, more concerned about the patient’s comfort, safety and preferences during the transfer than their own safety. It has been shown that the nurses chose the transfer technique according to what they thought was safe and comfortable for the patient, although it meant a more unsafe technique regarding their own safety (Garg et al., 1992). The importance of the transfer being safe and comfortable for the patient has been pointed out by nurses in other studies (Hignett and Richardson, 1995, Hignett, 2003b) as well as in documentation of transfer methods (Lagerstrom et al., 1999). It has also been suggested that using a safe transfer method when assisting older people to move can potentially increase their ability to move (Brown Wilson, 2002).

Nurses’ work technique, including use of transferring aids, is presumed to have an impact on patients’ perceptions of the transfer situation. It was shown in one study that the patients felt more comfortable and secure during patient transfer tasks after an ergonomic programme had been implemented (Owen et al., 2002).

The patient perspective on being assisted in transfers, for example from bed to wheelchair, has been considered in some studies. In these studies, however, the patient’s experience has been examined using deductive methods, i.e. already predefined attributes on fixed scales and response alternatives, often concerning comfort, security and safety (Kjellberg et al., 2004, Owen et al., 2002, Zhuang et al., 2000). It is often assumed, by researchers and health care professionals, that these aspects are important to patients, but there might also be other aspects that are equally or more important. An increased understanding of how patients experience the transfer situation could generate ideas concerning how to assist, with a view to improving the safety and the quality of care in transfer tasks for both the patient and the nurse.

1.3 A MODEL OF THE PATIENT TRANSFER TASK IN THIS THESIS

In this thesis “the patient transfer task” is the research problem. Figure 3 shows that the transfer task is an encounter and interaction between the nurse and the patient. For the nurse, on the one hand, assisting patients in a transfer is a work task that has been considered as hazardous with high load on the musculoskeletal system. Thus, it is presumed to be one risk factor for the development of WMSDs. Patients, on the other hand, have another view of the transfer situation, depending on their own needs and preferences. Experiences differ, as some patients only need some minor support, while others need to be transferred with lifting devices. For the patient, who is dependent on assistance from the nurse, the safety and comfort of the transfer situation is believed to be crucial. Thus, the patient transfer technique chosen by the nurse when assisting a patient to move, is not only a means to prevent the development of musculoskeletal problems for the nurse, but is also an aspect of the quality of nursing care.

Training programmes in patient transfer methods aim at creating prerequisites for nurses to learn a recommended work technique, and thus reduce physical load due to mechanical exposure on the musculoskeletal system, and make the transfer safe and comfortable for the patient. Training programmes can be viewed as primary prevention of WMSDs.
In order to evaluate nurses’ work technique in patient transfer tasks regarding musculoskeletal health and safety, there was a need for an instrument that was developed for this specific purpose. A video-based observation instrument was developed. However, making a video recording of a transfer for later assessments with the instrument was found to be costly and time-consuming. Another observation instrument, which was based on direct observations of patient transfers, was therefore developed. Consequently, the need for instruments that can be used to evaluate nurses’ work technique in patient transfer tasks regarding musculoskeletal health and safety has been fulfilled.

There is generally no evaluation of the effect of training programmes in patient transfer methods performed in daily work. It is, however, of importance to evaluate these programmes, both when they are performed in daily work and as research projects. The evaluation ought to focus not only on the musculoskeletal health and safety of the nurse, but also on the safety and comfort of the patient.

There are several factors related to WMSDs among nurses in daily work. These factors can be divided into individual (i.e. age, sex, body mass index (BMI), and work-related, physical exposure (i.e. load) and psychosocial exposure (i.e. job strain). Work technique can be seen as a modifier for mechanical exposure.

WMSDs is common among nursing personnel. The patient transfer task is one of many risk factors for WMSDs. If, however, training programmes are performed aiming at giving nurses prerequisites to learn a recommended work technique, and thus reduce physical load on the musculoskeletal system, the risk might decrease. Thus, an optimal patient transfer task is performed with as low physical load on the nurse as possible, and according to the needs and preferences of the patient.
Figure 3. A model of the relation between the patient transfer task and WMSDs. The model illustrates how training programmes in patient transfer methods could be a means of preventing WMSDs. The elements in bold have been studied in this thesis and the model is further explained in the text.
2 AIMS
The overall aim of this thesis was to develop and construct instruments which could be used by an observer, in daily work and in research, in order to register and assess nurses’ work technique in patient transfer tasks, and to evaluate whether their work technique improved after participating in a training programme in patient transfer methods. A further aim was to evaluate the patients’ perceptions of safety and comfort during the transfer, and to describe how the patients experienced being assisted in transfer situations.

2.1 SPECIFIC AIMS
- to construct an observation instrument for description and assessment of nursing personnel’s work technique in patient transfer tasks with regard to musculoskeletal health and safety, and to evaluate the validity and reliability of the instrument (Study I)
- to develop an observation instrument with which to assess nurses’ work technique in patient transfers directly when the transfers occur, and to test the validity and reliability of the instrument (Study II)
- to evaluate whether or not the participants in two models of learning improved their work technique after a training programme in patient handling and moving skills, and whether or not one model of learning was more effective than the other (Study III)
- to investigate whether nursing students improved their work technique when assisting a patient from bed to wheelchair after proficiency training, and to investigate if there was a correlation between the nursing students’ work technique and the patients’ experience of the transfer (Study IV)
- to explore older people’s experiences of being assisted in patient transfers (Study V).
3 PARTICIPANTS AND METHODS (I – V)
An overview of the types of study, samples, participants and data collection methods in studies I-V and the thesis is shown in Table 1. (For Tables 1 – 12, please see Appendix in this thesis.) In studies I and II, two observation instruments, Pate (I) and DINO (II), were developed, and evaluated concerning validity and reliability, for assessment of nurses’ work technique during patient transfer tasks, from video recordings and direct observation, respectively.

The Pate instrument was found to be useful as regards its purpose (Study III), although it was time-consuming and costly to make video recordings and later to register the nurses’ work technique from the recordings. It was concluded that it would be valuable to develop an instrument where there was no need for equipment, and where registrations could be made at the same time as the transfer was performed. This would simplify the registrations and thereby increase the possible numbers of registrations, and also where and by whom the instrument could be used. The Pate instrument consists of 24 items, and this number of items was assumed to be too many to manage in a direct observation. Thus a direct observation instrument (DINO), with fewer items, for assessment of nurses’ work technique was constructed, and evaluated regarding validity and reliability, in study II.

In study III, the Pate instrument was used to evaluate the effects of a training programme in patient handling and moving skills. The evaluation also included self-rated work technique, comfort and perceived physical exertion during the transfer. The patients (played by healthy persons) also rated their perceived comfort and safety during the transfer. Six months after the training programme came to an end, the participants completed a questionnaire where they reported musculoskeletal problems, perceived physical exertion, job strain, and their opinions of the training programme.

In study IV, nursing students’ work technique after participating in proficiency training in patient transfer methods, was evaluated. The direct observation instrument (DINO), constructed in study II, was used as one of the instruments for assessment of their work technique, and to investigate the relation between the nursing students’ work technique and the perceived safety and comfort of the patients (played by healthy persons) during the transfer.

In study V, experiences of being assisted in patient transfers were explored by interviewing persons over 65 years of age, who were inpatients at a rehabilitation clinic or living in a nursing home.

3.1 OBSERVATION INSTRUMENTS (I AND II)
3.1.1 Development of the video observation instrument (I)
A large number of video-recorded patient transfer tasks were used during the construction of the instrument and for reliability and validity testing. These video-recorded transfers were of different kinds and were performed by nurses in authentic work situations in two geriatric hospitals. An expert group was formed, consisting of one physiotherapist, who had been working with development and training in patient transfer technique for many years, and two researchers. The expert group identified work technique characteristics that are relevant for patient transfers and have implications for the musculoskeletal health of the nurse by studying:

- scientific literature (original and review papers)
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- text books, training material on transfer methods
- existing observation instruments
- publications concerning observation of work technique during manual handling tasks.

When selecting the items to be assessed in the video observation instrument the focus was on the lower back. The selected items were based on work technique characteristics/features:
- shown to be risk factors for musculoskeletal disorders and injuries
- related to musculoskeletal health
- related to musculoskeletal load
- related to generally accepted ergonomic, biomechanical and neuromotor principles, which transfer methods are based on, and which could be expected to be influenced by training in patient transfer technique.

Furthermore, items from two observation instruments (Folkerts, 1994, St-Vincent et al., 1989) were considered to be useful, and were used as a basis for the instrument. A few additional items were also constructed by the expert group.

The items were discussed thoroughly within the expert group, considering relevance, phrasing, definitions etc. Video-recorded patient transfers were used to test the items. Then modifications were made if/when there were uncertainties and divergent opinions among the group members on how to assess certain items. Two physiotherapists pre-tested the instrument after some minor adjustments had been made to the instrument.

The final selection for the instrument included 24 items arranged into three phases of a transfer: the preparation (7 items), the starting position (7 items) and the performance (10 items) phases (Table I:1). In the preparation phase, the items describe whether the nurse takes action to activate the patient, to correct the physical environment, to use a transferring aid and to obtain assistance from a co-worker. In the starting position, the body position and the posture of the nurse at the start of the transfer are observed. In the actual performance phase, the items describe if the nurse uses a starting sign, stimulates the patient verbally, and the movements and the forces exerted by the nurse during the transfer.

In this thesis the resulting video observation instrument is called Pate. The items in the preparation and actual performance phases, as well as two items (10 and 14) in the starting position, are assessed on a nominal scale, either with dichotomies (yes/no) or with three or four categories (Table I:1). Five of the items (8, 9, and 11-13) in the starting position are assessed on an ordinal scale with categories representing angular sectors (Table I:1).

The Pate instrument is designed to be used by an observer to register the work technique of a pre-selected nurse during one sequence of the transfer, referred to as one operation. Observations are made from video recordings. If all personnel participating in the transfer are to be observed, separate video recordings and observations have to be made.
3.1.2 Quantifications of the assessment – Pate instrument (I)

An attempt was made to quantify the assessments, by calculating an overall score of the work technique with regard to the level of musculoskeletal hazard and safety. The expert group studied the literature to find evidence for associations between work technique characteristics and musculoskeletal load and hazards. Seven items from the instrument were omitted (items 9-12, 17, 20 and 23), due to lack of consistency in the literature regarding the association with musculoskeletal load and/or problems of generalising the scoring to all kinds of transfer situations. The remaining seventeen items in the instrument were used to calculate the overall score (Table I:2). The categories of these items were scored by the expert group: 1 for a safe technique and 0 for a hazardous technique.

The expert group assumed that not all items of the instrument were equally important for the musculoskeletal load. Therefore weights were applied to the items. Five physiotherapists, all experienced in transfer technique, judged the importance of each item for the musculoskeletal health and safety of the nurse when performing a patient transfer. A magnitude-rating procedure was used. The item “back motion” was chosen as a reference item and assigned the value 100. The physiotherapists rated the importance of each item by indicating a number in relation to the “back motion” reference value 100. A geometric mean was calculated from the ratings for each item and rounded to the nearest value of 25. On a later occasion the expert group and the five physiotherapists met and discussed the calculated means and the weights proposed by the expert group. Discussions went on until a consensus was reached. The weights were divided by 100 to assume values between 0 and 2. The scores of the categories were multiplied by these weights when calculating the overall score (Table I:2).

To calculate the overall score for a registered transfer the weighted scores from all relevant items were summed. In the preparation and actual performance phases, the items 2-4, 6 and 21 were omitted from the calculation if the registered category was either “is enough/correct” or not applicable (Table I:2). These categories are used if the nurse cannot, due to the circumstances, take any action to perform an improvement in the item. In order to be able to make comparisons between different transfers the overall score was “normalised” by dividing the sum by the maximum possible score, with regard to any omitted items for the transfer. Thus, the overall score can assume a value between 0 and 1. The overall score is suggested as a rough summary measure of the performance of the nurse with regard to the level of musculoskeletal hazard and safety. A score equal to 1 would correspond to an ideal work technique for musculoskeletal health and safety.

3.1.3 Development of the direct observation instrument (II)

An expert group consisting of five physiotherapists, who were experts in ergonomics with broad experience of patient transfer technique, one registered nurse, and one psychologist, was formed to construct the instrument for direct observations (not video-recorded) of work technique during patient transfers. The group met six times during two years, and between the meetings two members revised the instrument according to the agreements from the last meeting.
The expert group identified work technique characteristics relevant for patient transfers, mainly focusing on the nurse’s lower back but also the neck, upper back and shoulders, and the selection of items for the instrument was based on:

- scientific literature (original and review papers)
- text books, training material on transfer methods
- the experience of the expert group
- the video-based instrument (Pate), (Kjellberg et al., 2000).

Further on in the development process, the experts also took into consideration:

- the needs of the patient
- documented risk factors for musculoskeletal disorders
- aspects of work technique related to the generally accepted ergonomic, biomechanical and neuromotor principles that transfer methods are based on.

The experience of using the Pate instrument in study III, was also taken into consideration when constructing the instrument and deciding which items and categories to use from the Pate instrument, and how to phrase them.

The starting position was not considered to be useful since when watching the video recordings the observers in study III found it difficult to decide when the starting position had been adopted.

The direct observation instrument, called DINO, consists of 16 items divided into three phases of a transfer: the preparation (7 items), the performance (6 items) and the result (3 items) phases (Table II:1), as well as a background description, which is optional. The latter can be collected in advance or after the transfer, if needed, and describes the characteristics of the nurse, the patient (for example, diagnosis, weight, ability to communicate and to perform voluntary movements) and the environment. In the preparation phase, the items describe whether the nurse takes action to encourage the patient, to correct the physical environment, to use a transferring aid and to obtain assistance from a co-worker. In the performance phase, the items describe to what extent the nurse’s performance during the transfers fulfils the criteria for good balance, coordination and movement economy, and low load on the back/shoulders. In addition, the fulfilment of the criteria of interaction and communication with the patient, and the patient’s participation according to movement ability are also described. In the result phase the items describe if the patient is comfortably and safely in a posture as planned when the transfer is completed.

In the preparation and result phases the items are assessed on a nominal scale and the response alternatives in the categories are Yes / No (Table II:1). During the preparation, it is possible to add information (called information category), to indicate that the preparation was impossible or unnecessary, or irrelevant. In the performance phase the items are measured on a five-point bipolar rating scale, where 0 means that the nurse does not at all fulfil the criteria, and 4 that the nurse totally fulfils the criteria of the item (Table II:1). The scale for assessment for the items in the performance phase is ordinal.

All items, categories and the criteria for fulfilling or not fulfilling, as well as a description of how to use the instrument, are provided in the key to the instrument.

The instrument was developed in Swedish and this was the language used in the test of validity and reliability. After the inter-reliability test some minor changes were suggested to the items to make them and the definitions in the key clearer, and this
version was tested in the intra-reliability test in this thesis. The instrument was translated into English after the inter-reliability test. Two native English speakers with knowledge in patient transfer tasks and instrument development have read through the translation of the instrument and the key and commented on it. Two bilingual translators have checked the translation of the instrument and one of the instrument and the key. Some minor changes have been made in the English instrument and accordingly also in the Swedish version. For example, “correct the bed” has been changed to “adjust the bed”.

3.1.4 The overall score of the DINO instrument (II)
To quantify the items according to musculoskeletal health and safety, the expert group constructed a scoring system. The expert group decided to treat all the items equally and assign the score 0 if the item was not performed in a safe way, and the score 1 if it was performed in a safe way (Table II:1). The information categories in items 2-7, in the preparation phase, are not included in the scoring system, since they only give information on why the action in the item is not performed by the nurse. Each of the scales (items 8-13) in the performance phase were given the score 0 if the demands on performance during the transfer, according to the definitions, were not fulfilled or there was a high load. The score 1 was given if the demands were fulfilled or there was a low load.

To calculate the overall score, applicable items performed in a safe way were divided by the maximal score on these items. The items 2-7 from the preparation phase were omitted in the calculation if the information category was filled in; thus the maximum score based on 16 items was reduced by the sum of the items that were not applicable. For example, when assisting a patient to move further back in a chair, there is no bed to adjust in the transfer. The information category "not relevant" is therefore filled in and the maximal score is reduced to 15. The number of applicable items can vary from 1-7 in the preparation phase, depending on how many of the information categories are filled in. Accordingly, the number of items assessed and the maximal score can vary between 10-16, depending on the number of applicable items in the preparation phase. By dividing the sum of the scores from applicable items by the maximal score on these items the overall score can thus assume a value between 0-1, depending on the musculoskeletal health and safety of the work technique used by the nurse. The overall score is suggested as a rough summary measure of the work technique of the nurse with regard to musculoskeletal health and safety. When the overall score is 1, the work technique used during the transfer in question is regarded as safe.

3.1.5 Differences between Pate and DINO
The Pate instrument is an indirect observation instrument and was designed for an observer to make registrations, of one nurse’s work technique, from video-recorded transfers. The DINO instrument was designed for direct observation, where an observer makes registrations of one nurse’s work technique in clinical and educational settings in everyday work and in research within the same settings. However, the DINO instrument was based on the Pate instrument, and there are some similarities between them. The differences between the two instruments are outlined in (Table II:2). Both instruments are divided into three phases of a transfer. The phases are somewhat different, except for the first phase: the preparation phase. In the
Pate instrument the second phase is the “starting position”, where initial postures and positions are described. However, in the DINO instrument the starting position was excluded and the second phase is therefore the performance phase. The third phase in the DINO instrument is the result phase, which is not included in the Pate instrument. A further difference between the instruments is that the DINO instrument, but not the Pate instrument, includes a background description (Table II:2).

### 3.1.6 Validity and reliability of the Pate instrument (I)

To evaluate the validity and reliability of the instrument, 35 video-recorded patient transfers, mostly transfers in bed, were selected from the material of recordings from geriatric hospitals (Table I:3). These transfers were performed by 23 nurses.

The expert group viewed the transfers on the video recordings and made registrations with the observation instrument. The video film was frozen when observing the starting position, and replayed in slow motion when observing the actual performance phase. Each transfer was viewed several times. Discussions were held within the expert group about these observations until a consensus was reached about which category to register. These observations, by the expert group, were treated as the “gold standard”.

Two physiotherapists, experienced teachers in transfer technique, were trained as observers during two four-hour sessions. First they were shown a video film, with clear examples of all categories of each item. Then they made observations from the video material during continuous discussions with, and feedback from, the expert group. The training continued until the observers’ registrations were approved by the expert group.

The two observers separately viewed the 35 transfers and made registrations with the observation instrument, and they were allowed to replay the videotape. Two weeks later one of the observers viewed the same transfers, in a changed order on the tape, a second time. The observers estimated that one transfer took approximately 10 minutes to observe and register.

First, the criterion-related validity was evaluated by comparisons of two observers’ registrations and the expert group’s registrations, i.e. the “gold standard”. Second, the inter-observer reliability was evaluated by comparisons of the two observers’ registrations. Third, the intra-observer reliability was evaluated by comparisons of the same observers’ registrations on two occasions.

### 3.1.7 Validity and reliability of the DINO instrument (II and the Thesis)

#### 3.1.7.1 Validity and inter-observer reliability (II)

The content validity was evaluated by using the procedure with an expert group, consisting of professionals with a broad knowledge and experience in patient transfer technique and/or instrument development. During the process, relevant scientific literature, textbooks, training material on transfer methods, existing observation instruments and publications on patient transfer were studied. The expert group evaluated that the items in the instrument were relevant, appropriate, and that they measured/covered dimensions of work technique.

Three observers, two physiotherapists and one occupational therapist, who all had experience in teaching patient transfer methods to nurses, were trained in how to use the DINO instrument for 7 hours by one person from the expert group. Before the training, two persons from the expert group had registered about 20 transfers with the instrument from video recordings, which were used to show clear examples from each
item of the instrument. It had not been possible to record an example of the endpoint of the rating scale for item number 8, i.e. not fulfilled according to the definitions, and it was therefore described verbally and demonstrated by the expert. After this the observers made registrations of transfers from the video material. During this process the expert continuously discussed with the observers and gave them feedback. Finally, the observers registered two transfers at a ward, which were also discussed. After this procedure the observers were considered sufficiently skilled to use the DINO instrument.

One physiotherapist was trained in how to use the PLIBEL instrument ("method for the identification of musculoskeletal stress factors which may have injurious effects") (Kemmlert, 1995) for about 4 hours, by the originator of the instrument.

All four observers registered 20 patient transfers in bed, 13 transfers from sitting to sitting and 12 transfers from sitting to standing. The 45 transfers were performed by 15 nurses and took place at a geriatric clinic during two ordinary working days.

To evaluate the criterion-related validity, one observer used the PLIBEL instrument to assess presence of ergonomic hazards in two of the nurses’ body regions (neck/shoulders/upper back region and lower back region) during the transfer. It was assumed that a nurse’s work technique during a transfer assessed with PLIBEL, showing no or low presence of ergonomic hazards, would correspond to a safe work technique, in the calculated overall score from the registrations made by the three observers with the DINO instrument.

The inter-observer reliability was evaluated for each item by the agreement between the observer’s registrations of each item in the DINO instrument in the 45 transfers and for the agreement of the calculated overall score.

3.1.7.2 Intra-rater reliability (Thesis)

One physiotherapy student, with experience of patient transfers from work in the health care sector for more than ten years, was trained for seven hours by one person from the expert group in how to use the DINO instrument. First, the instrument and the key were read through. Second, a video film with examples of all items and most of the categories for each item in the instrument was shown. The categories not shown on the video were described verbally and shown by the expert. After each transfer the observer and the expert discussed the items and categories. Third, when the observer was confident with the categories of the items, six transfers were registered from video recordings. After viewing the transfers, the observer and the expert discussed the registrations and feedback was given. After this procedure the observer was considered sufficiently skilled to use the DINO instrument.

To test the intra-observer reliability, the observer viewed 35 transfers from video recordings, performed by 21 nurses, and made registrations after each transfer with the direct observation instrument. Since, DINO is a direct observation instrument, and the circumstances were intended to be as similar to a direct observation as possible, it was decided that the replay and slow motion function was not to be used. Nine different types of transfers were observed and each transfer took between 6 and 197 seconds to watch (Table 2). Three weeks later, the observer viewed and registered the same 35 transfers, in a changed order on the tape, a second time.

The intra-observer reliability was evaluated by comparisons of the observers’ registrations on the two occasions.
3.1.8 Statistical methods in studies I, II and the Thesis

An overview of the statistical analyses used in studies I, II and in the thesis (previously not published data) is shown in Table 3.

For evaluation of validity and reliability of the Pate instrument (Study I), calculations of the overall proportion of agreement \( P_0 \), the kappa coefficient \( k \) (Fleiss, 1981), and the intraclass correlation coefficient (ICC) were calculated (Fleiss, 1986). The proportion of agreement and the kappa coefficient were calculated for the observations of each item separately (Fleiss, 1981). The ICC was calculated to evaluate the quantitative assessments of the transfers by the calculated overall scores.

For evaluation of validity in the DINO instrument, a one-way analysis of variance (ANOVA) was performed for the overall differences in the means of the overall scores of the DINO instrument between the three groups of ergonomic hazards assessed with the PLIBEL instrument for each observer. Fisher’s Protected Least Significant Difference was used as post hoc test to determine pairwise comparisons with multiple \( t \)-statistics (StatView©, 1998).

For evaluation of reliability of the DINO instrument, (Study II and Thesis), calculations of the percentage of agreement, the kappa coefficient \( k \) (Fleiss, 1981), and the ICC (2,1) (Shrout and Fleiss, 1979) were made (Fleiss, 1986). The calculation of percentage of agreement was calculated between two of the observers at a time, and for all three observers, for the observations of each item separately. When calculating the percentage of agreement between two observers in items 8-13, (bipolar rating scales) in the performance phase, ratings were registered as disagreeing when differences were more than one step on the scale. When calculating for all three observers, ratings had to be exactly the same to be regarded as agreeing. The kappa coefficient was also calculated for two observers at a time. The ICC and a 95% confidence interval (CI) were calculated between all three observers for items 8-13 in the performance phase, and for the overall score.

In both studies (I and II), the kappa value was interpreted on a three-degree scale: \( k > 0.75 \) = excellent agreement, 0.40-0.75 = fair to good agreement and <0.40 = poor agreement (Fleiss, 1981).

The ICC, in both studies (I and II) and in the thesis, were computed using one-way analysis of variance (ANOVA) with repeated measurers, and a rater’s random effects model (Fleiss, 1986). The ICCs were interpreted as suggested by Fleiss (1986), where values below 0.4 represent poor reliability, values between 0.4 and 0.75 represent fair to good reliability and values above 0.75 represent excellent reliability. The CIs in study II and the previously unpublished data in this thesis were calculated by hand, with the formula \( z \pm (1.96) \) (standard error), using Fisher’s \( z \) transformation for \( r \) (Hazard Munro and Batten Page, 1993). The corrected ICCs with a CI of 95% for study II and ICCs (CI 95%) for intra-rater reliability (Thesis) were computed for the items in the performance phase using the personal computer programme SPSS© for Windows, version 12.0.1.

3.2 EVALUATION OF TRAINING PROGRAMMES (III AND IV)

3.2.1 Training programme in patient handling and moving skills (III)

The training programme consisted of two models of learning: traditional training and quality circles. Traditional training was performed in a course of four consecutive
days. The quality circles basically followed the core principles for quality circles (Robson, 1982), and consisted of half-day meetings every second week during four to six months, a total of approximately four days. The training was voluntary and part of regular training, organised by the employer for newly employed personnel or those who had not attended this training earlier. Both models of learning had similar content, with both theoretical and practical parts, according to the STC (Lagerstrom et al., 1999).

### 3.2.2 Proficiency training (IV)

According to the curriculum in a 3-year undergraduate programme in nursing, at the second semester of the first year there is a five-week course consisting of two sub-courses: ‘general nursing’ and ‘clinical education - general nursing’. In the general nursing course the students participate in three hours of proficiency training in patient transfer methods before they start their clinical education. The time allocated for the training is three hours and the students train different variations of transfer techniques, depending on the patient’s ability to move, for two types of transfers: “from bed to wheelchair” and “further up in bed”. If there is only time for one type of transfer the transfer “from bed to wheelchair” is trained, since it is considered as one of the most risky transfer tasks (Daynard et al., 2001, Garg et al., 1992, Owen and Garg, 1989, Smedley et al., 1997). The proficiency training in patient transfer methods is compulsory and the students have to participate, whether or not they have previous work experience from the health care sector and training in patient transfer methods. A description of the proficiency training in patient transfer methods is shown in Figure IV:1.

### 3.2.3 Participants in study III

Fifty-one persons (4 registered nurses, 1 enrolled nurse, 23 occupational therapists, and 23 physiotherapists) employed at geriatric hospitals and/or in primary care, in one medical area of Stockholm County Council participated in the study. Most of them performed parts of their work in the patient’s home, i.e. in home care. Four traditional courses (T) with a total of 30 participants \(n_1 = 8, n_2 = 8, n_3 = 8, n_4 = 6\), and three quality circles (Q) with a total of 21 participants \(n_1 = 5, n_2 = 7, n_3 = 9\), seven courses in all, were included in the study. With the exception of one person in each model of learning, none of the participants had had any training in patient handling and moving skills during the last year before they took part in the training. There were no differences before training between the two groups, in terms of background factors regarding age, stature, BMI, working years and working hours (There were four and three men, respectively) (Table III:1).

### 3.2.4 Participants in study IV

The study was performed at a university in Sweden where a 3-year undergraduate programme in nursing is conducted. The process of the inclusion of students in the study is shown in Figure 4. In all, 172 students registered for the second semester (Figure 4). The students were divided into two parallel classes (A and B) by the administration at the university. One class attended the five-week course right at the beginning of the semester and became the intervention group (I) and the other class took the course five weeks later and became the control group (C). Seventy-one
nursing students volunteered to participate in the study, 35 in the intervention group (I) and 36 in the control group (C), from one class each. The inclusion criterion was students registering for the second semester. Exclusion criteria were ongoing musculoskeletal problems or pregnancy. In the intervention group the mean age was 30.2 (SD=8.0, R=21-50) and in the control group the mean age was 29.1 (SD=6.8, R=20-47). The mean age for all 172 students was 28.7 (SD 7.1 and R=20-51). In both groups 28 students had previous work experience within health care, and 17 and 19 respectively had received previous training in patient transfer technique. There were six and three male students in the respective groups. When dividing the nursing students in the intervention group and the control group into two subgroups (previous work experience and no previous work experience) there were no differences between the I group and the C group in the mean age between the subgroups respectively. There were four men in the intervention group with previous experience and two in the group without previous experience. In the subgroups of the control group there were two men in the group with experience and one in the group without experience.

### Figure 4. Description of the inclusion of students participating in the evaluation of proficiency training. Students with previous work experience (WE) and no work experience (NWE).

#### 3.2.5 Data collection in study III

The training programme was evaluated as one programme including both models of learning (T and Q). Both models of learning were also evaluated separately to test whether one model was more effective than the other. An overview of the dependent variables and the instruments used by the observers, participants and patients in study III is shown in Table 4. The following seven variables were used to measure the outcome:

- an observer’s assessment of each participant’s 1) work technique (work technique score), 2) subjective rating of each participant’s work technique
The patient transfer task - methods for assessing work technique

- the nursing students’ subjective ratings of perceived 3) work technique, 4) comfort, and 5) exertion during the transfers,
- the patients’ perceptions of 6) safety and 7) comfort during the transfer.

To evaluate the training programme and the models of learning, the Pate instrument (used by the observer) (Kjellberg et al., 2000), bipolar rating scales (Karlqvist, 1998), Borg’s RPE scale (Borg, 1990) and a questionnaire (Josephson et al., 1997), were used (Table 4). The Pate instrument and two rating scales (Bipolar rating scales and Borg’s RPE) were used to evaluate seven variables, called “work technique items” of the performance of the patient transfer “bed to wheelchair”. This transfer was chosen since nurses have rated this task as the most stressful task (Garg et al., 1992, Owen and Garg, 1989), and it has been shown to be a risk factor for low back pain when performed frequently (Smedley et al., 1997). Daynard et al. (2001) have shown that when performing this transfer the peak spinal compression values exceeds NIOSH limits of concern (3400 N) (NIOSH, 1981). The Pate instrument (Kjellberg et al., 2000) was used by an observer to assess and register the participants’ work technique (patient transfer technique) when performing patient transfers. Subjective ratings were performed by the participants using bipolar rating scales to rate their own work technique and comfort, and perceived physical exertion on Borg’s RPE scale (Borg 1990).

In the first and last sessions of all seven courses, each participant (except for one in each model of learning respectively) performed a transfer where they assisted the patient to move from bed to wheelchair. These transfers were video-recorded in a standardised way with two video cameras; one was facing the side and the other the foot end of the bed. After the performance of each of the two transfers, the participant, with the exception of the participants in the first quality circle, rated their work technique, comfort and perceived physical exertion on the subjective rating scales. The patient, played by a healthy person with experience from the health care sector, rated perceived safety and comfort during the transfer.

A total of 98 transfers were recorded, 49 before and 49 after the training programme, and put in a random order on a new video film.

Two physiotherapists were trained as observers to assess transfer tasks from video recordings by making registrations with the Pate instrument. Then the 98 transfers were viewed from the video recordings by the two observers who were unaware of the type of training and whether the sequence was recorded before or after training. The work technique was assessed for each transfer by making registrations with the Pate instrument. The observers registered approximately half of the 98 video-recorded transfers each.

One month after the registrations, one of the observers was trained for approximately two hours by an expert in ergonomics, in how to use a subjective rating scale to assess work technique on a bipolar rating scale of -4 to 4 with verbal endpoints –4 = very bad and 4 = very good (Table 4). Then the observer viewed the 98 video-recorded transfers and assessed each participant’s work technique, using the rating scale.

The questionnaire, which was a modified version of a questionnaire used in a study of nursing personnel, (Josephson et al., 1997) was filled in twice by the participants: at the first training session and six months after the last session. It contained questions regarding individual factors, physical exertion rated on Borg’s RPE scale (Borg, 1990),
during the transfer "bed to chair", job strain according to (Ahlberg-Hultén, 1999, Karasek and Theorell, 1990), and musculoskeletal problems according to the Nordic Musculoskeletal Questionnaire (Kuorinka et al., 1987). At the second measurement the questionnaire also contained questions concerning the participants’ opinion about the training programme. In the analysis of the questionnaires, ongoing neck/shoulder, and low back problems were dichotomised into no problems (0-1) or problems (2-9). The prevalence of ongoing musculoskeletal problems before and six months after the end of the training programme was measured for all participants (n=51). However, on the second measurement occasion 8 participants dropped out. In this thesis the prevalence is reported of ongoing musculoskeletal problems (MSP) after six months, among the 43 participants who answered the questionnaire twice. The psychosocial work environment was analysed concerning work demands, work control, opportunity to develop and use skills and opportunity to learn new things (Ahlberg-Hultén, 1999, Karasek and Theorell, 1990).

3.2.6 Data collection in study IV

The outcome of the proficiency training in patient transfer methods was evaluated regarding whether or not the nursing students in the intervention group (I) and the control group (C) improved their work technique when assisting a patient to move from bed to wheelchair. An overview of the dependent variables and the instruments used by the observers, participants and patients in study IV is shown in Table 4. The following six variables were used to measured the outcome:

- an observer’s assessment with the DINO instrument of each nursing student’s work technique (work technique score) and scores of the three subscales, 
- the nursing students’ subjective ratings of their work technique, comfort, and perceived exertion during the transfers, 
- the patients’ perceptions of safety and comfort during the transfer.

Two registered nurses and one public health research assistant were trained as observers using video-recorded patient transfers from authentic wards and classrooms. None of these observers had any previous experience in teaching patient transfer methods, and they had no knowledge of the content of the proficiency training, nor had they participated in the training. One of the authors (ML), was one of the observers, and registered two students’ work technique in the beginning, but was then considered to be too involved as an author and therefore not appropriate as an observer. The other two observers knew the authors from the workplace, and were involved with one of the authors (ML) in other research projects.

Three observers were trained in how to use the DINO instrument using video-recorded patient transfers from authentic wards and classrooms. Two experts in ergonomics had earlier assessed these video recordings using the DINO instrument jointly. One of the experts trained the observers for five hours. Examples of items and categories were shown and explained to the observers, and after the training they viewed and assessed four transfers separately. There was 80% agreement between each observer’s registrations for all 16 items and the registrations made jointly by the two experts, and this was considered satisfactory.

The “patient” was played by three healthy persons with work experience from the health care sector. The persons playing the patient acted according to a predetermined
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ability to participate. To make the prerequisites as similar as possible it was decided that the same person would play the role of patient on the two measurement occasions.

The students in both the intervention group and the control group performed the transfer of the patient from sitting on the bed to the wheelchair. This type of transfer was chosen since it has been reported to be a high-risk work task (reported earlier) and is therefore focused on during the proficiency training. The transfers were performed in a “mock-up” situation, where the patient acted according to a predesigned set-up which was intended to simulate an ordinary transfer situation at a ward. The nursing students met the same patient on both measurement occasions.

In the intervention group (I) the first transfer was performed before training and the second after training. The time between the two measurements was about 3-4 hours. In the control group (C) the first and second transfer were both performed before training, and the time between was about 15-30 minutes. Directly after each transfer the students rated their perceptions of their own work technique, comfort and perceived exertion, and the patient rated perceived comfort and safety, on subjective rating scales.

In all, 142 transfers were registered (I=70, C=72). One of the three observers registered 130 transfers, including all 72 transfers in the control group and 58 transfers in the intervention group, and the other two registered 8 and 4 transfers respectively. This means that the observer was not blinded as to whether the transfer was performed before or after training. It was unfortunately not possible to keep the observer blind, since the time between the two groups’ proficiency training was five weeks, and the students in each of the two classes (A and B) all belonged to either the I or C group respectively. Allocating the students randomly to the intervention group or the control group was considered, but this was not possible due to organisational circumstances in the students’ schedule. These problems would probably have limited the students’ opportunities to participate and would thereby have increased the risk of missing data.

### 3.2.7 Statistical methods in studies III, IV and the Thesis

An overview of the statistical analyses used in studies III, IV and new data in the thesis are shown in Table 5.

#### 3.2.7.1 Study III and Thesis

The differences between the participants in the two groups before training in background factors and the seven work technique items, i.e. work technique score and subjective ratings, were analysed with Student’s t-test. In order to compare the groups regarding changes between the two measurements in the seven work technique items two-way ANOVAs with repeated measurements in one factor (first and second measurement) and independent groups in the other (T and Q) were conducted. The questionnaire data concerning musculoskeletal problems were analysed with Chi-square tests, and Student’s t-tests in order to compare differences in job strain and perceived exertion before and after training.

In this thesis, supplementary statistical analyses were made using non-parametric statistics (Table 5). Comparisons of the work technique score and the subjective ratings between the two groups (T and Q) were computed with Mann-Whitney U-test, and the changes within each group before and after training were analysed with Wilcoxon’s signed rank test. An analysis of the prevalence of musculoskeletal problems in neck/shoulder and lower back regions was performed among participants who
answered the questionnaire before and six months after the training came to an end using Chi-square tests.

3.2.7.2 Study IV and Thesis
Mann-Whitney’s $U$-test was used to test the significance of the differences between the intervention (I) and the control group (C) on the two measurement occasions regarding work technique score (including the subscales for the preparation, performance and result phases), ratings of the nursing students’ and the patients’ subjective ratings.

Wilcoxon’s signed rank test was used to test the differences between the first and second measurement occasion (M1 and M2) within each group (I and C) regarding the same variables. Mann Whitney $U$-test was used to calculate the differences between the students in the I and C groups at M1 and M2.

According to a power analysis, of 80% and 0.15 SD and a significance level of 5%, 36 students were needed in each to show differences between and within groups. This calculation was made using the results regarding the work technique score from study III.

The correlations between the nursing students’ work technique score, the students’ three subjective ratings and the patients’ two subjective ratings were made using Spearman’s rank-order correlation coefficient ($r_s$). The correlation coefficients were calculated for both groups (I and C) together at the first measurement, since the prerequisites were the same, but at the second measurement the coefficients were calculated separately for the two groups.

In this thesis supplementary statistical analyses were made for study IV and an overview of the statistical analyses used in the thesis is shown in Table 5.

In this thesis the students in both the intervention group (I) and the control group (C) were divided into subgroups of students with earlier experience from work in the health care sector (WE) and students with no earlier experience from the health care sector (NWE).

Mann-Whitney’s $U$-test was used to test the significance of the differences between the students with previous work experience (WE) and no work experience (NWE) between the I and C group on both measurement occasions (M1 and M2) regarding work technique score (including the subscales for the preparation, performance and result phases), subjective ratings of the nursing students’ and the patients’. Wilcoxon’s signed rank test was used to test the significance of the differences between M1 and M2 in the subgroups (WE and NWE) in both the I group and the C group regarding the variables mentioned above.

In order to analyse the differences in changes between M1 and M2 between the two I and C groups, as well as between experienced (WE) and inexperienced (NWE) students, three-way ANOVAs were conducted.

3.3 EXPERIENCES OF BEING ASSISTED IN TRANSFERS (V)
3.3.1 Participants and context
A qualitative descriptive method as described by Sandelowski (2000) was chosen, as the focus was to describe the participants’ experiences of transfers. In order to select information-rich cases, a purposeful sampling was used (Maxwell, 1996). To obtain a rich variety of experiences, the participants in this study were either inpatients at a
geriatric clinic or living in a municipal nursing home. The physiotherapists were contacted and asked to choose participants with experience of being assisted in transfers. Thirteen people, 10 women and 3 men over 65 years of age (72-96), participated in the study. They were assisted in transfers and had a variety of future expectancies and required varying degrees of assistance. At the geriatric clinic, patients often came from short-stay hospitals for rehabilitation after, for example, a hip replacement, a fracture or a stroke. They stayed for an average of 6.5 days before being discharged. During this stay, the focus was on the rehabilitation process, and patients trained their ability to move, transfer and perform daily activities. In the nursing home, older people are considered as living within their own home, although nurses and staff are available 24 hours a day to assist in activities.

### 3.3.2 Data collection and analysis

The thirteen semi-structured interviews took place between October 2003 and February 2004. The interviews were conducted in a separate room at the geriatric clinic, or in the participants’ own homes. Before starting the interviews the participants were informed about the aim of the study and asked if they had any questions. An interview guide was used to make sure that related subjects were covered. Two main open-ended questions were asked in all the interviews. The participants were asked to describe in as much detail as possible two transfer situations: one that they thought had worked out well, and one that they thought had not worked out well. The interviews lasted between 20 and 50 minutes. All interviews were recorded with the participants’ consent. After each interview the interviewer also wrote field notes with reflections on the interviewee’s experiences. The interviews were transcribed verbatim after the interview by the first author (CJ).

The collection and analysis of data were carried out simultaneously and thereby shaped by each other. The interviews were analysed according to qualitative descriptive method (Sandelowski, 2000) and the process of the analysis was guided by Miller and Crabtree (2000).

The process of the analysis started with the author (CJ) reading through the 13 interviews several times to gain an overall picture. The interviews were further read through (CJ) with the aim of the study in mind. Meaning units were identified and codes were written in the margin. A coding scheme was developed, and both the authors, (CJ) and (ML), read through the interviews and separately added codes to the identified meaning units according to the coding scheme. The coding was discussed between the authors, and codes related to similar meaning units were grouped together into subcategories. Subcategories related to a similar issue were grouped into a category. The coded meaning units were then compared and classified into subcategories, and in the next step into categories. The authors discussed the appropriateness of the meaning units and checked this by referring back to the interview text. This part of the process, discussing the appropriateness, was done several times and changes were made. Finally the meaning units were all sorted under the subcategories. Excerpts from the meaning units listed were chosen to illustrate the subcategories and categories.
4 ETHICAL APPROVAL (I – V)

Ethical approval has been obtained for all studies in the thesis (I to V) from the Regional Ethics Committee of Karolinska Institutet in Stockholm.

Permission to perform the studies was obtained from the hospital director in the geriatric clinics, from the management at the nursing home and also from the head nurses of the wards in studies I, II and V.

In study III the head nurses, chief physiotherapist and chief occupational therapist were informed and gave their approval of the study.

Regarding the nursing students in study IV, approval for the study was given by the head of the department of nursing.

All participants were informed orally and in writing, and gave their consent to participating in the studies. The patients who were assisted in transfers when the observation instruments were tested for validity and reliability in studies I and II gave their consent after written and oral information.

For ethical reasons, it was not possible to transfer a “real” patient many times; thus, a healthy person served as the patient in studies III and IV.

All participants in studies III and IV were informed that their data from observations, ratings and answers in the questionnaire would be treated with confidentiality, and in study V no information was registered about the diagnosis or social number of the participants.

After the interview (Study V) the participants were encouraged to ask questions, make comments and contact the interviewer if they had any questions or comments later on.
5 RESULTS (I – V)

5.1 OBSERVATION INSTRUMENTS (I AND II)

5.1.1 Validity and reliability of the Pate instrument (I)
The criterion-related validity and inter-and intra-observer reliability, for most of the items in all the three phases of the instrument, were shown to be satisfactory (i.e. kappa values between 0.4 – 0.75), and for some of them the agreements were excellent i.e. kappa values > 0.75 (Table I:4).

In the preparation phase, two items concerning whether space is created around the transfer and if the height of the bed is corrected, showed poor agreements i.e. kappa values < 0.40, between one observer and the expert group. The item concerning correction of the bed height also showed poor agreements between the observers (Table I:4). In the starting position, the items concerning the “feet distance” and the “gait position”, showed poor agreements between the observers. In the performance phase item 16 “stimulates the patient verbally” showed poor agreement between one observer and the expert group and between the observers. The assessments of the back variables, the categories items 18 and 19, 4 and 3 respectively, caused problems. In these two items poor agreement was shown between the observers and the expert group in six and four respectively of the seven kappa values and between the observers in four of the seven kappa values. In item 20, concerning the use of the legs in an antero-posterior weight transfer, the agreement was poor between the observers and the expert group, between the observers and between one observer’s observations from two occasions (Table I:4).

For some of the items in the actual performance phase, low kappa values were achieved, although the percentages of agreement were high, due to low variability of observations between categories (Table I:4).

The intra-class correlation coefficients, used to test for agreements regarding the calculated overall scores between the two observers and the expert group were 0.77 and 0.80 respectively, and between the two observers were 0.71. The reproducibility within one observer was 0.90.

5.1.2 Validity and reliability of the DINO instrument (II and the Thesis)

5.1.2.1 Validity and inter-observer reliability (II)
The knowledge of the expert group and work technique characteristics described in the literature were used in the process to establish content validity. The expert group used their knowledge, experience and the literature, to evaluate that the items in the instrument were relevant, appropriate, and that the items measured dimensions of work technique. A consensus about the items in the instrument, the key and the scoring system was reached.

The criterion-related validity was shown to be satisfactory. The differences in the overall score in the DINO instrument showed a significant difference between the transfers classified into the three groups of ergonomic hazards assessed with PLIBEL for each of the observers (Figure II:1). The post hoc test (Fisher’s PLSD) showed that for all three observers (A, B and C) significant differences were shown in the overall DINO score between the groups of high and low presence of hazards. For observer A and B differences in the overall DINO score were shown between moderate and low
hazards. Regarding observer B the differences were between the groups of high and moderate hazards.

The inter-observer reliability, for most of the items in the preparation and result phases of the instrument, were shown to be satisfactory (i.e. kappa values between 0.4 – 0.75), and for some of them the agreements were excellent (i.e. kappa values > 0.75) (Table II:5). In the preparation phase, poor agreement was shown in item 1 “patient encouraged to cooperate” in two of the observers’ comparisons and in item 2 “enough space prepared for the transfer” in all three observers’ comparisons. In item 5 “use of transferring aids” the kappa values in two of the observers’ comparisons were not possible to calculate since only one of the observers used the information category. In the result phase, poor agreement was shown in item 16 “patient in a functional position” in one comparison between two observers.

The percentage of agreement in per cent between pairs of observers, and between all three observers is shown in Table II:6. The corrected agreement in this thesis between the registrations of the three observers regarding the items in the performance phase (8-13) were mostly acceptable except for item 8, according to the intraclass correlation coefficients (ICC) (Table 6). The ICC value for the agreement between the observers regarding the overall scores (work technique score) (n=42) was 0.72 (95% CI 0.59-0.83).

5.1.2.2 Intra-observer reliability (Thesis)
The intra-observer reliability, for three of the items in the preparation and result phases of the instrument, was shown to be satisfactory (i.e. kappa values between 0.4 – 0.75) and four items were shown to be excellent (i.e. kappa values > 0.75 ) (Table 7). One item in the preparation phase, item 7 “enough nurses”, and two items in the result phase, items 14 “causes pain” and 15 “cause feelings of fear or uncertainty” could not be calculated, since the observer used only one category on one or both measurement occasions. The intra-class correlation coefficients used to test for reproducibility for one observer in items 8 – 13 were satisfactory (Table 8), and for the overall score the ICC was 0.77 (CI 95% 0.48-0.89).

5.2 EVALUATION OF TRAINING PROGRAMMES (II, IV AND THE THESIS)
5.2.1 Evaluation of training in handling and moving skills (III)
Before training there were no significant differences between the participants in the two models of learning, traditional and quality circles (T and Q), concerning the seven items of work technique (Table III:4).

Both models of learning led to improvements in six of the work technique items (Table III:4), but no improvement was found for ratings of perceived exertion. The interaction effect between time and model of training was non-significant for all of the seven work technique items (Table III:4).

Six months after the training came to an end, 92 % of the participants reported in the questionnaire that they mostly or always used the new technique. However, there was no decrease in the participants’ musculoskeletal problems when comparing before training with six months after (Table III:5). The participants’ job strain was 0.66 before, and 0.62 six months after training, respectively (Table III:5). The prevalence of ongoing musculoskeletal problems in the neck/shoulder region was 50% before training and 41% after (n=42), and in the low-back 44% before and 32% after training n=41.
And there were no decrease in the prevalence of musculoskeletal problems in neck/shoulder and low back regions among participants (n=42 and n=41) who answered the questionnaire both before the training and six months after it came to an end.

When calculating the differences between the participants in the two models of learning concerning the seven work technique items before and after training, using non-parametric statistics in this thesis, the same results were shown (Table 9). This was also the case when showing improvements after training in the training programme (n=51), the traditional group (n=30) and the quality circles (n=21) (Table 9). However, in the quality circles there were two work technique items, the participants’ subjective ratings of work technique and comfort, where no improvement was found using non-parametric statistics (Table 9).

5.2.2 Evaluation of proficiency training in patient transfer methods (IV)

Descriptive data for the six measured variables for the intervention (I) and control (C) groups on the two transfer occasions (M1 and M2) are shown in Table 10. The differences between the I and C groups were small at the first measurement, and, as shown in Table 11, none of them were significant. On the second measurement occasion (M2) the I group had a higher work technique score (totally and in the three phases), and the nursing students in this group rated their work technique as better and their exertion as lower than the nurses in the control group. The patients’ safety ratings showed a difference in the same direction. All these differences were significant (Table 12). The nurse’s comfort rating was the only variable that did not differ between the groups at the second measurement occasion.

In the intervention group, the results showed significant improvements in all variables after training, as compared to before (Table 12). Improvements were also obtained in the control group’s work technique score and the students’ ratings of comfort and work technique, whereas no significant changes were found for the nurses’ exertion ratings or the patients’ ratings (Table 12). The analyses of the subscales of DINO showed that the control group had significantly improved their score in the performance phase, whereas the intervention group improved their score in all three phases (Table 12).

The three-way ANOVA showed that the improvement was significantly greater in the intervention group than in the control group in all variables except the DINO score in the result phase (as reflected by the interactions between group and measurement occasion).

At the first measurement, positive correlations were obtained between the patients’ subjective ratings of comfort and safety and the students’ work technique score (DINO) and subjective ratings of work technique and comfort, whereas the students’ perceived exertion was negatively correlated with the patients’ ratings (Table IV:3).

On the second measurement occasion the overall work technique score (DINO) and the patients’ subjective ratings of comfort and safety were correlated in both the intervention and the control group (Table IV:3). With the exception of perceived exertion in the intervention group the students’ ratings, of comfort and work technique, were not correlated with the patients’ ratings in either of the two groups (Table IV:3).
5.2.2.1 Students with or without previous work experience (Thesis)

Descriptive data for the six measured variables for the intervention and control groups, divided into two subgroups, previous work experience in health care (WE) and no previous work experience in health care (NWE), on the two transfer occasions (M1 and M2) are shown in Table 10. There were no differences, in the six variables and the three subscales, between the students in the WE and NWE groups when comparing between the I and C group at M1 (Table 11). When comparing between the WE students in the I and C groups at M2, differences were shown in four of the six variables and two of the subscales at M2 (Table 11). When comparing between the NWE students in the I and C groups at M2, differences were shown in three variables and two of the subscales (Table 11).

For the WE students in the intervention group the results showed improvements in all variables and the three subscales after training, at M2 as compared to before (Table 12). In the NWE group in the intervention group, the results showed improvements in five of the six variables and all three subscales after training at M2, as compared to before (Table 12). No significant improvement, i.e. decrease in the perceived exertion was shown after training.

In the WE group in the control group, the results showed improvements in two of the variables, the students’ ratings of comfort and their own work technique, at the second measurement, as compared to the first (Table 12). In the NWE group in the control group, the results showed improvements in two variables, the students’ ratings of their own work technique and the patients’ rating of safety, at the second measurement, as compared to the first (Table 12).

With respect to the effect of experience the three-way ANOVAs showed that the experienced group had higher work technique scores (DINO) and performance phase scores (the latter only in the intervention group), but experience did not affect the change of work technique scores from M1 to M2. However, improvements of self-rated comfort and work technique were greater among the students without work experience (the three-factor interaction indicated an insignificant trend for this effect to be greater in the I group than in the C group, p=.055 and .083, respectively). The experienced group generally rated their comfort, work technique as higher than the non-experienced group.

5.3 EXPERIENCES OF BEING ASSISTED IN TRANSFERS (V)

It was obvious from the interviews that transfers were seen in different ways; descriptions of different situations, and why these situations occurred, were given by the participants.

In the analysis of data, three categories emerged: “Own contribution”, “Nurses’ contribution” and “Time for cooperation” (Table V:1).

The participants’ description of their own contribution during the transfer was divided into two subcategories: “fear of falling and fear of pain” and “confident of my own ability”. Most of the participants emphasised that their inability gave rise to the fear of falling and fear of pain, and thus of endangering the healing process of, for example, a fracture when performing a transfer. All participants were fully aware of their physical disability, i.e. what activities they were unable to perform, such as getting out of bed, standing and going to the bathroom, as well as what assistance they needed. The
participants expressed that they were not able to contribute due to their disorders, but also due to being old and tired.

All participants emphasised that their own ability to perform movements was crucial to their contribution. Some of them stressed that if they were able to perform specific movements they wanted to use that ability, and this was also viewed as part of their rehabilitation. They recounted their abilities, what they accomplished and how, and further what kind of assistance they needed.

The participants’ view of the nurses’ contribution in a transfer was divided into two subcategories: “skills to make it safe and prevent pain” and “lack of skills to make it safe and prevent pain”.

The participants experienced that most of the nurses had skills and knowledge about how to take action and assist in a safe, secure and comfortable way. The nurses’ knowledge was emphasised in connection with the use of appropriate movements and use of transferring aids, if necessary, in taking action to prevent falls and slips.

The transfer could be performed in cooperation between participant and nurse in a safe and comfortable way when the nurses clearly guided the participant by informing what to do, how to do it and when.

Some participants expressed that the nurses did not know how to take action and how to assist in order to make the transfer safe and to prevent pain.

The category “time for cooperation” was divided into two subcategories: “Nurses have enough time” and “Nurses are short of time”.

The participants experienced that the nurses had enough time for cooperation during the transfers. Some participants, on the other hand, experienced that there was a shortage of staff, that the nurses had much to do, and that by asking for help the participants would be interrupting and disturbing the nurses.
6 DISCUSSION
6.1 METHODOLOGICAL CONSIDERATIONS
6.1.1 Observation instruments

In studies I and II observation instruments were developed for assessment of nurses’ patient transfer technique, i.e. work technique during patient transfer tasks, with regard to musculoskeletal health and safety. The Pate instrument (Study I) and the DINO instrument (Study II) were developed for assessment and registrations of a nurse’s work technique during a transfer, by an observer using video recordings and direct observations respectively. The observation instruments were developed after many years of performing training programmes in patient transfer methods based on the Stockholm training concept (Lagerstrom et al., 1999), where it was regarded as unsatisfactory to be unaware of the short- and long-term effects of the training on the participants’ work technique.

Thus, the Pate instrument was developed to meet the need for an accessible, i.e. easy to use, instrument, with a detailed description of the nurse’s work technique. This instrument was used by Kjellberg, who has collaborated in the development of both instruments for registration of nurses’ work technique (Kjellberg et al., 2003, Kjellberg et al., 2004) and in the evaluation of a training programme (Study III). The instrument was useful for its purpose, although when using the Pate instrument, it was found to be inconvenient, time-consuming and costly to make video recordings with two cameras and further to register the nurse’s work technique.

Moreover, it could also be considered unethical to make video recordings of transfers at the ward in daily work when evaluating training programmes. For this reason the DINO instrument was developed, in order to fill the need for an easy and cost-effective tool that was simple to use and did not need any special equipment.

The main application of the Pate and DINO instruments is in intervention studies, to evaluate training programmes such as on-the-job training, or according to a curriculum, where the aim is for nurses to learn and improve their work technique. Both instruments can be used by an observer to register different aspects of the nurse’s motor performance, arrangements of the physical environment and how the patient is encouraged to cooperate during the transfer. The instruments can also be used in epidemiological studies to explore the relationships between work technique and WMSDs. Furthermore, the instruments can be used to assess compliance to the learnt method in working life at the ward, and to assess nurses’ work technique as one tool for measuring quality of care. The instruments can also be used as pedagogical tools for participants, for example in training through assessment of one’s own performance by self-rating on each item in the instruments.

Both instruments can be used by persons with knowledge in patient transfer methods and ergonomics. Specific initial training of observers is needed, where expert feedback is given in order to provide the observers with accurate criteria for their judgements. When using the instruments, for example when observing nurses before and after training, it would be advantageous to use the same observer and compare the same type of transfers, with prerequisites as similar as possible. The background description in the DINO instrument was an attempt to make it possible for the observer to describe the type of transfer, characteristics of the nurse, the patient and the environment, and thus be able to compare similar transfers.
The new feature of the two developed instruments compared with other available observation instruments, is the focus on the assessment of the individual work technique during a patient transfer task, i.e. the nurse’s actions to modify the physical workload, rather than on the physical workload itself.

The instruments have different applications, since Pate is designed to make detailed descriptions from video recordings, while DINO, which has fewer items, is designed to be used in direct observations, but can also be used for video recordings. Further, with the DINO instrument, the patient safety and comfort during the transfer are assessed by the observer, which is not the case when using Pate.

However, it should be emphasised that neither the Pate nor the DINO instrument are suitable tools to identify overall musculoskeletal hazards; both instruments function on the individual level. Certain prerequisites on the organisational level that have an impact on the nurse’s work technique, such as sufficient staffing, enough space and the availability of transferring aids, are not focused on.

6.1.1.1 Work technique scores
The work technique score (overall score) of both instruments merely designates the musculoskeletal hazards due to the individual nurse’s work technique and does not cover risks due to other work or individual risk factors. Further, the relation of a work technique score to the level of musculoskeletal safety is not known. The work technique score gives an indication of musculoskeletal safety, but we do not know the clinical implication of a difference between, for example, a work technique score of 0.9 and 0.8. The work technique is regarded as a modifier to reduce the mechanical exposure and thus to reduce the physical load on the nurse. It is important to emphasise that the actual load on the nurse’s musculoskeletal system during the transfer is unknown. Objective measurements with technical instruments, using for example electromyographic recordings (EMG), and biomechanical analysis of load on the musculoskeletal system, are needed in order to evaluate the relation between work technique scores and the physical load on the nurse’s musculoskeletal system.

Until further knowledge can be gathered, the work technique score 1 is regarded as safe or ideal. Further, it is also necessary to evaluate if a safe work technique, i.e. overall score of 1, is highly correlated to other, more objective, direct measurements measuring physical load and energy expenditure. Also, prospective studies are needed to determine whether a “safe work technique” prevents WMSDs when other risk factors are considered.

The work technique score is intended to give a crude measure of the nurse’s work technique with regard to musculoskeletal health and safety. One transfer is assessed at a time, and therefore the score gives no information on the cumulative load of repeated performances of transfers. Also, other work tasks give rise to musculoskeletal load. The exposure of cumulative load on the nurse is of importance and it has been shown by Kumar (1990) that nurse’s aides with back pain had higher cumulative spinal loads compared with those without pain.

The observation instruments are not designed to measure exposure, but work technique in relation to musculoskeletal load. They do not give information on the exact amount of physical load that the nurse is exposed to during a transfer. Only the relative difference between two transfers can be registered. Thus, the score can only be interpreted in relation to another score, where the prerequisites are as similar as
possible, and where the same kind of transfer is compared. Kjellberg et al. (2003) has shown that the overall scores differed between two types of transfers. A higher score (i.e. a safer transfer) was obtained for the transfer higher up in bed when compared with the transfer from bed to wheelchair. It was suggested that the latter transfer is more complex and difficult. To be able to assess and compare transfers with as similar prerequisites as possible, a background description was constructed for the DINO instrument as one attempt to describe the prerequisites of a transfer.

The calculated overall scores of both instruments should be treated as a first attempt to roughly quantify the assessment of work technique. Adding the scores in both instruments to calculate the work technique score can be criticised, since the level of the data is ordinal and does not permit additions (Svensson, 1993). However, such a procedure is common in questionnaires and scales where a person’s total score is determined by summing item scores (Spector, 1992, Streiner and Norman, 2003). This approach of summing scores is also commonly used in other observation instruments developed for risk assessment and work technique (Hignett and McAtamney, 2000, Warming et al., 2004).

In study I, weighted score was added to the items since it was presumed that some of them were of greater importance. However, no weights were applied in study II, since the value and effect of using weights to make items contribute more or less to the total score of an instrument have been discussed in the literature. It has been suggested that the process of using weights is more time-consuming and prone to error; furthermore, it is not conclusive if the weights make any difference (Streiner and Norman, 2003).

6.1.2 Validity and reliability

Validity refers to the degree to which an instrument measures what it is supposed to measure. The evaluation of validity for both instruments mostly showed satisfactory results.

In both study I and study II, content and criterion-related validity were evaluated. When developing the two instruments, content validity was assessed by using expert groups judging that the instruments measured appropriate content, i.e. whether the instrument covered all relevant aspects of work technique. This procedure has been described in methodological literature (Spector, 1992, Polit et al., 2001, Streiner and Norman, 2003) and is a common approach in development of observation instruments (Feldstein et al., 1990, Karhu et al., 1977, Radovanovic and Alexandre, 2004, Warming et al., 2004).

Criterion-related validity was also evaluated in both instruments, but different criteria were used. In study I the validity was evaluated by comparing the registrations from the two observers with the registrations of the expert group, which were treated as the true observations, i.e. the “gold standard”. This procedure is common, but it may be questioned, as it examines the ability of the observers to use the instrument correctly and not the ability of the instrument to measure the correct dimension. The criterion-related validity for the Pate instrument was satisfactory concerning the values of the intraclass correlation coefficients of the overall scores between both observers and the expert group. When evaluating the observation of each item, a few items in the preparation phase and the actual performance phase caused problems. They were the items “creates space”, “corrects bed height”, “back motion” and some categories of “main motor components”. To improve the validity, some changes in the instrument
were made in order to make these items more exactly defined to provide observers with more consistent criteria concerning “enough space” and “corrects bed height”. It was also suggested that video recordings using two cameras instead of one would make it easier for observers and observation procedures in study I. These changes were taken into consideration in study III.

In study II, the criterion-related validity was evaluated by comparing the work technique score of the direct observation instrument with another validated instrument, PLIBEL (Kemmlert, 1995), where a relationship between the overall score of the observation instrument and ergonomic hazards could be assessed. The assessed transfers were classified into three groups of ergonomic hazards, according to PLIBEL. The differences in the overall score in the DINO instrument showed a difference between the three groups, where the higher score was in the group with low presence of risk factors. However, the range of the overall scores was widely distributed in the three groups of hazards. This might be explained by differences between the instruments. DINO is designed only to assess the nurse’s work technique, while PLIBEL measures hazards that might occur. This may explain a high score on DINO and a moderate or high presence of hazards according to PLIBEL. Further, the DINO instrument takes patient aspects into consideration, which the PLIBEL instrument does not. This may explain low scores on DINO and low presence of hazards according to PLIBEL.

The reliability of an instrument refers to the degree of consistency or accuracy with which an instrument measures the attribute it is supposed to measure (Polit et al., 2001). The agreements between the observers were satisfactory for most of the items of the Pate and the DINO instruments. However, in the Pate instrument, one of the items in the performance phase, “corrects the bed height”, showed poor reliability according to the kappa values. This was not the case in the DINO instrument, where agreements regarding this item were shown to be satisfactory. In the DINO instrument poor agreement between the observers was shown for two other items: “encourages the patient to cooperate” and “prepares enough space”. Also, in the starting position and the performance phase of Pate, some items were shown to have poor agreement between the observers. In the DINO instrument one item in the result phase had poor agreement between two of the observers.

The intra-rater reliability was satisfactory for all items in both the Pate and the DINO instrument. However, the kappa values were not possible to calculate for three items, since not all categories were used. The kappa value depends on an even distribution among the categories in the items, which implies that if a category occurs seldom or not at all, it is difficult to obtain a high kappa value (Streiner and Norman, 2003). The kappa values might have improved for some of the items in both instruments if it had been possible to control that all categories in the items occurred to the same extent. However, in study II it was not possible to control the distributions, since the observations took place during two days in an authentic clinical setting. There are difficulties associated with the interpretation and comparisons between kappa values in different studies. The kappa values depend on the proportion of subjects in each category. This implies that if the proportion in the categories is not equal in the studies, the chance expected frequencies are very different and it is difficult to compare the results (Altman, 1991). Further, the kappa values also depend on the number of categories in the items (Altman, 1991). This
makes it difficult to compare the kappa values from studies I and II with the Danish instrument (Warming et al., 2004), although all three include a preparation phase.

The inter-rater reliability of the items in the performance phase in the DINO instrument were shown to be acceptable, except for item 8 where it was shown to be poor. However, regarding the intra-rater reliability, all items in the performance phase can be considered as satisfactory (Fleiss, 1981).

The inter-rater reliability of the overall scores for the instruments were 0.71 and 0.72 respectively. The inter-rater reliability for the overall score was 0.9 for the Pate instrument and 0.77 for the DINO instrument. This could be considered as excellent according to Fleiss (1986). The lower intraclass correlation coefficients for the intra-rater reliability in DINO might be due to the fact that the observer was only allowed to view the video-recorded transfer once, without being able to replay or freeze the picture, which was one of the prerequisites for the observer using the Pate instrument. Intra-rater reliability is normally higher than inter-rater reliability. This has also been the case in other studies (Horneij et al., 2002). The higher intra-rater reliability can be explained by learning effects, i.e. the observer remembers the transfers observed and how they were judged if there is a short time between the observations (Kilbom, 1994). This was taken into consideration in both studies, where the time between the two observation occasions was two and three weeks respectively. Also, the order of the transfers on the video was changed. The errors of the scores of each item seemed to cancel each other out when the overall score was calculated. This could be one possible explanation for the reliability of the overall score being high, although the reliability of items 9-13 in the DINO instrument was at a lower, but acceptable, level. The intraclass correlation coefficients are also interpreted differently by different authors, and it is important to consider this in relation to how the instrument is going to be used. If important decisions are going to be made about an individual, a score of 0.90 is a minimum recommendation; 0.95 is more desirable (Nunally and Berstein, 1994), while 0.7 is moderate. The Pate and the DINO instruments are not intended to be interpreted in this way, and cannot be used when deciding if an individual nurse has a safe work technique or not. Their primary use is in evaluating effects of training. Fleiss (1986) has defined the lowest limit at 0.4, which indicates that the reliability is acceptable for the inter-rater reliability of performance phase of DINO, except for the item 8 (balance). An item with low reliability also has low validity, which means that further attention needs to be given to item 8.

However, validity and reliability is usually a matter of degree, and validity and reliability tests are not established once and for all, but are a never-ending process (Fleiss, 1986, Nunally and Berstein, 1994). To summarise, the instruments have an acceptable validity and have an acceptable reliability for their purpose to assess nurses’ work technique during a patient transfer task, but only for the tested groups. However, item number 8 needs to be redesigned and it is also recommended that the reliability should be tested when using the instruments.

The ability of both observation instruments to identify work technique features (physical exposure) associated with an increased risk of development of WMSSDs, i.e. external validity, is still a concern (Kilbom, 1994). Most items in both instruments were selected according to their relation to physical, i.e. musculoskeletal, load, as found in scientific articles, review articles and textbooks. Only a few items were based on epidemiological studies of risk factors. The ability of the work technique scores
(calculated as overall scores) of the instruments to predict risk of WMSDs should thus be a subject for future studies. It is discussed in the literature (Polit et al., 2001) that the more types of validity that are assessed, the better, but the instrument cannot be said to have everlasting validity. Validity needs to be established repeatedly with different aspects and for different groups.

### 6.1.3 Translation to other languages

When translating instruments into other languages it is proposed that certain procedures should be followed, and it is essential that congruency between words and their meaning is assured in the translated language (Bowling, 2004). When translating the DINO instrument into English, an attempt was made to ascertain these aspects by discussing both with native English people with knowledge in patient transfer tasks, and with two bilingual translators. However, this is not in accordance with the described procedures, and further examination of the appropriateness of the translation may be needed. This is a problem that is not often commented on in the development of observation instruments) in the ergonomic field. It is important when assessing work technique, but might be even more so when measuring health status, which probably more than anything else reflects the norms of society. Instruments generally reflect the cultural norm of the society in which they are developed (Bowling, 2004). Therefore, there is a need for a multicultural approach for further investigation of the generalisation to other countries and cultures. However, within the ergonomic community, agreement is rather well established concerning reduction of physical load on the nurse and patient safety. But it has been discussed at a workshop whether the instrument can be used in other countries or not, and further work with participants of the workshop, including the present author, is planned.

### 6.1.4 Evaluation of training in patient transfer methods

The main finding of study III was that the participants improved their work technique after participating in the training programme. These improvements were seen, irrespective of model of learning. Two models of learning were evaluated: traditional training and quality circles. There was a similar content in both models, since the same training method, “The Stockholm Training Concept”, was learned in both. However, the sessions were distributed differently in time, where the traditional groups had four consecutive days and the quality circles had meetings regularly over a period of several months. It was hypothesised that, as there was time for the participants in the quality circles to reflect and practise between training sessions, a quality circle would be a more effective way to learn a patient transfer method. This hypothesis was not supported, as improvements were seen in both the traditional training programme and in the quality circles. Interviews concerning the process of learning among participants in both models were performed a few months after training, and one apparent finding was that time for reflection was important. This opportunity had been given in both models (Carlsson et al.).

When study III was planned, it was suggested that the participants should be randomly allocated to each of the two models of learning. This random allocation, was, however, not possible, due to organisational factors. When comparing the participants in the two models of learning, it was seen that there were no differences between them with regard to background factors, such as age, stature, BMI, working years in health
The main findings in study IV were that the nursing students improved their work technique after participation in the proficiency training. It was also shown that previous work experience did not affect the change of work technique scores from the first measurement to the second measurement. Further, it was shown that the nursing students’ rated their work technique as better, more comfortable and less exerting after the training programme, and that patients rated the transfers more comfortable and safe at the second measurement. The students in the control group also improved their work technique, and rated their own work technique as better and more comfortable at the second measurement. However, the students in the intervention showed greater improvements in all measured variables compared with the students in the control group at the second measurement. Improvements of self-rated work technique and comfort were greater among the students with previous work experience. Furthermore, it was shown that students with previous experience rated their comfort and work technique as higher compared with the students without experience.

A limitation in study IV was the use of a convenience sample. The students should preferably have been allocated either to an intervention group or to a control group, but this was not possible, since the students started the proficiency training at different times during the semester. However, the comparison between the two groups showed that, except for the fact that there were more men in the intervention group, no differences were found regarding other background factors, such as age, previous experience from work in health care and previous training in patient transfer methods. Another limitation in this study was that the observer was not blinded to whether the participants were performing a transfer before or after the training. Consequently, this situation was not in accordance with an optimal study design (Bowling, 2004), but had to be accepted due to practical reasons because of the educational settings where the study took place. The fact that the observer knew whether the students belonged to the intervention group or to the control group may have influenced the registrations with the observation instrument. The observers could have assessed in a more favourable way knowing that the participants had received training and this could have resulted in higher work technique scores (Streiner and Norman, 2003). This is a threat to the external validity of the study, which means that the research results cannot be generalised to other groups of interest (Bowling, 2004). The problems associated with performing intervention studies in health care have been discussed by Kristensen (2000). It should be underscored that the results showed that the students had learnt the recommended transfer method and used a better work technique in a test situation, but nothing is known about their choice of work technique in real work situations. Due to these limitations the results must be interpreted with some caution and generalisations cannot be made. Further, we do not know how long the students in the intervention group might use the recommended work technique in the patient transfer task that they learnt. To be able
to get this information, a follow-up study would have to be performed, which is also planned for the last semester of the nursing studies.

It can also be discussed whether a decrease in the self-rated perceived exertion from 4 to 3, which was shown as a statistical difference in the intervention group when comparing before and after training, has any clinical relevance.

Another aspect of using an observation instrument is that the participants know that they are being observed, and thus do not perform in a “normal” way (Bowling, 2004). This could, however, work in two ways. It could lead to increased efforts to perform according to the learnt method, but it might also lead in the other direction, perhaps due to lack of self-confidence.

Another limitation in studies III and IV is that only one type of transfer, “from bed to wheelchair”, was evaluated. The use of a safe work technique in one type of transfer cannot be generalised to other types of transfers. Therefore, other transfers have to be evaluated.

A further limitation in both studies (III and IV) is that the “patient” was played by a healthy person, due to the fact that it would have been unethical to transfer a patient 98 times in study III and 142 times in study IV. This implies that the results cannot be interpreted as applying to “real patients”. Also, the patient rated only one type of transfer, “from bed to wheelchair”, and generalisations for other types of transfers cannot be readily made.

A basic principle of training programmes in patient transfer methods is that when the nurse uses safe work technique, this technique should also be safe and comfortable for the patient (Lagerstrom and Hagberg, 1997). In study IV, positive correlation was found between the nurse’s work technique and the patient’s safety and comfort. This indicates that this principle is relevant. However, since the role of the patient in the study was played by a healthy person, these results cannot be generalised. Further research is needed in this area.

6.1.5 The patient’s experience of transfer situations

In study V, a qualitative descriptive method was adopted and data was collected from semi-structured interviews, from a purposeful sample of 13 older people over 65 years of age in geriatric and municipal care. The interviews were analysed according to content analysis. The participants described their experiences of a transfer. It was evident that a transfer had several aspects and was consequently described as different activities in daily life. Further, when analysing the interviews, three categories emerged: “own contribution”, “nurses’ contribution” and “time for cooperation”.

Since the aim of this study was to describe older people’s experiences of being assisted in transfers, a qualitative descriptive method was considered appropriate. The intention was to stay close to the data and to use excerpts that represented the experiences of the patients. Since a purposeful sampling was used, i.e. people over 65 years of age, the findings cannot be transferred automatically to other settings and age groups. The experience of middle-aged and younger people who need assistance would probably be different, so further research is needed in this area.

The most prominent findings in this study were that the participants expressed their fear of falling and fear of pain, and thus of endangering the healing process, suggesting that this fear was connected to the transfer situation. Most of the participants emphasised that this fear of falling depended on their own inabilities, but
sometimes also on the nurse’s lack of skills. Several studies have shown that it is common for older people to develop a fear of falling (Delbaere et al., 2004, Fletcher and Hirdes, 2004, Friedman et al., 2002, Murphy et al., 2003), and the accuracy of this can be seen, as the incidence of falls was 18-41% among older people living in the community, at hospitals and in nursing homes (Cumming et al., 2000, de Rekeneire et al., 2003, Sadigh et al., 2004). This is a vicious circle, as falls are predictors of developing a fear of falling (Delbaere et al., 2004, Fletcher and Hirdes, 2004, Friedman et al., 2002, Murphy et al., 2003), but the fear of falling is also a predictor of falls (Friedman et al., 2002). The actual fear of falling limits older people’s ability to perform and participate in daily activities. It has been shown that this fear was related to a decline in ability to perform activities of daily living, and to poorer health (Cumming et al., 2000).

From a patient perspective, the transfer was sometimes viewed as an activity of being transferred from one hospital to another or being transferred home. In training programmes in transfer method, the transfer is generally viewed as a task where the nurse assists the patient to perform basic movements and move from one location to another, or from one position to another (Kjellberg et al., 2000). There is no consensus in the literature regarding when and for which activities the word ‘transfer’ can be used. The transfer situation has been viewed from different perspectives, and several definitions of activities described as transfers have been suggested. For example, when viewed from a research perspective, a transfer has been defined as a task where nurses assist a patient to move from one position to another, e.g. from bed to wheelchair (Kjellberg et al., 2000). This definition was also one of the author’s (CJ) preconceptions. Since the word ‘transfer’ is used in connection with many activities in daily life, the word could mean different things to nurses and patients. For example, in this study, where the interviewer expected the patients to describe transfers according to her preconception, patients talked instead about transfers between hospitals, and transfers to examinations. Interpreting a word differently might give rise to misunderstandings between nurses and patients, which in turn could lead to unnecessary problems. Thus, it is important to keep in mind that words can mean different things to people. The word transfer can be used to describe many activities.

6.2 GENERAL DISCUSSIONS

The patient transfer task is considered physically demanding. In the health care sector more than 90 per cent of the workers are women (Swedish Work Environment Authority, 2003). It has been shown that physical capacity decreases with age (Savinainen et al., 2004a, Savinainen et al., 2004b) and a great part of those performing the patient transfer task and other physically demanding work tasks are older employees. It has also been shown that in younger years women and men perform an equal amount of physically demanding work. However, it is more common that men advance at work and leave the physically demanding work, while women remain in physically heavy work tasks, especially in health care (Torgen and Kilbom, 2000). In the model of this thesis (Figure 3), training programmes in patient transfer methods are regarded as primary prevention against WMSDs. The training programmes aim at creating prerequisites for nurses to learn a recommended work technique, and thus reduce the physical load on the musculoskeletal system. In the evaluation, the
participating nurses and nursing students rated physical exertion, their own work technique, and comfort during each transfer, i.e. before and after training. The ratings were higher for comfort and work technique, but did not decrease for physical exertion. It could be argued that the new recommended work technique did not lead to a decrease in the load during the patient transfer. It could also be argued that the transfer situation, arranged for the purpose of the study, was a light transfer so that the participants should not hurt themselves. The patient was dependent but weight-bearing, and thus there could hardly be a decrease in physical exertion after training. The nurses (Study III) also filled in questionnaires concerning perceived physical exertion in their daily work both before and six months after training. After training they reported less exertion when performing “from bed to wheelchair”. This might indicate that the new recommended work technique led to a decreased physical load in daily work. However, it should be pointed out that the perceived exertion decreased from 6.7 to 5.7, which indicates that the transfer was rated as quite easy. The difference is probably statistical, and the influence on daily work can therefore be questioned.

In studies III and IV, work technique was improved among the nurses and nursing students who attended training in patient transfer methods. According to the model (Figure 2), work technique was seen as a modifier at the individual level. This is seen if the physical load on the nurse during the patient transfer could be decreased as a result of the nurse adopting a recommended work technique.

The way movements are performed is individual, and there are several theories of motor learning (Schmidt and Lee, 1999, Schmidt and Wrisberg, 2004, Shumway-Cook and Wollacott, 2001). The task of assisting another person to move i.e. a patient transfer task is complex. According to movement learning theory (Schmidt and Lee, 1999, Schmidt and Wrisberg, 2004, Shumway-Cook and Wollacott, 2001), we learn in a certain order, as a task gets more complicated. Nurses might for different reasons have difficulties in performing transfers tasks and may not have developed enough motor skills and may therefore have difficulties learning the recommended work technique. This implies that participants in training programmes might need different amount of time and different learning approaches to learn new skills and adopt a safe work technique.

Interventions aiming at decreasing the frequency of musculoskeletal problems among employees can be performed at several levels. Westgaard and Winkel (1997) suggested three levels: the community, the organisation (company) and the individual (worker) levels. In this thesis the individual level has been focused upon, since the training of nurses has been performed with the aim of increasing the skill of the individual. The observation instruments (Pate & DINO) contain an item concerning the use of transferring aids (in the preparation phase). To get a score on this item, the nurse must manage the lifting aids. The training programmes contain information on how to use and when to use lifting aids. Concerning lifting aids, the importance of the interventions at the organisational level is obvious. If the individual nurse learns about the use of lifting aids at her ward, this is of no use if there is no such equipment, if the equipment is not maintained, or if it is hidden in a place where it is not possible to find. These factors need to be attended to at the organisational level; i.e. the managers must realise the importance of lifting aids. If they are used in an optimal way, they decrease the load on the nurses’ musculoskeletal system (Elliord et al., 2000, Silvia et al., 2002, Zhuang et al., 1999). Thus, to be as optimal as possible, the interventions aiming at decreasing
physical load on the nurses, need to be attended to at different levels in the organisation.

Another item in the two observation instruments (Pate & DINO) is concerned with encouraging the patient to cooperate (in the preparation phase). This item has several implications, since the performance and safety of the transfer can be much improved for both the nurse and the patient if the latter gets the opportunity to cooperate according to his ability. When the patient can take part in the transfer and cooperates, this leads to decreased load on the nurse in most cases. Communicating with the patient during the transfer is also one way of minimising the occurrence of what is called “save the patient” situations, for example where the patient’s legs give way or where the patient is about to fall off a chair or out of a bed (Engkvist et al., 1998). A situation like this can lead to uncontrollable load on the nurse’s musculoskeletal system and can give rise to injuries on the low back or other regions of the body. For older people participating in study V, the fear of pain and of falling was an experience they expressed in the interviews. One participant had actually fallen on the floor and her words were: “and that really hurt and since then I haven’t tried any more”. The participants emphasised that this fear of falling and fear of pain depended on their own abilities, and on the nurses’ lack of skills to make the transfers safe and to prevent pain. The patient’s cooperation is not only a matter of security for the nurse, but also for the patient, and as such a matter of quality of care. The importance for nurses to learn to encourage and communicate with the patients cannot be overestimated as an aspect of a safe work technique. This was also shown, as there was a correlation between the work technique and the patients’ subjective ratings of comfort and safety during the transfer in the present study. Thus, the patient transfer method chosen by the nurse when assisting a patient to move, is not only a means of preventing the development of musculoskeletal problems for the nurse, but is also an aspect of nursing care.

It is also important to encourage the patient to cooperate in transfers according to their abilities as a part of their rehabilitation. Often the capability to move is crucial when decisions are made about discharge from a hospital and for continuing to live at home. Older people participating in the study expressed that nurses were short of time, and that there was little time for cooperation. The participants did not dare to ask the nurses for assistance in a transfer. The different aspects of a transfer from the point of view of physiotherapists and nurses could be highlighted. One study showed that physiotherapists saw a transfer as a way of rehabilitating the patient, whereas for nurses it was part of daily care on the ward, where the nurse’s own health and safety was important (Carlsson and Lagerstrom, 2002). Nurses’ responsibility in rehabilitation has traditionally been referred to as meeting personal needs associated with, for example, hygiene, dressing, changing position, movement and feeding (Kirkevold, 1997). There is also general agreement in the literature that nurses play an important role in the rehabilitation of patients, since they are present at the ward 24 hours a day, which provides opportunities for therapeutic work (Kirkevold, 1997). Nurses have the opportunity to activate and encourage the patients to train functional movements during their daily activities, according to their needs. However, the nurses’ role in rehabilitation has not been clearly defined. In one study it was reported that nurses did not view themselves as part of the rehabilitation team; they thought that rehabilitation was primarily the concern of occupational therapists and physiotherapists (Waters and
Christina Johnsson

Luker, 1996). In another study it was shown that nurses do not view adjusting patients’ poor positions as a nursing task. This was seldom performed when needed for the comfort of the patient; the few adjustments made were performed in activities such as giving food, where the primary intention was unrelated to position adjustments (Dowswell et al., 2000).

Another aspect of the shortage of time for the nurses’ cooperation in transfers, expressed by the older people participating in study V, was that there is often a lack of nursing personnel. The workload for each nurse gets heavier as she must attend to more patients, and with an increasing proportion of elderly persons in society, the percentage of older people with multidiagnoses will probably increase. These problems need attention and interventions at the organisational and community levels.

In the model of this thesis (Figure 3) work technique is regarded as a modifier on the individual level. Thus a safe work technique can be regarded as a protective factor for WMSDs at the individual level. If the work technique of a nurse is given the score of 1 in the observation instruments (Pate & DINO), it is considered safe, and as such could be presumed to prevent WMSDs. But if the score is less than 1, meaning that the work technique is not optimal, it can be regarded as a risk factor for WMSDs. In the studies there were few nurses and nursing students with ideal work technique, indicating that there seems to be a need for training in recommended patient transfer methods. It has been shown that being older and suffering from low back problems was also associated with poor work technique when transferring a patient higher up in bed and from bed to wheelchair (Kjellberg et al., 2003). These outcomes indicate that special attention might be necessary when planning training programmes for these groups of employees.

There are also risk- or protective factors in the work organisation. One of these factors is job strain, according to Theorell-Karasek’s model (Karasek and Theorell, 1990). According to Ahlberg-Hulthén et al. (1995), psychosocial factors: psychological demands, authority over decisions, skill utilisation, and support at work, were related to symptoms from the lower back among Swedish nurses. In study III the nurses were asked about job strain before, and six months after, training in patient transfer methods. There was no decrease in the perceived job strain after training. In the study, however, job strain was not related to musculoskeletal problems, but to the idea that increased knowledge in how to perform patient transfer tasks. Thus, gaining a sort of control in this situation might lead to decreased job strain. There were, however, few participants and many dropouts at the time of the second questionnaire, and as such the statistics might not have been completely valid.

WMSDs are the final outcome if primary prevention and other risk- or protective factors are unable to prevent the development of the disorder, according to the model of this thesis (Figure 3). One major concern in Swedish society is the great number of people on long-term sick leave and people with disability pension (Dellve et al., 2003). The group most affected by these problems is women in the health care sector. From the statistics of 2003 it was obvious that nurse’s aides and enrolled nurses were at much higher risk for both reported musculoskeletal diseases and reported occupational over-exertion accidents than employees in all other professions in Sweden (Swedish Work Environment Authority, 2003). On the other hand, as shown in the statistics, being a registered nurse seems rather to be a protective factor, which is connected with the physically lighter work tasks and not the profession per se. Another professional group with physically demanding work tasks is home care workers, also with a majority of
women, where the most important risk factor for permanent work disability due to musculoskeletal problems has been shown to be poor ergonomic/lifting conditions (Dellve et al., 2003).

In study III there was no decrease in neck/shoulder or low back problems among the participants six months after the training sessions. It has, however, been discussed whether a recommended work technique can improve already ongoing musculoskeletal disorders (Kemmlert et al., 1993). Thus, a safe work technique can be a protective factor but should not be seen as a treatment for WMSDs. The role of work technique as a protective factor for WMSDs needs to be elucidated further in epidemiological studies with a long-term perspective.
7 MAJOR CONCLUSIONS

- Two observation instruments for assessment of work technique in patient transfer tasks (Pate and DINO) have been developed. The Pate instrument is based upon video recordings, and DINO on direct observation of the nurse in a transfer task. The tests of validity and reliability were satisfactory for both instruments, and the evaluations of work technique showed that they functioned as intended.

- After training in a recommended patient transfer method, the nurses’ work technique was evaluated, among other things by using the observation instruments. The results showed that the work technique had improved directly after training, but six months later, no reduction of musculoskeletal problems was reported.

- Patient ratings of perceived safety and comfort in a transfer situation increased and it was shown that there was a positive correlation between work technique and the perception of safety and comfort during transfer after the nurses had participated in a training programme in a recommended patient transfer method.

- The results showed that older people, who were either inpatients at a geriatric clinic or living in a municipal nursing home, experienced fear of falling and fear of pain, and thus of endangering the healing process in assisted transfers. The participants considered that this fear depended both on their own inability and on the nurses’ lack of knowledge in performing safe patient transfers.

- There is a need for further research in the area of evaluation of the observation instruments’ validity and reliability, also with respect to other patient groups. More research is needed in order to evaluate training programmes where interventions are carried out both on individual and organisational levels. Evaluations of different types of transfers and programmes need to be made, as well as follow-up studies of nurses’ work technique in daily work situations. There is also a need for further research regarding experiences from transfer situations among other patient groups.
8 Thesis Summary

The ability to move is an important part of everyday life. A person who has suffered from stroke or a fracture, usually needs assistance in transfer situations such as moving from bed to wheelchair. Every transfer is unique, and is an encounter and interaction between the nurse and the patient. Assisted transfers, at hospitals or at home, could lead to high physical load on the nurse’s musculoskeletal system, which in turn could cause musculoskeletal problems. Using training programmes in recommended patient transfer methods, can be seen as primary prevention, since these programmes make it possible for the nurse to learn work technique that will lead to a decreased load on the musculoskeletal system. For the patient, the nurse’s acquired skill, leads to a safer and more comfortable transfer and consequently to improved quality of care.

The overall aim of this thesis, was to develop methods for assessing nurses’ work technique in patient transfers tasks, with the focus on the load on the musculoskeletal system, and to evaluate the work technique after participation in training programmes. Further aims were to evaluate the patient’s safety and comfort in transfer situations, and to describe older people’s experiences of transfer situations.

Study I An observation instrument for assessment of work technique in patient transfer tasks

The aim of this study was to develop a video-observation instrument for assessment of nurses’ work technique in patient transfer tasks, and to relate this to musculoskeletal health and safety, and also to evaluate the validity and reliability of the instrument. When developing the instrument and testing validity and reliability, video recordings of patient transfers performed by 23 nurses at a ward, were used. The observation instrument, named Pate, consists of 24 items, divided into three phases of a transfer: the preparation phase, the starting position and the performance phase. Seventeen items are used to calculate an overall score for the instrument, the so-called “work technique score”. The results showed that validity, inter- and intra-observer reliability were satisfactory both for most of the items, and for the work technique score.

Study II A direct observation instrument for assessment of nurses’ patient transfer technique (DINO)

The video-observation instrument Pate (Study I) was useful, but had some limitations. The aim of this project was to develop a direct observation instrument to assess the work technique of nursing personnel during patient transfers, and to relate this to health and safety in the musculoskeletal system, and also to evaluate the validity and reliability of the instrument. The development of the instrument was based on the Pate instrument. Four observers, who simultaneously registered 45 patient transfers at two different wards, did the validity and reliability tests. Three observers used the instrument in question; the fourth observer used a risk assessment instrument.

The direct observation instrument, DINO (Direct Nurse Observation instrument), consists of 16 items, divided into three phases of a transfer: the preparation phase, the
performance phase and the result phase. All items are used to calculate the overall score of the instrument, the so-called “work technique score”.

The test results showed that the inter-observer reliability was satisfactory, both for most of the items, and for the work-related score. The validity of the overall score was also satisfactory.

**Study III**  Evaluation of training in patient handling and moving skills among hospital and home care personnel

The aim of this study was to evaluate a training programme in patient handling and moving skills. The training programme consisted of two models of learning: traditional groups and quality circles (n=30 and n=21). The 51 participants were video-recorded in one standardised transfer situation: assisting the patient to move from bed to wheelchair, before and after training.

The participants’ work technique was evaluated with the observation instrument Pate (Study I). The patient rated perceived safety and comfort, while the participants rated their own work technique, comfort and perceived exertion during the transfer using rating scales. The participants also filled in a questionnaire both before training and six months after training. The questionnaire covered individual factors, such as the presence of musculoskeletal problems, job strain and perceived exertion during transfers in daily work.

The result showed that immediately after training the participants in both models of learning had improved their work technique, and that both the patient and the nurse perceived the transfer to be more comfortable. There was no difference in the effect of the two models of learning. When comparing the evaluations made by the participants before training with the ones made six months after training, it was shown that the transfer from bed to wheelchair was perceived as less exerting. On the other hand, no decrease of musculoskeletal problems was reported.

**Study IV**  Evaluation of nursing students’ work technique after proficiency training in patient transfer methods during undergraduate education

The aim of this study was 1) to evaluate the work technique of nursing students after proficiency training in patient transfer methods and 2) to investigate a possible correlation between work technique and the patient’s perception of the transfer.

The 71 students (35 in the intervention group and 36 in the control group) performed two patient transfers from bed to wheelchair. In the intervention group the students performed one transfer before and one after training, while the control group performed the two transfers before training. An observer registered the work technique of the students with the use of the direct observation instrument DINO (Study II). The patient rated perceived safety and comfort, while the participants rated their own work technique, comfort and perceived exertion during the transfer, using rating scales.

The results showed that the students improved their work technique after training. Both the patient and the students perceived the transfer to be more comfortable. There was also a positive correlation between the student’s work technique and the patient’s perceptions of safety and comfort during transfer.
Study V Older people’s experiences of being assisted in transfers
The aim of this study was to explore older people’s experiences of being assisted in transfers. Thirteen participants with various diagnoses were interviewed. They were either inpatients at a geriatric clinic or living in a municipal nursing home, and had either long- or short-term experience of being assisted in transfers.

Semi-structured interviews with certain themes were held and the participants described different transfer situations. The themes were constructed, with the use of relevant literature, but also with the help of results from previous studies. The interviews were transcribed verbatim and analysed, using a qualitative descriptive method. The data analysis resulted in three categories: “My contribution”, “The nurse’s contribution” and “Time for cooperation”. The results showed that older people experienced fear of falling and fear of pain, and thus endangering the healing process in assisted transfers. The participants considered that this fear depended both on their own inability and on the nurse’s lack of knowledge in performing safe patient transfers.

Conclusions

- Two observation instruments for assessment of work technique in patient transfer tasks (Pate and DINO) have been developed. The Pate instrument is based upon video recordings, and DINO on direct observation of the nurse in a transfer task. The tests of validity and reliability were satisfactory for both instruments, and the evaluations of work technique showed that they functioned as intended.

- After training in a recommended patient transfer method, the nurses’ work technique was evaluated, among other things by using the observation instruments. The results showed that the work technique had improved directly after training, but six months later, no reduction of musculoskeletal problems was reported.

- Patient ratings of perceived safety and comfort in a transfer situation increased and it was shown that there was a positive correlation between work technique and the perception of safety and comfort during transfer after the nurses had participated in a training programme in a recommended patient transfer method.

- The results showed that older people, who were either inpatients at a geriatric clinic or living in a municipal nursing home, experienced fear of falling and fear of pain, and thus of endangering the healing process in assisted transfers. The participants considered that this fear depended both on their own inability and on the nurses’ lack of knowledge in performing safe patient transfers.

- There is a need for further research in the area of evaluation of the observation instruments’ validity and reliability, also with respect to other patient groups. More research is needed in order to evaluate training programmes where interventions are carried out both on individual and organisational levels. Evaluations of different types of transfers and programmes need to be made, as well as follow-up studies of nurses’ work technique in daily work.
situations. There is also a need for further research regarding experiences from transfer situations among other patient groups.
9 SAMMANFATTNING (SUMMARY IN SWEDISH)

Förmågan att förflytta sig är en viktig del i det dagliga livet. En person som drabbas av exempelvis stroke eller fraktur kan behöva assistans vid förflyttningar t ex från säng till rullstol. Varje förflyttning är unik och innebär ett samspel mellan vårdare och patient. Assisterade förflyttningar på sjukhus och i hemmiljö, kan innebära hög fysisk belastning på vårdaren, vilket kan leda till besvär från rörelseorganen. Utbildning i form av träningsprogram i en rekommenderad patientförflyttningsmetod betraktas som en primärpreventiv åtgärd, eftersom dessa program skapar förutsättningar för vårdare att lära sig arbetsteknik som ska leda till minskad belastning. För patienten innebär vårdarens utbildning att förflyttningen ska kunna utföras säkert och bekvämt och därmed ge ökad kvalitet i vården. Det övergripande syftet med denna avhandling var att utveckla metoder för att bedöma vårdarens arbetsteknik vid assisterade förflyttningar med fokus på belastning av rörelseorganen, och att utvärdera arbetsteknik efter deltagande i träningsprogram. Syftet var också att utvärdera patientens säkerhet och bekvämlighet vid förflyttningar, samt att beskriva äldre personers uppfattning och erfarenheter av förflyttningssituationen.

Delarbete I An observation instrument for assessment of work technique in patient transfer tasks

Syftet med projektet var att utveckla ett videoobservationsinstrument för bedömning av vårdpersonals arbetsteknik vid patientförflyttningar i relation till hälsa och säkerhet i rörelseorganen och att utvärdera instrumentets validitet och reliabilitet. Vid utveckling av instrumentet och vid test av validitet och reliabilitet användes videofilmade patientförflyttningar utförda av 23 vårdare på vårdavdelning. Observationsinstrumentet, kallat Pate, består av 24 bedömningspunkter, indelade i tre faser av en förflyttning; förberedelsefasen, startposition och genomförande. 17 bedömningspunkter används för att beräkna en total poängsumma för hela instrumentet, s k "arbetsteknikpoäng". Resultaten av testet visade att validitet, inter- och intrabedömarreliabilitet var tillfredsställande både för de flesta bedömningspunkterna och den totala poängsumman.

Delarbete II A direct observation instrument for assessment of nurses’ patient transfer technique (DINO)

Videoobservationsinstrumentet Pate (delarbete I), visade sig användbart, men begränsningar fanns. Syftet med detta projekt var att utveckla ett direktobservationsinstrument för bedömning av vårdarens arbetsteknik vid patientförflyttning i relation till hälsa och säkerhet i rörelseorganen och att utvärdera instrumentets validitet och reliabilitet. Med Pate som utgångspunkt utvecklades instrumentet. Test av reliabilitet och validitet genomfördes genom att fyra observatörer samtidigt bedömde 45 patientförflyttningar på två vårdavdelningar. Tre av observatörerna använde det aktuella instrumentet, medan den fjärde använde ett riskbedömningsinstrument. Direktobservationsinstrumentet, kallat DINO (Diirect Nurse Observation instrument), består av 16 bedömningspunkter, indelade i tre faser av en förflyttning; förberedelse-, utförande- och resultafas. Samtliga bedömningspunkter används för att beräkna en total poängsumma för hela
instrumentet, s k "arbetsteknikpoäng". Resultatet av testet visade att interbedömarreliabiliteten var tillfredsställande, både avseende överensstämmelse mellan observationerna för de flesta av bedömningspunkterna och för arbetsteknikpoängen. Validiteten för den totala poängsumman var också tillfredsställande.

**Delarbete III**  Evaluation of training in patient handling and moving skills among hospital and home care personnel


**Delarbete IV**  Evaluation of nursing students’ work technique after proficiency training in patient transfer methods during undergraduate education


**Delarbete V**  Older people’s experiences of being assisted in transfers

Syftet med projektet var att beskriva äldre personers erfarenheter av att bli assisterade vid förflytningar. Tretton patienter med olika diagnoser på geriatrik klinik och boende inom kommunal omsorg, med kort eller lång erfarenhet av assisterade förflytningar intervjuades. Halvstrukturerade frågor med förutbestämda teman

**Slutsatser**

- Två observationsinstrument (Pate & DINO) för utvärdering av arbetsteknik vid patientförflyttning har utvecklats. Instrumenten baseras på videorespektive direkt observation av en vårdare vid en förflyttning. Testet för reliabilitet och validitet var tillfredsställande för bågge instrumenten och vid genomförda utvärderingar av arbetsteknik fungerade på det sätt som avsågs.

- Efter träningsprogram i en rekommenderad patientförflyttningsmetod utvärderades vårdarnas arbetsteknik bl a med observationsinstrumenten. Resultaten visade att arbetstekniken förbättrades direkt efter genomfört träningsprogram, men sex månader senare rapporterades ingen minskning av besvär i rörelseorganen.

- Patienters skattnings visade att säkerhet och bekvämlighet i förflyttningssituationen ökade och att det förelåg ett positivt samband mellan arbetsteknik och skattning av säkerhet och bekvämlighet under förflyttningen efter att vårdarna genomfört träningsprogram i en rekommenderad patientförflyttningsmetod.

- Upplevelser av förflyttningar hos äldre patienter på geriatrisk klinik och boende inom kommunal omsorg, alla i behov av assistans vid förflyttningar, var rädsla för smärta, rädsla för att falla och för att på så sätt försämra pågående läkningsprocess. Deltagarna ansåg att denna rädsla berodde på egen oförmåga och på sjuksköterskors bristande kunskaper i att genomföra förflyttningar på ett säkert sätt.

- Fortsatt forskning avseende utvärdering av instrumentens validitet och reliabilitet behövs, även avseende andra patientgrupper. Vidare forskning behövs också för att utvärdera träningsprogram där interventioner görs på organisatorisk och individuellt nivå. Flera varianter av förflyttningar och olika program behöver utvärderas, liksom även uppföljning av deltagarnas arbetsteknik i det dagliga vårdarbetet. Vidare behövs ytterligare forskning avseende upplevelser och erfarenheter i förflyttningssituationen av andra grupper vårdtagare.
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11 REFERENCES


The patient transfer task - methods for assessing work technique


Table 1  Overview of type of study, sample, participants and data collection methods in studies I-V and in the thesis.

<table>
<thead>
<tr>
<th>Type of study</th>
<th>Study I</th>
<th>Study II</th>
<th>Study III</th>
<th>Study IV</th>
<th>Study V</th>
<th>Thesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instrument development</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participants</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
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<td>Expert group</td>
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<td>7</td>
<td></td>
<td></td>
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<tr>
<td>Teachers in transfer technique</td>
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<td>Observers</td>
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<td>15</td>
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<td></td>
<td></td>
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<td>Participants</td>
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<td>Nursing students</td>
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<td>3</td>
<td>13</td>
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<td>Observers in training programmes</td>
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<tr>
<td>Patient's experience</td>
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<td>Patients</td>
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<td>Data collection methods (I-V)</td>
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<tr>
<td>Video recordings (Pate)</td>
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<td>X</td>
<td>X</td>
<td></td>
<td>X (DINO)</td>
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<td>Direct observations (DINO) (PLIBEL)</td>
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<td>Subjective ratings (scales)</td>
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<td>Questionnaire</td>
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<td>Interviews</td>
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<td></td>
<td></td>
<td></td>
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</tbody>
</table>
**Table 2** The type, number and time of the transfers registered by the observer from video-recorded transfers, n =35.

<table>
<thead>
<tr>
<th>Type</th>
<th>Number</th>
<th>Time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Further up in bed</td>
<td>9</td>
<td>18 - 105</td>
</tr>
<tr>
<td>From lying on the bed to sitting on the edge of the bed</td>
<td>5</td>
<td>6 - 197</td>
</tr>
<tr>
<td>Sitting on the edge of the bed to lying down in bed</td>
<td>6</td>
<td>9 - 62</td>
</tr>
<tr>
<td>Turning in bed</td>
<td>2</td>
<td>15 - 136</td>
</tr>
<tr>
<td>From sitting to standing</td>
<td>5</td>
<td>10 - 79</td>
</tr>
<tr>
<td>From standing to sitting down</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>From sitting on the edge of the bed to wheelchair and vice versa</td>
<td>6</td>
<td>8-152</td>
</tr>
<tr>
<td>Shower trolley to bed</td>
<td>1</td>
<td>47</td>
</tr>
</tbody>
</table>

Previously unpublished data.
Table 3  Overview of dependent variables, measurement scales and statistical analyses used in studies I, II and the thesis.

<table>
<thead>
<tr>
<th>Dependent variables</th>
<th>Measurement scales</th>
<th>Statistical analysis</th>
<th>Parametric or non-parametric statistics</th>
<th>Study I</th>
<th>Study II</th>
<th>Thesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation items (Pate)</td>
<td>Nominal and Ordinal</td>
<td>Overall proportion of agreement</td>
<td>Non-parametric</td>
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<tr>
<td>All three phases 1-24</td>
<td></td>
<td>Kappa coefficient</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work technique score</td>
<td>Ordinal</td>
<td>Intraclass correlation coefficient (based on ANOVA)</td>
<td>Parametric</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observation items (DINO)</td>
<td>Nominal</td>
<td>Overall proportion of agreement</td>
<td></td>
<td></td>
<td>X</td>
<td>x</td>
</tr>
<tr>
<td>Preparation phase 1-7</td>
<td></td>
<td>Kappa coefficient</td>
<td>Non-parametric</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Result phase 14-16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observation items Performance phase</td>
<td>Ordinal</td>
<td>Overall proportion of agreement</td>
<td></td>
<td></td>
<td>X</td>
<td>x</td>
</tr>
<tr>
<td>Work technique score</td>
<td>Ordinal</td>
<td>Intraclass correlation coefficient (based on ANOVA)</td>
<td>Parametric</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CI 95%</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Work technique score</td>
<td>Ordinal</td>
<td>ANOVA differences in work technique scores (DINO)</td>
<td>Parametric</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Work technique score</td>
<td>Ordinal</td>
<td>ANOVA differences in work technique scores (PLIBEL)</td>
<td>Parametric</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work technique score</td>
<td>Ordinal</td>
<td>ANOVA differences in work technique scores (PLIBEL)</td>
<td>Parametric</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Table 4** Overview of the dependent variables and the instruments used by the observers, participants and patients in studies III and IV.

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Instruments</th>
<th>Study III</th>
<th>Study IV</th>
</tr>
</thead>
</table>
| **Work technique** | *Instrument used by the observer*  
  Video observation instrument Pate  
  The overall score assumes a value between 0 and 1, where 1 is supposed to correspond to an ideal technique. | X | |
|                   | Direct observation instrument DINO  
  All three phases are used to calculate the overall score that assumes a value between 0 and 1, where 1 is supposed to correspond to an ideal and safe technique. The three subscale scores (one score for each phase) assume the value between 0 and 1, where 1 indicates that all items in the phase are performed correctly. | | X |
| **Subjective rating scales used by the participants** | | | |
| Comfort | Bipolar rating scale of -4 to 4 with verbal endpoints -4 = very uncomfortable and 4 = very comfortable. | X | X |
| Work technique | Bipolar rating scale of -4 to 4 with verbal endpoints -4 = very bad and 4 = very good*. | X | X |
| Exertion | Borg’s RPE scale a 15-grade scale for ratings of perceived exertion, of 0 to 14 with 1 = very light and 13 = very hard. | X | X |
| **Subjective rating scales used by the patients** | | | |
| Comfort | Bipolar rating scale of -4 to 4 with verbal endpoints -4 = very uncomfortable and 4 = very comfortable. | X | X |
| Safety | Bipolar rating scale of -4 to 4 with verbal endpoints -4 = very unsafe and 4 = very safe. | X | X |

* This rating scale was also used by the observer in study III to rate the work technique (patient transfer technique) of the participants.
Table 5  Overview of dependent variables, measurement scales and statistical analyses used in studies III, IV and the thesis.

<table>
<thead>
<tr>
<th>Study</th>
<th>Dependent variables</th>
<th>Measurement scales</th>
<th>Statistical analysis</th>
<th>Parametric or non-parametric statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study III</td>
<td>Work technique items</td>
<td>Ordinal</td>
<td>ANOVA</td>
<td>Parametric</td>
</tr>
<tr>
<td></td>
<td>Work technique score (Pate)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subjective ratings</td>
<td>Ordinal</td>
<td>ANOVA</td>
<td>Parametric</td>
</tr>
<tr>
<td></td>
<td>Questionnaire MSP</td>
<td>Ordinal</td>
<td>Chi-square test</td>
<td>Non-parametric</td>
</tr>
<tr>
<td></td>
<td>Job strain</td>
<td>Ordinal</td>
<td>Student's t-test (paired)</td>
<td>Parametric</td>
</tr>
<tr>
<td>Thesis</td>
<td>Work technique items</td>
<td>Ordinal</td>
<td>Mann-Whitney U-test</td>
<td>Non-parametric</td>
</tr>
<tr>
<td></td>
<td>Work technique score</td>
<td></td>
<td>Wilcoxon’s signed rank test</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subjective ratings</td>
<td>Ordinal</td>
<td>Mann-Whitney U-test</td>
<td>Non-parametric</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wilcoxon’s signed rank test</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Questionnaire MSP</td>
<td>Ordinal</td>
<td>Chi-square test</td>
<td>Non-parametric</td>
</tr>
<tr>
<td></td>
<td>Job strain</td>
<td>Ordinal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study IV</td>
<td>Work technique score</td>
<td>Ordinal</td>
<td>Mann-Whitney U-test</td>
<td>Non-parametric</td>
</tr>
<tr>
<td></td>
<td>(DINO)</td>
<td></td>
<td>Wilcoxon’s signed rank test</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Spearman’s rank-order correlation coefficient</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subjective ratings</td>
<td>Ordinal</td>
<td>Mann-Whitney U-test</td>
<td>Non-parametric</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wilcoxon’s signed rank test</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Spearman’s rank-order correlation coefficient</td>
<td></td>
</tr>
<tr>
<td>Thesis</td>
<td>Work technique score</td>
<td>Ordinal</td>
<td>ANOVA</td>
<td>Parametric</td>
</tr>
<tr>
<td></td>
<td>Subjective ratings</td>
<td>Ordinal</td>
<td>ANOVA</td>
<td>Parametric</td>
</tr>
</tbody>
</table>
**Table 6** Inter-observer reliability of items 8 - 13, expressed as Intraclass Correlation Coefficients (ICC) with a 95% CI, between all three observers (A-C), and as percentage of agreement in percent (%) between pairs of observers at equal steps on the scale, n = 45.

<table>
<thead>
<tr>
<th>Items</th>
<th>Performance phase</th>
<th>A and B (%)</th>
<th>A and C (%)</th>
<th>B and C (%)</th>
<th>ICC</th>
<th>CI 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. Balance</td>
<td>42</td>
<td>36</td>
<td>36</td>
<td>.16</td>
<td>-.01-.36</td>
<td></td>
</tr>
<tr>
<td>9. Coordination</td>
<td>29</td>
<td>29</td>
<td>40</td>
<td>.48</td>
<td>.31-.65</td>
<td></td>
</tr>
<tr>
<td>10. Movement economy</td>
<td>33</td>
<td>47</td>
<td>33</td>
<td>.56</td>
<td>.4-.70</td>
<td></td>
</tr>
<tr>
<td>11. Load back/shoulders</td>
<td>40</td>
<td>38</td>
<td>38</td>
<td>.56</td>
<td>.4-.71</td>
<td></td>
</tr>
<tr>
<td>12. Communication</td>
<td>36</td>
<td>27</td>
<td>51</td>
<td>.56</td>
<td>.4-.71</td>
<td></td>
</tr>
<tr>
<td>13. Ability to move</td>
<td>22</td>
<td>40</td>
<td>38</td>
<td>.49</td>
<td>.31-.65</td>
<td></td>
</tr>
</tbody>
</table>

Text of the items is abbreviated. For full text see Table II:1. CI = Confidence Interval.

**Table 7** Intra-observer reliability of items 1 - 7 and 14 - 16, expressed as kappa coefficient ($k$) and the percentage of agreement in per cent (%), n=35.

<table>
<thead>
<tr>
<th>Preparation phase</th>
<th>Intra-observer reliability</th>
<th>%</th>
<th>k</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Encourages patient to cooperate</td>
<td>86</td>
<td>0.71</td>
<td></td>
</tr>
<tr>
<td>2. Enough space prepared</td>
<td>86</td>
<td>0.70</td>
<td></td>
</tr>
<tr>
<td>3. Objects positioned and locked correctly</td>
<td>89</td>
<td>0.76</td>
<td></td>
</tr>
<tr>
<td>4. Corrects bed height?</td>
<td>91</td>
<td>0.83</td>
<td></td>
</tr>
<tr>
<td>5. Uses transferring aids</td>
<td>97</td>
<td>0.94</td>
<td></td>
</tr>
<tr>
<td>6. Correct use of transferring aids</td>
<td>91</td>
<td>0.87</td>
<td></td>
</tr>
<tr>
<td>7. Enough nurses</td>
<td>97</td>
<td>a</td>
<td></td>
</tr>
<tr>
<td>Result phase</td>
<td>14. Transfer technique causes pain to the patient</td>
<td>100</td>
<td>a</td>
</tr>
<tr>
<td>15. Transfer technique causes feelings of fear or uncertainty for the patient</td>
<td>100</td>
<td>a</td>
<td></td>
</tr>
<tr>
<td>16. Patient in a functional position</td>
<td>71</td>
<td>0.43</td>
<td></td>
</tr>
</tbody>
</table>

Text of the items is abbreviated. For full text see Table II:1. a: Not possible to calculate since not all categories were used.

**Table 8** Intra-observer reliability of items 8 - 13, expressed as ICCs with a 95% CI, and the percentage of agreement in per cent (%) at one-step difference on the scales and equal, n = 35.

<table>
<thead>
<tr>
<th>Items</th>
<th>Performance phase</th>
<th>% difference</th>
<th>% equal</th>
<th>ICC</th>
<th>CI 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. Balance</td>
<td>100</td>
<td>60</td>
<td>.57</td>
<td>.27-.76</td>
<td></td>
</tr>
<tr>
<td>9. Coordination</td>
<td>91</td>
<td>51</td>
<td>.53</td>
<td>.22-.74</td>
<td></td>
</tr>
<tr>
<td>10. Movement economy</td>
<td>94</td>
<td>60</td>
<td>.61</td>
<td>.34-.78</td>
<td></td>
</tr>
<tr>
<td>11. Load back/shoulders</td>
<td>94</td>
<td>48</td>
<td>.64</td>
<td>.40-.80</td>
<td></td>
</tr>
<tr>
<td>12. Communication</td>
<td>91</td>
<td>57</td>
<td>.74</td>
<td>.48-.87</td>
<td></td>
</tr>
<tr>
<td>13. Ability to move</td>
<td>97</td>
<td>54</td>
<td>.76</td>
<td>.57-.87</td>
<td></td>
</tr>
</tbody>
</table>

Text of the items is abbreviated. For full text see Table II:1. ICC= Intraclass Correlation Coefficient, CI= Confidence Interval.
Table 9 Differences in the work technique items, between the participants in the quality circles (Q) and in traditional groups (T) calculated with Mann-Whitney’s U-test at the first and second measurement, (M1, M2 respectively), and differences between the first and second measurement, (M1, M2 respectively) for both groups (T and Q).

<table>
<thead>
<tr>
<th>Work technique items</th>
<th>Between groups</th>
<th>Before and after training</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=30</td>
<td>n=21</td>
</tr>
<tr>
<td></td>
<td>T/Q M1</td>
<td>T/Q M2</td>
</tr>
<tr>
<td>Observation instrument</td>
<td>p-value</td>
<td>p-value</td>
</tr>
<tr>
<td></td>
<td>.89</td>
<td>.86</td>
</tr>
<tr>
<td>Observers’ ratings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participant’s work technique</td>
<td>.43</td>
<td>.15</td>
</tr>
<tr>
<td>Participants’ ratings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comfort</td>
<td>.64</td>
<td>.89</td>
</tr>
<tr>
<td>Transfer technique</td>
<td>.34</td>
<td>.46</td>
</tr>
<tr>
<td>Perceived exertion</td>
<td>.78</td>
<td>.15</td>
</tr>
<tr>
<td>Patients’ ratings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comfort</td>
<td>.68</td>
<td>.89</td>
</tr>
<tr>
<td>Safety</td>
<td>.13</td>
<td>.87</td>
</tr>
</tbody>
</table>

See table 4 for an overview of the instruments.
Table 10 Descriptive data of the outcome variables, at the first (M1) and second (M2) measurement, concerning, the observers’ assessment of the work technique score (WT) with the observation instrument (DINO), the nursing students’ subjective ratings of comfort, work technique and exertion, and the patients subjective ratings of comfort and safety.

<table>
<thead>
<tr>
<th>Observer</th>
<th>Intervention group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All n=35</td>
<td>WE* n=28</td>
</tr>
<tr>
<td></td>
<td>M1  M2  M1  M2</td>
<td>M1  M2</td>
</tr>
<tr>
<td>WT score (0-1)</td>
<td>.4  .8  .48  .80</td>
<td>.32  .75  .35</td>
</tr>
<tr>
<td>Nursing students</td>
<td>Comfort</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Md</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>(-4-4)</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>WT</td>
<td>Md</td>
</tr>
<tr>
<td></td>
<td>(-4-4)</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>Exertion</td>
<td>Md</td>
</tr>
<tr>
<td></td>
<td>(0-14)</td>
<td>R</td>
</tr>
<tr>
<td>Patients</td>
<td>Comfort</td>
<td>Md</td>
</tr>
<tr>
<td></td>
<td>(-4-4)</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>Safety</td>
<td>Md</td>
</tr>
<tr>
<td></td>
<td>(-4-4)</td>
<td>R</td>
</tr>
</tbody>
</table>

* Nursing students with working experience (WE) from the health care.  
  b Nursing students without working experience (NWE) from the health care. 
  c Subscale scores assume the value between 0 and 1, where 1 indicates that all items in the phase are performed correctly.
### Table 11

Differences in the outcome variables, shown in p-values from Mann-Whitney U tests, between the intervention group (I) and the control group (C), and divided into subgroups with previous work experience (WE) and no work experience (NWE), at the first and second measurement. I n=35 (WE n=28, NWE n=7), C n=36 (WE n=28, NWE n=8).

<table>
<thead>
<tr>
<th></th>
<th>First measurement</th>
<th></th>
<th></th>
<th>Second measurement</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All I and C</td>
<td>WE *I and C</td>
<td>NWE *I and C</td>
<td>All I and C</td>
<td>WE *I and C</td>
<td>NWE *I and C</td>
</tr>
<tr>
<td><strong>p-value</strong></td>
<td>p-value</td>
<td>p-value</td>
<td>p-value</td>
<td>p-value</td>
<td>p-value</td>
<td>p-value</td>
</tr>
<tr>
<td><strong>Observers’ assessment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work technique score</td>
<td>.3</td>
<td>.2</td>
<td>.81</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
<td>.003</td>
</tr>
<tr>
<td>Subscales</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preparation phase</td>
<td>.15</td>
<td>.16</td>
<td>.63</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
<td>.001</td>
</tr>
<tr>
<td>Performance phase</td>
<td>.57</td>
<td>.91</td>
<td>.052</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
<td>.11</td>
</tr>
<tr>
<td>Result phase</td>
<td>.18</td>
<td>.19</td>
<td>.75</td>
<td>.0004</td>
<td>.003</td>
<td>.02</td>
</tr>
<tr>
<td><strong>Students’ ratings</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comfort</td>
<td>.7</td>
<td>.64</td>
<td>.71</td>
<td>&lt;.0001</td>
<td>.09</td>
<td>.15</td>
</tr>
<tr>
<td>Work technique</td>
<td>.71</td>
<td>.8</td>
<td>.48</td>
<td>&lt;.0001</td>
<td>.003</td>
<td>.34</td>
</tr>
<tr>
<td>Exertion</td>
<td>.86</td>
<td>.28</td>
<td>.017</td>
<td>.001</td>
<td>&lt;.0001</td>
<td>.059</td>
</tr>
<tr>
<td><strong>Patients’ ratings</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comfort</td>
<td>.84</td>
<td>.75</td>
<td>.95</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
<td>.041</td>
</tr>
<tr>
<td>Safety</td>
<td>.67</td>
<td>.65</td>
<td>.53</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
<td>.022</td>
</tr>
</tbody>
</table>

*a Nursing students with work experience (WE) from health care. 
*b Nursing students with no work experience (NWE) from health care.

The overall score assumes a value between 0 and 1, where 1 is supposed to correspond to an ideal technique. 
Subscale scores assume the value between 0 and 1, where 1 indicates that all items in the phase are performed correctly. 
On a bipolar rating scale of -4 to 4 with -4 = very: uncomfortable, bad, unsafe, and 4 = very: comfortable, good, safe. 
On a Borg’s RPE scale of 0 to 14 with 1 = very, very light and 13 = very, very hard.
Table 12 Differences within the outcome variables, shown in p-values from Wilcoxon’s signed rank test, between the first and second measurement for both the intervention group (I) and the control group (C), and with the I and C divided into subgroups with previous work experience (WE) and no work experience (NWE), at the first and second measurement.

<table>
<thead>
<tr>
<th></th>
<th>Intervention group, first and second measurement</th>
<th>Control group, first and second measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All (n=35)</td>
<td>WE (n=28)</td>
</tr>
<tr>
<td></td>
<td>NWE (n=7)</td>
<td>C (n=36)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WE (n=28)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NWE (n=8)</td>
</tr>
<tr>
<td>p-value</td>
<td></td>
<td>p-value</td>
</tr>
<tr>
<td>Observers’ assessment</td>
<td></td>
<td>p-value</td>
</tr>
<tr>
<td>Work technique score</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.018</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.17</td>
</tr>
<tr>
<td>Subscales</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preparation phase</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.018</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.62</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.58</td>
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* Nursing students with work experience (WE) from health care. † Nursing students with no work experience (NWE) from health care. The overall score assumes a value between 0 and 1, where 1 is supposed to correspond to an ideal technique. Subscale scores assume the value between 0 and 1, where 1 indicates that all items in the phase are performed correctly. On a bipolar rating scale of -4 to 4 with -4 = very uncomfortable, bad, unsafe, and 4 = very: comfortable, good, safe. On a Borg’s RPE scale of 0 to 14 with 1 = very, very light and 13 = very, very hard.