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Evaluation of an intervention comprising a No Lifting Policy in Australian hospitals ☆

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Abstract

The No Lifting Policy has been adopted in Australia to prevent back pain and injuries among nurses. The present study focuses on the intervention of the "No Lift System" (NLS). The purpose of this cross-sectional study was to evaluate the use of transfer equipment, number of injuries, pain/symptoms and absence from work among nurses after the intervention of the NLS ($n = 201$), and compare to nurses at two control hospitals ($n = 256$). A comprehensive questionnaire was used for data collection. The results show that at the hospital where the NLS had been introduced, the nurses used the purchased transfer equipment regularly. They had significantly fewer back injuries, less pain/symptoms and less absence from work due to musculoskeletal pain/symptoms compared with nurses at the control hospitals. The study showed strong evidence for supporting the implementation of the NLS. The positive results shown in the present study can probably be explained by the agreement between the management, the union and the nurses concerning the implementation of the NLS, as well as its comprehensive approach and participatory design.
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Keywords: Back injury; Intervention; Musculoskeletal disorder; Nurse

1. Background

Nursing personnel have a high prevalence of back pain and occupational over-exertion injuries compared with other occupational groups (Gluck and Oleinick, 1998;Goldman et al., 2000; Gonge et al., 2001; Engkvist et al., 1992). Several studies show that reported back injuries among nursing personnel are related to patient transfers (Engkvist et al., 1992, 2000, 2001; Engels et al., 1996; Burdorf and Sorock, 1997; St-Vincent et al., 1999; Goldman et al., 2000; Retsas and Pinikahaba, 2000). For this reason, many prevention programmes have been, or are being, introduced around the world, in order to avoid or decrease the manual lifting of patients. These programmes are based on different concepts and are more or less comprehensive. Some examples of concepts are No Lifting Policy (Loyd and Coleman, 1996), Zero Lift (Silverstein, 2000; Collins et al., 2004), Healthier Health Care (Engels et al., 1997) and Safe Handling (Wilson, 2001). Others are special Lifting Teams (Charney et al., 1991; Charney, 1997) or Lifting Teams in combination with other interventions (Guthrie et al., 2004).

Training in patient transfer is often required in order to prevent back injuries among nursing personnel (Yassi et al., 1995). However, the traditional approach to training of patient-handling techniques has shown little, or no, long-term preventive effect (Hignett, 1996, 2003; Hsiang et al., 1997; Owen, 2000; Engkvist et al., 2000). Occupational injuries entail great costs for society, employers and employees (Bigos et al., 1991; Dempsey et al., 1997; Seferlis, 1999). In Australia, the number of reported injuries at each hospital influences the hospital's insurance premium (WorkCover premium) and a high incidence of injuries leads to an increased insurance premium.

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With the aim of decreasing the number of injuries among nursing personnel, the Victorian branch of the Australian Nursing Federation (ANF) adopted a No Lifting Policy, based on the UK Royal College of Nursing Policy (Smith and Seccombe, 1996), in 1998 (Australian Nurses Federation (Victoria Branch), 1998). The policy states that

(1) Manual lifting must be eliminated, excluding exceptional or life threatening circumstances.
(2) Patients are to be encouraged to assist.
(3) Manual lifting is permitted, only if it means not lifting most or all of a patient's weight.

Regulations for manual handling operations, HSE 1992, were introduced in the UK in order to decrease manual handling and risk of injury. However, in a review, Kneafsey (2000) stated that they had only had a minor impact. Several factors contribute to the accident process when an injury occurs. These factors are related to shortcomings in the physical environment and the organisation, but also to the nurse and to the patient (Engkvist et al., 1998, 2000; Engkvist, 2004). Several No Lifting programmes are running in hospitals in the state of Victoria on a consultancy basis. In the present study, the introduction of the O'Shea No Lift System (NLS) has been followed. The NLS takes organisation, work environment, the nurse and the patient in consideration.

1.1. No Lift System

The O'Shea No Lift System is a people-/materials-handling programme and uses formal policies, procedures and protocols to implement and maintain the system within the organisation. Roles of executive management, unit managers and hospital staff are clearly defined prior to commencement, with appropriate time frames and outcomes identified. The implementation is carried out in three steps:

Pre-implementation, which includes risk assessment of the area, sufficient space, equipment audit, modifying the patient assessment tools and programme to suit the area, marketing the programme to appropriate stakeholders, identifying trainers and preparing training rosters, organising equipment trials, choosing equipment in cooperation with the nurses on the ward, purchasing equipment needed and developing related policy, procedures and evaluation tools to support and maintain the system, and setting up committees at the local and management level to manage the system.

Implementation, which includes training trainers, training the rest of the staff, competency assessment, patient assessment and problem solving connected with workplace scenarios. Trainers (4 nurses/ward) get 8 h of training and are helpers when training the rest of the nurses (3 h).

Post-implementation, which includes ongoing problem-solving, monitoring compliance with policy and procedures, and regular reporting by the middle management on the set indicators.

1.2. Aim of the study

The purpose of this cross-sectional study was to evaluate the use of transfer equipment, number of injuries, pain/symptoms and absence from work among nurses after the intervention of the NLS, and make a comparison with nurses at two control hospitals.

The study was approved by The Royal Melbourne Hospital Research Foundation, Clinical Research and Ethics Committee, Melbourne. The study was performed in accordance with the Declaration of Helsinki of the World Medical Association.

2. Methods

The study had a cross-sectional design. Three hospitals took part in the study, with the participation of eight wards at one hospital where the NLS had been introduced 6–14 months earlier (NLS hospital), and 11 corresponding wards at two hospitals (control hospitals). Wards included were medical, surgical, orthopaedic, obstetrics & gynaecology, intensive care and emergency wards. The emergency ward at the control hospital withdrew from the study before data collection due to lack of time.

The source population consisted of all nursing personnel (level-one nurses (registered general nurses), level-two nurses (state-enrolled nurses) and service assistants/clinical assistants (auxiliary nurses)) who were employed at the eight wards at the NLS hospital and the 11 wards at the control hospitals. A total of 587 persons were included, all of who belonged to one health care network in Melbourne. Questionnaires were distributed by the head nurses of the wards to all nursing personnel, individually, together with a self-addressed, prepaid envelope. The questionnaire was to be filled in anonymously. The response rate for the questionnaire was 73% at the NLS hospital (201 nurses) and 82% at the control hospitals (256 nurses). At the NLS hospital, 90% worked as level-one nurses, 3% as level-two nurses and 7% as service assistants/clinical assistants. At control hospitals, 92% worked as level-one nurses, 5% as level-two nurses and 3% as service assistants/clinical assistants. In the following text, all will be treated as one group and referred to as "nurses". Background factors and some organisation factors are presented in Table 1.

Table 1
Background and organizational factors of nurses working at a hospital with NLS and at control hospitals

	Hospital	
	NLS ($n = 201$)	Control ($n = 256$)
Age (years)		
Mean	36	32
Range	20–62	21–60
Years in nursing profession		
Mean (years)	15	10
Years in nursing profession (%)		
<1 year	3	2
1–5 years	26	39
>6 years	71	59
Gender female/male (%)	90/10	84/16
Working full-time (%)	29	59
Working on rolling schedule (%)	74	79
BMI		
Mean	24	24
Range	17–42	17–38

2.1. Wards which had NLS for 12 months or longer

At the NLS hospital, the NLS had been in use for at least 12 months on the medical, surgical and orthopaedic wards. In all, there were 93 nurses on these wards at the NLS hospital, and 164 nurses at the control hospitals. The mean age of nurses at the NLS hospital was 35 years (range 21–62 years) and at the control hospitals 30 years (range 21–60 years). Fifty-five per cent had been working 10 years or longer at the NLS hospital compared with 29% at the control hospitals.

2.2. The questionnaire

The questionnaire included a total of 107 questions covering background factors, work-related exposure factors, tiredness, musculoskeletal symptoms and work-related accidents leading to injury in any body part. Most questions had fixed response alternatives, a few being followed by an open question to obtain additional information (Table 2). The questionnaire ended with an open question where the nurse was given an opportunity to add her/his own comments.

2.3. Equipment

Both the NLS and control hospitals were poorly supplied with transfer equipment before the introduction of the NLS. However, the NLS hospital had electric beds for all patients before the introduction of the NLS, as did the orthopaedic ward at the control hospital. The electric bed was also assessed as transfer equipment, since it was used when raising the patient from lying to sitting, lowering the bed so the patient could put his/her feet on the floor and raise him/herself with minimal support when getting out of bed, etc. The nurses at the NLS hospital tested equipment and participated when deciding what equipment should be purchased. Equipment was purchased depending on each ward's assessed needs: 3 hoists, 2 standing walker hoists, 210 slide sheets, 3 rolling frames, 25 walk-belts, 44 foot-stools, 41 bed-ladder straps. The need for a second standing walker hoist was also stated, and this was planned to be purchased later.

2.4. Data treatment and statistical analyses

When analysing dichotomous variables, χ^2 analyses were used to perform a comparison between the NLS hospital and the control hospitals. For continuous variables, *t*-tests for independent groups were used. Total numbers of patient transfers per shift were calculated as the sum of each median value for the nine studied patient transfers in order to represent the total number of patient transfers per shift. The analyses are based on each ward. The analyses were performed with SPSS (Norusis, 1990).

The three wards (medical, surgical and orthopaedic), where the NLS had been in use for at least 12 months, were compared with similar wards at the control hospitals regarding the number of work-related accidents leading to injuries during the last 12 months. The background factors: age, number of years in the nursing profession, number of years at the specific ward, working full-time and working shifts, were also compared for nurses working at these three wards.

3. Results

3.1. Physical exposure

Number of patient transfers and use of transfer equipment The median number of patient transfers by nurses was 20 per work shift, both at the NLS and control hospitals. There were, however, substantial differences between the different wards at the hospitals (Table 3). These differences were the same at the NLS and control hospitals. Most patient transfers were performed at the medical, surgical and orthopaedic wards. The most frequently performed patient transfers per shift were transfers in the bed: moving up in the bed, turning or rolling in the bed and moving from lying to sitting in the bed. Eight nurses, each at the NLS and control hospitals, reported that they never performed any patient transfers.

Table 2
Factors included in the questionnaire

Factors
Background
Gender
Age
Occupation
Height
Weight
Number of years in the nursing profession
Number of years at the specific ward
Work organisation
Type of clinic
Working hours
Working on rolling schedule
Training in use of equipment at own ward
Received training in NLS
Length of training in NLS
Enough training in NLS to manage the daily work?
Enough equipment on the ward to manage the work?
If not, what is missing?
Physical exposure
Number of performed patient transfers during a shift
How often a piece of equipment is used during these transfers
How often the nurse assists in nine different patient transfers during a shift
How often a piece of equipment is used during each of these nine transfers
How many times a certain piece of equipment (of 15) is used per shift
How physically demanding the nurse perceived her work to be on an ordinary day
Symptoms and injuries
"Ongoing symptoms today" referring to a drawing of a man with nine specified body parts
"Symptoms during the last six months" referring to a drawing of a man with nine specified body parts
Have sustained an injury at work in any of these nine body parts during the last 12 months
If so, has this injury been reported on an injury form?
Have had to stay home due to pain from the musculoskeletal system during the last six months
Tiredness
How physically tired the nurse feels after an ordinary working shift
How mentally tired the nurse feels after an ordinary working shift

3.2. Use of transfer equipment

At the NLS hospital, the median value for using transfer equipment was as high as the response alternative "60% of the transfers", compared with the median value "none or nearly none of the transfers" among the control hospitals (Table 3). Use of transfer equipment differed depending on the type of ward. Most often, equipment was used during the patient transfers in the bed. The equipment that was most often used at the NLS hospital was the electric bed, followed by the slide sheet and the monkey bar/bed ladder. In cases when equipment was used at control hospitals, the most frequently used pieces of equipment were the electric bed, the draw sheet, the pat slide and the monkey bar/bed ladder.

3.3. Training in NLS and satisfaction with the amount of equipment at the NLS hospital

Training received in the NLS was reported by 98% of the nurses. Seventy-seven per cent reported that they felt they had received enough training in how to handle the transfer equipment to manage their work, while 23% reported that they felt they had not had enough training. Access to enough transfer equipment to manage their work at the NLS hospitals was reported by 74% of the nurses, while 26% reported they did not have enough. The equipment the nurses most frequently wanted more of was standing walkers (13 nurses), hoists (10 nurses), slide sheets (6 nurses), better chairs (3 nurses), bed sticks (3 nurses) and monkey bars (2 nurses). More equipment in general was requested, so that it did not have to be shared with another ward (2 nurses). Several nurses added that they wanted more training and also more staff.

3.4. Age and years in the nursing profession

As shown in Table 1, more nurses at the NLS hospital were of a higher age than nurses at the control hospitals ($t = 4.764$, $df = 448$, $p < 0.001$). They had also been working longer in the nursing profession ($t = 4.795$, $df = 375$, $p < 0.001$). It was found that nurses at wards where the NLS had been in use for 12 months or longer were of a higher age (mean = 35 years) compared with nurses at similar wards at the control hospitals (mean = 30 years, $t = 3.536$, $df = 252$, $p < 0.001$). On average, they had also been working longer in the nursing profession (5.6 years) than nurses at the control hospitals (4.0 years, $t = 2.349$, $df = 248$).

3.5. Perceived physical exertion and tiredness

Nurses at the NLS hospital rated their physical exertion on an ordinary day to a mean value of 7.2 (range 1–13.5), similar to the mean value of 7.4 (range 1–14) for the nurses at the control hospitals, which means that they were comparable in this respect. Despite this, nurses at the NLS hospital rated their physical tiredness after a normal working shift significantly lower (mean = 5.5, range 0–9) than nurses at the control hospitals (mean = 6.2, range 0–9; $t = 3.77$, $df = 439$, $p < 0.01$). However, there was no difference in mental tiredness rated by the nurses at the NLS hospital (mean = 5.9, range 0–9) and at the control hospitals (mean = 6.2, range 0–9; $t = 1.83$, $df = 438$).

Table 3
Comparison of the corresponding wards at the NLS and control hospitals after introduction of the NLS at the NLS hospital

	Ward[a]											
	Medical		Surgical		Orthopaedic		Obstetrics & Gynaecology		Intensive Care		Emergency	
	NLS	Control	NLS	Control	NLS	Control	NLS	Control	NLS	Control	NLS	Control
No. of nurses (*n*)	46	59	25	73	22	32	35	35	46	55	27	—
No. of patient transfers per working shift (median value)	44	25	23	25	22	42	Not every shift	5	17	11	14	—
Use of equipment during patient transfer (%)	80	~0[b]	40	~0[b]	60	20	~0[b]	~0[b]	80	~0[b]	60	—
No. of months since introduction of NLS	14	—	12	—	12	—	7	—	10	—	6	—

[a]Two nurses at the Control hospitals did not fill in which ward they were working on.
[b]~0 has been used to cover the response alternative "None or nearly none".

3.6. Pain and symptoms

Fewer nurses (65%) working at the NLS hospital reported pain/symptoms from any body part during the last six months, compared with nurses at the control hospitals (76%). Especially back pain was reported less at the NLS hospital (52%) compared with the control hospitals (71%, $\chi^2 = 16.01$, $df = 1$, $p < 0.001$). Fewer nurses (59%) working at the NLS hospital had reported ongoing pain/symptoms from any body part compared with nurses at the control hospitals (69%, $\chi^2 = 5.083$, $df = 1$, $p = 0.02$). Ongoing back pain/symptoms were reported by 50% of the nurses at the NLS hospital compared with 61% at the control hospitals ($\chi^2 = 5.694$, $df = 1$, $p = 0.02$). Of those who had reported ongoing low back pain, nurses at the NLS hospital rated the intensity of their pain the same (mean 4.0, range 1–9) as those at the control hospitals (mean 4.4, range 1–9).

3.7. Absence from work

During the previous six months, 18% of the nurses at the NLS hospital had, on some occasion, stayed home from work due to pain from the musculoskeletal system, compared with 28% at the control hospitals ($\chi^2 = 5.833$, $df = 1$, $p = 0.02$).

3.8. Injuries during the previous 12 months

At wards where the NLS had been in use for 12 months or longer, an injury in one or several body parts was reported by 24% of the nurses at the NLS hospital, compared with 44% among nurses at the control hospitals ($\chi^2 = 10.262$, $df = 1$, $p = 0.001$). Back injuries were most frequent, being reported by 18% of the nurses at the NLS hospital compared with 36% of the nurses at the control hospitals ($\chi^2 = 8.280$, $df = = 1$, $p = 0.004$). Of the nurses who had had a back injury at these wards, 20% at the NLS hospital and 28% at the control hospitals had filled in injury insurance forms. Injuries in one or several body parts were equally spread over the age groups.

3.9. Costs for the introduction of the NLS

Costs in connection with the introduction of the No Lifting Policy amounted to $A 112,225. Costs for management time and time for participating in committees at the local and management level are not included in the calculation. Licence fees, including a No Lift Consultant and eight trainers, amounted to $A 5000. One nurse at the NLS hospital worked 2 days/week for 3 years as a No Lift Coordinator with the introduction and maintenance of the NLS ($A 59,700). Instead of having substitutes during the training sessions, 3 h of the training per nurse was carried out during paid overtime ($A 59,700). Purchase of equipment amounted to $A 32,000. There were neither organisational changes resulting in costs nor any need for additional staff. The hospital had the required space, so there was no need for rebuilding. Based solely on the costs to cover sick pay and medical expenses for a back injury during the 24 months before the introduction of the No Lifting Policy, the mean costs for an injury were $A 1459 (range $A 115–7168). This involves both minor claims and standard claims. Information concerning the cost of introducing the No Lifting Policy at the NLS hospital was provided by the hospital administration, as was information concerning the mean cost of sick pay and medical expenses for a back injury during the 24 months before the introduction of the NLS. Unfortunately, it was not possible to obtain the correct numbers of reported injuries for the years preceding the study from the hospitals.

4. Discussion

The study showed strong evidence for supporting the implementation of the NLS. The positive results shown

in the present study can probably be explained by the agreement between the management, the union and the nurses concerning the implementation of the NLS, as well as its comprehensive approach and participatory design. It involved assessment of risks in the environment, cooperation with the nurses concerning which equipment should be purchased, training the nurses in patient transfer and in how to use the equipment, as well as arranging the space needed and assessing how each patient should be transferred. All nurses also became personally involved by participating in committees or having the responsibility for a certain task, e.g., for loading the batteries to the hoists or having clean draw sheets, which had an impact on social support and decision latitude. Hignett (2003) found that multifactorial interventions, based on a risk assessment programme, were most likely to be successful for the reduction of risk factors associated with patient-handling activities.

The nurses at the compared hospitals performed a similar number of patient transfers and worked shifts to the same extent, which shows that they were exposed to rather similar working conditions. All nursing staff at all wards are to be involved in the No Lifting Policy; consequently wards with very few patient transfers were also included in the study, to get experience and opinions from a group representing all nurses.

Nurses at the NLS hospital used transfer equipment to a very high degree. Equipment was most often used during patient transfers in the bed, which also constituted the most frequent transfer. Even in hospitals with transfer equipment at the ward, a reluctance to use transfer equipment has been found in other studies (Prezant et al., 1987; Engkvist et al., 1992; Garg et al., 1992; Bewick and Gardner, 2000). The explanations found were that nursing personnel could not understand how to use the equipment, or they lacked experience in using it (Bell, 1984; Owen, 1988), or the nurse did not think it was necessary (Evanoff et al., 2003), it was too time-consuming (Evanoff et al., 1999), there was a lack of space, there was no suitable equipment or the equipment was inconveniently stored (Engkvist et al., 1992). All three hospitals were poorly equipped before the introduction of the NLS. Consequently, most of the nurses at the control hospitals had fewer opportunities to use transfer equipment. One exception was the orthopaedic ward at the control hospital which had electric beds and more of other equipment, and also used the transfer equipment. An important part of the NLS is to identify each ward's need for suitable and good transfer equipment. Thus there was more transfer equipment at the NLS hospital after the NLS was introduced.

Compared with nurses at the control hospitals, those at the NLS hospital reported fewer injuries, both in any body part and in the back, which was also the main goal for adopting the No Lifting Policy. The study seems to show that a step towards this goal may have been taken. Under-reporting of back injuries among nursing personnel is known from earlier studies (Owen, 1989; Engkvist et al., 2000). It might be expected that nurses at the NLS hospital hesitated to report an injury when an intervention programme to prevent injuries had been implemented. Nevertheless, no difference in under-reporting was shown between the nurses at the NLS hospital and those at the control hospitals.

Most often, the nurses in the study had long experience of their work, which indicates that the healthy-worker effect had a minor impact. More nurses at the NLS hospital had longer experience, which has been shown to increase the risk of injury due to accident (Kumar, 1990; Owen and Damron, 1984; Stubbs et al., 1983). In the present study, there was a lower risk of injury for the nurses at the NLS hospital compared with those at the control hospitals. Hagen et al. (2000) showed that older women (40–53 years of age) had more back pain compared with younger women or men. Nurses at the NLS hospital had less ongoing back pain/symptoms today, and also during the previous six months, compared with nurses at the control hospitals. They also had less absence from work due to musculoskeletal pain/symptoms. All these findings may indicate preventive effects of the NLS on injuries and back pain.

More nurses at the control hospitals worked full-time, which has been shown to constitute a risk of back injury (Engkvist et al., 2000, 2001). This might have influenced the results so that the increased risk among nurses at the control hospitals is somewhat overestimated. It has been found that nurses aged 50 years or older run an increased risk of injuries, but this was not found in the present study, as the injuries were spread similarly over the age groups (Engkvist et al., 2000).

The most frequently performed patient transfers were in bed and to/from bed, which has also been found to be when most reported injuries occur (Engkvist et al., 1998; Collins et al., 2004; Engkvist, 2004). More than 15 lifts per shift, of 25 kg or more, have been found to be a risk factor for back pain (Hoogendoorn et al., 2000). Investigation of reported back injuries among nurses at the same network as in the present study showed that the transferred patients had a mean weight of 90 kg (range 40–200 kg) (Engkvist, 2004). Therefore it is of greatest importance to have enough good equipment for transfers in bed and to/from bed so as to reduce the load. It is also very important to have enough space to use it, since lack of space has been found to contribute to back injuries among nursing personnel (Engkvist et al., 1998; Engkvist, 2004). Nurses who have received practical training in using the transfer equipment on their own ward, or have frequently used transfer equipment, have a lower risk of back injuries (Engkvist

et al., 2000). Nearly all nurses at the NLS hospital had received training in patient transfer using the equipment and they also used the equipment to a very high degree. Use of lifting equipment has not only proved to greatly decrease the back compression forces, but also to greatly increase the patient's rating of comfort and security during the transfer (Zhuang et al., 1999, 2000). To maintain the NLS at the hospital it is important to have enough equipment, so the nurse does not have to consider whether she should look for equipment or perform the task manually, which might be quicker. Lack of time was mentioned by several nurses as an obstacle for using the NLS, in the same way as shortage of staff, which meant having to perform the task alone, even if two people were needed.

Nurses at both the NLS and control hospitals rated their perceived physical exertion on an ordinary day to be about the same. Yassi et al. (2001) showed decreased fatigue among personnel using transfer equipment. Nurses at the NLS hospital rated their *physical* tiredness after a normal work shift lower than the nurses at the control hospitals did, which is in agreement with findings by Dixon et al (1996), while there were no differences in the rating of *mental* tiredness. Even if the number of manual transfers is reduced, nurses are exposed to other physical and psychosocial work risk factors due to other practical nursing tasks, e.g. feeding and dressing (Josephson et al., 1999). Ergonomic prevention strategies that aim to minimise the risk of work-related back disorders should focus not only on physical, but also on psychosocial risk factors at work (Devereux et al., 1999). However, the literature regarding the relationship between psychosocial demands and back pain is contradictory (Snook, 2004). The patients were encouraged to cooperate as much as possible during the transfer, or were instructed how to perform the transfer themselves. An earlier study has shown that implementation of a No Lifting Policy gave the patients increased independence (Dixon et al., 1996), which many nurses also noted in the questionnaire as a benefit of the NLS. Nearly one in four of the nurses felt that they needed more training and stated that they felt insecure with some equipment. A second training session should be planned and scheduled in advance, so as to provide an opportunity to repeat and review the training, and to discuss special problems identified by the nurses such as how to perform specific patient transfers that have been found to be difficult.

Before drawing confident conclusions regarding the positive effect of the No Lifting Policy that has been shown in the present cross-sectional study, a longitudinal study is needed. Also, the economic outcome of the intervention cannot be evaluated too soon after the implementation due to the fact that even if injuries are much too common, they occur on an irregular basis and must be studied over a longer period of time.

5. Conclusions

The study showed strong evidence for supporting the intervention of the No Lift System. At the hospital where the NLS was introduced, the nurses

- used transfer equipment regularly,
- rated physical tiredness lower,
- had fewer injuries, especially back injuries,
- had less pain/symptoms and
- had less absence from work due to musculoskeletal pain/symptoms compared with nurses at the control hospitals.

The positive results shown in the present study can probably be explained by the agreement between the management, the union and the nurses concerning the implementation of the NLS, as well as its comprehensive approach and participatory design.

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