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The influence of individual and organisational factors on nurses' behaviour to use lifting devices in healthcare

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ABSTRACT

Aims: This study evaluates the influence of individual and organisational factors on nurses' behaviour to use lifting devices in healthcare.
Methods: Interviews among nurses were conducted to collect individual characteristics and to establish their behaviour regarding lifting devices use. Organisational factors were collected by questionnaires and walk-through-surveys, comprising technical facilities, organisation of care, and management-efforts. Generalised-Estimating-Equations for repeated measurements were used to estimate determinants of nurses' behaviour.
Results: Important determinants of nurses' behaviour to use lifting devices were knowledge of workplace procedures (OR = 5.85), strict guidance on required lifting devices use (OR = 2.91), and sufficient lifting devices (OR = 1.92). Management-support and supportive-management-climate were associated with these determinants.
Conclusion: Since nurses' behaviour to use lifting devices is influenced by factors at different levels, studies in ergonomics should consider how multi-level factors impact each other. An integral approach, addressing individual and organisational levels, is necessary to facilitate appropriate implementation of ergonomic interventions, like lifting devices.

1. Introduction

Among nurses, low back pain is a common musculoskeletal disorder (Knibbe and Friele, 1996; Lagerstrom et al., 1998; Smedley et al., 1995). A significant proportion of back pain episodes can be attributed to events that occur during patient handling activities when nurses are exposed to heavy lifting, awkward back postures, and pushing and/or pulling (Da Costa and Vieira, 2010; Smedley et al., 1995; Warming et al., 2009).

In the past years, many ergonomic interventions have been developed, like lifting devices, to reduce mechanical load related to patient handling activities in order to (partly) decrease the occurrence of low back pain. The efficacy of lifting devices designed to reduce mechanical load has been demonstrated in several laboratory studies (Garg et al., 1991; Silvia et al., 2002). However, the timely and integrated implementation at the workplace remains difficult. Various intervention studies have indicated that individual behaviour of nurses is a key factor in successful implementation of lifting devices in healthcare (Koppelaar et al., 2009). As examples, Evanoff et al. (2003) and Li et al. (2004) identified the lack of perceived need to use lifts as an important barrier in the effectiveness of lifting devices at the workplace. Nelson et al. (2006) showed that acceptance of patient handling equipment by the staff was a crucial facilitator in the implementation process of a multiple intervention aimed at patient handling in healthcare. A previous study in hospitals and nursing homes showed that individual behaviour of nurses, i.e. nurses' motivation to use lifting devices, was strongly associated with lifting devices use (Koppelaar et al., 2011). This study also pointed at the influence of organisational-level measures on nurses' behaviour, comprising both factors in each ward as well as at the managerial level of the healthcare institute. Thus, the appropriate implementation of ergonomic devices requires a careful process whereby individual behaviour is supported by organisational measures in order to enable and support the individual to adopt the required behaviour to prevent musculoskeletal complaints. A recent systematic review corroborated that upstream organisational strategies had a profound impact on musculoskeletal health (Westgaard and Winkel, 2011).

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This important principle has been stressed also in adjacent areas in healthcare, such as patient safety, whereby it is important to consider how factors at different levels, for example nurses, wards, and organisations, interact to impact safety outcomes such as adverse drug events and patient harm (Karsh and Brown, 2010).

Individual factors can be identified directly in a traditional analysis of the influence of individual characteristics on the use of lifting devices. However, organisational factors at different levels in a healthcare institute, such as patient's room, ward, and organisation, are hierarchically linked and, therefore, cannot be analysed without taking into account their interdependency. In order to gain more insight into the interrelationship between individual and organisational barriers and facilitators of behaviour among nursing personnel to use lifting devices, a survey was conducted across hospitals and nursing homes in the Netherlands. The particular aim of this study was to evaluate the influence of individual and organisational factors on the individual behaviour of nurses to use lifting devices when required during transfer activities with patients in healthcare.

2. Methods

2.1. Study population

The present cross-sectional study took place in 19 nursing homes and 19 hospitals with a structured patient handling programme. This programme centred around the presence of an ergocoach at each ward. This is a nurse or nursing aid trained and specialised in ergonomic principles, who is responsible for supporting the process of working according to ergonomic principles in his ward. Their activities include being available for questions from colleagues, identifying problems, contributing to workplace improvements, and training personnel (Knibbe et al., 2007).

In total, 41 nursing homes and 42 hospitals were approached with written information about the study purpose with a supportive letter of the national organisation in the healthcare sector responsible for training and support of ergocoaches. A subsequent visit was paid to each organisation in order to explain aims and time constraints of the study in more detail. Eventually, 19 nursing homes (response 46%) and 19 hospitals (response 45%) decided to participate. Primary reasons for non-participation were lack of time, merger of the facility, and construction work in the facility.

In the Netherlands there are two types of nursing homes. First, the home which is destined for long term care for elderly who are not able to live entirely independent ($n = 10$). The home for elderly provides general support for uncomplicated nursing care for physical, psychogeriatric, or psychosocial problems as a result of old age. Second, the home that is intended for people who need specific nursing care, residential care or revalidation as a result of disease, disorder, or old age but no longer need specialised medical care in a hospital ($n = 9$). This study took place also in general hospitals in wards with a patient population staying at least a couple of days.

The data collection was carried out between 2007 and 2009. Individual factors of behaviour of nurses and nursing aids (hereafter referred to collectively as nurse) with regard to lifting devices were collected by a short interview ($n = 238$). Each nurse was asked about age, presence of back complaints, presence of any other musculoskeletal complaints, work experience, and typical behaviour regarding lifting devices. At the organisational level, ward characteristics and policies were collected by means of a self-administered questionnaire filled out by the team leader of the ward, activities of the ergocoach was gathered through a self-administered questionnaire for ergocoaches, and institutional characteristics and policies were collected by means of a self-administered questionnaire filled out by the manager. A checklist was completed by researchers during a walk-through survey of all participating wards ($n = 107$) and patient's rooms within each ward. The checklist was filled out before observations on individual nurses were conducted. In this list information was collected on storage location of lifting devices, location of bathroom towards patients' room, presence of patient specific protocol for lifting devices use, number of lifting devices, number of patients, number of nurses, and number of ergocoaches. Overall, 107 team leaders, 38 managers, and 193 ergocoaches filled out a self-administered questionnaire and an additional 107 checklists were filled out by researchers.

Informed consent was obtained verbally from all nursing homes and nurses prior to the study in accordance with the requirements for non-identifiable data collection in the Dutch Code of Conduct for Observational Research (www.federa.org).

2.2. Behaviour and individual factors

The structured interviews with nurses were based on a Dutch questionnaire on behavioural aspects with sufficient consistency validity per behavioural group of 0.55–0.67 (Cronbach's α) in a different application (van Duijn et al., 2004). A theory of planned behaviour was used to distinguish different stages in individual behaviour with respect to use of lifting devices (Urlings et al., 1990). Six questions were used to identify the six consecutive stages of planned behaviour, varying from paying attention to the offered information to maintenance of the new behaviour (Koppelaar et al., 2011). Since some answering categories had low numbers, these six stages of behaviour were categorised into three mutually exclusive behavioural groups: intended behaviour, changed behaviour, and maintenance of behaviour. In the statistical analysis the first two groups were collated.

Individual characteristics were age (in years), work experience (in years), presence of low back pain in the past 12 months, and presence of any musculoskeletal complaint in the past 12 months (Kuorinka et al., 1987). The ability of nurses to adopt usage of lifting devices was assessed by work experience and knowledge about existing workplace guidelines (Koppelaar et al., 2011). Age and working experience were dichotomised and median values were used as the cut off.

2.3. Organisational factors

Information about organisational factors was obtained at the level of the institute, ward, as well as the patient's room, in order to consider differences between and within the organisations and between and within wards. These organisational factors were selected from a systematic review on determinants of implementation of primary preventive interventions on patient handling in healthcare (Koppelaar et al., 2009). The factors were categorised according to the scheme presented by Shain and Kramer (2004).

At the level of the healthcare institute, management support was ascertained with three questions related to the commitment of employers to the lifting devices. This was obtained through self-administered questionnaires by managers. At the level of each ward management climate and general support was measured by questionnaires filled out by the ward's team leader and by the ergocoach. The management climate was regarded as supportive when the need for use of lifting devices was regularly enforced. General support was characterised by the specific role of the ergocoach, distinguishing three key roles in innovation processes: *knowledge manager, linkage agent, and capacity builder* (Ward et al., 2009). Each role was characterised by 4 activities measured on a five point scale, sum scores were calculated, and a score above median within each key role indicated the ergocoach performed this role. It must be stated that the distinguished three roles were not mutually exclusive and, thus, an ergocoach could conduct several roles. The role as *knowledge manager* (who creates, diffuses and uses knowledge and skills and facilitates or

manages these activities) was defined by the following four activities: 1) giving colleagues advice in the field of mechanical load, 2) addressing colleagues who fail to work the proper way, 3) giving colleagues positive feedback when working the proper way, and 4) giving colleagues suggestions about which and when ergonomic devices should be used during lift and transfer activities (Cronbach's α 0.82). The role as *linkage agent* (who focuses on the interface between creators and users of knowledge and skills and seeks to foster links between the two) was defined by the following four activities: 1) detecting and resolving barriers in the field of mechanical load, 2) discussing the planned activities in the field of mechanical load with the team leader, 3) conferring the progress of the introduction of and compliance with the national practical guidelines with the team leader, and 4) advising the team leader about adjustments in the policy of mechanical load (Cronbach's α 0.85). The role as *capacity builder* (who enhances access to knowledge and skills by providing training to knowledge and skills users which may lead to positive social outcomes) was defined by the following four activities: 1) giving training or instructions in ergonomic device use, 2) giving training or instructions in lift and transfer techniques, 3) organising training or instructions in ergonomic device use and lift and transfer techniques, and 4) checking if new colleagues are being instructed in the field of mechanical load (Cronbach's α 0.85).

At the level of a patient's room, technical facilities were evaluated through a checklist, focussing on availability, convenience, and easily accessibility of lifting devices. These facilities included the presence of sufficient lifting devices in the close vicinity of the bed. In addition, it was ascertained whether in the patient's care protocol specific guidance was stipulated on how patient transfer activities should be conducted for those patients with a reduced mobility (Knibbe et al., 2007).

2.4. Data analysis

The influence of individual and organisational factors on sustained behaviour of nurses to use lifting devices during patient transfers was analysed by logistic regression analysis with generalised estimating equations (GEE), suitable for the analysis of measurements with a hierarchical structure. The odds ratio (OR) was used as measure of association, and an OR >1 indicates a positive influence of a specific factor on the individual behaviour of nurses.

The following procedure was used to identify determinants of nurses' sustained behaviour to use lifting devices. First, all individual, patient's room, ward, and institutional variables were analysed in univariate models. The variables with a *p*-value less than 0.10 were selected for further investigation. Second, a multivariate model with individual and organisational variables as independent variables was constructed by forward selection. Variables with a *p*-value less than 0.10 were retained in the final model. The interrelationships between different hierarchical levels in the organisation, namely patient's room, ward and institute, were analysed with spearman correlation coefficients. Statistical analyses were performed using Proc Genmod in the statistical package of SAS version 9.2 software (SAS Institute, cary, NC, USA).

3. Results

Table 1 presents the characteristics of the study population, which consisted predominantly of women. The 12-month prevalence of back complaints was 42–45% and of any musculoskeletal disorders 58–64%. Nursing homes and hospitals differed considerable with respect to number of wards, number of workers, and number of patients per ward. The ratio of patients per full time equivalent nurses per ward ranged from 0.3 to 7.8 for nursing homes and for hospitals from 0.2 to 2.3.

Two-thirds of the nurses in nursing homes were classified as having sustained behaviour to use lifting devices when required during transfer activities with patients (Table 2). In hospitals, only a quarter of the nurses sustained their behaviour to use lifting devices. Nursing homes more often had a favourable ratio of lifting devices per patients and presence of patient specific protocols for lifting devices use than hospitals. Supportive management climate and management support were more common in nursing homes than in hospitals. The ergocoach in the role of capacity builder was most prevalent in nursing homes, whereas the ergocoach as linkage agent was most common in hospitals.

The univariate analyses shows that knowledge of the workplace guidelines and patient's room factors were important factors for nurses' sustained behaviour to use lifting devices during transfer activities with patients (Table 3). Factors at the level of ward were not significantly associated with nurses' behaviour. At the level of institutional management, spending money on maintenance of ergonomic devices was significantly associated with nurses' behaviour. In the multivariate model, individual factors as well as patient's room characteristics remained important for nurses' behaviour to use lifting devices. Knowledge of workplace guidelines, availability of patient specific protocols for lifting devices use, and a favourable ratio of lifting devices per patient were associated with sustained behaviour among nurses to use lifting devices with ORs of 5.85, 2.91, and 1.92, respectively.

Fig. 1 shows the interrelationships between factors at different hierarchical levels in the organisation. Managerial decisions to reserve and spend money on maintenance of ergonomic devices and measures to reduce mechanical load were positively associated with ward characteristics, such as a procedure to regularly check the availability of ergonomic devices in proportion to the mobility of patients and a policy on maintenance of ergonomic devices. An institutional policy to provide yearly training for personnel in use of

Table 1
Organisational characteristics of nursing homes and hospitals, ward characteristics and individual characteristics of nurses in these organisations in the study population.

Characteristics	Nursing homes	Hospitals
Institute	*(n = 19)*	*(n = 19)*
Number of wards per organisation, median (range)	4 (1–12)	29 (5–111)
Workers (fte) per organisation,[a] median (range)	118 (26–400)	1600 (393–3000)
Patients per organisation, median (range)	126 (68–320)	453 (150–1070)
Number of observations of transfer activities where a lifting device was required[b]	145	80
Proportion of lifting devices use when required	72%	43%
Ward	*(n = 46)*	*(n = 61)*
Patients per ward, median (range)	30 (12–74)	19 (8–38)
Nurses (fte) per ward,[a] median (range)	14 (4–62)	22 (10–64)
Ratio patient/fte nurses per ward,[a] median (range)	2.1 (0.3–7.8)	1.0 (0.2–2.3)
Ratio fte nurses per peer leader (ergocoach),[a] median (range)	9 (3.2–30.0)	13.5 (5.5–64.0)
Individual	*(n = 125)*	*(n = 113)*
Age, yrs, mean (SD)	37 (13)	32 (12)
Gender, female %	93%	94%
Working experience (years), median (range)	7 (0–43)	7 (0–40)
Back complaints in the past 12 months (%)	42%	45%
Any musculoskeletal complaints in the past 12 months (%)	58%	64%

[a] fte = full time equivalent.
[b] According to national practical guidelines.

Table 2
Occurrence of individual and organisational factors at the level of the nurse, patient's room, ward and institute in nursing homes and hospitals.

Type	Category	Measurements	Prevalence	
			Nursing homes	Hospitals
Individual	Behaviour	Actual behaviour to use lifting devices: Attention through intention	8%	36%
		Changed behaviour	29%	36%
		Maintenance of behaviour	63%	27%
	Ability[a]	Work experience	52%	49%
		Knowledge of workplace guidelines	98%	93%
Patient's room	Interactivity[b]	Presence of patient specific protocol for lifting devices use	65%	4%
	Easily accessibility[b]	Bathroom attached to patients' room	61%	65%
	Availability[b]	Favourable ratio of lifting devices per patient	56%	33%
	Convenience[b]	Lifting devices close to bed	11%	7%
Ward	Supportive management climate[d]	Regular checking of amount of ergonomic devices in proportion to mobility of patients	95%	78%
		Policy on maintenance of ergonomic devices	94%	82%
		Mechanical load a regular topic in team meetings	73%	35%
	General support (Ergocoach)[c]	Knowledge manager	33%	39%
		Linkage agent	50%	47%
		Capacity builder	53%	42%
Institute	Management support[e]	Management spending money to maintain ergonomic devices	90%	47%
		Management reserving money for activities or supplies to reduce mechanical load	60%	49%
		Managers offering yearly training in the use of ergonomic devices	86%	80%

[a] Structured interview.
[b] Checklist filled out by researcher.
[c] Self administered questionnaire of ergocoach.
[d] Self administered questionnaire of team leader.
[e] Self administered questionnaire of manager.

ergonomic devices supported the ergocoach as capacity builder. In turn, these factors in each ward positively influenced the inclusion of guidance for lifting devices use in a patient's care protocol and a favourable ratio of lifting devices per patient.

4. Discussion

This study shows that nurses' behaviour, i.e. the motivation of nurses to use lifting devices during transfer activities with patients, was associated with knowledge of existing workplace guidelines, availability of sufficient lifting devices, as well as the presence of guidance on lifting devices use in a patient's care protocol. At higher hierarchical levels in the organisation, management support and a supportive management climate were associated with these factors supporting sustained behaviour among nurses.

There are a few limitations that must be taken into account in this study. First of all, the cross-sectional design of this study does not permit statements on causality of the associations between individual and organisational factors and nurses' behaviour to use lifting device. Second, selective participation compromising external validity might have occurred, since participation of nursing homes and hospitals was on a voluntary basis and targeting those that employed ergocoaches on wards. However, information from national surveys in 2008 showed that 85% of nursing homes have employed ergocoaches on wards (Knibbe and Knibbe, 2008). Information from national surveys among hospitals in 2005 showed that ergocoaches were present in 56% of the hospitals, having increased from less than 10% in 2001 (Knibbe et al., 2007). This suggests that the results of this study adequately reflect the situation in Dutch nursing homes and hospitals. Third, since only Dutch healthcare organisations with a structured patient handling programme including the presence of ergocoaches were targeted in this study, some caution is needed with regard to the generalisability of the study results to other countries. Fourth, individual information was collected by interviewing nurses who may have provided socially desirable answers to the questions about their motivation to use lifting devices during transfer activities and their knowledge about workplace procedures. Thus, the proportion of nurses with sustained behaviour and good knowledge may be overestimated. Information at other levels was gathered by walk through surveys and by questionnaires. It is of interest to note that the factors in a patient's room that contributed to sustained behaviour of nurses were all collected by objective measurements.

This study showed that factual knowledge on workplace procedures on mechanical load as well as (technical) facilities had a direct influence on nurses' behaviour to use lifting devices. Knowledge of existing workplace guidelines was strongly associated with nurses' behaviour to use lifting devices. This is not completely unexpected, since this study took place in institutes with a structured approach for the prevention of musculoskeletal disorders including workplace guidelines. Apparently, knowledge is indeed important for nurses' behaviour to use lifting devices. Evanoff et al. (2003) also reported lack of knowledge as a barrier in the implementation of ergonomic interventions. Although, training as primary preventive intervention to decrease the occurrence of back pain seems not effective (Hignett, 2003; Martimo et al., 2008), training could be used as a first step to increase knowledge in order to stimulate nurses' behaviour to use lifting devices. This survey showed that knowledge on workplace guidelines coincides with sustained behaviour to use lifting devices. Due to the study design, it is not possible to determine whether this knowledge is an important prerequisite for changing behaviour or whether a changed behaviour will sensitise nurses to the existence of workplace guidelines.

The direct physical environment of nurses, i.e. the availability of sufficient lifting devices against the number of patients, was also

Table 3
The influence of individual and organisational factors at the level of the patient's room, the ward, and the institute on nurses' sustained behaviour to use lifting devices during transfer activities with patients in hospitals and nursing homes.

	Nurses' sustained behaviour to use lifting devices during transfer activities with patient			
	Univariate ($N = 238$)		Multivariate	
	OR	95% CI	OR	95% CI
Individual				
Age less than 30 years	0.63	(0.31–1.29)		
Back complaints (in the past 12 months)	0.69	(0.34–1.41)		
Any musculoskeletal complaints (in the past 12 months)	0.81	(0.39–1.69)		
Work experience of 7 years or more	1.34	(0.66–2.73)		
Knowledge of workplace guidelines	9.24**	(1.72–49.63)	5.85**	(1.09–31.27)
Patient's room				
Availability of patient specific protocol for lifting devices use	3.87**	(1.96–7.65)	2.91**	(1.50–5.67)
Bathroom attached to patients' room	2.09*	(0.92–4.76)		
Favourable ratio lifting devices per patient	2.30**	(1.08–4.89)	1.92*	(0.89–4.16)
Lifting devices close to bed	7.99	(0.76–84.43)		
Ward				
Regular checking of amount of ergonomic devices in proportion to mobility of patients	0.78	(0.24–2.50)		
Policy on maintenance of ergonomic devices	1.01	(0.34–2.98)		
Physical load regular topic in team meetings	1.21	(0.57–2.59)		
Ergocoach as knowledge manager	0.73	(0.36–1.49)		
Ergocoach as linkage agent	0.65	(0.32–1.33)		
Ergocoach as capacity builder	0.85	(0.42–1.72)		
Institute				
Management spending money to maintain ergonomic devices	2.55**	(1.14–5.67)		
Management reserving money for activities or supplies to reduce mechanical load	0.72	(0.35–1.46)		
Managers offer yearly training in the use of ergonomic devices	0.62	(0.22–1.74)		

**$p = <0.05$, *$p = <0.10$, N = number of nurses, OR = Odds Ratio, 95% CI = 95% Confidence Interval.

important for nurses' behaviour. This is in agreement with several intervention studies that have reported the working environment of nurses as barrier or facilitator in the implementation of ergonomic interventions (Evanoff et al., 2003; Fujishiro et al., 2005; Li et al., 2004; Ronald et al., 2002). Li et al. (2004) and Ronald et al. (2002) reported the lack of manoeuvring space and structure of the building as barriers in the implementation of lifting devices in hospitals in the USA and Canada. Misplacement or lack of sufficient lifting devices was described as barrier in lifting devices use by Evanoff et al. (2003). Fujishiro et al. (2005) reported a lower employee-to-ergonomic device ratio as facilitator in the implementation of lifting devices in nursing homes and hospitals in the USA. The present study showed that a high availability of lifting devices most likely enhanced nurses' behaviour to use lifting devices. Availability of sufficient lifting devices should be incorporated in policies of management.

The presence of specific guidance on lifting devices use in a patient's care protocol was strongly associated with nurses' behaviour to use lifting devices as well. Protocols that incorporate requirements on safe patient handling into the daily care of patients will avoid that the way a patient is being assisted is no longer largely determined by the individual nurse. A policy of mandatory use of equipment was also reported as a facilitator of the implementation of ergonomic devices in healthcare by Evanoff et al. (2003) and Charney et al. (2006). Thus, workplace policies are required that target mandatory use of lifting devices. The proportion of nurses with sustained behaviour on use of lifting devices differed substantially between nursing homes and hospitals, respectively 63% versus 27%. This could partly be explained by the rapid changing patient population in hospitals. Nurses may not have sufficient time to adopt their behaviour to the needs of a specific patient with regard to use of a lifting device during transfer. A changing patient population was also reported as important factor in the implementation of lifting devices by Yassi et al. (2001) and Evanoff et al. (2003). Besides, due to the rapidly changing patient population in hospitals, patient's care protocol with specific guidance to stipulate lifting devices use were less present or not up to date most of the time. Another explanation for

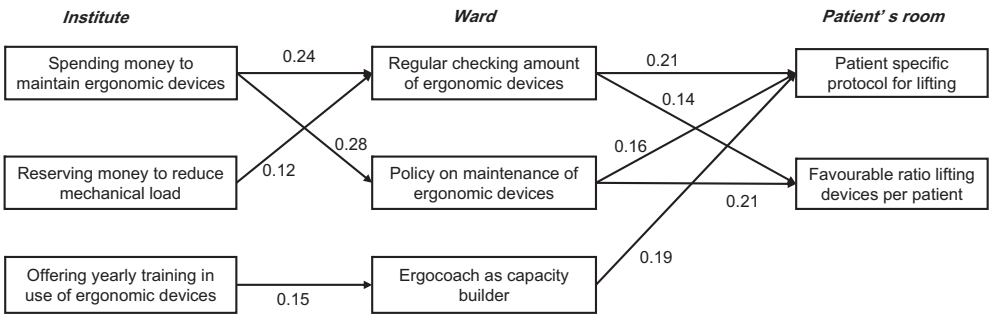

Fig. 1. Simplified conceptual model of the contributions of individual and organisational factors to an appropriate use of lifting devices.

the observed striking difference in behaviour among nurses could be the size of the participating institutes. Nursing homes were small to medium-sized enterprises, whereas hospitals were typically large enterprises. More interaction may be present between management and individual nurses in smaller organisations.

Factors at the level of the ward and the institute were not directly associated with nurses' behaviour. The influence from these higher levels was less important than the direct facilities of nurses in influencing nurses' behaviour. There were, however, moderate interrelationships between more upstream factors at the level of the patient's room, the ward, and the institute. This indicates that management can create important conditions (Westgaard and Winkel, 2011).

A limited set of organisational factors was assessed in this study. It should not be ruled out that other factors could be of importance as well. In healthcare, the patient is an important external factor, encompassing the physical and cognitive capabilities of the patients, as well as the attitudes of the patients towards the intervention (Evanoff et al., 2003). Different studies have described the attitudes or preferences of patients towards lifting devices as important factor for nurses' behaviour to use lifting devices (Yassi et al., 2001; Owen et al., 2002; Nelson et al., 2006). In addition, attitudes of co-workers (social support) could have an impact as well. The factors time required to alter work culture and nurses wanting to transfer the patient "the old way" were described as barriers in intervention studies (Chhokar et al., 2005; Best, 1997). This study assessed the influence of general support by the presence of an ergocoach at each ward. However, no association with nurses' behaviour to use lifting devices was found. In a multifaceted ergonomics program to prevent injuries due to patient handling tasks peer leaders, known as Back injury Resource Nurses, played an essential role (Nelson et al., 2006). The peer leaders were ranked as extremely effective by 66% of the nurses, but their influence was not assessed separately in this study. Thus, more research is required on the influence of individual and organisational factors on behaviour.

The appropriate implementation of ergonomic devices is a complex phenomenon that can be influenced by various factors at different levels in a healthcare organisation. Individual as well as organisational factors were associated with nurses' behaviour to use lifting devices. The organisational factors were present at three different levels, i.e. the room, the ward, and the institution. Since there is a hierarchical structure (rooms within ward and wards within the institute), these organisational factors cannot be analysed simultaneously on the classical regression models and use of statistical models that take into account this hierarchical structures advocated. In addition, the interrelations between different levels should be analysed in order to evaluate the structural links between the chain of factors. The need to look at multiple levels in implementation research is not solely applicable to the ergonomic area. Karsh and Brown (2010) have emphasised for patient safety programs the need to study relationships among variables at different levels and to look across system levels so that the right interventions for the right situations are implemented. Thus, studies on ergonomics should consider multi-level analyses to understand how variables at different levels interact. In conclusion, this study shows that an integral approach that addresses individual nurses, care procedures, and workplace policies is necessary to facilitate appropriate implementation of ergonomic interventions, such as lifting devices.

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