Individual and organisational determinants of use of ergonomic devices in healthcare

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ABSTRACT

Objective This study aims to identify individual and organisational determinants associated with the use of ergonomic devices during patient handling activities.

Methods This cross-sectional study was carried out in 19 nursing homes and 19 hospitals. The use of ergonomic devices was assessed through real-time observations in the workplace. Individual barriers to ergonomic device use were identified by structured interviews with nurses and organisational barriers were identified using questionnaires completed by supervisors and managers. Multivariate logistic analysis with generalised estimating equations for repeated measurement was used to estimate determinants of ergonomic device use.

Results 247 nurses performed 670 patient handling activities that required the use of an ergonomic device. Ergonomic devices were used 68% of the times they were deemed necessary in nursing homes and 59% in hospitals. Determinants of lifting device use were nurses’ motivation (OR 1.96), the presence of back complaints in the past 12 months (OR 1.77) and the inclusion in care protocols of strict guidance on the required use of ergonomic devices (OR 2.49). The organisational factors convenience and easily accessible, management support and supportive management climate were associated with these determinants. No associations were found with other ergonomic devices.

Conclusions The use of lifting devices was higher in nursing homes than in hospitals. Individual and organisational factors seem to play a substantial role in the successful implementation of lifting devices in healthcare.

INTRODUCTION

Low back pain is the most common musculoskeletal disorder among nurses. A significant proportion of back pain episodes can be attributed to events that occur during patient handling activities. Nurses are exposed to lifting, awkward working postures, and pushing or pulling during patient handling activities. These activities have been reported to be an important cause of back complaints.

In the past number of years many ergonomic interventions have been developed to reduce exposure to physical load related to patient handling activities. The efficacy of ergonomic devices designed to reduce exposure to physical load has been assessed in a number of laboratory studies. However, the implementation of these ergonomic devices in the actual work situation remains difficult, and workplace studies have difficulties showing the effectiveness of ergonomic devices as regards the occurrence of back complaints. An important step in the implementation process is the identification of obstacles to changing work practices, which may arise at the level of individuals as well as the wider environment. In the review of Koppelaar et al, five studies identified individual factors, such as lack of perceived need and lack of knowledge, and nine studies identified organisational factors, such as lack of time, lack of a policy of mandatory lift usage and employee-to-ergonomic device ratio, which may hamper the effective implementation of ergonomic devices in the workplace. Although many barriers have been identified in intervention studies, none of the intervention studies assessed the influence of these barriers on the actual use of the ergonomic devices.

Therefore, the aim of this study was to evaluate the influence of individual and organisational determinants on the actual use of ergonomic devices during patient handling activities in healthcare.

Method

Study population

This cross-sectional study took place in 19 nursing homes and 19 hospitals in the Netherlands. Organisations with a structured patient handling programme including the presence of ergocoaches were included. An ergocoach (also called a peer leader, lifting coordinator, back injury resource nurse, lifting specialist and mobility coach) is a person trained and specialised in ergonomic interventions.
principles who works in a ward like any other nurse. An ergocoach is responsible for starting and maintaining the process of working according to ergonomic principles by being available for questions from colleagues, identifying problems with and conducting assessments of physical load, contributing to workplace improvements, and training personnel.\textsuperscript{17} Nursing homes and hospitals were contacted and 46\% and 45\%, respectively, agreed to participate. Primary reasons for non-participation were lack of time, merger of the facility, and construction work in the facility. Participating and non-participating facilities did not differ as regards location (city versus village); however, no additional information was collected about non-participating facilities. Informed consent was obtained verbally from all nursing homes and hospitals prior to the study.

In the Netherlands, there are two types of nursing homes. First, there are those for long term care of the elderly who are not able to live independently (n=10). These provide general support and uncomplicated nursing care for those with physical, psychogeriatric or psychosocial problems as a result of old age. The other type of home looks after those who need specific nursing care, residential care or rehabilitation as a result of disease, disorder or old age but no longer need specialised medical care in a hospital (n=9). This study also took place in general hospitals in wards with a patient population staying at least a couple of days.

Data collection was carried out between 2007 and 2009 among nurses as well as organisations. Individual nurses (professional nurses and nursing assistants) were observed while performing patient handling activities and interviewed afterwards to gather additional information on individual characteristics and barriers to the use of ergonomic devices during patient handling activities. At the organisational level, information on ward characteristics and ward policies was collected by means of a self-administered questionnaire completed by the team leader on the ward and the ergocoach. Managers of the nursing homes and the hospitals were asked about organisational policies in self-administered questionnaires.

### Use of ergonomic devices

Observations in the workplace were carried out to collect information about the type of ergonomic devices used during the different patient handling activities. Real-time observations were conducted to assess patient handling activities in relation to the demands of national practice guidelines developed by the healthcare sector.\textsuperscript{17,\textsuperscript{18}} A checklist was used to collect information about the types of ergonomic devices and the necessity for ergonomic devices. The different ergonomic devices assessed during patient handling activities were lifting devices for transferring a patient, an electrically operated adjustable bed and adjustable shower chair for use during personal care, an electrically operated adjustable bed and slide sheet for repositioning a patient in bed, and a compression stocking slide for putting on and taking off anti-embolism stockings.\textsuperscript{17} For personal care of patients, use of an adjustable bed and use of an adjustable shower chair were assessed separately because these ergonomic devices were used in different personal care situations. An adjustable bed is used during personal care in bed, such as washing and dressing a patient, and an adjustable shower chair is used for showering a patient in a sitting or semi-sitting position. For repositioning patients in bed, the use of an adjustable bed and the use of a slide sheet were assessed separately since the criteria for use of these ergonomic devices differ. An adjustable bed is used to reduce awkward trunk postures, but can also eliminate the need for a transfer and/or reduce the power required for a transfer, while a slide sheet is a friction-reducing device aimed to reduce the manual forces required.\textsuperscript{18}

The requirement for and actual use of the ergonomic devices were assessed according to national practice guidelines developed by the healthcare sector.\textsuperscript{17,\textsuperscript{18}} The criteria for use of specific ergonomic devices during patient handling activities are based on the functional mobility of the patients. Three levels can be distinguished: (1) patients who are able to perform activities by themselves; (2) patients who are able to assist and contribute actively, but unable to perform the activity on their own; and (3) patients who are passive with no or very little contribution to the required movements.\textsuperscript{19} For transferring a patient, a lifting device is compulsory for a patient in the second and third categories. Adjustable beds are also compulsory for patients in the second and third categories. Adjustable beds were present in most wards and actual use by the nurse was defined when the height of the adjustable bed was appropriate for the patient handling activity being performed. Adjustable shower chairs are required when a patient in the second or third category is showered in a sitting position. For repositioning patients in bed, an adjustable bed and slide sheet are compulsory for patients in the second and third categories. A compression stocking slide should always be used for putting on and taking off patient anti-embolism stockings, independent of the functional mobility of the patient.\textsuperscript{19} For each patient a specific protocol is available stating when an ergonomic device should be used, whereby the patient’s functional mobility is linked to the national practice guidelines for use of ergonomic devices in specific situations. In the absence of this information, nurses were asked to provide information about functional mobility to assess the requirement for an ergonomic device relative to the patient’s characteristics. During the observations the researcher first collected information on the required use of ergonomic devices and subsequently determined during patient handling activities whether these ergonomic devices were actually used. At the start of the observations nurses were asked to participate in the study. The nurses were observed in real-time during a specific patient handling activity. In total, 670 patient handling activities were observed with a total duration of approximately 54 h.

### Determinants of ergonomic device use

Information on potential determinants of ergonomic device use during patient handling activities was obtained at three levels: organisations, wards and individual nurses. For each organisation information was gathered about the number of wards, number of workers and number of patients. For each ward within the organisation, information was obtained about the number of patients, number of nurses and number of ergocoaches. The ratios of (full-time equivalent) nurses per ergocoach and the ratio of (full-time equivalent) nurses per patient were calculated per ward and median values were used as the cut-off. Nurses were interviewed concerning age, back complaints and any musculoskeletal complaints, defined as “the presence of pain or discomfort in the past 12 months”,\textsuperscript{20} and planned behaviour with regard to ergonomic device use.

Two interlinked approaches were used to identify individual and organisational determinants of ergonomic device use (table 1) as described in the review by Koppelaar et al.\textsuperscript{16} The first approach of Rothschild is oriented towards individual factors, whereas the second approach of Shain and Kramer primarily focuses on the organisational context.\textsuperscript{21,\textsuperscript{22}} The definition of the different categories and the measurement methods are described in table 1. The individual factor motivation to use lifting devices

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\textsuperscript{16} Koppelaar E, Knibbe JJ, Miedema HS, et al. Occup Environ Med (2010). doi:10.1136/oem.2010.055939
or other ergonomic devices was measured according to a planned behaviour model following the six consecutive stages of planned behaviour. These stages of planned behaviour were categorised into three groups: attention through intention, changed behaviour and maintenance of behaviour.

Data analysis

The influence of individual and organisational determinants (table 1) on the outcome variable actual use of ergonomic devices was analysed using multivariate logistic regression analysis with generalised estimating equations (GEE), suitable for the analysis of repeated measurements. The analyses were performed for each patient handling activity separately: (1) lifting device use during transfer of a patient; (2) adjustable bed or adjustable shower chair use during personal care of patients; (3) slide sheet or adjustable bed use during repositioning of patients in bed; and (4) compression stocking slide use during putting on and taking off anti-embolism stockings. The OR was used as measure of association, and indicates the influence of a determinant on ergonomic device use during patient handling activities. An OR >1 reflects that the determinant is associated with increased use of an ergonomic device.

The following procedure was used to identify determinants of actual use of ergonomic devices during patient handling activities. First, all individual as well as organisational variables were analysed in univariate logistic GEE models. The categories with a p value less than 0.20 were selected for further investigation. These stages of planned behaviour were categorised into three groups: attention through intention, changed behaviour and maintenance of behaviour.

### Table 1 Definitions and methods of measurement of individual and organisational determinants according to the models of Rothschild and Shain and Kramer

| Determinants                  | Definition                                                                 | Source | Measurement                                                                 |
|-------------------------------|---------------------------------------------------------------------------|--------|---------------------------------------------------------------------------|
| 1. Individual determinants    | Motivation: willingness of a nurse to undertake the necessary actions to commit to the intervention | N      | 1. Attention: do you know the existence of the workplace guidelines for physical load? |
| 2. Environment determinants  | Ability: capability of a nurse to do something that requires specific skills, knowledge and experience | N      | 2. Understanding: do you know when and which ergonomic device you have to use when lifting or transferring patients? |
|                               | Convenience and easily accessible: availability of resources to use ergonomic devices | R      | 3. Attitude: do you think it is always necessary to use ergonomic devices when lifting or transferring patients with limited mobility or passive patients? |
|                               | Management support: commitment of employers to the ergonomic devices       | M      | 4. Intention: do you always intend to use ergonomic devices when lifting or transferring patients with limited mobility or passive patients? |
|                               | Supportive management climate: a work organisation which actively promotes use of ergonomic devices | T      | 5. Changed behaviour: do you always use ergonomic devices when lifting or transferring patients with limited mobility or passive patients? |
|                               | Interactivity: reinforcement of ergonomic devices by other work practices   | E      | 6. Maintenance of behaviour: does it happen, once in a while, that you do not use ergonomic devices when lifting or transferring patients with limited mobility or passive patients? |
|                               |                                                                           |        |                                                                           |
| Source                        |                                                                           |        |                                                                           |
| Statistical analyses were performed using Proc Genmod in SAS v 9.2. |       |                                                                           |

The association of upstream factors with the individual factor motivation of nurses to use lifting devices as well as the availability of patient specific protocols with strict guidelines for ergonomic device use were analysed with Spearman correlations. Statistical analyses were performed using Proc Genmod in SAS v 9.2.

RESULTS

Of the 162 team leaders from nursing homes and hospitals invited to participate in the study, 144 returned the self-administered questionnaire (89% response). Of the 269 ergocoaches invited to participate, 233 returned the self-administered questionnaire (87% response). All managers (n=38) invited to participate returned the self-administered questionnaire (100% response). In total, 343 nurses participated in this study and for 247 nurses data collection on observations of patient handling activities and interviews was complete. Nurses participated anonymously in this study. None of the nurses who were invited to contribute to the study refused to participate. A total of 96 nurses were not included because they performed patient handling activities without needing an ergonomic device or were not interviewed due to lack of time. The 247 nurses performed 670 patient handling activities that required the use of an ergonomic device.

The study population consisted predominantly of women, ranging in age from 16 to 62 years (table 2). The average working experience of the nurses was slightly higher in nursing homes than in hospitals. The 12-month prevalences of back complaints and of any musculoskeletal complaints were 43–45% and
Table 2 Organisational and ward characteristics of nursing homes and hospitals, and individual characteristics of nurses in these organisations

| Characteristics                                      | Nursing homes | Hospitals |
|------------------------------------------------------|---------------|-----------|
| Organisation                                         | (n=19)        | (n=19)    |
| Number of wards per organisation, median (range)     | 4 (1–12)      | 29 (5–111)|
| Workers (fte) per organisation, median (range)       | 118 (28–400)  | 1600 (390–3000)|
| Patients per organisation, median (range)            | 126 (68–320)  | 453 (150–1070)|
| Ward                                                 | (n=66)        | (n=96)    |
| Patients per ward, median (range)                    | 30 (12–74)    | 19 (8–41)|
| Nurses (fte) per ward, median (range)                 | 14 (4–62)     | 22 (11–64)|
| Ratio patient/fte nurses per ward, median (range)    | 1.7 (0.3–7.8) | 1.0 (0.2–2.3)|
| Ratio fte nurses per peer leader, median (range)     | 9.7 (2.7–30.0)| 13.7 (5.5–64.0)|
| Individual                                           | (n=132)       | (n=211)   |
| Age, years, mean (SD)                                | 37 (13)       | 33 (12)|
| Gender, female, %                                    | 92%           | 91%      |
| Working experience (years), median (range)           | 7 (0–43)      | 6 (0–40)|
| Back complaints in the past 12 months, %             | 43%           | 45%      |
| Any musculoskeletal complaints in the past 12 months, %| 58%           | 65%      |

fte, full-time equivalent.

58–65%, respectively. Nursing homes and hospitals differed considerably with respect to number of wards, number of workers and number of patients per ward and per organisation. The ratio of patients per full-time equivalent nurses per ward ranged from 0.3 to 7.8 for nursing homes and from 0.2 to 2.3 for hospitals.

Table 3 describes the prevalence of individual and organisational determinants of ergonomic device use during patient handling activities by healthcare branch. The prevalence of barriers was generally higher in hospitals than in nursing homes. A low amount of time spent on ergocoach activities, an unfavourable ratio of slide sheets per patient, and lifting devices not close to the bed were more prevalent in nursing homes (59%, 62% and 89%, respectively). In hospitals an unfavourable ratio of adjustable shower chairs per patient, lifting devices not close to the bed, and absence of patient specific protocols with strict guidelines for ergonomic device use were more prevalent (70%, 95% and 96%, respectively).

Table 4 provides descriptive information on 670 observed patient handling activities which required the use of an ergonomic device, performed by 247 nurses. The actual use of ergonomic devices when required during patient handling activities ranged from 0% for adjustable shower chairs in hospitals to 92% for adjustable beds in hospitals. The use of ergonomic devices was similar between nursing homes and hospitals, except for a higher use of lifting devices during the transfer of a patient and of adjustable shower chairs during personal care of patients in nursing homes.

Table 3 Occurrence of individual and organisational barriers to ergonomic device use during patient handling activities in nursing homes and hospitals

| Type            | Category       | Source | Barriers                                      | Nursing homes | Hospitals |
|-----------------|----------------|--------|-----------------------------------------------|---------------|-----------|
| Individual      | Motivation     | N      | Actual behaviour to use lifting devices       | Attention through intention 8% | 36%       |
|                 |                |        |                                               | Changed behaviour 29% | 36%       |
|                 |                |        |                                               | Maintenance of behaviour 63% | 27%       |
|                 |                | N      | Actual behaviour to use other ergonomic devices| Attention through intention 17% | 45%       |
|                 |                |        |                                               | Changed behaviour 31% | 29%       |
|                 |                |        |                                               | Maintenance of behaviour 52% | 24%       |
|                 | Ability        | N      | Low work experience                           | 48%           | 51%       |
|                 |                | N      | Lack of knowledge of workplace guidelines     | 2%            | 7%        |
| Organisational  | Convenience    | R      | Unfavourable ratio of lifting devices per patient| 44%           | 67%       |
|                 | and easily     | R      | Unfavourable ratio of slide sheets per patient | 62%           | 40%       |
|                 | accessible     | R      | Unfavourable ratio of adjustable shower chairs per patient | 21%           | 70%       |
|                 | Management     | M      | Lifting devices not close to bed              | 89%           | 93%       |
|                 | support        | R      | Other ergonomic devices not close to bed       | 13%           | 38%       |
|                 |                | R      | Bathroom not attached to patient’s room       | 39%           | 35%       |
|                 |                | M      | Management spending little money to maintain ergonomic devices | 10%           | 53%       |
|                 |                | M      | Management not reserving any money for activities or supplies to reduce physical load | 40%           | 51%       |
|                 | Supportive     | M      | Nurses not trained in use of ergonomic devices each year | 14%           | 20%       |
|                 | management     | T      | No regular checking of amount of ergonomic devices in proportion to mobility of patients | 5%            | 22%       |
|                 | climate        | T      | No policy on maintenance of ergonomic devices | 6%            | 18%       |
|                 |                | T      | Physical load not a regular topic in team meetings | 27%           | 65%       |
|                 | Interactivity  | E      | Little time spending on peer leader activities per week | 59%           | 68%       |
|                 |                | R      | Absence of patient specific protocols with strict guidelines for ergonomic device use | 35%           | 96%       |

E: self-administered questionnaire of ergocoach; M: self-administered questionnaire of manager; N: structured interview of nurses; R: checklist filled out by researcher; T: self-administered questionnaire of team leader.
Table 5  Associations between individual and organisational factors and the use of lifting devices during the transfer of a patient in nursing homes and hospitals

| Lifting device use during patient transfer | Univariate | OR 95% CI | Multivariate (N = 238) | OR 95% CI |
|------------------------------------------|------------|-----------|------------------------|-----------|
| Individual factors                       |            |           |                        |           |
| Motivation: changed or maintenance of behaviour to use lifting devices | 2.37† | 1.20 to 4.67 | 1.96† | 1.00 to 3.86 |
| Ability                                   | 0.64       | 0.36 to 1.13 |               |           |
| Work experience                           | 0.63       | 0.36 to 1.12 |               |           |
| Knowledge of national guidelines          | 0.64       | 0.12 to 3.36 |               |           |
| Back complaints in the past 12 months     | 1.52       | 0.85 to 2.72 | 1.77* | 0.99 to 3.22 |
| Any musculoskeletal complaints in the past 12 months | 1.20       | 0.67 to 2.14 |               |           |
| Organisational factors                    |            |           |                        |           |
| Convenience and easily accessible         | 0.82       | 0.39 to 1.71 |               |           |
| Management support                        | 1.34       | 0.71 to 2.53 |               |           |
| Supportive management climate             | 2.03*      | 0.87 to 4.74 |               |           |
| Regular checking of amount of ergonomic devices in proportion to mobility of patients | 1.57 | 0.70 to 3.51 |               |           |
| Policy on the maintenance of ergonomic devices | 1.30 | 0.57 to 2.96 |               |           |
| Physical load a regular topic in team meetings | 1.48 | 0.80 to 2.73 |               |           |
| Interactivity                             | 2.13**     | 1.20 to 3.76 |               |           |
| Amount of time spent on peer leader activities per week | 1.45 | 0.78 to 2.70 |               |           |
| Availability of patient specific protocols with strict guidelines for ergonomic device use | 2.67† | 1.40 to 5.09 | 2.49† | 1.27 to 4.89 |

*p < 0.10.  †p < 0.05.  N, number of nurses.
ensuring good maintenance. Evanoff on the ward, by providing easily available lifting devices, and by that enough lifting devices are available in proportion to patients’ behaviour to use lifting devices when required by making sure levels.

The actual use of ergonomic devices could have been influenced by differences in the patients within these three levels. This study shows that three determinants were strongly associated with lifting device use during the transfer of a patient. First, the motivation of nurses to use lifting devices was strongly associated with increased lifting device use during the transfer of a patient. Several intervention studies have identified lack of motivation as a barrier to the successful implementation of lifting devices in healthcare.6 Motivation can be influenced by several different factors. In the present study, three organisational factors were moderately associated with motivation of nurses to use lifting devices: a favourable ratio of lifting devices per patient on the ward, lifting devices available close to patients, and management maintenance of ergonomic devices, with Spearman correlations of 0.15, 0.14 and 0.20, respectively. This indicates a managerial influence on nurses adopting the behaviour to use lifting devices when required by making sure that enough lifting devices are available in proportion to patients on the ward, by providing easily available lifting devices, and by ensuring good maintenance. Evanoff et al as well as Lynch and Freund have previously reported that the lack of availability of lifting devices was perceived as a barrier to successful implementation of lifting devices in healthcare.27 28 Ceiling lifts instead of floor lifts might be a solution, since these lifting devices are always in the room of the patient and available for use. Alamgir et al reported that staff preferred to use ceiling lifts for transferring and also found them less physically demanding.59 Moreover, their study showed that transfers performed with ceiling lifts compared to floor lifts required on average less time and were found to be more comfortable for patients.

Second, the availability of patient specific protocols with strict guidelines for ergonomic device use was strongly associated with lifting device use. These protocols that incorporate requirements on safe patient handling into the daily care of patients mean that the way a patient is assisted is no longer largely determined by the individual nurse. A policy of mandatory use of equipment was also reported as facilitate the implementation of lifting devices in healthcare by Evanoff et al and Charney et al.27 30 Patient specific protocols with strict guidelines for ergonomic device use were available in 65% of the nursing homes but only 4% of the hospitals in this study. The low percentage in hospitals can be partly explained by rapid improvements in functional mobility in patients who usually stay in hospital for only a few days. In this study four organisational factors were associated with the availability of patient specific protocols with strict guidelines for ergonomic device use: management ensuring ergonomic devices were maintained (r=0.21), management reserving money for activities or supplies to reduce physical load (r=0.40), regular checking of the availability of ergonomic devices in proportion to the mobility of patients (r=0.21), and a policy on the maintenance of ergonomic devices (r=0.16). This indicates that the commitment of employers to the use of ergonomic devices has a positive influence on the availability of patient specific protocols with strict guidelines for ergonomic device use.

Third, the presence of back complaints in the past 12 months resulted in higher lifting device use among nurses. Apparently, having had back complaints triggers nurses to use lifting devices when required. Lifting devices are, however, intended to prevent both the onset as well as the recurrence of back pain episodes. Thus, nurses without back complaints should be encouraged to use lifting devices when required in order to prevent the onset of these complaints. Although the national practice guidelines advise the use of lifting devices for all nurses, whether or not they have back complaints, compliance with these guidelines is obviously far from optimal.

The use of lifting devices when required was much higher in nursing homes than in hospitals (72% vs 43%). The study by Evanoff et al also showed higher compliance in using lifting devices in long term care facilities compared to hospitals (38% vs 15%).27 Yassi et al identified the rapidly changing patient population in hospitals as a barrier to the implementation of lifting devices.31 Our results, however, indicate that individual and organisational determinants within specific organisations are more important than differences between healthcare branches. In the multivariate analysis, the influence of type of branch on lifting device use disappeared when adjusted for the difference in motivation of the nurses to use lifting devices (63% vs 27%) and the availability of patient specific protocols with strict guidelines for ergonomic device use (65% vs 4%). Also, in hospitals motivation of nurses to use lifting devices and the availability of patient specific protocols with strict guidelines for ergonomic device use influenced required lifting device use, despite the rapidly changing patient population.

For patient handling activities other than transfers, none of the determinants had any association with required ergonomic device use. Other factors, not assessed in this study, may have had an influence. With regard to the use of sliding sheets, McGill and Kavic concluded that the worker’s personal technique and movement strategy is a critical determinant of back load in the use of these devices.15 Pompeii et al reported that about a quarter of patient handling injuries resulted from repositioning patients in bed.32 Thus, training in the use of sliding sheets might help nurses to actually use the sliding sheets in order to prevent the occurrence of back complaints due to repositioning patients in bed. The lack of manoeuvring space, mentioned by Li et al and Pompeii et al as a barrier to lifting device use, might also be a barrier to shower chair use during personal care.32 33 Another possible explanation for the lack of association could that our study did not having enough power due less observations of other patient handling activities.

In conclusion, the use of lifting devices was higher in nursing homes than in hospitals. The use of lifting devices when required was strongly associated with motivation among nurses to use lifting devices and experienced back complaints in the past 12 months, as well as the availability of patient specific protocols with strict guidelines for ergonomic device use. This study demonstrated that barriers have a strong effect on the use of lifting devices. Individual and organisational factors seem to have considerable influence on whether ergonomic interventions will indeed contribute to a reduction in physical load in the workplace.
Funding This study was funded by a grant (number 63200014) from the Netherlands Organization for Health Research and Development (ZonMw).

Competing interests None.

Provenance and peer review Not commissioned; externally peer reviewed.

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