

Low back problems and possible improvements in nursing jobs

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Aim. This paper reports a study that aimed to evaluate the workload, to identify problems leading to the higher incidence rate of work-related low back injury among nurses in the orthopaedic and intensive care unit departments of the hospital, and to gather information about improvements that the nurses would like in the workplace.

Background. The literature shows that low back injuries are common among nurses, and intervention programmes are needed to address this problem.

Method. The hospital injury records were examined in a retrospective study. In addition, a validated questionnaire was administered between January and May 2005 to 47 nurses (23 orthopaedic and 24 intensive care nurses). The questionnaire contained questions on workload, history of back injuries, problems, possible solutions and psychophysical measures of exertion.

Findings. The life-time incidence and point prevalence of low back pain were 65% and 30%, respectively, in orthopaedic nurses, and 58% and 25%, respectively, in the intensive care nurses. The mean weight handled was reported to be 47 ± 30 kg by the orthopaedic nurses and 26 ± 10 kg by the intensive care nurses. The low back scored highest for body-part discomfort – 4.6 and 4.0, respectively, on a 10-point scale. The rate of perceived job exertion was 6.7 ± 1.8 (very strong), and 5.8 ± 1.9 (strong) on Borg's 10-point scale. The total effort required by the job, rated on Visual Analogue Scales, was $67 \pm 14\%$ and $68 \pm 15\%$ of the maximum, respectively. The Borg scores and the total effort according to the Visual Analogue Scale, and the Borg scores and force effort on the Visual Analogue Scale were moderately correlated ($r = 0.53$, $P < 0.01$ for both comparisons).

Conclusion. The methodology proposed here is practical for job evaluation and to design a participatory ergonomic intervention aiming at reducing low back injuries in nursing jobs. There are workload differences between nursing jobs. Lifting devices, biomechanical training, bigger rooms, adequate set-up and additional staff are suggested improvements.

Keywords: cross-sectional study, intensive care nursing, low back injuries, orthopaedic nursing, prevention, questionnaire, workload

Introduction

There is a high incidence of work-related low back injury (WLBI) in nurses (Buckle 1987, Bejia *et al.* 2005). This is the most prevalent and most costly musculoskeletal disorder (Woolf & Pfleger 2003). Several epidemiological studies have shown that musculoskeletal disorders (including WLBI) and workload are related (Bernard 1997). In this paper we present an exploratory study of WLBI and workload from a nursing point of view by administering a questionnaire collecting qualitative information and psychophysical measures of exertion.

Background

Nurses are among those professionals with the highest incidence rates of WLBI (Kumar 2004). According to Jensen (1987) they have the highest incidence of disabling back injuries in the USA. The annual incidence rate of WLBI among nurses working in hospitals in France in 1990 was 57% (Niedhammer *et al.* 1994). The incidence of WLBI is also high in Italy (Larese & Fiorito 1994). In China, the prevalence rate of WLBI for nurses at a teaching hospital has been reported as approximately 57% (Smith *et al.* 2004). These examples show that the WLBI problem is significant worldwide.

Based on a review of more than 80 papers on WLBI in nurses, Hignett (1996) reported an average point prevalence of WLBI of 17 in nurses, an annual incidence rate between 40 and 50, and a lifetime incidence rate between 35 and 80. However, according to the author, these figures are 'a gross under-estimation of the problem' because of the recording systems used and under-reporting (Hignett 1996, p. 1243). Higher figures were reported by Hofmann *et al.* (2002) in a large cross-sectional questionnaire study: a point prevalence of WLBI of 61 for the nurses; a lifetime incidence rate of 87; and a relative risk between 1.35 and 1.47 for nurses ($n = 2207$) in relation to administrative clerks ($n = 1177$). In addition, French *et al.* (1997) reported a similar lifetime incidence rate of WLBI of 81 based on a questionnaire study involving 47 Registered Nurses; 92% of nurses who had suffered some form of back pain never reported it.

Bending, twisting, lifting heavy weights and making forceful movements were shown to be related to WLBI (Punnett *et al.* 1991). Combined lifting, prior injury, and being overweight were found to be risk factors for WLBI

among nurses (Fuortes *et al.* 1994). In a 3-year prospective study including 861 workers, it was seen that spinal kinematics was critical to the development and aggravation of WLBI (Hoogendoorn *et al.* 2000).

Hignett (1996) did not find any studies using participative or interview methods to evaluate the problem among nurses, and commented about the limitation and lack of usefulness of the quantitative experimental studies. She reported that qualitative exploratory studies could significantly contribute to the identification of factors leading to the high incidence of WLBI among nurses. Nurses frequently perform tasks involving many of the established risk factors for WLBI, such as patient handling and transfers. Studies of low back pain in nurses are common in the literature, however, the problem is still substantial and little success has been achieved in preventing the problem. For these reasons, it is important to develop assessment tools and implement WLBI control programmes in nursing jobs.

The study

Initially, a retrospective epidemiological study was performed using information derived from the injury records of the acute care teaching hospital evaluated for the period from 1999 to 2003. The hospital mean number of workers per year in the period was 788 (± 174). The recorded cases of WLBI were reviewed, including injury date, job and department where the WLBI occurred, and injury type (first aid, medical aid, or lost time claim). First aid is any work-related injury/illness that did not require healthcare provider treatment and did not necessitate absence from work. Medical aid is any work-related injury/illness that required healthcare provider treatment and did not necessitate absence from work for more than the day of injury. A lost time claim is any work-related injury/illness that necessitated absence from work for more than the day of the injury. Based on the initial evaluation (findings presented in the Results section) it was decided to administer a questionnaire to the Registered and Licensed Practical Nurses of the orthopaedic department and of the intensive care unit (ICU) of the hospital.

Aims

The aims of this study were to evaluate the workload, to identify problems that might be leading to the higher incidence rate of WLBI among nurses in the orthopaedic

and ICU departments of the hospital, and to gather information about possible improvements that nursing staff would like to see implemented in the workplace. A new validated questionnaire was used to collect the data and its usefulness was investigated.

Design

A questionnaire survey was used to collect the data, and was administered between January and May 2005 in one teaching hospital in Canada.

Participants

All Registered and Licensed Practical Nurses of the orthopaedic and ICU departments of the hospital ($n = 91$) were eligible to complete the questionnaire. The jobs and shifts were the same for all nurses in the orthopaedic department, and the ICU had only Registered Nurses. For these reasons, the Registered and Licensed Practical Nurses were evaluated together and are referred to as orthopaedic nurses (ONs) or ICU nurses (INs) throughout the paper. Twenty-three ONs (response rate of 96% of the full-time ONs) and 24 INs (response rate of 72% of the full-time INs) completed the questionnaire. Most nurses were female (87% of the ONs and 96% of the INs). The mean ages for the ONs and INs were 34 (± 9) and 36 (± 8) years, mean weight was 76 (± 6) and 67 (± 10) kg, and mean body mass indices were 26 (± 5) and 25 (± 4) kg/m² respectively. The mean height for both groups was identical being 167 (± 7) cm.

The response rate (including 98% and 72% of the full-time ONs and INs, respectively) was higher than the minimal (70%) recommended by National Institute for Occupational Safety and Health (NIOSH) for epidemiological studies (Bernard 1997). Thus, selection bias can be considered negligible.

Nursing role

The nursing role in the orthopaedic department involves medication administration and providing activities of daily living for patients who have undergone orthopaedic surgery (e.g. total joint replacements, fractures and back surgery). The activities of daily living help included dressing/undressing, feeding, showering, help in the bathroom and oral care of patients. The job activities also included head-to-toe body assessments, preparing patients for surgery and return from surgery, inserting and removing tubes, catheters and drains. Among the most frequent tasks were: moving and transferring patients; moving furniture and patients from one room

to another; turning and repositioning patients in bed and chair; bed making; holding limbs for dressing changes and office work. The assistance devices most often used for patient transfers were belts, sliding boards and sheets. Mechanical lifts such as a sit-stand, a medi-lift, and a sling lift were also available but were not used as often. The nurses did seven 12-hour shifts over 2 weeks (Week 1: 2 days on, 2 days off, 3 days on; week 2: 2 days off, 2 days on, 3 days off). The day and night shift rotation scheme was not clearly defined and varied.

The INs took care of one or two patients per shift. This involved complete care of critically ill patients who were usually intubated (dead weighted). The activities included: administering medication, changing intravenous bags and prisma dialysis, monitoring, head-to-toe body assessments, bed bathing, mobilizing and repositioning patients in bed for procedures and X-rays, adjusting, moving and lifting equipment. Very frequent activities were lifting patients in the bed (twisting and pulling or pushing the patients – usually unconscious), and turning the patients from side to side (at least every 2 hours). The nurses worked four to five 12-hour shifts per week, totalling 77.75 hours every 2 weeks. The night and day shift rotation was not clearly defined; the nurses worked 2–3 days in a row followed by 2–3 days off.

Questionnaire

The questionnaire was peer-reviewed and published (Vieira *et al.* 2005). It included questions on the nurses' personal traits, their job characteristics, and on their physical perceptions of their jobs. It also included the following validated psychophysical measures of exertion for the whole job.

Body Part Discomfort Index (Corlett & Bishop 1976)

This is a body map on which the nurses rated their perceived discomfort by the end of the shift on a 10-point severity scale from 'no discomfort' (1), to 'very uncomfortable' (10). This technique has been previously validated (Boussenna *et al.* 1982).

Borg rating of perceived exertion (Borg 1962, 1982, 1990)

This is a 10-point scale on which the nurses rated their job exertion from 'nothing at all' (1), to 'maximal' (10). It has been used for more than 40 years, and its validity and reliability have been established by Chen *et al.* (2002), among others. Despite all the changes and advancements over the past 40 years, this tool was included in the questionnaire because it is a validated psychophysical measure of physical stress; it is frequently used by ergonomists, and has been

widely accepted in the ergonomics field. For more information on this tool see Dawes *et al.* (2005).

Visual Analogue Scale (Huskisson 1983)

This is a 100-mm long horizontal line on which the nurses marked their effort between 'no effort' and 'maximal effort'. The nurses were asked to mark the amount of effort their job requires on five different Visual Analogue Scales (VAS), one for each of the following physical exertion variables – posture, movements, repetitions, force and duration. This tool was initially used to measure pain perception, but it has been used for other types of evaluations and its reliability and validity has been established, including its ability to assess musculoskeletal loads (Huskisson 1983, Lee *et al.* 1991).

Ethical considerations and data collection

The study was approved by the university and hospital human research ethics boards. Participation was voluntary; the nurses were informed about the study by a recruitment poster, and those who decided to participate were asked to inform the clinical educator and/or the nurse in charge of their shift.

On the days of administration of the questionnaire, the clinical educator was responsible for sending those nurses who had volunteered to participate to a room set aside for this purpose. The volunteers received further explanations about the objectives and procedures of the study, including a statement of their right not to participate and to withdraw at any time with no consequence to them. After a consent form was signed, the questionnaire was handed out. It was completed during the shift in the presence of the researcher.

Data analysis

The data were analysed using the software SPSS for Windows (SPSS Inc., Chicago, IL, USA). Descriptive statistics were calculated. The annual incidence rate was calculated by dividing the number of new cases of WLBI recorded per year between 1999 and 2003 by the total number of working nurses per year for the same period. The point prevalence rate was calculated by dividing the number of nurses that reported having low back pain at the time of questionnaire completion by the total number of respondents. Finally, the lifetime incidence rate was calculated by dividing the number of nurses who reported having at least one episode of low back injury during their working life by the total number of respondents (Fletcher *et al.* 1988). The data from the five VASs were added to calculate the total effort required by the jobs. The total effort was transformed into a percentage of

the maximum effort possible ($5 \times 100 \text{ mm} = 500 \text{ mm}$). The total effort on the VAS and Borg scores were correlated using the Pearson correlation coefficient. Each of the variables on the VAS was standardized as a percentage of the total effort. The discomfort ratings of the different body parts and the five VAS scores were compared using a one-way ANOVA with Fisher's least significant difference *post hoc* test. The significance level was set to $P < 0.05$.

Results and discussion

Retrospective epidemiological study

Between 1999 and 2003, the total number of injuries recorded in the hospital was 677. Of these injuries 547 were first aid (81%), 18 were medical aid (3%), and 112 were lost time claim (16%) injuries. Cases of WLBI represented 23% of all injuries ($n = 159$), 16% of all first aid ($n = 87$), 17% of all medical aid ($n = 3$), and 62% of all lost time claim injuries ($n = 69$). Seventy-four per cent of the WLBI were classified as overexertion injuries ($n = 117$). Registered Nurses ($n = 504$) and Licensed Practical Nurses ($n = 96$) had the highest annual incidence rates of WLBI per hundred workers (respectively, 3.1% and 4.3%). The annual incidence rates of WLBI in the nurses were similar to the ones reported previously by Klein *et al.* (1984) for Licensed Practical Nurses (3.3%), and for other heavy jobs involving manual material handling such as lumbermen (3.3%) and construction workers (2.8%). Together, Registered and Licensed Practical Nurses, represented 78% ($n = 123$) of all cases of WLBI recorded in the hospital during the period analysed and 83% of the lost time claim WLBI cases. Approximately 70% of the WLBI in the Registered and Licensed Practical Nurses happened while transferring or moving patients. The department where the WLBI among Licensed Practical Nurses occurred most often was orthopaedics (32%), and the department where the WLBI among Registered Nurses happened most often was the ICU (17%).

Reported lifetime incidence and point prevalence of WLBI

Sixty-five per cent of the ONs and 58% of the INs reported to have had at least one WLBI during their working life. While the rate found for the INs was very similar to the 57% found by Bejia *et al.* (2005) in the Fattouma Bourguiba teaching hospital in Monastir, Tunisia, the lifetime incidence rate among ONs was somewhat higher. This trend is also observed when comparing the incidences we found with the 60% 'lifetime prevalence of low back pain' among nurses reported by Smedley *et al.* (1995). Forty-three per cent of the

ONs and 33% of the INs reported that they were currently experiencing some musculoskeletal pain. Of these, low back pain represented 70% (point prevalence of 30) among the ONs and 75% among the INs (point prevalence of 25). The percentage of low back pain (70% and 75%) among the nurses who reported some type of musculoskeletal pain currently, was higher than the 63% previously reported by French *et al.* (1997) among Registered Nurses ($n = 47$) in a similar study. The orthopaedics departments of hospitals were previously found to have a higher incidence of WLBI in relation to other departments (Yassi *et al.* 1995). In addition, the WLBI point prevalence found for the ONs (30) was higher than those found for different populations. Reigo *et al.* (1999) found a back pain point prevalence of 23 [95% confidence interval (CI) 21–25] for the Swedish population aged between 20 and 59 years. Picavet and Schouten (2003) found a back pain point prevalence of 27 (95% CI 26–28) for the Netherlands population. Likewise, Walker *et al.* (2004) found a back pain point prevalence of 26 (95% CI 24–28) for the Australian population. The sample size (23 ONs and 24 INs) is too small to allow statistical comparisons between the groups, and any generalizations to the general population of nurses would be inappropriate. Despite this limitation, the data show some interesting trends within the hospital; the data also concur with other studies using bigger samples.

Exercising, smoking and WLBI

The ONs and INs who reported that they exercised regularly (respectively, 57% and 50%) said that the mean time they exercised was 198 (± 119) and 195 (± 93) minutes per week, respectively. The ONs and INs who reported that they smoked (respectively, 35% and 21%) said that they smoked 8 (± 5) and 10 (± 3) cigarettes per day, respectively. Eighty per cent of the ONs and 70% of INs who exercised regularly did not report WLBI; neither did 80% of the ONs and 90% of the INs who did not smoke, and 67% of the ONs and INs who exercised and did not smoke. On the other hand, 62% of the ONs and 64% of the INs who did not exercise reported WLBI, and so did 75% of the ONs and 80% of the INs who smoked, and all ONs and INs who did no exercise and smoked.

These findings point to a relationship between smoking and lack of exercise with low back injuries. Despite the small sample size of this study, the observed trend is in agreement with other studies. Tsai *et al.* (1992) found higher odds ratios of WLBI for smokers (1.54, $P < 0.01$) and overweight workers (1.42, $P < 0.01$). Bejia *et al.* (2005) found a WLBI odds ratio of 1.69 (95% CI = 1.03–3.07) for tobacco users and also found that exercising has a protective effect ($P = 0.019$). According to Frymoyer *et al.* (1983), the cigarette nicotine causes vasoconstriction, which reduces the blood flow to the muscles and the intervertebral discs, and predisposes smokers to low back injuries. In a previous study, the authors suggested that increased coughing among smokers is also related to increased risk of low back injuries in this group (Frymoyer *et al.* 1980). Additionally, Fogelholm and Alho (2001) proposed the hypothesis that cigarette smokers have an increased risk of low back injuries because of intervertebral disc degeneration and spinal instability caused by increased proteolytic activity. The authors cite studies where the odds ratio of low back injuries among smokers compared with non-smokers varies between 1.3 and 2.5. The percentage of the ONs who reported that they smoked (35%) is higher than that of the province of Alberta or the Canadian national averages, which are, respectively, 23% and 22% of the population (Bowerman 2004). In addition to smoking and a sedentary life style, advanced age, female gender, increased body mass index, and disturbed psychological profile are among other individual factors shown to be related to an increased risk of WLBI (Bejia *et al.* 2005).

Manual handling

The weight handled and the numbers of transfers by the INs were smaller than those reported by the ONs ($P < 0.006$). The number of lifts in general (patients, furniture, or equipment) reported by the INs was also smaller ($P = 0.029$); the differences between the number of lowers, pushes, and pulls during the work shift were not statistically different (Table 1).

The difference between the weights manually handled by the ONs and INs may be explained by the smaller number of

Table 1 Weight handled, number of transfers and number of repetition of tasks per shift by orthopaedic (ONs) and intensive care nurses (INs)

	Weight handled in kg	Number of transfers performed			Number of repetitions of the tasks			
		Bed to chair/commode	Stretcher to bed	Chair to chair/commode	Lifting	Lowering	Pulling	Pushing
ONs	47 \pm 30	11 \pm 6	8 \pm 5	4 \pm 2	19 \pm 13	11 \pm 9	9 \pm 6	9 \pm 7
INs	26 \pm 10	1 \pm 1	1 \pm 1	0 \pm 1	13 \pm 8	8 \pm 5	14 \pm 11	12 \pm 8

transfers performed by the INs. However, the INs reported that they turned their usually incontinent patients from back to side and vice versa every 2 hours during the shift and also helped the other INs to turn their patients. The mean number of patient turns in bed per shift reported by the INs was 8 (± 3). The fact that the INs perform less patient transfers (lifting and lowering), but more patient turns (pulling and pushing) is reflected by the number of repetitions of the tasks. The variation on the average weight and the number of transfers and repetitions of the tasks reported by the nurses, may be explained by the variability in the job itself.

Despite the differences, the weight manually handled, as reported by both ONs and INs, was higher than the limit proposed in the NIOSH 1991 lifting equation as the maximum recommended weight in 'optimal conditions' (occasional lifting in the sagittal plane, with good couplings, and vertical displacement of < 25 cm). The NIOSH limit is 23 kg and it causes 3400 N spinal compression, requires 3.5 Kcal/minute energy expenditure, and is acceptable by 99% of males and 75% of females (Waters *et al.* 1993). Manual transfer and repositioning patients in bed were previously reported as being associated with an increased risk of WLBI (Smedley *et al.* 1995). Manual patient transfer was reported by nurses as the most stressful method (Garg & Owen 1994).

Very frequent postures and activities in the jobs

Figure 1 presents the percentage of the nurses who marked different postures as very frequent in their job.

Standing with the trunk flexed was the posture most frequently identified as very frequent in the job of both ONs and INs. In addition to the postures illustrated in Figure 1, 32% of the ONs and 22% of the INs reported other postures:

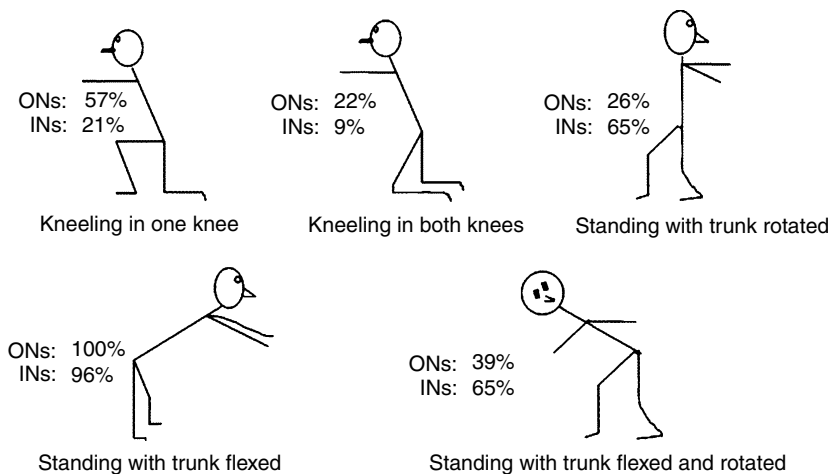


Figure 1 Percentages of orthopaedic nurses (ONs) and intensive care nurses (INs) who classified different postures as 'very frequent' in their jobs.

63% of the ONs and 40% of the INs indicated squatting, and 37% of the ONs and 60% of the INs indicated that twisting and reaching postures were very frequent in their job. The mean time the nurses reported that they maintained a static posture before a break or change in position was 2.4 (± 1.7) minutes for the ONs and 4.1 (± 2.2) minutes for the INs.

Squat lifting and pulling were the activities most often identified as very frequent in the job of an ON, while for the INs the most frequent activities were pushing and pulling. These findings agree with the reported numbers of the tasks (Table 1) and show the internal consistency of the questionnaire. Other activities mentioned were holding a limb up, and combined lifting and pulling by the ONs, and bringing the patient up in bed by the INs.

Reported discomfort by the end of the shift

Figure 2 presents the discomfort experienced by the end of the shift rated by the nurses on the body part discomfort index (10-point scale). In ONs, the low back discomfort rate was higher than for most other body parts ($P < 0.01$) except for the neck ($P = 0.06$). In INs, the low back discomfort rate was higher than for all the body parts ($P < 0.03$) including the neck ($P = 0.01$). There were no significant differences between the discomfort rates indicated for each of the body parts by ONs and INs.

Rates of perceived physical exertion

The perceived exertion was rated on the 10-point Borg scale as 6.7 (± 1.8) (very strong) by the ONs and as 5.8 (± 1.9) (strong) by the INs. On the VAS, the total effort required by the jobs was 67% (± 14) of the maximum for the ONs and

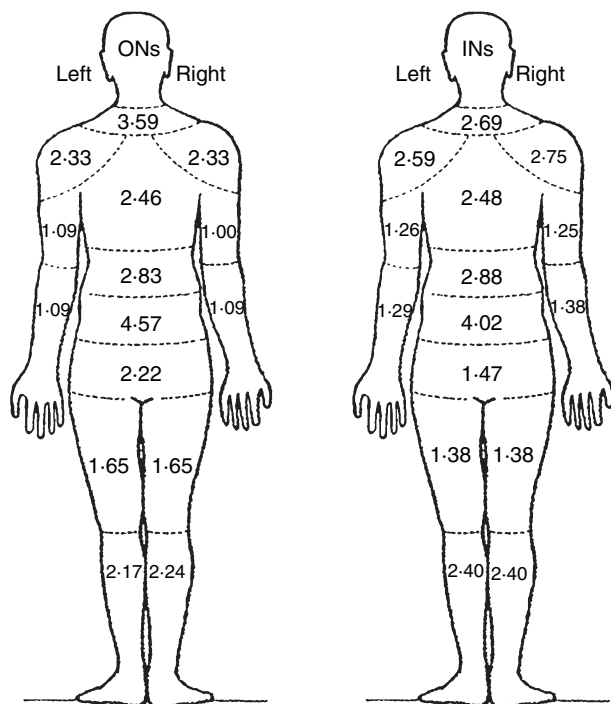


Figure 2 Discomfort felt by the end of the shift in different body parts by orthopaedic (ONs) and intensive care nurses (INs) – 10-point scale.

68% (± 15) for the INs. The Borg scores and the total effort on the VAS, and the Borg and force effort on the VAS were moderately correlated ($r = 0.53$, $P < 0.01$ for both comparisons) (Munro 1997). There were no differences between the scores given by the ONs and INs to each variable on the VAS (posture, movements, repetitions, force and duration), and no variable scored significantly higher than the others. Figure 3 presents the results of the VAS.

Because of the fact that five physical exertion variables were evaluated as representing the total job effort, a 20%

representation for each would be expected if the physical workload was equally distributed. Even though no significant differences were found, in general, force and movements contributed more to the total ONs job effort, while force and posture contributed more to the total INs job effort. This trend is in agreement with the observed job demands and described job tasks. Thus, this method of analysing the physical effort in relation to its different components seems to be interesting and useful. Additional research on its use and applications should be carried out because no study using this method was found.

Problems related to WLBI and suggested improvements

Table 2 presents the issues reported as related to the high incidence of WLBI among the nurses and their suggestions for improvement.

Lifting and transferring patients was previously reported as the main cause of WLBI among nurses (Yassi *et al.* 1995). Stobbe *et al.* (1988) compared the frequency of low back injuries in two groups of nurses. One group was classified as having high frequency of patient lifting (more than five patient lifts per shift, $n = 317$) and the other group was classified as having low frequency of patient lifting (less than two patient lifts per shift, $n = 98$). Their study showed that lifting patients was directly associated with the probability of nurses experiencing WLBI; the low frequency of lifting group ‘survived’ longer without a WLBI than the high frequency of lifting group (10% difference after 1215 days, $P < 0.01$). Specifically for the Licensed Practical Nurses in that study, those in the high lifting frequency group were 7.54 times more likely to have a WLBI than those in the low frequency of lifting group (Stobbe *et al.* 1988). Hignett (1996) also reported that the greater the manual handling of patients, the higher the incidence rate of WLBI.

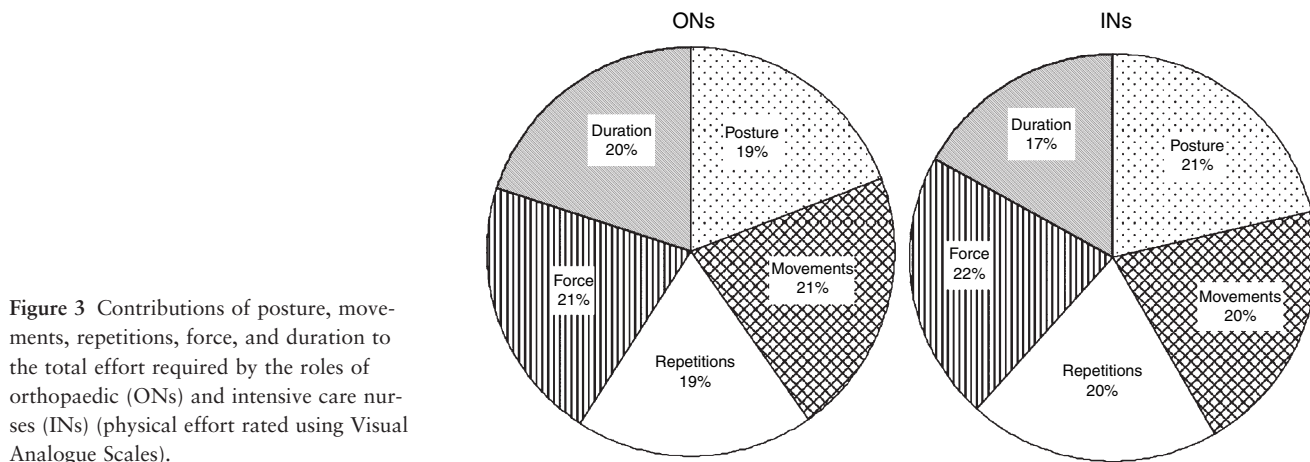


Figure 3 Contributions of posture, movements, repetitions, force, and duration to the total effort required by the roles of orthopaedic (ONs) and intensive care nurses (INs) (physical effort rated using Visual Analogue Scales).

Table 2 Problems reported and suggestions by orthopaedic (ONs) and intensive care nurses (INs) to reduce the number of work-related low back injuries in their jobs

Problems	% of responses	Group	Relevant suggestions	% of responses	Group
The rooms are too small	29	ONs	Bigger rooms and to adjust environment	13	ONs
	6	INs	(rooms) set up ergonomically	6	INs
Staff shortage and lack of encouragement to ask for help	15	ONs	Increase staff and/or add assistants to help	28	ONs
	39	INs	with transfers and encouragement to ask other staff members (nurses, physiotherapists, occupational therapists) for help and to use assistance devices even if it takes more time	25	INs
Patients too heavy for the staff and unexpected movements	15	ONs	Pre-employment functional capacity evaluations and regular exercise programme	5	ONs
	14	INs			
Working with inexperienced staff; lack of training on lifting and patient transfer, and the postures required	13	ONs	Training in lifting and patient transfer, especially for new staff, and to be reminded to use proper posture	10	ONs
				10	INs
Manually handling heavy bags. The nurses have to squat to hang 5 kg bags of fluid on the holders of the dialysis machine, and some of the intravenous infusion poles are not adjustable	13	INs	New adjustable intravenous poles and higher fluid bag holders on the dialysis machines	9	INs
Shortage of lifting devices for moving and patient transfers; equipment is less than ideal; it is too time consuming, or the equipment is not well maintained	10	ONs	Additional and more adequate devices for patient transfer	18	ONs
	6	INs		31	INs
Many transfers due to surgeries, X-rays, and room transfers, and having to rush to get next patient discharged or admitted from surgery	8	ONs	Rotate the staff due to the high acuity of the patients and put very heavy patients in different rooms, and to spread the number of X-rays, surgeries, tests throughout the week to avoid peak days	8	ONs
				3	INs
The X-rays are done at 06-00 in the ICU. At this time the nurses are tired because it is close to the end of the shift	13	INs	Beds with X-ray capabilities and schedule the X-rays for the beginning of the shift	13	INs
Shifts are too long (12 hours)	6	ONs	Reduce shifts to no longer than 8 hours	8	ONs
Repetitive holding of patients' limbs and reaching over the bed to reposition the patients	6	INs	Always encourage patient to help as much as possible	8	ONs
Overestimation of patient capabilities and lack of patient education preoperation	2	ONs	Give guidelines for lifting/turning patients	3	INs
Inadequate system to lower bed rails	2	ONs	Patients should come back from operation room already in their beds	2	ONs
	3	INs			

In addition to the well recognized and important relationship between patient manual handling and WLBI, the results presented in Table 2 also point out other problems related to WLBI in nursing jobs that deserve attention. Among these problems it is relevant to highlight environmental and organizational issues such as the room sizes and setup, and the X-ray and shift schedules. Training in biomechanics and lifting techniques helps, but it alone is not enough to reduce the number of cases of WLBI in the workplace (Hignett 1996). The introduction of new assistance devices results in higher compliance to prevention programmes than training

alone (Daynard *et al.* 2001). Marras *et al.* (1999) studied manual patient transfers and repositioning using different techniques; they reported that manual patient handling is an extremely risky task for WLBI. The authors stated that 'to have an impact on low back disorders, it is necessary to provide mechanical lift assist devices' (Marras *et al.* 1999, p. 904). Elford *et al.* (2000) studied patient transfer from chair to chair with and without lifting slings. The authors found higher velocities, accelerations, and body part stress reported on VAS for the manual transfers than when using lifting slings. However, not all studies show that the use of

What is already known about this topic

- Low back injury is the most prevalent and most costly musculoskeletal disorder.
- Nurses are among the professionals with the highest incidence rates of work-related low back injury.
- Participatory ergonomic interventions can help to reduce the number of musculoskeletal disorders in nurses.

What this paper adds

- A tested and practical questionnaire to identify problems of high incidence of low back injuries among nurses and possible solutions or improvements.
- Nursing jobs should be evaluated specifically according to the specialty because the demands and risks differ.
- Additional transfer devices, training programmes, bigger rooms, adequate set-up, and additional nurses to help with turns and transfers are recommended to reduce the number of low back injuries.

lifting devices for patient transfers is always good. The main problem is that transfers take longer when using assistance devices (Garg & Owen 1994). Daynard *et al.* (2001) showed that, despite reducing the peak load, the use of some devices may increase the total cumulative load because of the longer time required to perform the transfers. Cumulative compression and shear forces were shown to be higher in institutional aids with low back pain than in those without pain (Kumar 1990). Thus, each situation has to be studied specifically in order to find the safest way of moving and transferring patients.

Ergonomic assessment and interventions have been shown to improve the control of musculoskeletal disorders among nurses (e.g. Garg & Owen 1994). Hignett (2001) reports a successful ergonomic experience at Nottingham City Hospital, UK. The 5-year programme resulted in 33% reduction in manual handling incidents, and 36% reduction in days lost through musculoskeletal disorders. A generally accepted approach is to identify tasks with high risk, determine the critical factors in the tasks, and modify those critical factors to reduce the risk of WLBI. Different modifications are being discussed based on the results. In general, additional equipment for patient transfer, training programmes, bigger rooms, adequate room set up, and additional staff are recommended interventions. Considering that the questionnaire response rate was higher than 70%, the results and conclusions can be generalized for all the ONs and INs of this hospital (Bernard 1997). However, the sample size was small

and the results and conclusions should not be generalized for nurses in every hospital. Specific studies are required in different hospitals because the problems potentially causing low back injuries may differ. The questionnaire used was shown to be an adequate tool for identifying the relevant issues that should be addressed.

Conclusion

The questionnaire used is practical and useful to initiate an evaluation of nursing jobs. It facilitates the systematic collection of staff input. It helps to identify problems and possible solutions or improvements to nursing jobs that can be used to design participatory ergonomic interventions aimed at reducing WLBI. The jobs in the orthopaedic and ICU departments have heavy workloads. Many WLBI risk factors such as bending, twisting, lifting heavy weights and making forceful movements are present in these jobs. However, there are differences between the jobs. Thus, nursing jobs should be evaluated specifically according to the department because the demands and risks differ. Specific modifications are being studied. The general recommendations to improve the control of WLBI in the jobs are:

- Increasing the number of patient transfer devices.
- Delivering training programmes.
- Increasing the size of the rooms and/or adjusting the room set-up ergonomically.
- Hiring additional nurses and/or nursing aids to help with patient turns and transfers.

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Author contributions

ERV, SK and HJCG were responsible for the study conception and design and drafting of the manuscript. ERV and YN performed the data collection and data analysis. ERV, SK and HJCG obtained funding and provided administrative support. ERV, SK, HJCG and YN made critical revisions to the paper. SK and HJCG supervised the study.

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