

# Forecasting the risk of WRMSDs in home care nurses

Carneiro, Paula<sup>a</sup>, Braga, A. Cristina<sup>a</sup>, Barroso, Mónica<sup>a</sup>

<sup>a</sup> Department of Production and Systems Engineering, School of Engineering, University of Minho, [pcarneiro@dps.uminho.pt](mailto:pcarneiro@dps.uminho.pt); [acb@dps.uminho.pt](mailto:acb@dps.uminho.pt); [mbarroso@dps.uminho.pt](mailto:mbarroso@dps.uminho.pt)

## Abstract

Studies regarding work related musculoskeletal disorders (WRMSDs) in nurses have been carried out mostly in hospitals or in other institutional contexts. Information about this theme in providing home-based care is scarce. The main goals of this work are the characterization of musculoskeletal complaints in nurses who work at the Health Centers of the northern Portugal and that provide home-based care, the identification of the main risk factors present in the homecare context and the development of statistical models to forecast the risk in the same context. The principal methodology used in this work was a questionnaire developed in electronic format which was based on the "Standardized Nordic Questionnaire" for the analysis of musculoskeletal symptoms. It were used univariate models of binary logistic regression to estimate the risk of WRMSDs present in the practice of home-based care and also to assess which risk factors that could contribute to the appearance of complaints in the lumbar region in the professionals who provide homecare. The body areas with more musculoskeletal complaints are the back and the shoulders. The nurses who provide home care have nearly triple chance of having musculoskeletal complaints in the lumbar region than their counterparts of Health Centers (OR=3.19 ( $p<0.05$ ), 95% Confidence Interval [1.26; 8.08]). We obtained various statistical models for forecast the risk of having low back complaints in home care nurses. From all of them was selected the one that presented more stability and reliability. The model performance was evaluated by ROC (Receiver Operating Characteristic) analysis yielding a value for the area under the ROC curve of 0.889 ( $p<0.05$ ). This value reveals a high discriminating power, that is, the model is able to correctly forecast the complaints in the lumbar region in 88.9% of cases.

*Keywords:* Musculoskeletal Disorders; Nurses; Home Care; Logistic Regression

## 1. INTRODUCTION

Work related musculoskeletal disorders (WRMSDs) have been described as the most important occupational health problem tormenting the nurses (Barroso et al. 2007; Smith et al. 2006). Some authors report that about 3.5% of nurses leave the profession due to musculoskeletal problems (Stubbs et al. 1998). Further evidence of this problem are the high prevalence of both symptoms and injuries related to the musculoskeletal system in nurses (Alexopoulos et al. 2006; Barroso and Martins 2008; Barroso et al. 2007; Daraiseh et al. 2010; Menzel et al. 2004; Smith and Leggat 2003; Smith et al. 2004; Trinkoff et al. 2003; Yip 2001).

Caring for people is considered a risk activity, with a high prevalence of musculoskeletal complaints related mainly to the back (Alexopoulos et al. 2006; Barroso et al. 2007; Daraiseh et al. 2010; Knibbe and Friele 1996; Menzel 2004).

Despite back problems in nurses have a multifactorial etiology that includes physical, psychosocial and individual factors (Sherehiy et al. 2004), the manual handling of patients is considered one of its main causes (Hodder et al. 2010). In fact, the tasks involving manual handling of patients are those that are most often highlighted as causes of back problems (Byrns et al. 2004; Garg 2006; Hignett 1996; Lagerström et al. 1998; Marras et al. 1999; Violante et al. 2004; Yassi et al. 1995; Yip 2001). It's very important to reduce back complaints, because that may lead to the suffering of professionals, to a greater absenteeism and in some cases to an early retirement. In addition, have symptoms in the lumbar region can lead to the appearance of symptoms in other body regions (Daraiseh et al. 2010).

In general, studies conducted on this subject have been carried out in the hospital or institutional context. Information regarding WRMSDs in providing home-based care is scarce and in Portugal, for example, there is no knowledge of any study about this theme.

Although hospitals and similar institutions are applying policies to dramatically reduce manual handling of patients, in most cases of home care the use of mechanical lifting devices remains rare and manual handling of patients by only one person remains a very common task (Hess and Kincl 2006). Some studies indicate that injury and musculoskeletal disorders of the back and other body parts constitute a serious problem for professionals who provide home-based care, especially nurses and nursing assistants (Brulin et al. 1998a, 1998b; Cheung et al. 2006; Knibe and Friele, 1996; Meyer and Muntaner 1999; Ono et al. 1995; Pohjonen et al. 1998; Smith and White 1993).

In a study involving a comparative analysis of musculoskeletal disorders between Greek and Dutch nursing personnel, in hospitals and nursing homes, the authors refer that the work in the latter seems to entail similar risks as in hospital

care, perhaps even a little more, as the work environment is less controlled and standardized (Alexopoulos et al. 2006). Following the reasoning of the authors, it can be assumed that the provision of home care can lead to yet a higher risk, since patients' homes are a work environment even less controlled, without any kind of pattern.

Based on the above information, it was thought that WRMSDs in nurses who provide home care was an issue of major importance.

The objectives of this work are the characterization of musculoskeletal complaints in nurses who work at the Health Centers of the northern Portugal and that provide home-based care; verify if provide home-based care, by itself, represents a risk factor for WRMSDs; identify the main risk factors present in the homecare context; development of statistical models to forecast the risk in the homecare context.

## **2. MATERIALS AND METHODS**

The principal methodology used in this work was a questionnaire developed in electronic format which was based on the "Standardized Nordic Questionnaire" for the analysis of musculoskeletal symptoms (Kuorinka et al. 1987). It is a questionnaire well tolerated by workers, it's widely used and has been tested previously for reliability and validity (Björkstén et al., 1999). There have been some adjustments in order to better adapt to nursing activities carried out during the home-based care. Several questions were added in order to collect more information to enable the application of statistical techniques to identify the largest possible number of WRMSDs risk factors and evaluate its impact on the appearance of musculoskeletal complaints. The contents of the questionnaire were validated by nurses from several Health Centers. These nurses completed the questionnaire on paper, communicating to us afterwards if they had had some difficulty in interpretation of questions, if suggested any changes or even if they thought that should add questions. Thus, after several iterations, we obtained the final version of the questionnaire with their content validated. The questionnaire was available on a website to be filled in anonymously by nurses belonging to Health Centers from the North Region of Portugal.

The questionnaire was divided into four parts: A, B, C and D. Part A covers demographic aspects and aspects relating to the profession. It also incorporates an issue that allows us to distinguish between nurses who work only in the Health Center and those who provide home-based care. Part B includes the identification and characterization of complaints and musculoskeletal symptoms self-reported by nurses. Part C, which can only be filled by nurses who provide home-based care, begins by asking how many hours per week on average, are dedicated to home-based care. The following is a list of nursing activities, which asked the nurse to select the activity performed most often during the provision of home-based care. In view of this activity, the nurses are asked to answer to a series of questions that are, in fact, an adaptation of the technique REBA (Hignet and McAtamney 2000) for musculoskeletal risk assessment. With these questions, we wanted to know what was the perception that nurses had about the postures related to various body segments (trunk, neck, legs, arms, forearms and wrists), that they adopt in general during their activity more frequent at home visits, about the force exerted during the activity and also about certain features, for example whether the activity has a repetitive nature, whether nurses adopt static postures, the type of connection between nurse and patient, among others. The last part of the questionnaire, Part D, contains questions relating to various aspects still unexplored in the previous parts, as some physical factors and also psychosocial factors (Carneiro et al. 2010).

The questionnaire was released through an e-mail message sent to all Health Centers in the northern region of Portugal during the second half of 2009 and also through mail during the first half of 2010.

To estimate the risk of WRMSDs present in the practice of home-based care, we used univariate models of binary logistic regression. In this process, provide home-based care or not, was the factor used to evaluate the association with the musculoskeletal complaints related to the body zones under study. Based on these results, we used logistic regression to predict which risk factors that could contribute to the appearance of complaints in the lumbar region on the professionals who provide homecare. The evaluation of the performance of the resulting model was carried out using the ROC curve.

## **3. RESULTS AND DISCUSSION**

We received 147 complete responses (response rate of 5.1%). The questionnaires received have been treated statistically by Statistical Package for Social Sciences (SPSS or PAWS Statistics 19.0<sup>®</sup>).

It was found that about 87% of nurses are female and about 13% are male. The average age of nurses that are part of the sample is 35.7 years (sd - 8.88); the seniority in the profession is 12.8 years (sd - 8.39); the seniority in Health Centers is 9.2 years (sd - 7.06). About 85% of respondents refer that provide home health care.

For the overall sample the body regions with most complaints are the back (the cervical region with about 73.5% of complaints followed the lumbar region with 64.6% and the dorsal region with 49.0%) and the shoulders with 49.0%, equal to the dorsal region. These values are somewhat consistent with those of other studies that also used questionnaires based on the "Standardized Nordic Questionnaire" (Kuorinka et al. 1987), carried out both at hospital context and at home care settings (Barroso et al. 2007; Cheung et al. 2006; Knibe and Friele, 1996). Based on this sample of respondents, no differences were found between the two groups of nurses at the level of complaints in various

body zones, with except of the lumbar region for which the values are 40.9% and 68.8%, respectively for nurses who don't provide home care and for the nurses who do this.

All results presented from now relate only to the group of nurses who provide home care. It was found that in general, the home care nurses work alone. In this study, about 32.8% of them say they never have help from colleagues and 38.4% said they rarely have help. The remaining 28.8% says that have some help from colleagues with frequency, often and always.

The activities carried out more frequently in the home care settings are the treatment of pressure ulcers (44.8%) and the implementation of dressings (40.8%).

About the height of the bed (or any other surface) where the treatment of patients was performed, 80.8% consider it low, 18.4% consider it appropriate and 0.8% considers it high. Ninety-two point eight percent of nurses who provide home care reported that usually they need to move the patient to treat him and 97.6% of nurses reported that in general there are no patients lifting/transferring devices.

In the questionnaire, nurses were asked to make a general characterization of the space where performed their duties. This characterization should be done for three parameters (disposition of furniture and equipment, available space for moving around the patient, arrangement and hygiene) and should be done using a *Likert* scale with five levels (1 – bad; 2 – mediocre; 3 – satisfactory; 4 – good; 5 - very good). The results obtained can be seen in the following three Figures (1, 2 and 3):

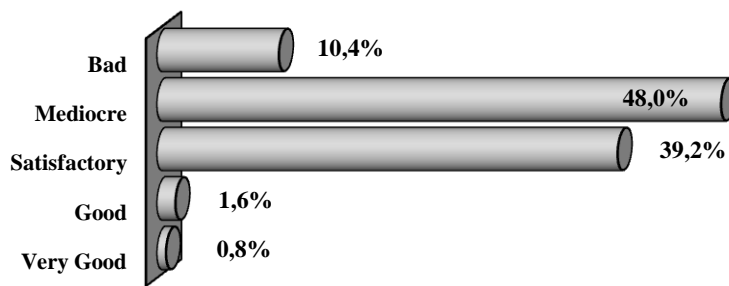


Figure 1 - Characterization concerning the disposition of furniture and equipment.

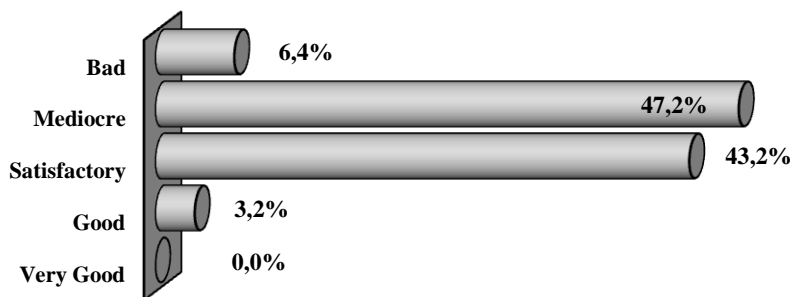


Figure 2 - Characterization concerning the availability of space for moving around.

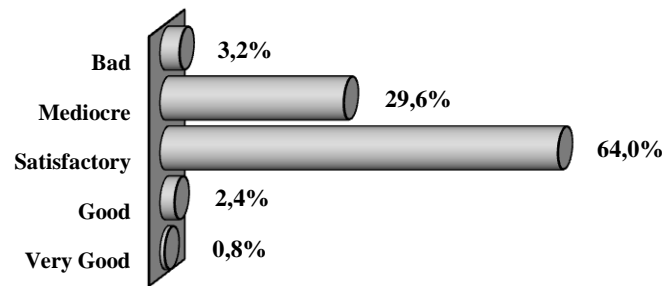


Figure 3 - Characterization concerning the arrangement and hygiene of the place.

As one can see in the graphs above, the results obtained for the characterization of the workplace are not very good, especially in what concern to the disposition of furniture and equipment and also in what concern to the availability of space for moving around. Sometimes, the lack of enough space for the nurse to move around the patient and a poor organization of the workspace, force the professional to adopt inappropriate postures that can lead to the appearance of musculoskeletal complaints (Barroso et al. 2006; Cappiello et al. 2005).

About 78.4% of home care nurses refer they feel satisfy with their work at the patients house.

To measure the association between the factors “provide home-based care” and “to have complaints at different body areas” (dependent variables) was carried out models of binary logistic regression to evaluate the odds ratio and respective confidence intervals. It was detect statistically significant association only for the lumbar region (OR=3.19 ( $p < 0.05$ ), 95% Confidence Interval [1.26; 8.08]), as can be seen in Table 1. This signifies that the nurses who provide home-based care have nearly triple chance of having musculoskeletal complaints in the lumbar region than their counterparts of Health Centers.

Table 1 – Odds ratio and 95% CI for the different complaints.

Complaints	Odds ratio	95% CI
Cervical	1.045	(0.377, 2.897)
Dorsal	1.468	(0.585, 3.681)
<b>Lumbar</b>	<b>3.185</b>	<b>(1.256, 8.076)</b>
Thighs	0.782	(0.212, 2.883)
Knees	0.601	(0.165, 2.188)
Ankles/feet	1.412	(0.426, 4.678)
Shoulders	0.769	(0.310, 1.910)
Wrists/hands	0.972	(0.376, 2.573)
Elbows	0.611	(0.156, 2.395)

After this verification, was investigated what factors, related only with home-based care nurses, which are associated with "to have complaints in the lumbar region". To this end, we used univariate models of binary logistic regression. We selected the variables that had a p-value lower than 0.2 ( $p < 0.20$ ). We considered that the variables selected could contribute to the dependent variable (complaint in the lumbar region). Then, the variables were introduced in the forecasting model. To obtain statistical models for forecast the risk of low back complaints in home care nurses were used different methods for the selection of variables. From various statistical models obtained, was selected which presented more stability and reliability. To obtain this statistical model for forecast it was used stepwise forward (Wald Statistic) selection method. This process resulted in eight variables that, together, have a contribution to the risk of having complaints in the lumbar region. The contribution of each one may be positive or negative depending on the sign of the estimated coefficient. Positive contribution means that when the variable in question is verified in a particular work situation, increases the probability of lumbar complaints. In contrast, a negative contribution means that when the variable in question is verified, decreases the probability of lumbar complaints. The forecast model can be seen in Equation (1):

$$\text{logit} = 2.719 + 1.584 *X_1 - 2.222*X_2 - 1.237*X_3 + 2.093*X_4 + 1.187*X_5 - 3.404*X_6 - 4.047*X_7 - 2.056*X_8 \quad (1)$$

The meaning of the above variables is as follows:

$X_1$  - Complaints in the hands / wrists;  $X_2$  - Complaints in the thighs;  $X_3$  - Posture of the forearm;  $X_4$  - Repetitive movements;  $X_5$  - Posture of the arm;  $X_6$  - The arm or its weight is supported;  $X_7$  - Assistive devices for lifting/transferring patients;  $X_8$  - Job satisfaction.

For a nurse who provides home care, calculating the likelihood of having complaints in the lumbar region is made through the Equation 2, below:

$$\hat{\pi} = \frac{e^{\text{logit}}}{1 + e^{\text{logit}}} \quad (2)$$

Some of the variables that are part of the forecasting model are often associated to back problems. Exemplifying and despite opinions are not unanimous, several authors refer that, whenever possible, should be used assistive devices for lifting/transferring patients in order to decrease the possibility of musculoskeletal problems (Elford et al., 2000; Evanoff et al. 2003; Kromark et al. 2009; Smith et al., 2006; Zhuang et al., 2000). The job satisfaction is also a factor sometimes referred to as a potential contributor to the occurrence of fewer musculoskeletal disorders. The dissatisfaction with certain working conditions may lead to musculoskeletal symptoms (Daraiseh et al. 2003). Repetitiveness of movements is also a recognized risk factor of WRMSDs (Bernard 1997; Brulin et al. 1998b). Other variables that are part of the statistical model for forecast the risk are less relevant in the literature, or even no, with respect to their possible influence on the occurrence of musculoskeletal disorders. However, it is known that sometimes the variables have no influence per se, but have it when combined with other variables. The inverse is also true. This is exemplifying in a literature review on risk factors associated with musculoskeletal problems (Malchaire et al. 2001). In fact, our study goes to meet the study of Daraiseh and colleagues, in which they stated that the complex interaction and the synergistic effects of different working conditions of nursing needed a better understanding since most researchers had not considered these aspects (Daraiseh et al. 2003).

The performance of the model was evaluated by ROC analysis yielding a value for the area under the ROC curve of 0.889 ( $p < 0.05$ ). The ROC curve obtained is in Figure 4. In this case, the area under the curve reveals a high discriminating power, that is, the model is able to correctly forecast the complaints in the lumbar region in 88.9% of cases.

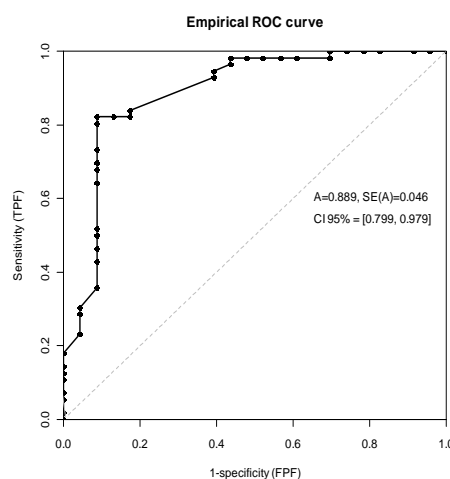


Figure 4 – Empirical ROC curve for the model.

#### 4. CONCLUSIONS

Given that the number of responses received so far does not allow an inference about the population, however we can characterize this sample according to some important aspects, namely:

- To the overall sample the body zones with the greater number of complaints are the back (cervical – 73.5%, lumbar – 64.6%, dorsal – 49.0%) and shoulders (49.0%).
- About 80.8% of home care nurses consider the height of the bed (or other surface where’s the patient) low; 18.4% consider it suitable and 0.8% consider it high. This is an important aspect because previous studies already revealed as a factor in the emergence of awkward postures and consequently of musculoskeletal complaints (de Looze et al. 1994).
- The results concerning to the characterization of the workplace performed by home-based care nurses are not very encouraging, especially in what concern to the disposition of furniture and equipment and also in what concern to the availability of space for moving around. Some of these aspects may even lead the nurses to the adoption of inadequate postures and consequently to the appearance of musculoskeletal complaints.
- We find a statistically significant association between “musculoskeletal complaints in the lumbar region” and “provide home-based care”, (OR=3.19 (p<0.05), 95% Confidence Interval [1.26; 8.08]). So, the nurses who provide home-based care have circa triple chance of having musculoskeletal complaints in the lumbar region than their colleagues of Health Centers.
- To the group of nurses who provide home-based care, we find a model that includes eight factors that may contribute, positively or negatively, to the appearance of lumbar complaints. These factors are: complaints in the hands/wrists; complaints in the thighs; posture of the forearm; repetitive movements; posture of the arm; have the arm or its weight supported; assistive devices for lifting/transferring patients; job satisfaction. The statistical model obtained is able to correctly forecast the risk of having complaints in the lumbar region in 88.9% of cases.

As future work, new models for forecasting are going to be evaluated, only for the lumbar region since this was the only one that showed significant association with the provision of home care.

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