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Psychometric properties evaluation of a new ergonomics-related job factors questionnaire developed for nursing workers

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ABSTRACT

The objectives of this study were to develop a questionnaire that evaluates the perception of nursing workers to job factors that may contribute to musculoskeletal symptoms, and to evaluate its psychometric properties. Internationally recommended methodology was followed: construction of domains, items and the instrument as a whole, content validity, and pre-test. Psychometric properties were evaluated among 370 nursing workers. Construct validity was analyzed by the factorial analysis, known-groups technique, and convergent validity. Reliability was assessed through internal consistency and stability. Results indicated satisfactory fit indices during confirmatory factor analysis, significant difference ($p < 0.01$) between the responses of nursing and office workers, and moderate correlations between the new questionnaire and Numeric Pain Scale, SF-36 and WRFQ. Cronbach's alpha was close to 0.90 and ICC values ranged from 0.64 to 0.76. Therefore, results indicated that the new questionnaire had good psychometric properties for use in studies involving nursing workers.

1. Introduction

Work-related musculoskeletal disorders are one of the most important causes of occupational injuries and socioeconomic problems in developed countries as well as in developing countries.

Studies have highlighted the health care workers as a risk group for the development of work-related musculoskeletal disorders, particularly vertebral pains (Cole et al., 2001; Alexopoulos et al., 2004; Salik and Özcan, 2004; Aasa et al., 2005; Freitag et al., 2007; Lorusso et al., 2007). Many studies also have shown that nursing workers have high incidence of musculoskeletal symptoms, and their most frequent symptom is pain in the lumbar spine (Gurgueira and Alexandre, 2003; Kjellberg et al., 2003; Smedley et al., 2003; Violante et al., 2004; Freitag et al., 2007; Lorusso et al., 2007; Kromark et al., 2009). These same studies showed a significant occurrence of musculoskeletal symptoms in other areas, such as cervical, thoracic, shoulders, hips/thighs, knees, and ankles/feet.

There is no unique cause related to these disorders, however literature shows that various job factors can contribute to their appearance, such as repetitiveness of movements, maintaining postures for long periods of time, physical effort, invariability of tasks, mechanical pressure on certain parts of the body, static work, impact, vibration, cold, organizational and psychosocial factors (Punnett and Wegman, 2004).

Therefore, nursing workers are exposed to risk factors at their workplace, which include biomechanical (awkward movements and postures), environmental (workplace layout), psychosocial (work pressure, low autonomy and competitiveness), and organizational factors (low number of colleagues during the shift and inadequate equipment and no maintenance) (Coluci and Alexandre, 2012).

There is no measurement instrument that evaluates the perception of these workers regarding the influence of job factors in the development of musculoskeletal symptoms. A questionnaire for this purpose would facilitate achievement of surveys on nursing working conditions, prioritizing certain factors in different work sectors, and it could be a simple tool that can direct the use of other instruments of objective measures which take more time and costs.

The aim of this research was to develop and validate a questionnaire regarding the nursing workers' perception of job factors that may contribute to the onset of musculoskeletal symptoms.

2. Methods

This study was conducted in two hospitals located in the state of São Paulo, Brazil. In order to cover nursing workers from different

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environments, two hospitals were chosen based on their differences on infrastructure and on the type of patients, since one of them is intended to provide public services and the other one is restricted to insured and private patients.

Nurses, licensed practical nurses (LPN), and nurse technicians (NT), with at least six months of professional activity participated in the study. The Law Number 7498 from the Brazilian Federal Nursing Council (Brasil, 1986) determines the functions performed by these professionals. According to this law, nurses must perform all activities of nursing in direct care of critically patients, in addition to planning, organizing, directing, implementing and evaluating nursing services. Both NT and LPN perform predominantly direct care of patients, however the activities of the NT require lower level of decision than those performed by the LPN.

Workers who were dismissed from their activities during the period of data collection were excluded.

As this research refers to the construction of a new measuring instrument, which must include a confirmatory factor analysis, the sample size was calculated based on the number of variables in the questionnaire. It was assumed that the sample size should be at least ten subjects per variable (Hair et al., 1998). As the final instrument consists of 32 items, the minimum sample for statistical analysis was 320 subjects.

Office workers of both hospitals also participated in the study to permit evaluation of the construct validity using the known-groups technique. These workers performed functions predominantly in a sitting position without conducting physical effort. They were selected in order to have some variables similar to the group of nursing workers, such as age, sex, body mass index (BMI), and time work experience.

The sample size of the two groups to construct validation was calculated assuming a statistical power of 80%, a significance level of 0.05 (5%), and able to detect a moderate effect size of $d = 0.5$ (Cohen, 1988) to the difference in mean scores between the two groups (Machin and Campbell, 2005). Initially, a number of 64 subjects per group was estimated, however, to avoid possible losses, it was suggested to extend this estimate in 20% of cases in each group. Thus, the final sample size was in 154 subjects, 77 subjects in each group.

To evaluate the stability of the questionnaire, the number of subjects who were included in the retest procedure was calculated with an estimate considering the statistical measure that would be used to assess the reliability, ie, the intraclass correlation coefficient (ICC). This calculation indicated a minimum of 55 subjects in the retest.

2.1. The process of developing the research questionnaire

The procedure of development of the questionnaire was based on the international literature, respecting the stages of item selection, construction of domains, and psychometric properties study (Lynn, 1986; Streiner and Norman, 1995; Turner et al., 2007; Snyder et al., 2007).

The first step was the development of the domains based on the theoretical area of ergonomics. In the second step, the questionnaire items were selected. The techniques used to select the items included literature research and interviews with a sample of the population (Streiner and Norman, 1995; Turner et al., 2007). A literature review searching for other measuring instruments related to the area of interest and involving nursing workers was also realized.

Data obtained from these two steps allowed the construction of the questionnaire items considering the main factors present in nursing work recognized as ergonomic risk.

The last stage of development of the new instrument was to review the previous steps, organize items in their respective domains, and check the general format of the questionnaire, considering its title, instructions and response scale. The instrument consisted of 30 items divided into three distinct domains (biomechanical, organizational and psychosocial factors).

The type of response scale was based on a generic questionnaire (Bork et al., 1996; Rosecrance et al., 2002; Goldsheyder et al., 2002; Coluci and Alexandre, 2009), considering the easiness of response and subjects' understanding (Turner et al., 2007). The analysis of the score of each item underwent an adaptation and a new classification was used: 0–1 "no influence", 2–4 "minimal influence", 5–7 "moderate influence", and 8–10 "important influence". Seeking to facilitate the evaluation of the instrument, a score for each domain was created ranging from 0 to 100 (0-19 means "no influence", 20–49 "minimal influence", 50–79 "moderate influence", and 80–100 "important influence").

2.2. Content validity

The assessment of content validity was conducted by two subject matter experts (SMEs) who used quantitative procedures during this process (Tilden et al., 1990; Burns and Grove, 1997; Hyrkas et al., 2003; Alexandre and Coluci, 2011). During the development of a new measuring instrument, it is recommended that this assessment should be done at two different times, with specific guidelines for each phase (Berk, 1990). First, it is suggested that a panel of SMEs makes an evaluation during the phase of specification of domains, checking if they are suitable and representative for the studied construct. After, a second panel of SMEs performs the evaluation during the phase of items development aiming to assess the instrument as a whole, since the wording of items to the response scale (Berk, 1990).

The first committee was composed of ten judges (Lynn, 1986). The process began with an invitation to SMEs, including an explanatory letter which provided the reason for the choice of the expert as judge, and the exposition of the relevance of the involved concepts and the instrument as a whole (Lynn, 1986; Salmond, 2008; Alexandre and Coluci, 2011).

The SMEs received an instrument with specific instructions for guiding the content validity evaluation and were asked to perform it individually during a period of ten days (Berk, 1990). Attached to this instrument, they received two questionnaires (a generic questionnaire and its adaptation to physiotherapists that were used as basis for the development of the questionnaire), and the new questionnaire.

The first committee evaluated the three domains and 30 items by using the percent agreement score. The SMEs verified the comprehensiveness of the domains, and evaluated the items individually, considering its clarity and representativeness.

The percent agreement score was interpreted considering the domains and the items appropriate when they reached a percentage greater than or equal to 90% agreement by the committee (Wynd et al., 2003; Alexandre and Coluci, 2011). With the results of this evaluation and SMEs suggestions, the questionnaire was redesigned and its second version became with 34 items divided into four domains.

This second version was reviewed by another expert committee, which evaluated the title, format, instructions, items, domains, scores and its analysis using the Content Validity Index (CVI). The CVI is calculated using a four Likert-type scale. To assess the relevance/representation, the SMEs can choose the following answers: 1 = not relevant or not representative, 2 = item needs major revision to be representative, 3 = item needs minor revision to be representative, or 4 = relevant or representative item (Lynn, 1986;

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