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Cut-off points for mild, moderate, and severe pain on the visual analogue scale for pain in patients with chronic musculoskeletal pain

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ABSTRACT

The aim of this study was to find the cut-off points on the visual analogue scale (VAS) to distinguish among mild, moderate, and severe pain, in relation to the following: pain-related interference with functioning; verbal description of the VAS scores; and latent class analysis for patients with chronic musculoskeletal pain. A total of 456 patients were included. Pain was assessed using the VAS and verbal rating scale; functioning was assessed using the domains of the Short Form (36) Health Survey (SF-36). Eight cut-off point schemes were tested using multivariate analysis of variance (MANOVA), ordinal logistic regression, and latent class analysis. The study results showed that VAS scores $\leqslant$3.4 corresponded to mild interference with functioning, whereas 3.5 to 6.4 implied moderate interference, and $\geqslant$6.5 implied severe interference. VAS scores $\leqslant$3.4 were best described for patients with chronic musculoskeletal pain as mild pain, 3.5 to 7.4 as moderate pain, and $\geqslant$7.5 as severe pain. Latent class analysis found that a 3-class solution fitted best, resulting in the classes 0.1 to 3.8, 3.9 to 5.7, and 5.8 to 10 cm. Findings from our study agree with those of some other studies, although many other studies found different optimal cut-off point schemes. As there appear to be no universally accepted cut-off points, and in view of the low-to-moderate associations between VAS scores and functioning and between VAS and verbal rating scale scores, the correct classification of VAS scores as mild, moderate. or severe in clinical practice seems doubtful.

1. Introduction

Assessment of pain intensity is considered to be 1 of the core outcome domains in clinical pain research [21]. Pain intensity is therefore widely assessed [8]. Pain intensity is often measured with a self-report single-item measure such as a visual analogue scale (VAS), numeric rating scale (NRS), or verbal rating scale (VRS) [8]. An advantage of VAS and NRS is that these scales tend to approximate ratio-level scales for groups of patients [16,19], allowing parametric tests to be used in statistical analysis. The VAS and NRS have been found to be more sensitive than the VRS when 4 or fewer categories were used in the VRS [3]. However, estimating pain intensity with the VAS or NRS requires the ability to transform a subjective experience into a visuospatial display or numbers, and this ability may influence the results. The advantage of VRS is that mild, moderate, and severe are categories often used in communications between patient and health care provider in clinical practice [4].

However, translating continuous measures such as VAS and NRS into discrete categories such as VRS is not straightforward. Simply dividing a VAS or NRS into equal parts and using these for the comparison with VRS scores is not a valid method [6,27]. Serlin et al. [20] tried to solve this problem by comparing pain intensity with the impact of the pain on daily functioning, using a specific statistical technique for patients with pain due to cancer. Their statistical technique has been repeated in the same patient population, that is, cancer patients [18], as well as in other patient populations, for example, patients with subacute low back pain [13,22,28], diabetic peripheral neuropathy [29], and spinal cord injury [11]. The cut-off points on scales derived from the association between pain intensity and functioning, however, is a matter of interpretation rather than being based solely on the perception of pain. Although moderate to high correlations have been found between NRS, VAS, and VRS scores,

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there is large variation in individual scoring [3,27]. The individual differences may be caused by the fact that words have various nuances of meaning, and ratings of pain intensity may differ greatly from 1 person to the next. A newly emerging method to distinguish classes in scores for a specific construct scored with a VAS—in our case, pain—is that of latent class analysis. Latent class analysis [26] is based on the assumption that chronic musculoskeletal pain (complaints) measured with a VAS can be represented by a model in which patients are divided into a number of groups. The average VAS scores differ across groups and are randomly distributed within groups. The groups are called latent classes because group membership is not directly observed. As far as we know, latent class analysis has not yet been applied to VAS scores.

The aim of our study was to identify the cut-off points on the VAS using the above-mentioned 3 methods, and to compare the results. We chose the VAS as the measure to score pain intensity, as it is commonly used in clinical practice.

2. Methods

2.1. Patients

Patients with chronic musculoskeletal pain admitted to the 'Revalidatie Friesland' Rehabilitation Centre (the Netherlands) were included in the study. Revalidatie Friesland offers in-patient treatment in 1 department, and outpatient treatment in 5 rehabilitation departments of hospitals in the northern region of the Netherlands. It offers multidisciplinary treatment for patients with pain-related disabilities of a wide range of complexity. The majority of patients have back or neck pain, fibromyalgia, or widespread pain. The area where the Centre is situated, in the northern Netherlands, is partly rural and partly industrialized, with medium-sized towns. The study sample consisted of patients who were participating in a research project to assess the outcomes of rehabilitation at the 'Revalidatie Friesland' Rehabilitation Centre. The present survey was added to the outcome study after it had been underway for some years. The study included patients treated between April 2008 and December 2011. Patients were included at the beginning or immediately after their treatment, and 1 year after treatment. Inclusion criteria were: age >18 years, pain due to musculoskeletal problems that had been present for >3 months, and having been admitted to or being treated in a rehabilitation program. Exclusion criteria were inability to understand the questions in Dutch, current major psychiatric disorder (eg, active psychosis, severe depression with risk of suicide attempt, addiction), unwillingness to provide data for research purposes, and a score of "no pain" on the VAS and VRS (see Section 2.2, Measurements). The first assessment in the outcome study, using questionnaires, was done just before the start or during the first 2 weeks of treatment; the second assessment was done in the last week of treatment or during the first 4 weeks after the end of the treatment; and the third assessment was done 12 to 18 months after the end of treatment. The present study used the first questionnaire received from each patient within in the study period. A total of 466 patients returned at least 1 questionnaire within the study period (estimated response rate, 60%). Eleven patients had missing data on at least 1 essential question, and 4 patients had a score of 'No pain' on the VRS and a score <5 on the VAS (for all 4 patients, this concerned the questionnaire sent after 1 year). Five patients did not give permission to use their data for research purposes. Thus, a total of 456 patients were included in the analysis.

2.2. Measurements

The following characteristics were assessed using a self-constructed questionnaire: age, gender, marital status (married or living together; single), educational level (8 levels, from primary school to university level) and duration of current pain. Missing data from patients were supplemented, insofar as possible, with data retrieved from the medical files.

The VAS for pain consists of five 10-cm lines, the left end labeled 'No pain' (0 cm) and the right end 'Very severe pain' (10 cm). Patients were asked to draw a vertical mark on the top line for their current pain, on the second line for their average pain during the last week, on the third line for their worst pain in the last week, on the fourth line for their lowest pain level in the last week, and on the fifth line for their average pain during the last 4 weeks.

Interference with daily life functioning was assessed using the domains of the Short Form (36) Health Survey (SF-36) [1]. This instrument consists of 36 questions, relating to 8 dimensions: physical functioning, social functioning, physical role restriction, emotional role restriction, mental health, vitality, pain, general health, and health change. Scores range from 0 to 100 for each dimension, with a lower score indicating more disability or more pain. In view of our study aims, we used only the domains of functioning (ie, physical functioning, social functioning, physical role restriction, emotional role restriction, mental health, and vitality) as parameters to assess interference with daily life functioning.

The VRS we used was the seventh question in the SF-36 [1], which asks about the average pain level during the last 4 weeks, with answering options of none, very mild, mild, moderate, severe, and very severe.

2.3. Study design

The study was a cross-sectional study within usual care.

2.4. Statistical analysis

Descriptive statistics were used for the characteristics of the study sample. Marital status was dichotomized into living alone versus being married or living with a partner, and educational level was trichotomized, with low meaning primary school to lower vocational education, intermediate meaning secondary vocational education, and high meaning pre-university secondary education and higher, including university degree.

2.5. Cut-off points on the VAS in relation to interference of pain with functioning

We studied the cut-off points on the VAS in relation to the interference of pain with functioning by means of the statistical method described by Serlin et al. [20] to determine the optimal boundaries for mild, moderate, and severe pain. We used the VAS for the average pain over the last 4 weeks in the models, as the SF-36 also assesses pain and functioning over the last 4 weeks. We classified each patient's pain intensity rating on the VAS as mild, moderate, or severe using 8 different classification schemes, referred to by the upper values used for the mild and moderate categories, in accordance with other studies, as follows [11,18,20]:

1. *Cut-off point* (*CP*) *scheme* 3,5 with 1 to 3 classified as mild, 4 to 5 as moderate, and 6 to 10 as severe;
2. *CP scheme* 3,6 with 1 to 3 classified as mild, 4 to 6 as moderate, and 7 to 10 as severe;
3. *CP scheme* 3,7 with 1 to 3 classified as mild, 4 to 7 as moderate, and 8 to 10 as severe;
4. *CP scheme* 4,5 with 1 to 4 classified as mild, 5 as moderate, and 6 to 10 as severe;
5. *CP scheme* 4,6 with 1 to 4 classified as mild, 5 to 6 as moderate, and 7 to 10 as severe;