

Development of a pictorial scale of pain intensity for patients with communication impairments: initial validation in a general population

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ABSTRACT – This study evaluated a new six-point ordinal scale for measuring pain intensity. Seventy-two participants aged between 23 and 87 years rated the intensity of 'present pain' as well as remembered episodes of 'severe' and 'mild' pain on the scale of pain intensity (SPIN), a 10 cm visual analogue scale (VAS) and a 0–10 numeric scale, in random order. Retesting followed an intervening assessment. Participants' comments on the scales were analysed thematically. Spearman's correlation between scales all exceeded 0.78 ($p < 0.001$). Test-retest of the SPIN gave percentage agreements (weighted kappa) of present pain 69% (0.83), severe pain 94% (0.94) and mild pain 83% (0.85). Most participants preferred using an ordinal scale to the continuous VAS. Some found numbers easier to use whereas others found the SPIN more helpful. We conclude that the SPIN provides a valid measure of pain intensity in patients fully able to communicate their views and experiences. Investigation in patients with cognitive or communication impairments is now required.

KEY WORDS: communication deficits, measurement, pain intensity, stroke

Introduction

Self-report of pain intensity using a simple rating scale is indispensable to the successful management of painful conditions.¹ However, many patients with

cognitive or communication problems, for example due to stroke or other brain injury, dementia, confusion or other severe illness, may have difficulty in using such instruments. Consequently, recording pain intensity tends to be imprecise, making it difficult to follow the changing course of the patient's condition in response to interventions designed to alleviate it.²

The validity and reliability of self-report pain intensity scales has been appraised extensively in general populations³⁻⁵ but less so in adults with cognitive and communication difficulties as two problems arise. Firstly, it may be difficult to establish with the patient that the topic being considered is their pain. Once this has been established, it then may be difficult for the patient to understand the measurement tool being used. For example, although some have found a visual analogue scale (VAS) to be the most comprehensible,⁶ difficulty with rating pain on continuous scales has been reported in people whose ability to think in abstract terms may be diminished,⁷ in older people,⁸ and in stroke patients.⁹ Moreover verbal and numeric scales may be perplexing for people who are illiterate,¹⁰ dyslexic, dysphasic,¹¹ or otherwise unfamiliar with the alpha-numeric system.

The faces pain scale is an alternative tool which has been shown to assist children and older adults to rate pain,^{12,13} though some expressions could be interpreted as representing pain affect,¹⁴ or mood states such as sadness, sleepiness or boredom,¹³ all of which are common in hospitalised people. Similarly, elderly people with mild and moderate cognitive deficits have shown poor comprehension of this concept.⁶

Given the variety of impairments that may arise (motor control, vision, perception, cognition, use of language etc), it is probably unrealistic to expect any single pain scale to be usable by all people. Rather, a choice of simple pain assessment instruments may be needed to enable patients with a range of impairments to communicate most effectively about their pain.

We have devised a new pictorial scale of pain intensity (SPIN) which is designed to be used with either simple verbal or picture cues to convey information regarding both pain intensity and location.

Key Points

Patients with cognitive and communication problems may have difficulty in reporting pain location and severity, and visual cues may help communication

The visual scale of pain intensity (SPIN) is designed to help such patients to quantify their pain, but it required initial testing in patients who are fully able to describe their pain symptoms

This study demonstrates that the SPIN quantifies pain as well as a 0–10 numerical rating scale in a general population of patients with painful conditions

Exploratory work in patients with complex neurological disability indicates that it is easy to present and score, and some of our patients have been able to convey information on the intensity and circumstances of their pain using this tool when they were unable to use standard pain assessments. We suspect it may also have wider application in patients who are too ill, tired or confused to report pain accurately. However, because comparison against existing pain measures is limited in this group of patients, it was first necessary to test the scale in a group of patients without cognitive or communication problems, both to determine that it measures pain and to explore the comparative merits of different tools.

This study sets out to establish whether the new scale is able to measure severity of pain; the focus is on its ability to quantify the severity, not on its ability to characterise the pain.

Materials and methods

Scale development

The SPIN consists of a sequence of red circles, and is designed to avoid the use of numbers, words or faces and to promote clarity for patients with visual impairments. Red was chosen for its strong visual impact and because its intuitive association with pain has previously been found useful for conveying the concept of pain in scales designed for children and adults.^{14,15} The scale is aligned vertically to minimise difficulty for patients with visuo-spatial neglect¹⁶ and to make it more user-friendly.¹⁷ The bottom and top of the scale are anchored by two extremes, 'no pain' and 'pain as bad as it could be', marked with either verbal or visual cues. The intervening points are represented by red circles increasing proportionally in size (Fig 1). The respondent can mark the circle that best indicates their pain intensity with a pen or point to it for another person to record.

In this study, pain ratings on the SPIN were compared with a 10 cm VAS and a 0–10 numeric rating scale (NRS). To

investigate face validity and user acceptance, participants' views and preferences for the three scales were invited. Full ethical approval was obtained for the study.

Participants

Eligible patients due to attend outpatient rheumatology, chronic pain and joint injection clinics at two hospitals were sent information about the study, together with a letter of invitation to participate signed by their doctor. To be included, the participant had to experience some pain. Patients were excluded if they were known to have difficulties which would preclude participation, for example the frail elderly, those with poor visual acuity, and those unable to understand English.

Procedure

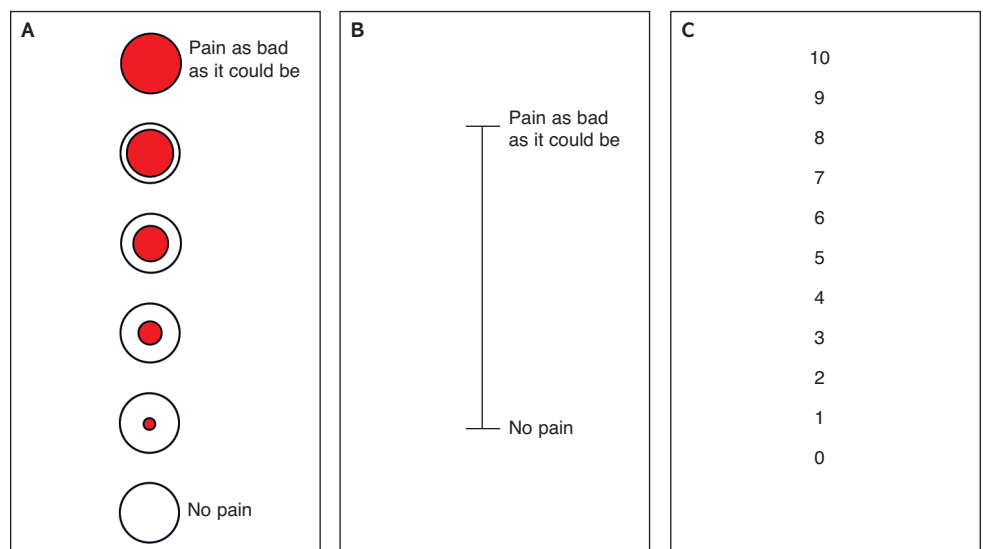
Participants were asked to arrive an hour before their appointment time. They gave written consent and the task was explained to them in full. They described the site and nature of the physical sensation of their pain in three situations: (a) pain felt at the time (present pain); (b) a recent episode of severe pain; and (c) a recent episode of mild pain. For each situation, the site of pain and words describing it were recorded by the researcher to form a 'pain record'. This was read back to the participant to confirm its accuracy.

With their pain record available for reference, participants were asked to rate the intensity of their pain in each of the three situations on each of three scales. The nine evaluations were presented separately in a different computer-generated random order for each participant. Each scale was removed before the next was presented.

To test repeatability, the procedure was replicated after an intervening 'distraction interview'. This comprised completion of two standard assessments – the Hodkinson mental test¹⁸ and the body care and movement subsection of the functional limitations

Fig 1. The three scales used in the study (40% actual size).

A: Scale of pain intensity (SPIN). Each circle is 20 mm in diameter and the diameters of each inner red circle are 4, 8, 12, 16 and 20 mm respectively. The distance between the mid points of the bottom and top circle is 150 mm and the mid points of each circle are 30 mm apart. In this study we used verbal anchors, but pictorial anchors may be used for patients who are unable to read. **B:** 10 cm visual analogue scale (VAS). **C:** 0–10 Numeric Rating Scale (NRS). The SPIN scale is reproduced with copyright permission from the North West London Hospitals NHS Trust.



profile (FLP)¹⁹ – followed by some general conversation. After 10 to 15 minutes, each participant’s pain record was again placed close at hand as a reminder for the pain situations being rated. The nine evaluations were presented a second time in a new random order. Finally, participants ranked the scales in order of preference and gave free comments, which were documented.

Data analysis

Demographic data and all scores and preference rankings were coded and entered into SPSS.²⁰ Ratings on the new tool were scored from zero (the bottom circle) to five (the top circle); visual analogue ratings were scored as the distance in millimetres between the anchor line at the bottom of the scale and the mark made across it; and numerical ratings were entered as the number chosen.

To evaluate concurrent validity, pain ratings on the SPIN were compared with visual and numerical ratings using Spearman’s rank correlation coefficients. Test–retest reliability was evaluated by percentage agreement and quadratic-weighted kappa statistics for the SPIN computed in Stata,²¹ and using intraclass correlation coefficients (ICC) for the visual and numerical ratings.

Comments were evaluated using thematic analysis.²² One researcher developed a coding framework in which nine themes were defined, described and illustrated by examples. Two raters then independently re-coded the comments into the pre-defined themes. Their codings were compared: 1 was scored if both raters agreed on a theme; 0 was scored if raters disagreed on a theme or if one rater coded themes not coded by the other. Percentage agreement within each theme was calculated by dividing the times both coders agreed by the number of possible instances of coding and multiplying by 100. Agreement ranged from 43% to 86%. Disagreements were resolved by consensus.

Table 1. Characteristics of recruited participants (n=72).

Category variables	n	(%)
Gender		
Male	32	(44.4)
Female	40	(55.6)
Diagnostic group		
Arthritic disease	15	(20.8)
Musculoskeletal conditions	6	(8.3)
Low back pain	29	(40.3)
Neurological disorders	6	(8.3)
Iatrogenic conditions	15	(20.4)
Vascular disorders	1	(1.4)
Time since onset of condition		
<1 year	12	(16.7)
1–5 years	27	(37.5)
>5 years	22	(30.5)
Unknown	11	(15.3)

Results

Of 203 patients who met the inclusion criteria and who were sent information about the study, 72 were willing and able to spare the time to participate and were recruited. They were aged between 23 and 87 years (mean 55.6 (SD 15.6)), and comprised 45 chronic pain and rheumatology outpatients and 27 injection clinic day-patients. All scored above seven for cognitive function on the mental test.¹⁸ Their disability scores on the functional limitation profile ranged from 0–48%. The distribution of scores was positively skewed, indicating that only a few participants were moderately disabled and none severely so. Their characteristics are shown in Table 1.

Overall, scores for the SPIN ratings were distributed across the whole scale as shown in Table 2, suggesting a capacity for broad discrimination between different intensities of pain.

Several participants made ratings between two numbers on the NRS (n=3), between two circles on the SPIN (n=3), or between points on both NRS and SPIN (n=4). The interposed marks were fairly evenly distributed along the scales and eight pairs were repeated between first and second ratings. Although this indicated that some participants found the SPIN (and the NRS) insufficiently sensitive, they were few in number.

Concurrent validity

Since results were similar for both first and second ratings for each of the three pain episodes, they are presented for the first set only. Plots displaying inter-relationships between present pain scores using the three scales are shown in Fig 2. It is notable that the correlation between the SPIN and the numerical rating is similar to the correlation between the numerical and visual rating scales.

Test–retest reliability

Test–retest results are presented in Table 3, showing that the new scale’s repeatability is similar to that of the numerical and VAS. Percentage agreement for test–retest of the SPIN was high for severe pain (94.3%) and mild pain (83.3%), but lower for present pain (68.6%).

Table 2. Distribution of first set of the scale of pain intensity (SPIN) ratings for all three episodes of pain.

SPIN levels	Present pain	Severe pain	Mild pain	Total ratings
5	3	33		36
4	7	30		37
3	23	6	9	38
2	23	1	25	49
1	10		31	41
0	2		2	4

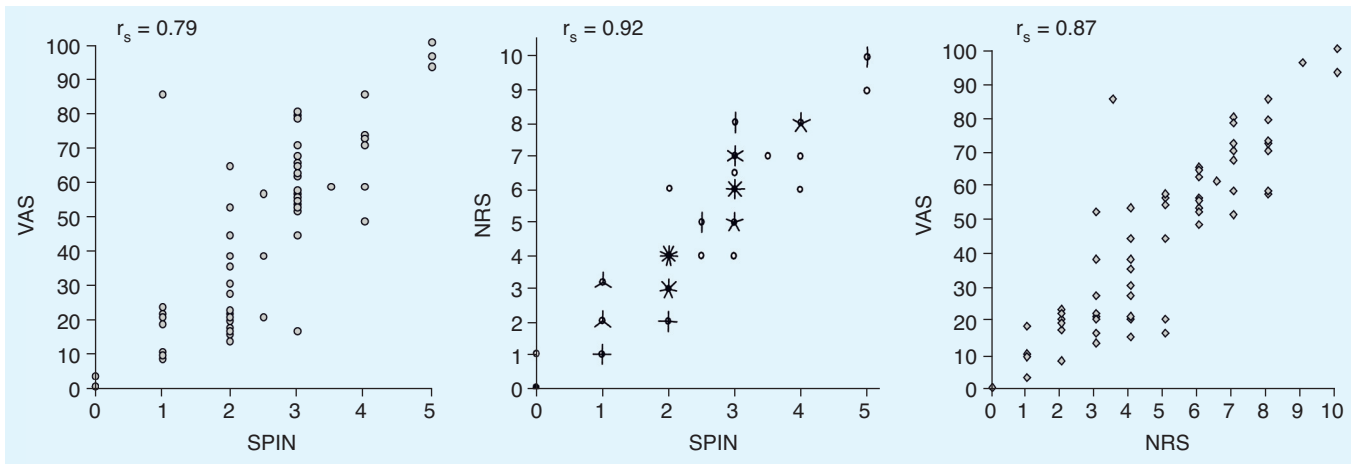


Fig 2. Plots showing relationships between the SPIN, VAS and NRS ratings of present pain (n=72). In the sunflowerplot showing NRS versus SPIN ratings, each petal represents one case. Spearman's rank correlation coefficients (r_s) were all significant at $p < 0.001$. NRS = numeric rating scale; SPIN = scale of pain intensity; VAS = visual analogue scale.

Preferences for the scales

The numerical scale was the first choice for 35 participants (49%). The SPIN was favoured by 28 (39%) and the VAS was the least popular with only eight (11%) participants ranking it first. One participant could not state a preference.

Participants preferred the numerical scale for several reasons. Almost a third cited previous experience and familiarity: 'I am used to using numbers daily and they are a familiar concept used by my GP'. Others found they could relate their experience of pain better to a numbered scale and two could, 'think of pain in terms of numbers'. On the other hand, several found numbers conceptually more difficult, 'numbers are just ordinary. They don't relate to pain'. Overall, having 11 choices on the scale and being able to target their experience of pain to a specific point was regarded as the best combination among the three scales.

Reasons for preferring the SPIN clustered around the theme of relating the scale to the experience of pain. The visual properties were particularly helpful to some, 'the visual image makes it easier to relate to pain. It relates to throbbing pain and describes it best'. While from a different perspective, 'the size of shape shows quantity of pain' and 'the red centre relates to pain being mild or all consuming'. On the downside, two participants found it respectively, 'confusing' and 'harder to understand'. The limited choice for scoring was criticised by nineteen participants

– although one, reflecting on her hospital experience after an accident, said she would have found the SPIN easier to see and less demanding to rate at that time, since fewer choices would have required less thought.

Lastly, the VAS was generally not liked, though a few found the greater choice helpful, 'more flexibility – you can choose to be at any point on the pain scale', or found it conceptually more meaningful, 'the line seems to relate to pain on a sliding scale'. A far greater number, however, found it difficult to judge where to rate their pain on the line, 'not very accurate – sort of random', and some commented that divisions would have helped, 'it was almost guesswork. In my mind I was trying to work it into numbers first'.

Discussion

In this initial study in patients able to report their pain symptoms, the SPIN performed well in comparison with two well-validated pain intensity scales, and quantified the severity of pain as well as the current preferred tool (the numbered rating scale). Test-retest reliability was also favourable, although the short time between test and retest was a limitation of the study. To minimise this confound, the two tests each included nine different ratings in randomised order separated by a 'distraction interview'.¹⁰ The lower percentage agreement for present pain

intensity was found for all scales and is likely to reflect its fluctuating nature; indeed, several participants commented that their pain had worsened on sitting during the study. Further studies on repeatability will be needed.

There was a clear preference for the two ordinal scales (NRS and SPIN) over the continuous VAS; most found it easier to target the intensity of their painful incident to

Table 3. Test-retest reliability of the scale of pain intensity (SPIN) evaluated by weighted kappa coefficients and of the visual analogue scale (VAS) and numeric rating scale (NRS) by intraclass correlation coefficients (ICC), with 95% confidence intervals (CI) for present pain, severe pain and mild pain.

		Present pain	Severe pain	Mild pain
SPIN*	Wgt kappa (95% CI)	0.83 (0.59, 1.07)	0.94 (0.70, 1.18)	0.85 (0.62, 1.10)
VAS	ICC (95% CI)	0.91 (0.85, 0.97)	0.94 (0.89, 0.99)	0.79 (0.65, 0.92)
NRS	ICC (95% CI)	0.88 (0.76, 0.99)	0.87 (0.69, 1.06)	0.86 (0.70, 1.02)

* Scores made between scale points were excluded.

a defined point as opposed to judging where to mark a continuous line, though not everyone was of this view. Two broad groups were identified; one finding numbers easier to use and to relate to pain and another finding the visual SPIN more helpful on both these counts.

The numerical scale was favoured over the other two scales by half of the participants. This finding endorses a growing consensus among pain specialists that the numerical rating scale should be the scale of choice for clinical and research purposes.^{1,23} Nevertheless, for people who may have difficulty reporting their pain through this medium, a choice of pain assessment instruments may capitalise on their strengths and compensate for their weaknesses. Moreover, allowing individual preference to determine which scale is used may optimise its face validity.¹³

In general, the SPIN was found to be acceptable, clear and relevant, indicating good face validity in a general patient population. Many commented on aspects of its appearance that reflected their experience of pain; for example, relating the increasing size of red circles to quantity of pain. Not surprisingly, the colour red was associated with pain because it was known that pain was being rated. It could be that individuals without this prior knowledge might perceive the colour differently, for example, as representing anger, and this should be investigated further. Nonetheless, communication with patients can be facilitated through symbols and pictures,²⁴ visual cues and gestures.²⁵

One advantage of using a specific colour (in contrast to simple black) is that the colour can be used on separate diagrams to help indicate the anatomical location of interest, or indeed the type of phenomenon being investigated. A variant of the SPIN which uses grey circles (the depression intensity scale circles (DISCs)) has also been developed to assess depression in people with cognitive and communication deficits. Evaluation of the DISCs in a brain-injured population has demonstrated concurrent validity in relation to both other visual analogue scales and verbally-based symptom scores.²⁶

The main disadvantage of the SPIN was the limited choice for scoring, which was criticised by a quarter of participants and highlighted by the few who rated their pain between points on the scale. However, others saw this simplicity as a strength. For a pain intensity scale to have clinical utility it must be sensitive enough to show a change in relation to intervention, or over time. As a change in pain of two points on a 0–10 numeric rating scale has been shown to represent a clinically important difference,²⁷ a change of one point on the SPIN has the potential to match this level of sensitivity. Increasing the number of points on the scale could make it more confusing for the groups for whom it is intended.

In conclusion, whilst generalisation of these findings to other populations cannot yet be made, the SPIN appears to provide a valid measure of pain intensity in patients fully able to communicate their views and experiences. Further development and evaluation in patients who are unable to use existing pain intensity scales because of cognitive or communicative difficulties should now be undertaken.

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Note

The SPIN may be used freely. Laminated SPIN charts are available at cost from the corresponding author.

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