J Rehabil Med 2012; 44: 609–610

COMMENTARY

THE USE OF THE VISUAL ANALOGUE SCALE (VAS) IN REHABILITATION OUTCOMES

The Visual Analogue Scale (VAS) is a common form of response option in health outcome studies, often used to measure pain, amongst other things, and is generally presented as a single line of 100 mm with anchor words at either end (e.g. no pain – worst possible pain). It was first published in the early 1920's (1, 2) though not widely used at that time (3). There are variations on the VAS theme, sometimes with shorter lines (e.g. 65 mm), and whatever the length, while they are typically presented in horizontal format, they can also be presented as vertical lines (4), and the two forms of presentation have been considered as equivalent (5). Another alternative is where it is presented as a thick line of blocks (looking much like bricks laid end-to-end) with 11 categories, ranging from 0–10, which is called a Numeric Rating Scale (NRS). VAS and NRS formats have also been shown to be equivalent (6, 7). The VAS has a long history of use in medical outcome studies, and is ubiquitous across all specialities, including Physical and Rehabilitation Medicine (8–10). It is used either in the form of a single Item scale (e.g. for pain), or as a type of response option for multiple item scales (11,12). For example, the VAS is used as part of the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) (13), the Chalder Fatigue Scale (14), and the EuroQol-5D (15).

A VAS is considered to reduce the confounding effect of variation between individual interpretations of the graduations used for rating scales; is preferred by participants who perceive their desired response as not corresponding with rating scale graduations (16) and enables a finer distinction between subjective states to be made (3). However, it has also been found that patients find it difficult to judge how to rate their pain on the pain VAS line, finding it 'not very accurate', 'sort of random', 'almost guesswork' or having to 'work it into numbers first' (17). Consequently, in some studies, very low test-retest reliability has been reported (18).

An implicit assumption made by the majority of people who use a VAS (or NRS) in either their clinical practice or research, is that the scale is interval in nature, or even ratio (7, 19–21). Thus, all sorts of mathematical and parametric procedures are applied. For example Bland and Altman plots have been used together with intra-class correlation coefficient (ICC), two-way mixed effects analysis of variance model with patients random and rating method fixed (7). Means and standard deviations are all commonly reported for VAS and its variants (22). Other types of calculations such as Minimally Important Difference (MID) are also common (23–27). This is a little unfortunate as it has been shown that the type of data derived from a VAS does not support such calculations (3, 28–30). In the British Medical Journal over 20 years ago, the authors of one paper clearly stated that 'although usually converted to either cm or per cent the visual analogue scale has no true unit of measurement and is accordingly ordinal only' (28). It has also been shown that VAS data cluster into 7 distinct groups, which are not equally spaced (29). Svensson (30) also clearly placed the VAS among ordinal scales.

It was again in the predecessor of the Journal of Rehabilitation Medicine, the Scandinavian Journal of Rehabilitation Medicine, that the first empirical evidence was presented which clearly demonstrated that the VAS was ordinal (31). Using Rasch analysis, that study showed the non-linear nature of the VAS, whereby the scale works just like any other ordinal scale. Since that time, other work has shown the same and, how misuse of VAS scales can, for example, lead to the calculation of spurious effect sizes, which could affect outcomes from clinical trials, or sample size estimates (32). Likewise, in a study comparing VAS with a verbal rating scale, a conclusion was reached that VAS should be analysed as non-continuous using statistical methods for ordinal data (33).

However, despite these warnings, a common practice has been, and remains so, to treat the VAS as an interval scale. For example, several papers published over the past 5 years in rehabilitation journals have used a VAS as either their primary or secondary outcome of their study, and have used parametric analyses to evaluate the results (34–37). The ordinal nature of VAS data means that change scores cannot be used to compare change in individuals or groups of patients, as a given change in one patient may be of different magnitude than the same apparent change in another. Similarly, VAS change scores may seriously over- or underestimate changes resulting from rehabilitation. Thus, incorrect analyses, using parametric statistics on VAS data, may have implications for the interpretation of the effectiveness of interventions and services. Consequently, and particularly when VAS are used as primary outcome measures, there is a risk that effective services may not be commissioned, or closed down, because they seem to be ineffective when the VAS is treated as an interval scale. The opposite may also occur, that ineffective rehabilitation interventions or services are inappropriately continued. Further, using VAS as interval scaled data for sample size calculations in clinical trials will risk over- or underpowered studies and may, as a consequence, lead to inappropriate conclusions of trials.

CONCLUSION

This commentary has summarised the evidence for the measurement properties of the VAS, a type of outcome scale widely used in Physical and Rehabilitation Medicine. We conclude that there is sufficient evidence that VAS data are ordinal. Consequently the VAS should be treated as such, and analysed appropriately from a statistical perspective by using non-parametric statistics.

Conflict of interest and funding

The authors declare no conflict of interest. No funding was received for the preparation of this manuscript.

 doi: 10.2340/16501977-0999

 ISSN 1650-1977

REFERENCES

1. Hayes MHJ, Patterson DG. Experimental development of the graphic rating method. Psychol Bull 1921; 18: 98.
2. Freyd M. The graphic rating scale. J Educ Psych 1923; 14: 83–102.
3. Aitken RC. Measurement of feelings using visual analogue scales. P Roy Soc Med 1969; 62: 989–993.
4. Scott J, Huskisson EC. Vertical or horizontal visual analogue scales. Ann Rheum Dis 1979; 38: 560.
5. Flynn D, Van Schaik P, Van Wersch A. A comparison of multi-item Likert and Visual Analogue Scales for the assessment of transactionally defined coping function. Eur J Psychol Assess 2004; 20: 49–58.
6. Breivik EK, Björnsson GA, Skovlund E. A comparison of pain rating scales by sampling from clinical trial data. Clin J Pain 2000; 16: 22–28.
7. Hollen PJ, Gralla RJ, Kris MG, McCoy S, Donaldson GW, Moinpour CM. A comparison of visual analogue and numerical rating scale formats for the Lung Cancer Symptom Scale (LCSS): Does format affect patient ratings of symptoms and quality of life? Qual Life Res 2005; 14: 837–847.
8. Murtezani A, Hundozi H, Orovcanec N, Sllamniku S, Osmani T. A comparison of high intensity aerobic exercise and passive modalities for the treatment of workers with chronic low back pain: A randomized, controlled trial. Eur J Phys Rehabil Med 2011; 47: 359–366.
9. Franceschini M, Rampello A, Bovolenta F, Aiello M, Tzani P, Chetta A. Cost of walking, exertional dyspnoea and fatigue in individuals with multiple sclerosis not requiring assistive devices. J Rehabil Med 2010; 42: 719–723.
10. Werhagen L, Borg K. Effect of intravenous immunoglobulin on pain in patients with post-polio syndrome. J Rehabil Med 2011; 43: 1038–1040.
11. Huskisson EC. Measurement of pain. Lancet 1974; 2: 1127–1131.
12. Hewlett S, Hehir M, Kirwan JR. Measuring fatigue in rheumatoid arthritis: a systematic review of scales in use. Arthritis Rheum 2007; 57: 429–439.
13. Bellamy N, Buchanan WW, Goldsmith CH, Campbell J, Stitt LW. Validation study of WOMAC: a health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. J Rheumatol 1988; 15: 1833–1840.
14. Chalder T, Berelowitz G, Pawlikowska T, Watts L, Wessely S, Wright D, et al. Development of a fatigue scale. J Psychosom Res 1993; 37: 147–153.
15. The Euroqol Group. EQ-5D |Internet]. 2009. Available from: http://www.euroqol.org/.
16. Hjermstad MJ, Fayers PM, Haugen DF, Caraceni A, Hanks GW, Loge JH, et al. Studies comparing numerical rating scales, verbal rating scales, and visual analogue scales for assessment of pain intensity in adults: a systematic literature review. J Pain Symptom Manag 2011; 41: 1073–1093.
17. Jackson D, Horn S, Kersten P, Turner-Stokes L. Development of a pictorial scale of pain intensity for patients with communication impairments: Initial validation in a general population. Clin Med 2006; 6: 580–855.
18. Carlsson AM. Assessment of chronic pain. I. Aspects of the reliability and validity of the Visual Analogue Scale. Pain 1983; 16: 87–101.
19. Myles PS, Troedel S, Boquest M, Reeves M. The pain visual analog scale: Is it linear or nonlinear? Anesth Analg 1999; 89: 1517–1520.
20. Hartrick CT, Kovan JP, Shapiro S. The Numeric Rating Scale for clinical pain measurement: a ratio measure? Pain Practice 2003; 3: 310–316.
21. Price DD, Bush FM, Long S, Harkins SW. A comparison of pain measurement characteristics of mechanical visual analogue and simple numerical rating scales. Pain 1994; 56: 217–226.
22. Heymans MW, Van Buuren S, Knol DL, Van Mechelen W, De Vet HCW. Variable selection under multiple imputation using the bootstrap in a prognostic study. BMC Med Res Methodol 2007; 7: 33.
23. Rejas J, Pardo A, Ruiz MA. Standard error of measurement as a valid alternative to minimally important difference for evaluating the magnitude of changes in patient-reported outcomes measures. J Clin Epidemiol 2008; 61: 350–356.
24. Bird SB, Dickson EW. Clinically significant changes in pain along the visual analog scale. Ann Emerg Med 2001; 38: 639–643.
25. Gallagher EJ, Liebman M, Bijur PE. Prospective validation of clinically important changes in pain severity measured on a visual analog scale. Ann Emerg Med 2001; 38: 633–638.
26. Jensen MP, Chen C, Brugger AM. Interpretation of visual analog scale ratings and change scores: A reanalysis of two clinical trials of postoperative pain. J Pain 2003; 4: 407–414.
27. Khanna D, Pope JE, Khanna PP, Maloney M, Samedi N, Norrie D, et al. The minimally important difference for the fatigue visual analog scale in patients with rheumatoid arthritis followed in an academic clinical practice. J Rheumatol 2008; 35: 2339–2343.
28. Forrest M, Andersen B. Ordinal scale and statistics in medical research. BMJ. 1986; 292: 537–538.
29. Munshi J. A method for constructing Likert scales. Sonoma State University. [Internet]. 1990 [updated 2011 Nov 7]. Available from: http://www.munshi.4t.com/papers/likert.html.
30. Svensson E. Guidelines to statistical evaluation of data from rating scales and questionnaires. J Rehabil Med 2001; 33: 47–48.
31. Thomee R, Grimby G, Wright BD, Linacre JM. Rasch analysis of Visual Analog Scale measurements before and after treatment of Patellofemoral Pain Syndrome in women. Scan J Rehabil Med 1995; 27: 145–151.
32. Kersten P, White PJ, Tennant A. The Visual Analogue WOMAC 3.0 scale – Internal validity and responsiveness of the VAS version. BMC Musculoskel Dis 2010; 11.
33. Lund I, Lundeberg T, Sandberg L, Budh CN, Kowalski J, Svensson E. Lack of interchangeability between visual analogue and verbal rating pain scales: a cross sectional description of pain etiology groups. BMC Med Res Methodol 2005; 5: 31.
34. Chan CW, Mok NW, Yeung EW. Aerobic exercise training in addition to conventional physiotherapy for chronic low back pain: A randomized controlled trial. Arch Phys Med Rehabil 2011; 92: 1681–1685.
35. Giovannelli M, Borriello G, Castri P, Prosperini L, Pozzilli C. Early physiotherapy after injection of botulinum toxin increases the beneficial effects on spasticity in patients with multiple sclerosis. Clin Rehabil 2007; 21: 331–337.
36. Huang Y, Liang P, Pong Y, Leong C, Tseng C. Physical findings and sonography of hemiplegic shoulder in patients after acute stroke during rehabilitation. J Rehabil Med 2010; 42: 21–26.
37. Povlsen B. Physical rehabilitation with ergonomic intervention of currently working keyboard operators with nonspecific/type II work-related upper limb disorder: A prospective study. Arch Phys Med Rehabil 2012; 93: 78–81.

Submitted March 19, 2012; accepted April 23, 2012

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