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DEBATE

HOW SHOULD WE USE THE VISUAL ANALOGUE SCALE (VAS) IN REHABILITATION OUTCOMES? II: VISUAL ANALOGUE SCALES AS RATIO SCALES: AN ALTERNATIVE TO THE VIEW OF KERSTEN ET AL.

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The commentary by Kersten et al. (1) contains faulty assertions that could have destructive consequences for pain measurement. They erroneously claim, as do others (2, 3), that an 11 point numerical rating scale (NRS) and a visual analogue scale (VAS) have equivalent formats and that both scales provide only ordinal but not interval or ratio scale measurement. Yet NRS and VAS are certainly not equivalent. Considerable research has shown at least some types of VAS are ratio scales and have psychometric properties that are superior to that of the 11 point NRS. Contrary to Kersten et al.'s assertion (1), 5 separate studies, including those directed toward moderate (4) and severe clinical pain (5) and those directed toward *both* experimental and clinical pain (6–8) demonstrated ratio scale properties for at least one type of VAS. Common to these studies is the demonstration that separate judgments of ratios or proportions of pain intensity are in quantitative agreement with VAS ratings of pain. In addition, the studies that include both clinical and experimental pain show reliable stimulus-response power functions and a zero point for the VAS scale, further validating its ratio properties (6–8). This approach is in contrast to some studies that only use cross sectional or Rasch analysis of clinical pain ratings to examine ordinal, interval, or ratio level of measurement (9). If a VAS is a ratio scale, then it must have interval properties as well and parametric statistics are appropriate for data analysis.

Besides ratio scale level of measurement, VAS also fulfill other criteria for adequate measurement (10, 11), including high test-retest reliability and repeatability (12), internally consistent measures of clinical and experimental pain (6–8, 11), sensitivity to variables that increase or decrease pain (11,13), capacity to measure multiple dimensions of pain (6–8, 11, 14), strong association with measures of pain-related activity in the human brain (15), and in the case of mechanical or electronic VAS, simplicity and ease of use (8, 16, 17). The latter property is in direct contradiction to Kersten et al.'s (1) assertion, based on a single study, that "patients find it difficult to judge how to rate their pain on the VAS line" (18). This particular study fails to provide any information as to how individuals were instructed in use of the scale. Difficulty of use is a likely problem in the absence of good instructions. "Ease of use" is a consistent feature of VAS when adequate instructions are given, as described in the Methods section of research reports, and when mechanical or electronic scales are provided (16, 17). Pencil-and-paper versions of VAS are more difficult to use in cognitively impaired individuals (19). On the other hand, studies that include over a thousand participants find that the vast majority of participants can easily use VAS when properly instructed (11 and references therein).

It is not widely recognized that VAS have measurement properties that are superior to the commonly used 11 point NRS. Unlike VAS, the 11 point-NRS has been demonstrated to lack ratio scale properties because it has no distinct zero point, inaccurately predicts separate judgments of ratios of pain intensity (6, 8) and has been repeatedly shown to evoke artificially high ratings at the lower end of the scale (8, 20). The notion that NRS ratings can substitute for VAS ratings because they are highly correlated with each other would be misguided. For example, one study demonstrated that both scales display monotonic functions of stimulus intensity and are likely to be highly correlated, yet the 11 point-NRS stimulus-response curve was displaced above the VAS curve (8). Only the VAS stimulus-response curve reflected accurate ratios or proportions of pain intensity and demonstrated a zero point (8). Given known psychometric features of VAS, the claim of lack of interval or ratio scale properties of VAS (1) is not supported by the evidence, as are past recommendations of use of 11 point NRS over VAS in clinical trials (19, 21).

CONCLUSIONS

We disagree with the admonition by Kersten et al. (1) that parametric statistics should not be used for VAS rating data because the VAS only has ordinal scale properties. The authors claim that "VAS change scores may seriously over- or underestimate changes resulting from rehabilitation" (1). We think their arguments are flawed for reasons given above. It is the 11 point NRS that has been shown *not* to be a ratio scale (8, 20) despite recommendation of its use in clinical trials (21). For example, a study by Hartrick et al. (20), cited in the Kersten et al commentary, begins with past evidence that VAS is a ratio scale and then provides evidence that NRS shows systematic deviations from ratio scale characteristics (see also 8). The 11 point NRS, not the VAS, may lead to inappropriate conclusions of trials, particularly those stating percentages of changes in pain intensity. On the other hand, parametric statistics are entirely appropriate for at least some VAS because they have ratio scale (and therefore interval scale) properties but are less appropriate for category scales or 11 point NRS.

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