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Studies with pain rating scales

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SUMMARY Good correlation has been shown between pain scores derived from 4 different rating scales. The correlation was maintained when presentation of the scales was separated by a series of questions and by physical examination. There is good evidence that the 4 scales are measuring the same underlying pain variable as they calibrate well. There is also evidence that an 11-point (0–10) numerical rating scale performs better than both a 4-point simple descriptive scale or a continuous (visual analogue) scale.

In the assessment of efficacy of anti-inflammatory drugs, relief of pain is one of the most important variables (McGuire and Wright, 1971). Numerous scales are available for 'measuring' pain levels and these have been critically reviewed recently (Huskisson, 1974; Scott and Huskisson, 1976). The most fundamental form is a 'simple descriptive scale' (SDS) which uses 4 or 5 points based on verbal description (nil, mild, moderate, severe, very severe). The use of this scale for comparative purposes is limited by its lack of sensitivity for detecting relatively small changes. Improvement in discrimination can be achieved by using a numerical rating scale (NRS), eg, marked 0–10 or 0–20, or by the introduction of the visual analogue scale (VAS). This last technique utilises a straight line, conventionally 10 cm long, whose extreme limits are marked by perpendicular lines. The ends of the scale carry a verbal description of each extreme of the symptom to be evaluated, and the patient is asked to mark the line at a position between the two extremes which represents the level of pain. The present study was designed to investigate the degree of correlation between pain scores registered on 4 different rating scales. The scales chosen were a 4-point simple descriptive scale, a 0 to 10 numerical rating scale, and the visual analogue scale used both horizontally and vertically.

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Methods

In the first phase of this study 100 patients with a variety of rheumatic diseases were asked to score their pain levels on the 4 scales presented in random order one after the other. The SDS used the terms nil, mild, moderate, and severe. The formats of the NRS and VAS (used both horizontally and vertically) are shown in Fig. 1. In this phase, the total time taken to complete the scales was approximately 30s. In the second phase of the investigation, a further 104 patients were interviewed and again asked to complete the 4 identical scales. The scales were presented in a random order based on a Latin Square design. On this occasion the presentation of each scale was preceded by a standard series of questions relating to the patient's arthritis, and an item of physical examination, eg, measurement of grip strength, joint circumference, or assessment of the articular index of joint tenderness (Ritchie *et al.*, 1968). The insertion of this 'distraction' material

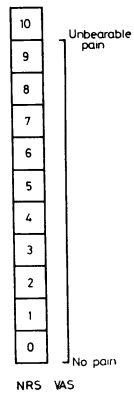

Fig. 1 *Formats of the numerical rating (NRS) and visual analogue (VAS) scales.*

Table 1 *Correlation matrix for pairs of results obtained in phase 1*

Rating scales	*SDS*	*NRS*	*VAS (vertical)*	*VAS (horizontal)*
SDS	1·000	0·680	0·705	0·726
NRS		1·000	0·640	0·616
VAS (vertical)			1·000	0·907
VAS (horizontal)				1·000

Table 2 *Correlation matrix for pairs of results obtained in phase 2*

Rating scales	*SDS*	*NRS*	*VAS (vertical)*	*VAS (horizontal)*
SDS	1·000	0·883	0·748	0·782
NRS		1·000	0·896	0·914
VAS (vertical)			1·000	0·886
VAS (horizontal)				1·000

was designed to assess the effect of time in diluting any carry-over effect from the previous scale. The total time involved to complete each interview in this phase was approximately 10 minutes.

Results

The correlation coefficients between pain scores derived from the different scales in the first phase are shown in Table 1. High correlations were obtained when any 2 pairs of data were compared.

The corresponding results from the second phase of the study (when dilutional material was introduced into the interview) are shown in Table 2. In this study, the correlations obtained were approximately the same, indicating that any carry-over effect on successive scales was not affected by the time interval introduced by the additional interview material.

Table 3 shows further analysis of phase 2 data. Minor changes in correlation were noted when comparing pairs of results which were separated by one or two blocks of dilutional material but, in general, high correlations were maintained in spite of increasing separation of time between the completion of the scales. It should be noted that some of the estimated correlation coefficients are based on very small sample sizes giving rise to rather unreliable estimates. For example, an estimate of −0·395 is based on a sample size of 4 pairs of data.

Figure 2 shows the data points derived from the NRS plotted against the SDS in phase 2. For the purposes of this analysis, we have plotted only pairs of data derived from scores separated by a single block of interview material. Fig. 3 shows a similar plot of scores derived from the vertical VAS against the SDS. In both figures there is considerable overlap of numerically derived scores (NRS and VAS) between groups defined on a verbal basis (SDS).

Since replication is not possible in the present context, a proper pain score would be better derived from a standard factor analysis (Anderson, 1976). This would also provide information on the relative merits (calibration, accuracy) of the different scales. Table 4 shows that the factor loadings are similar in all the cases, indicating that there are no real calibration differences among the scales. However, the NRS appears to have some advantages over the other scales as far as accuracy is concerned.

Discussion

The results indicate that there is good correlation between pain scores derived from the 4 scales used in the present survey. It is interesting to note that this correlation is maintained even when completion of the scales is separated in time. This may suggest that there is no significant carry-over effect from one scale to the next. On the other hand, it may also indicate a strong halo effect where the first scale dominates the readings obtained from successive scales. This has important consequences since it is common to assess several subjective phenomena using a series of rating scales within a single interview. The results of the present investigation do not unfortunately clarify this issue.

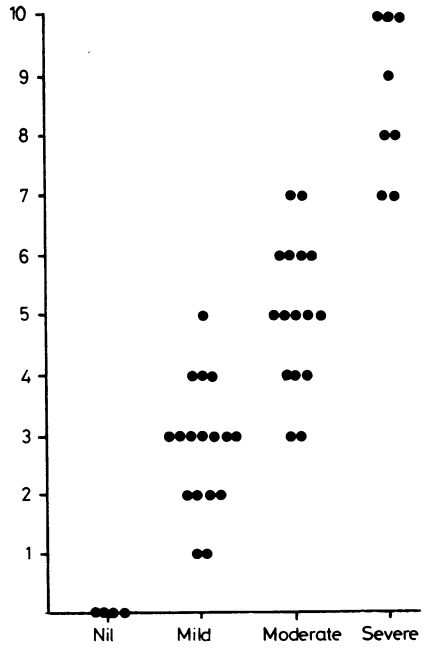

Fig. 2 *Scores from NRS plotted against SDS terms.*

Table 3 *The effects of order and separation-correlation coefficients*

Rating scales	*No. of separation blocks*	*Rating scales (order)*																	
		NRS						*VAS (vertical)*						*VAS (horizontal)*					
		All		*First*		*Second*		*All*		*First*		*Second*		*All*		*First*		*Second*	
		n	*r*	*n*	*r*	*n*	*r*	*n*	*r*	*n*	*r*	*n*	*r*	*n*	*r*	*n*	*r*	*n*	*r*
SDS																			
	0	46	0·912	21	0·929	25	0·902	52	0·772	31	0·820	21	0·660	58	0·772	26	0·822	32	0·767
	1	34	0·873	20	0·825	14	0·964	36	0·672	18	0·655	18	0·689	34	0·827	16	0·816	18	0·883
	2	24	0·837	11	0·742	13	0·909	16	0·796	7	0·847	9	0·716	12	0·715	8	0·912	4	−0·395
NRS																			
	0							58	0·865	27	0·886	31	0·860	52	0·918	28	0·895	24	0·949
	1							34	0·939	19	0·942	15	0·944	36	0·896	19	0·959	17	0·829
	2							12	0·966	6	0·965	6	0·995	16	0·946	7	0·961	9	0·944
VAS (vertical)																			
	0													46	0·896	27	0·920	19	0·861
	1													34	0·871	17	0·762	17	0·962
	2													24	0·917	11	0·887	13	0·985

The sample size (n) is shown and the correlation coefficient (r) is calculated for each pair of variables combined according to: (a) the order of presentation (first or second) or irrespective of any order (all) in which case all observations are included, and (b) the number of blocks separating them: zero blocks (0—the scales are presented one immediately after the other); one block apart (1); and two blocks apart (2) where one scale of the pair to be presented to the patient is necessarily first and the other last.

Table 4 *One factor estimates of the measurement error*

Rating scale	*Eigen values*	*Loadings*	*Communalities*	*Variance of the measurement error (specific variance)*
SDS	3·558	0·850	0·722	0·278
NRS	0·278	0·998	0·996	0·004
VAS (vertical)	0·111	0·910	0·827	0·173
VAS (horizontal)	0·053	0·937	0·877	0·123

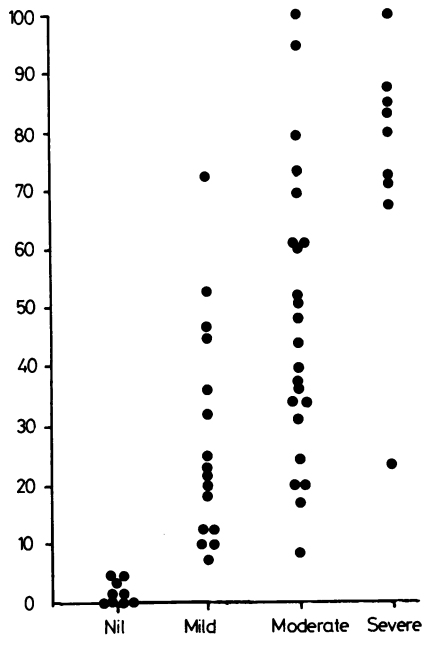

Fig. 3 *Scores from VAS plotted against SDS terms.*

The overlap of numerical scores when plotted against descriptive terms indicates the difficulty of defining patient groups in terms of pain level. However, the NRS is to be preferred on the grounds of measurement error. This may be because it provides a good compromise between the SDS which offers only a few choices and the VAS where the great freedom of choice may be confusing.

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