

Measuring disability after a stroke

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SUMMARY A ranked activities of daily living (ADL) scale has been developed for stroke patients, on which an individual's score predicts his/her overall function ability. With an unranked scale the same total score can be obtained from different combinations of items and gives little idea of the patient's general pattern or degree of disability. The items in the scale are easy to assess on both inpatients and outpatients, and accepted criteria for valid ranking are fulfilled. A strong relation was found between scale score one month post-stroke and length of stay in hospital. Low scores at one month were also associated with high mortality during the subsequent five months. "Formal" and "informal" methods of ADL assessment were compared, and only small and unimportant differences were found. Assessments by postal questionnaire were also evaluated and agreed well with formal assessments carried out by visiting the patients' homes. Use of some or all of these methods would help to simplify and standardise follow up records for both routine care and research.

Many scales have been developed to measure functional ability or activities of daily living (ADL).¹⁻⁴ They are all made up of separate items relating to self-care (eg, feeding, dressing, washing), mobility, and continence. When qualitatively different activities, such as dressing ability and walking, are combined into a single score, no indication is given of the pattern of disability or even the amount of help required. To remedy this, the scores on each item can be kept separate, or a ranked scale can be constructed.⁵ The latter method has so far been assessed only on patients aged under 65;⁶ (about 15% of all stroke patients.)⁷ Ranked (or Guttman) scales have the advantage that patients with the same scores are able to perform the same activities so that each point on the scale represents an easily identified step on the road back to full independence.

From a list of ADL items commonly used in stroke rehabilitation we have constructed a 10 point ranked scale and assessed its value in two groups of stroke patients admitted to Nottingham hospitals. We have also evaluated "informal" ADL assessments and postal questionnaires as ways of reducing the time and effort spent in measuring recovery in stroke patients.

Methods

A set of 19 activities was taken from the ADL scales used at Northwick Park and Rivermead, using the same criteria for assessing independence.^{2,6} These criteria were discussed with the occupational therapists carrying out the assessments and also printed on the back of the forms. Two groups of patients were studied.

Group I consisted of 78 inpatients at various stages of recovery from their strokes and currently undergoing rehabilitation. Occupational therapists were asked to rate their functional ability using standard procedures. The data were then analysed to see which of the 19 activities assessed would form an acceptable Guttman scale.

Group II consisted of 107 patients assessed by a single observer one month after a stroke causing admission to hospital. They were taken consecutively from a register of all acute stroke admissions. Forty-eight of the 107 patients had been discharged by one month and were assessed at home, the remainder being seen on the wards. For the latter we used reports from nursing and rehabilitation staff on the amount of help needed for washing, toileting and feeding. In 32 consecutive patients this "informal"

assessment was compared with an independent full occupational therapy (OT) assessment carried out during the same week, in which every item was formally tested.

The 48 group II patients seen at home were assessed on seven ADL items. A subgroup of 26 consecutive patients before being visited, were sent a questionnaire which asked whether help was required with these activities. The results of postal and OT assessments were then compared.

Having selected a suitable set of ADL items on the basis of group I results, Guttman scaling procedures were then applied to the ADL data collected from group II. The validity of a Guttman scale is measured by considering coefficients of reproducibility and scalability. The former is an estimate of the accuracy with which a patient's scale score predicts which ADL items are passed or failed. Scalability is similar to reproducibility but is corrected for the relative frequency with which each item is passed. Both coefficients range from 0 to 1. A scale is usually considered to be valid and unidimensional if the coefficient of reproducibility is greater than 0.9 and the coefficient of scalability exceeds 0.6.⁸ Patients were assigned a scale score based on the most difficult activity passed and were grouped by score, and survival at six months and median length of hospital stay were calculated for each of these groups. Analysis was carried out using *Statistical Package for Social Sciences*.⁸

Results

The 107 patients in group II were recruited over three months. During this time a total of 200 stroke admissions were registered (one month mortality, 46%). Fifty two percent of all admissions were male and the mean age was 71 years. For the two study groups the respective figures were: 53% male and 69 years (group I); 59% male and 69 years (group II).

Ten ADL items were chosen out of the 19 assessed, and they are shown in table 1, together with the proportions of patients in both groups able to carry out each one without assistance. The 10 items were all reasonably easy to test in both inpatients and outpatients and represented a range of activities necessary for self-care.

A valid Guttman scale was produced from the group I data with coefficients of reproducibility and scalability of 0.92 and 0.72 respectively. When applied to group II data the same ordering gave coefficients of 0.94 and 0.84. When the order of items (that is, walking and dressing) in the middle of the scale was changed these values were increased to 0.95 and 0.87. Twenty four (22%) patients did not fit the scale exactly, 19 of them having scores between 2

Table 1 ADL items used for scale and number (%) of stroke patients able to carry out each item independently

Item	Group I		Group II	
	Number	(%)	Number	(%)
Drink from a cup	73	(94)	82	(77)
Eat	51	(65)	80	(75)
Wash face and hands	51	(65)	68	(64)
Transfer from bed to chair	30	(39)	53	(50)
Walk (or use wheelchair) indoors	21	(27)	51	(48)
Toilet	24	(31)	48	(45)
Undress	34	(44)	46	(43)
Dress	28	(36)	45	(42)
Make a hot drink	14	(18)	38	(36)
Get in and out of bath	5	(6)	18	(17)
Totals	78		107	

and 6. Table 2 shows the distribution of scores for group II and errors of prediction. Ninety two percent of patients had scores that predicted abilities to within one scale point.

Table 2 Distribution of ADL scores for group II showing number of subjects with errors in scaling

ADL scale score	Number of subjects	Errors in scaling	
		± 1 scale point	more than ± 1 scale point
0	19	0	0
1	4	2	1
2	21	7	0
3	7	1	2
4	5	1	2
5	0	-	-
6	5	2	3
7	3	0	1
8	5	0	0
9	21	2	0
10	17	0	0

There was a significant relation between length of hospital stay and scale score at one month (Kruskal-Wallis 1-way anova, chi-square = 20.01, $p = 0.018$). Of the 24 patients who died between one and six months, 16 (67%) had scored less than 3 points at one month. Of the 18 (17%) patients still in hospital six months after their stroke, 15 had scored less than 4 at one month. The relation between ranked scale score and survival and median length of hospital stay are shown in table 3.

The figure compares the results of formal OT and informal ADL assessments on the series of 32 consecutive patients who had had both done. There were disagreements on two items in five cases and on three items in three cases. These disagreements were in the assessment of drinking, eating, and washing face and hands (five cases) and dressing/undressing

Table 3 Relation between ranked scale score at one month and survival and median length of hospital stay

Scale score	Number of subjects	Number of deaths	Median hospital stay for survivors (days)
0	19	11	168
1	4	1	81
2	21	4	65
3	7	0	56
4	5	2	41
5	0	—	—
6	5	1	34
7	3	0	24
8	5	0	32
9	21	3	20
10	17	2	7

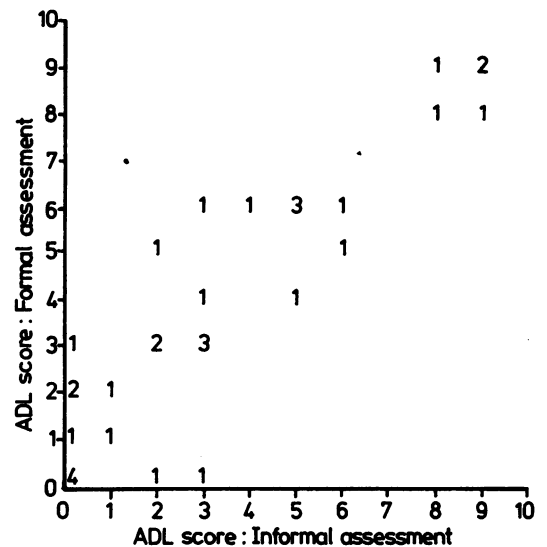
(three cases). In all, there were 20 (6%) disagreements out of 320 items assessed. The mean difference between formal and informal assessments was 0.5 scale points which is of no statistical or practical significance.

Of 26 patients receiving a postal questionnaire aiming to assess ADL, 22 (85%) returned satisfactory forms. The other four were dysphasic and/or dysgraphic. Since these patients were more independent, having been discharged within a month of their stroke, we assessed only items 5 to 10 of the original scale together with two extra activities: climbing stairs and shopping. When the results of assessments by post and by visit were compared, there were eight (5%) disagreements out of 154 items tested.

Discussion

A method of ADL assessment has been produced which is quick and easy to carry out, is appropriate for stroke patients being treated in hospital or recently discharged and fulfills accepted criteria of scalability. The close association between scale score at one month and time spent in hospital is useful for patient management and also supports the concept of a sequential return of function after stroke. The high mortality among those with low scores also agrees with previous findings from a retrospective study.⁹ The patients in group I were more heterogeneous in terms of time since onset and functional ability, and this probably accounts for differences in ordering in the middle of the ADL scale.

A ranked scale offers two main practical advantages. Firstly, we have shown that there is a direct relation between degree of independence and scale score, that is, number of items passed. Secondly, in some circumstances, it is sufficient to test only three or four of the items on the scale since a patient who fails on the second or third item is most unlikely



Comparison of formal occupational therapy and informal activities of daily living assessments. Numbers are patients.

to pass on the sixth or seventh, for instance. It is safer to assess more activities in patients with scores in the middle of the scale since the ranking is less "stable" here (that is, there is little difference in the proportion of patients able to pass successive items). For this reason a small number of patients are misclassified by the scale, so that their overall score incorrectly predicts which activities they can and cannot do. Only 8% of patients in group II had errors of prediction of greater than one scale point, however. These patients can be treated in one of two ways: they may be assigned a score based on the number of activities passed or they may be given a scale score based on the most difficult item passed. The former is more appropriate if changes in scores with time are of interest. In practice, we have found that when a patient is misclassified the criteria for passing or failing have often been incorrectly applied.

Comparisons of ADL scores between groups are often made using parametric techniques which are inappropriate as the data are neither continuous nor normally distributed. Ranked scales are ordinal measures and are best compared by using non-parametric significance tests, for example, Mann-Whitney U test. A ranked scale is more precise than a simple classification of outcome such as "dependent"/"independent," and the sample sizes needed for comparative studies can therefore be reduced. Furthermore, with a ranked scale, several

disparate items can be summarised in a single score, instead of having to treat them separately.

Our results confirm the usefulness of "informal" ADL assessment. The information is easy to obtain, and the patient is spared the indignity of undergoing a battery of consecutive tests. Furthermore, the results are based on observations over several days rather than at a single point in time when they can be affected by factors such as time of day, use of drugs, and fatigue. If anything, informal assessments tended slightly to underestimate patients' true ability, but the overall disagreement of 6% with formal assessments was small compared with the day to day variation seen in some patients.

Agreement between postal and direct ADL assessments was good enough for classifying patients into functional groups. Questionnaire methods could be more widely used both for rehabilitation studies and as part of routine follow up, as a way of screening for unforeseen problems occurring after discharge.

These results suggest several ways in which ADL assessment could be simplified without significant loss of information. Standardisation of follow up records would greatly benefit both routine patient care and research.

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