J Rehab Med 2001; 33: 61–70

AN INITIAL INVESTIGATION OF THE RELIABILITY OF THE RIVERMEAD EXTENDED ADL INDEX IN PATIENTS PRESENTING WITH NEUROLOGICAL IMPAIRMENT

Philippe Rossier, Derick T. Wade and Margaret Murphy

From the Rivermead Rehabilitation Centre, Oxford, UK

The objective of this study was to establish the reliability and sensitivity of both postal and interviewer-administrated versions of the Rivermead Extended Activities of Daily Living (READL) index, which assesses six domestic activities and six community activities. Sixty patients with stable neurological impairment were recruited. In one group ($n = 40$), every patient was assessed face-to-face using the READL, the Barthel index (BI) and the short orientation memory and concentration test (SOMC). One week later, the READL was repeated by the same person, in the same place. In the second group ($n = 20$), all the patients were first sent a postal form of the READL and were then seen face-to-face for assessment as in group 1. To be included patients had to score at least 18/28 points on the SOMC. Scores were compared using scatterplots, Bland and Altman plots and correlation coefficients, and difference scores were calculated. Sensitivity was established comparing groups of patients expected to differ in their activities. Repeated assessment score, both face-to-face and by post, showed significant correlation (Pearson coefficient = 0.97 and 0.88, respectively). Most scores were within four points of each other, with no systematic bias, although patients tended to rate themselves more independent. Both methods were able to detect differences in the level of activities as predicted between more and less dependent groups (t-test: $p < 0.00001$ and $p = 0.00087$). The READL index appears to be a reliable and sensitive measure, with some evidence for validity, but further research is needed.

Key words: outcome measure, rehabilitation, extended ADL.

J Rehab Med 2001; 33: 61–70

Correspondence address: Professor Derick T. Wade, Rivermead Rehabilitation Centre, Abingdon Road, Oxford, OX1 4XD UK

(Accepted August 22, 2000)

INTRODUCTION

There are many scales, probably hundreds, that assess personal activities of daily living (ADL), such as dressing and bathing, but there are relatively few, probably tens, that assess more complex activities such as shopping and cooking (1–3). These activities are not essential to basic functional independence but are needed to achieve independence in the community. They are usually referred to as "extended" or "instrumental" ADL (EADL or IADL). Rehabilitation services aim to achieve social independence in the community if at all possible, and need to use an appropriate measure of EADL when evaluating themselves.

One of the first published measures to include more complex functioning was the Functional Life Scale (3), which included "outside activities" (e.g. using transport public) and "social interaction" (e.g. going out to dinner). It also included assessments of cognitive and functional abilities. It is difficult to interpret and takes a long time to complete. Two better known EADL indices are the Nottingham Extended ADL index (2) and the Frenchay Activities Index (1, 4). The Nottingham Extended ADL index is divided into four sections (mobility, tasks in the kitchen, domestic tasks and leisure activities). Although used in randomized controlled trials (5), there is relatively little published evidence concerning validity, reliability and sensitivity. The Frenchay Activities Index comprises 15 items covering a range of activities (e.g. cooking, doing housework, shopping, walking, travelling, gardening or working). It has also been used in clinical research (6) and a recent study has investigated reliability, showing relatively poor agreement between the postal and interviewer-administrated versions (7).

Many other measures include items or parts that cover EADL (6, 8). However, these measures usually also assess other, different domains and are not specific for domestic and community activities. This makes them both cumbersome and relatively insensitive to use when one wishes simply to assess the level of independent community living.

Thus, it was felt that none of the existing measures satisfied the need for a measure that concentrated solely on those activities needed for independent community living, because the measures currently available include some activities that are not necessary for community independence and miss out other activities that are necessary for community independence.

In this initial pilot study an index is described that considers the main activities needed for living independently in the community. The index covers both domestic and community activities with six items in each domain. The primary aim of this study was to establish the reliability of the new measure and to see whether it could be used as a postal questionnaire. Some evidence on validity and sensitivity was anticipated, but further studies will be needed to investigate other psychometric

 ISSN 1650–1977

Table I. *Demographic and clinical descriptors of the patients studied*

	Patients assessed twice face-to-face ($n = 40$)	Patients assessed once face-to-face and once by postal test ($n = 20$)	p-value group 1 vs group 2
Age (years)	53 ± 10	49 ± 15	0.10
Gender ratio (M/F)	24/16	7/13	0.04
Time since onset of the disease (years)	8.2 ± 9.8	8.7 ± 10.6	0.05
Time between test 1 and test 2 (days)	7 ± 1	12 ± 6	< 0.0001
Barthel index (/20)	12.1 ± 5.6	12.0 ± 6.3	0.47
SOMC (/28)	24.8 ± 3.5	23.9 ± 3.9	0.19
READL (/36): total	19.2 ± 8.8[a]	17.1 ± 9.9[b]	0.20
READL (/18): domestic activities	8.0 ± 6.4[a]	7.7 ± 5.7[b]	0.47
READL (/18): community activities	11.2 ± 3.9[a]	9.5 ± 5.0[b]	0.07

Data are means ± S.D.
[a] First occasion.
[b] Questionnaires assessed face-to-face.
SOMC = short orientation memory and concentration test; READL = Rivermead extended activities of daily living.

properties such as its predictive validity as a measure of actual independent community living and its scalability.

METHODS

The patients involved in the study were mainly outpatients at two specialist neurological rehabilitation centres (Rivermead Rehabilitation Centre and Ritchie Russell House), with a few inpatients approaching discharge. All presented with a more or less severe impairment due to a neurological or neuromuscular disease. To be included in the study, the patients had to give their consent, had to be in a clinically stable state unlikely to change over 2 or 3 weeks, and had to score at least 18/28 in the short orientation–memory–concentration (SOMC) test (9), indicating a reasonable cognitive and communicative ability.

The Rivermead Extended Activities of Daily Living (READL) index has been used and developed informally over several years and items have been modified in the light of experience. The version used for this study is shown in the Appendix and comprises two domains: domestic activities (six questions) and community activities (six questions). For each item there are four possible answers (able to do it alone = 3 points, with minor physical support = 2 points, with major physical assistance = 1 point and unable to do it = 0 point) and the score was summed, giving a value between 0 (inactive) and 36 (active).

In the first study of test–retest reliability by one observer assessing patients face-to-face, 40 patients were assessed face-to-face using the READL index, and they were also assessed on the Barthel ADL index (10) and the SOMC test (9). The READL index was repeated 1 week later at the same place and by the same observer.

In the second study of test–retest reliability using two different methods of assessment (postal questionnaire and face-to-face interview), 20 patients were first sent a simplified postal questionnaire version of the READL index (see Appendix). When the completed questionnaire had been received, the patient was assessed using the face-to-face version of the READL index, and on the Barthel ADL index and the SOMC test.

In both studies the Barthel ADL index was used to characterize (describe) the patients. Further, it was anticipated that patients who were more dependent in personal ADL would, as a group, be less independent in the community (a test of validity). The SOMC test was used to select out patients with severe cognitive losses and to describe the patients. It was also anticipated that patients with less good cognitive function might be less independent.

Agreement between first and second test was assessed using Bland & Altman's method (11). In this method the difference between two scores is plotted against the average of the same two scores for each patient, and it shows both the differences observed and whether the difference is related to the score. In addition, scatterplots were plotted and the Pearson correlation coefficient and the chi-square test were used.

RESULTS

The study included 21 patients with stroke, 18 with multiple sclerosis, six with head injury, four with spinal cord injury, three with spina bifida and hydrocephalus, and one each with transverse myelitis, cervical myelopathy, Becker-type muscular dystrophy, Huntington's disease, myotonic dystrophy, anoxic brain damage, polyneuropathy and motor neurone disease. Table I shows the main clinical features of the patients and the mean ± S.D. scores for the three tests used. There was no difference between the two groups for age, the time since the onset of the neurological disease and the scores on the three indices. There was a higher proportion of women in the second study and the interval between assessments was longer in the second study.

The reliability for the READL index is shown in Fig. 1a and b for the face-to-face assessment and in Fig. 2a and b for the postal questionnaire (scatterplot and Bland & Altman's method for each index). Table II shows the scores on the first and second assessments and the difference between scores: range, mean, standard deviation, median, and 5th and 95th percentiles. It can be seen that patients tended to score themselves lower (i.e. less independent) on the postal questionnaire by about 3 or 4 points, although this was not statistically significant ($p = 0.102$). Sixteen patients (80%) rated themselves lower than they were rated at face-to-face interview.

The correlation coefficients between test scores on the first and on the second occasion and between the Barthel index and the SOMC are summarized in Table IIIa for the patients assessed face-to-face and in Table IIIb for those assessed once face-to-face and once by postal questionnaire. These tables show the expected high correlations between both total scores and for each domain of the READL index when assessed face-to-face.

There was also a strong correlation between the READL index and the Barthel ADL index score, also shown in Fig. 3a and b. There was absolutely no correlation between the READL index score and the SOMC test score (Fig. 4).

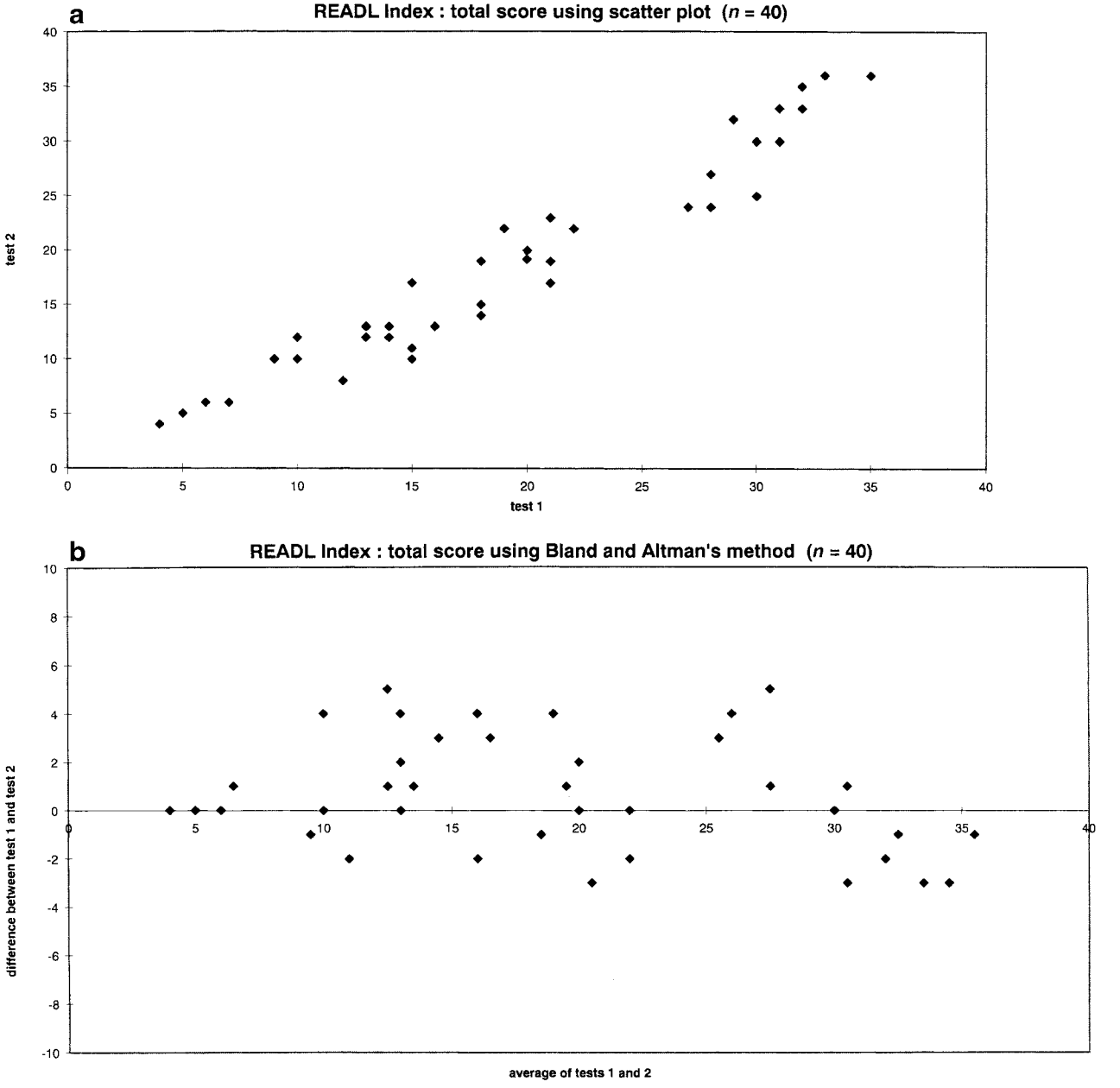

Fig. 1. Rivermead extended activities of daily living (READL) index using the assessment face-to-face. (a) Scatterplots of results, READL score 1 vs score; (b) plot of difference scores (test 1–test 2) against mean score on test 1 and test 2.

The relationship with the Barthel index was as expected, and simply confirms that patients who were less independent in personal ADL also tended to be less independent in community activities. However, the scatterplot shows that the relationship was quite loose, and that dependence in personal ADL did not preclude reasonable independence in extended ADL activities. The lack of any relationship between cognitive impairment and performance on the READL was initially surprising, but probably arose because the selection criteria curtailed the full range of cognitive function because patients with more severe losses were excluded.

At first glance many items, especially in domestic activities, suggest a bias towards those activities more usually undertaken by women. Analysis of the data (Table IV) did not support such a gender bias. The score for the total READL and its two domains of activities was higher for men, but the data also show that in this study the degree of disability was greater in women and this may account for the difference.

Finally, to investigate the relative sensitivity of the READL index in detecting differences, patients were divided into two equal groups according the median score in the Barthel index, in the expectation that more patients more dependent in personal ADL would be, as a group, more dependent in EADL. The results show that the READL index was able to detect the

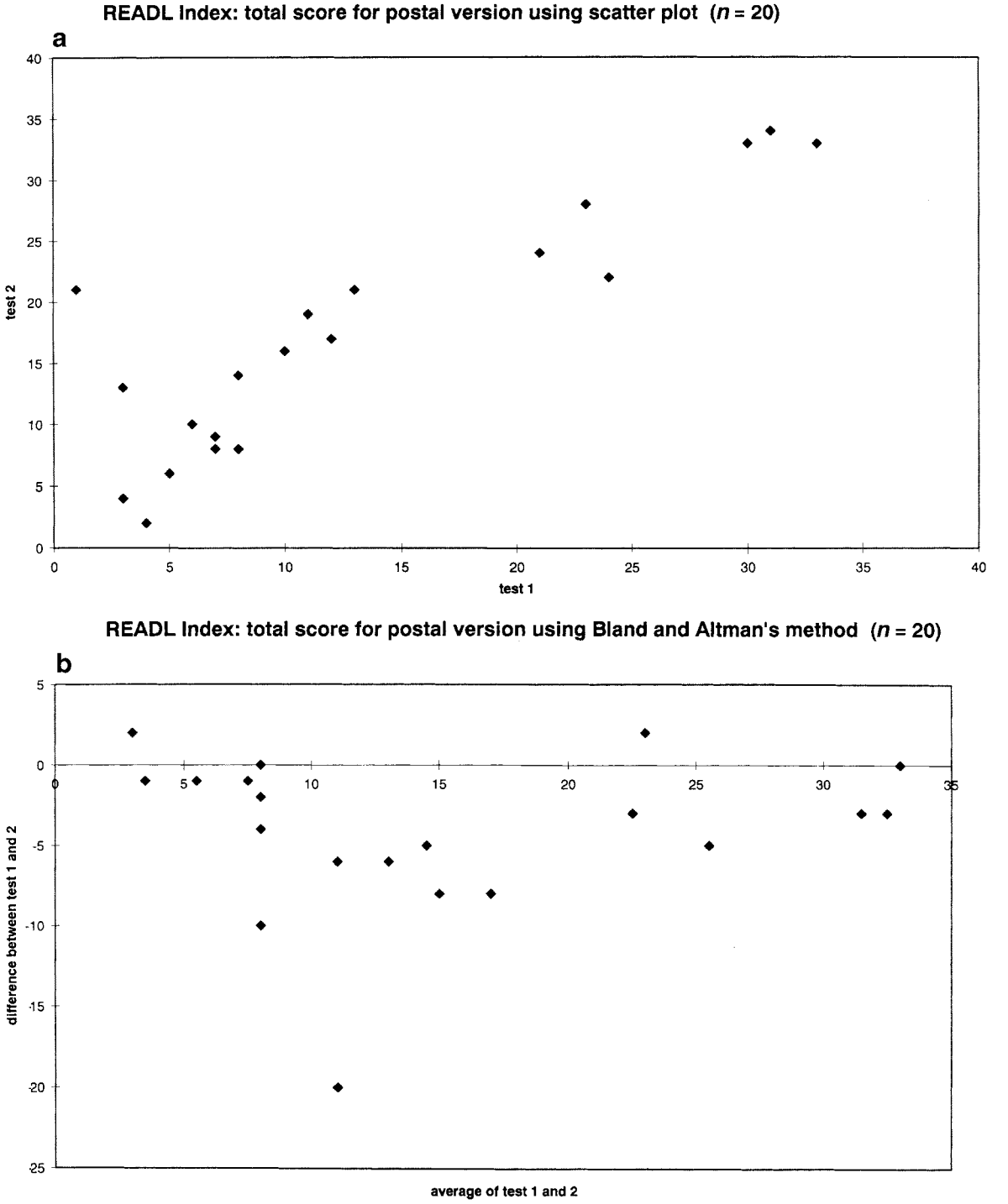

Fig. 2. Rivermead extended activities of daily living (READL) index using postal version. (a) Scatterplots of results, READL score 1 vs score; (b) plot of difference scores (test 1–test 2) against mean score on test 1 and test 2.

difference both for the patients assessed face-to-face and for those assessed by postal questionnaire (Table V).

DISCUSSION

This initial study suggests that the READL index is reasonably reliable when patients are assessed by the same observer twice, but that patients rate themselves less independent when assessing themselves using a postal version. As expected, patients who were more dependent in personal ADL were less independent in extended activities, but the presence of cognitive problems did not appear to be associated with a lower level of

Table II. *Scores for each measure on each occasion, and difference scores (occasion 1–occasion 2)*

	Statistics					
Item	Min	5%	50% (median)	95%	Max	Mean ± S.D.
First occasion						
READL total (ff)	4	5.95	18.5	32.05	35	19.2 ± 8.8
READL total (p)	1	2.9	9	31.1	33	13.0 ± 10.2
Second occasion						
READL total (ff)	4	5.95	18	35.05	36	18.6 ± 9.4
READL total (ff)	2	3.9	16.5	33.05	34	17.1 ± 9.9
Difference (1–2)						
READL total (ff–ff)	−3	−3	0.5	4.05	5	0.7 ± 2.3
READL total (p–ff)	−20	−10.5	−3	2	2	−4.1 ± 5.0

Data are range, percentiles (5, 50, 95) and means ± S.D.
READL = Rivermead Extended Activities of Daily Living index; ff = face-to-face rating; *p* = patient self-rating by postal questionnaire.

independence. The utility of this measure in clinical practice and in research has yet to be established, and other psychometric properties including validity as an actual indicator of the ability to live independently will need further investigation.

The patients studied are reasonably representative of patients being seen in neurological disability services, except that patients with obvious severe cognitive losses were excluded. It is possible that such patients could be assessed using information gleaned from carers or family members, as the data suggest that patients with cognitive impairment may still be capable of some extended ADL. The index has not been tested in patients with non-neurological diseases, but there is no reason to anticipate any difference in that population.

The measure has obvious face validity, since it includes behaviours that are necessary for anyone living independently in the community. Other activities could have been included, such as simple household repairs or interacting with bureaucracy, but the authors feel that the activities covered are those that are most important for independent survival in the community on a day-by-day basis. It had the expected relationship with a measure of dependency in personal ADL, but this was loose and so this measure should give useful additional information. Other aspects of its validity have yet to be established.

This initial study has not investigated statistically some psychometric aspects of the new measure, such as whether it forms a hierarchy, whether it forms a single construct and whether the weights are appropriate. This could be done using Rasch analysis in future studies. However, although superficially it seems sensible to give differential weights to items, the available evidence suggests that this does not necessarily add additional discriminatory power (12, 13) and it certainly complicates scoring. Future research should explore this further.

Table III. *Correlation coefficients using data from the average of test 1 and test 2, except with the same test when data from test 1 correlated with data from test 2*

(a)	Face-to-face (1)		
Face-to-face (2) ($n = 40$)	READL total	READL domestic	READL community
READL total	0.97	0.94	0.81
READL domestic		0.96	0.55
READL community			0.91
Barthel index	0.83	0.75	0.71
SOMC	−0.17[a]	xx	xx

(b)	Postal version		
Face-to-face ($n = 20$)	READL total	READL domestic	READL community
READL total	0.88	0.96	0.95
READL domestic		0.88	0.83
READL community			0.80
Barthel index	0.74	0.75	0.65
SOMC	−0.02	—	—

[a] NS (all others $p < 0.01$).
READL = Rivermead Extended Activities of Daily Living index; SOMC = Short Orientation Memory Concentration test.

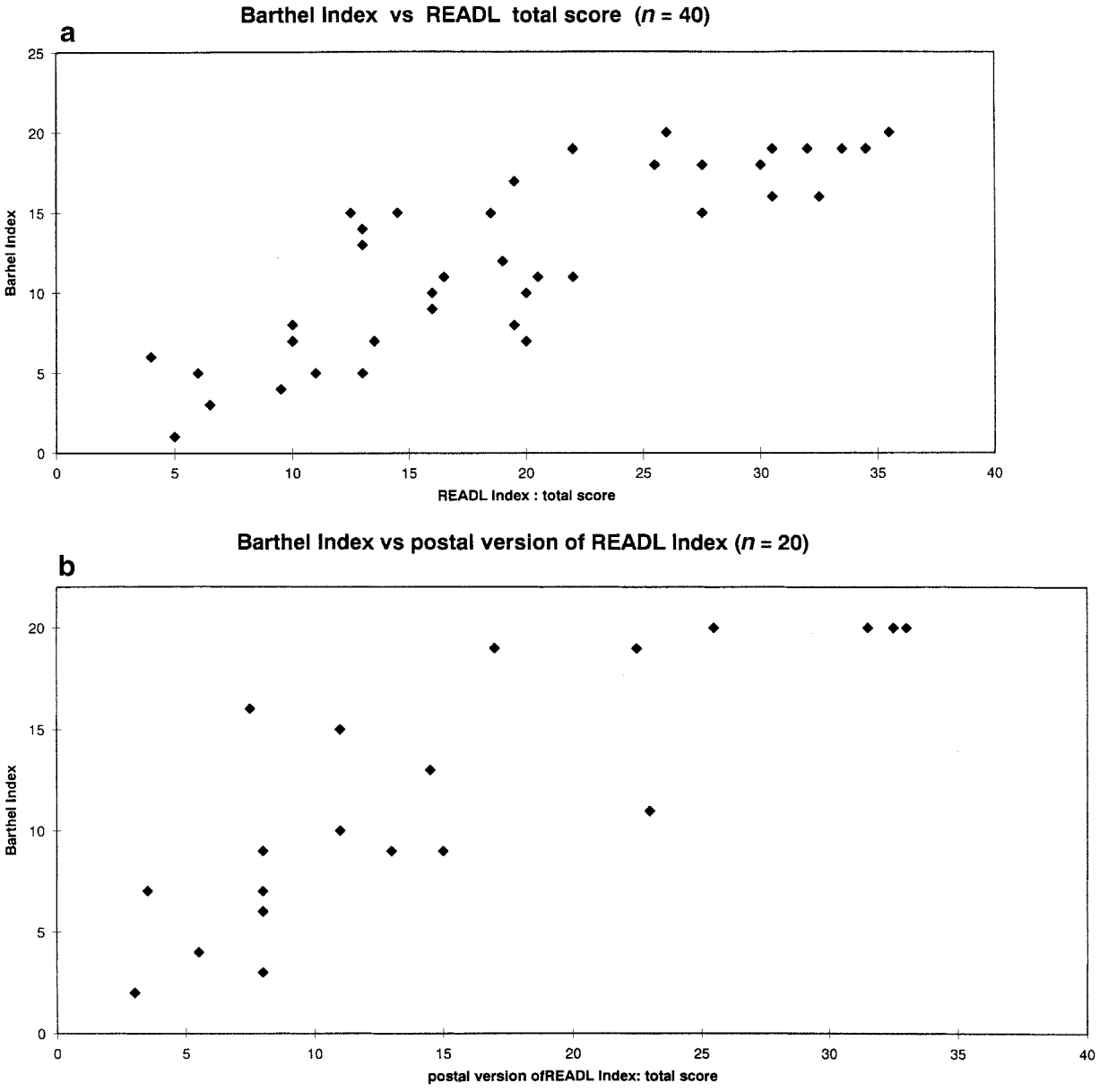

Fig. 3. Plots of Barthel index against (a) Rivermead extended activities of daily living (READL) index using the assessment face-to-face; and (b) READL index using postal version.

The practical utility of this measure is still uncertain. This study suggests that clinical assessment through asking questions is reasonably consistent and that it could be used in that way. Results from postal assessment should only be compared directly with results from face-to-face assessment cautiously [as shown for the Frenchay Activities Index (3)], but it is unclear whether postal evaluation itself is any more or less reliable or valid.

Further work is needed. First, the utility of this measure in research can only be established in a trial or another study. However, the data given here will facilitate the calculation of statistical power. Secondly, its utility in service audit and other aspects of clinical work will need evaluation. However, the measure is clinically relevant, which should commend it to clinicians, patients and service purchasers. Thirdly, its validity

Table IV. *Total score of the Barthel index and the READL index for women and men*

	Women ($n = 29$)	Men ($n = 31$)	p-value
Barthel	10.6 ± 5.5	13.4 ± 5.8	0.05
READL	16.3 ± 9.0	20.5 ± 9.0	0.04

Data are means ± S.D.
READL = Rivermead Extended Activities of Daily Living index.

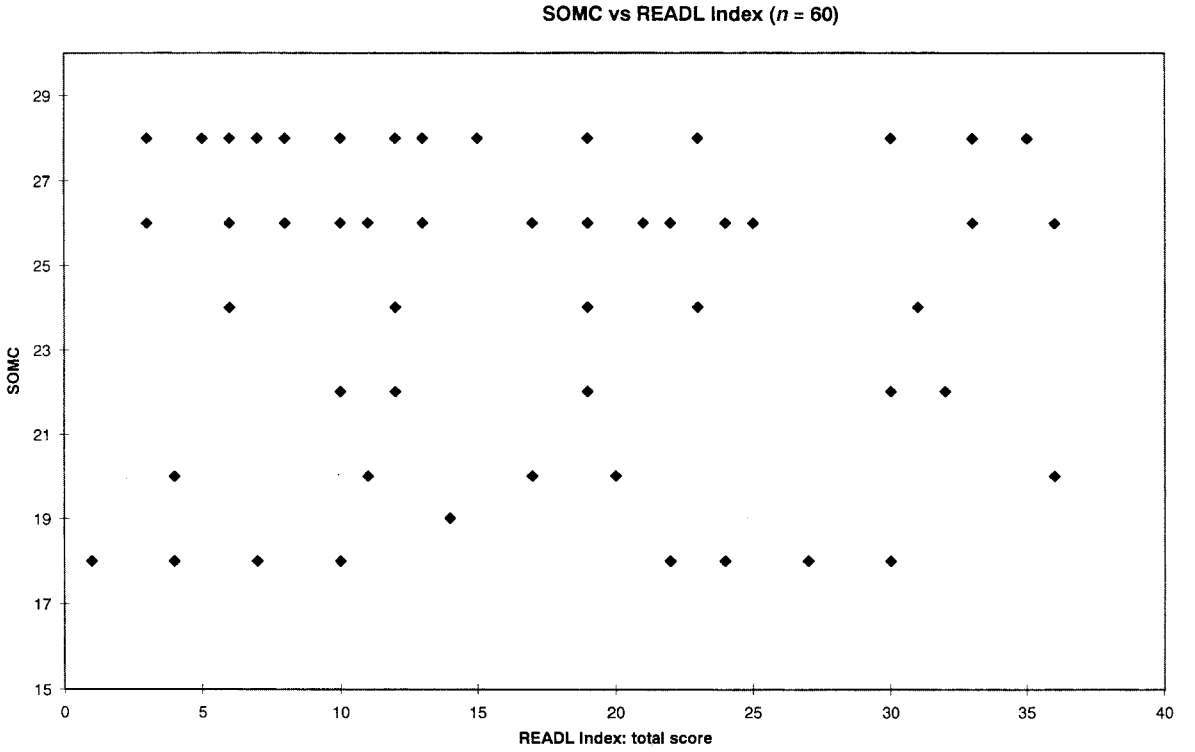

Fig. 4. Plot of short orientation memory and concentration test (SOMC) against Rivermead extended activities of daily living (READL) index using the assessment face-to-face.

Table V. *Comparison of READL scores between less and more disabled people according their score on the Barthel index*

	Less disabled people Barthel > 12.5	More disabled people Barthel < 12.5	*p* value
Face-to-face version	*n = 20*	*n* = 20	
Barthel index	17.0 ± 2.2	7.2 ± 3.1	<0.00001
READL total (test 1)	24.9 ± 7.5	13.6 ± 6.0	<0.00001
Postal version	*n* = 10	*n* = 10	
Barthel index	17.3 ± 3.3	6.6 ± 2.8	<0.00001
READL total	19.5 ± 10.8	6.5 ± 2.8	= 0.00087

Data are means ± S.D.
READL = Rivermead extended activities of daily living.

as a measure of a patient's ability to survive in the community without support needs confirmation in a larger study against other, independent observations of help given. Lastly, analysis of data from a larger sample should be undertaken to investigate whether the items form a hierarchy and whether differential item scores (weights) would be more informative.

ACKNOWLEDGEMENTS

We thank Professor A. So and the SIPCA Foundation in Lausanne, Switzerland, for arranging financial support for Dr Rossier. We thank all patients for their co-operation and the Occupational Therapy departments at Rivermead and Ritchie Russell House for their help.

REFERENCES

1. Holbrook M, Skilbeck CE. An activities index for use with stroke patients. Age Ageing 1983; 12: 166–170.
2. Nouri FM, Lincoln NB. An extended activities of daily living scale for stroke patients. Clin Rehabil 1987; 1: 301–305.
3. Sarno JE, Sarno MT, Levita E. The functional life scale. Arch Phys Med Rehabil 1973; 54: 214–220.
4. Wade DT, Legh-Smith J, Langton Hewer R. Social activities after stroke: measurement and natural history using the Frenchay Activities Index. Int Rehabil Med 1985; 7: 176–181.
5. Walker MF, Gladman JF, Lincoln NB, Siemonsma P, Whitely T. Occupational therapy for stroke patients not admitted to hospital: a randomised controlled trial. Lancet 1999; 354: 278–280.
6. Wade DT. Measurement in neurological rehabilitation. Oxford: Oxford University Press, 1992.
7. Carter J, Mant F, Mant J, Wade DT, Winner S. Comparison of

postal version of the Frenchay Activities Index with interviewer-administered version for use in people with stroke. Clin Rehabil 1997; 11: 131–138.
8. Lincoln N, Edmans JA. A re-validation of the Rivermead ADL scale for elderly patients with stroke. Age Ageing 1990; 19: 9–24.
9. Wade DT, Vergis E. The short orientation–memory–concentration test: a study of its reliability and validity. Clin Rehabil 1999; 13: 164–170.
10. Wade DT, Collin C. The Barthel ADL Index: a standard measure of physical disability? Int Disabil Stud 1988; 10: 64–67.
11. Bland JM, Altman DG. Statistical methods for assessing agreement between two methods of clinical measurement. Lancet 1986; i: 307–310.
12. Bebbington AC. Scaling indices of disablement. Br J Prevent Soc Med 1977; 31: 122–126.
13. Jenkinson C, Mant J, Carter J, Wade DT, Winner S. The London Handicap Scale: a re-evaluation of its validity using standard scoring and simple summation. J Neurol Neurosurg Psychiatry, in press.

APPENDIX: Rivermead Extended Activities of Daily Living questionnaire

(interview/examiner rating version)

In the last four weeks how has the patient undertaken the following activities. Score as below:

0 = Not at all
1 = Participated, but only with major physical and/or supervisory assistance
2 = Undertaken spontaneously, but needed some minor physical and/or supervisory support
3 = Undertaken independently, without any support (and as often as needed/requested)

Day						
Month						
Year						
Domestic activities						
Prepare a hot drink Make a cup of tea/coffee/chocolate with all equipment and consumables on work surface. Needs to fill kettle or saucepan, heat up water and/or milk.						
Prepare cold or hot snack Make a snack of a sandwich, or cheese on toast or beans on toast using cooker or microwave if needed. Materials to be available in cupboards or in shelves as appropriate.						
Prepare a hot main meal Prepare and cook a main meal. Materials to be available in kitchen cupboards or on shelves as appropriate.						
Use the vacuum cleaner Take from storage place, switch on, vacuum clean room/area, switch off and return to storage place.						
Do some washing up (dishes) Take dirty utensils previously assembled (at least 12 items—plates, cups, cutlery, etc.). Fill bowl or sink. Use detergent and dry or leave to dry.						
Wash dirty clothes Take dirty clothes and wash them (any method) and prepare them ready for wearing.						
Community activities						
Use the phone Find and write down a number from the phone book. Use the telephone to convey a message.						
Go to local shop Leave home (or hospital ward), visit shop and return with two or more minor items such as newspaper and sweets.						
Go to large shop and buy 10+ items Leave home (or hospital ward), buy and return with correct items (decided upon in advance). Travel by any means.						
Cross a road Cross any road with significant traffic (more than one car per minute) at a pedestrian crossing.						
Use bus/train/taxi or car Leave home or hospital ward, catch a public bus or train, or use a taxi or own car. Travel to correct destination and return.						
Undertake a leisure activity Go to church, cinema, theatre, pub or participate in any leisure activity (includes going to day centre where actively participates).						
TOTAL						

Rivermead Extended Activities of Daily Living questionnaire

(postal version)

These questions are about looking after yourself at home. For each question please circle one answer:

N = Not applicable (not relevant; you do not want to; you never used to) 0 = Not able to do at all
1 = Only able to do with help or supervision from someone
2 = Able to do alone with difficulty, or using special equipment
3 = Able to do easily and do as much as you want to

Do you:	Answer	Comment
Make a hot drink?	N 0 1 2 3	
Make a hot or cold snack?	N 0 1 2 3	
Cook a full hot meal?	N 0 1 2 3	
Wash up dishes?	N 0 1 2 3	
Clean the house (e.g. vacuum)?	N 0 1 2 3	
Do laundry/wash clothes?	N 0 1 2 3	
Use the phone?	N 0 1 2 3	
Shop locally for a few items?	N 0 1 2 3	
Do a major shop (10+ items)?	N 0 1 2 3	
Drive a car or use a bus or taxi?	N 0 1 2 3	
Cross a busy road?	N 0 1 2 3	
Undertake any leisure activity?	N 0 1 2 3	