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An evaluation of the reliability and sensitivity of the London Chest Activity of Daily Living Scale (LCADL)

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Abstract We have previously reported the validity of a new assessment tool; the London Chest Activity of Daily Living Scale (LCADL). This work investigates the reliability and responsiveness of that measure. Reliability was assessed in 19 patients with stable severe chronic obstructive pulmonary disease (COPD); median age (range) 66 (55–79) years, FEV_1 mean (SD) 0.91 (0.29) l, by test–retest 4 weeks apart. Responsiveness was assessed in 59 patients; median age (range) 66 (38–84) years, FEV_1 mean (SD) 0.87 (0.30) l, who had undergone at least 6 weeks of pulmonary rehabilitation. Test–retest scores of the LCADL showed a strong relationship with one another, Intraclass correlation coefficient Icc=0.93 95%CI (0.82–0.97) demonstrating evidence of good reliability. With the exception of the Domestic component, all domains of the LCADL showed a statistically significant reduction in dyspnoea during ADLs after pulmonary rehabilitation. There was a statistically significant improvement in the total LCADL score (mean difference (95% CI) −5.91 (from −9.23 to −2.60) after rehabilitation. These data support the use of the LCADL as an outcome measure in COPD which is valid, reliable and responsive to change.

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Keywords activities of daily living; chronic obstructive pulmonary disease; reliability.

INTRODUCTION

We have previously reported the development of a new outcome tool designed to assess dyspnoea during daily activities in patients with severe chronic obstructive pulmonary disease (COPD) (1). Evidence was presented of face and construct validity of the London Chest Activity of Daily Living Scale (LCADL) (see the appendix). The questionnaire showed high internal consistency with an α value of 0.98 and there was evidence of discriminative ability. However, the reliability and sensitivity of the questionnaire are unknown.

Reliability is essentially the degree to which a measure is able to distinguish real changes that occur in an individual from measurement errors. Measurement errors may occur as a result of questionnaire design, inconsistent or ambiguous questions, subject errors, inconsistent answers or poor recall. Reliability is a combination of the internal consistency of the measurement, the consistency of the response to the various items of the questionnaire and the repeatability, or the extent to which the questionnaire provides the same results on a single subject. "A measurement that is totally unrepeatable clearly has no validity " (2).

For a measure to be reliable, it should be both, repeatable under similar conditions and show change when relevant conditions alter. We have, therefore, calculated the Intraclass correlation (Icc) coefficient, a dimensionless measure of reliability, and investigated the change in LCADL after an intervention in order to examine its responsiveness.

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METHODS

Patients

Reliability

Reliability of the questionnaire was assessed by test–retest over a 4-week period. Patients were assessed as part of a pulmonary rehabilitation programme and were informed that they were to begin the rehabilitation programme after this "run in" period. Twenty-two patients with stable severe COPD, median age (range) 66 (55–79) years were invited to participate in the evaluation of

the reliability of the LCADL questionnaire. There was no change to their normal treatment during this period. The study was approved by the Ethics committee of East London and the City Health Authority with all patients providing written, informed consent.

Sensitivity

The ability of the LCADL to detect change was assessed in 59 patients with stable, severe COPD, median age (range) 65 (38 - 84) years, who had undergone at least 6 weeks of pulmonary rehabilitation. All patients were administered the LCADL pre- and post-rehabilitation. The exercise programmes have previously been described (3,4). It was required that patients had no exacerbations for at least 4 weeks prior to entry to pulmonary rehabilitation. Patients included in the study had a history of severe COPD with forced expiratory volume in 1s (FEV_1) $<50\%$ predicted with $<15\%$ reversibility to inhaled salbutamol (400 mg). All patients had limited exercise tolerance due to dyspnoea.

Assessments

The following baseline assessments were made:

Lung function and exercise tolerance: Resting blood gases were obtained from earlobe samples, while breathing room air at rest for at least 20 min and analysed on a Ciba-Corning 278 Blood Gas Analyser; (Medfield, MA, U.S.A.) (5). Spirometry was performed using a rolling seal spirometer (PK Morgan Ltd., Rainham, U.K.). Exercise capacity was assessed using the shuttle walk test (SWT) which is an incremental, externally paced exercise test (6). Two walking tests were performed with a rest of at least 20 min between each walk. SaO_2 was monitored throughout the walk using a pulse-oximeter (Minolta Pulsox 7, AVL Instruments, Schaffhausen, Switzerland).

Activity of daily living assessment: The London Chest Activity of Daily Living Scale (LCADL) is a 15-item questionnaire designed to measure dyspnoea during routine daily activities in patients with COPD. It consists of four components: Self-care, Domestic, Physical and Leisure. Patients score from 0: "I wouldn't do anyway", to 5: "Someone else does this for me (or helps)", with higher scores representing maximal disability. Development and validation of the questionnaire have been reported previously (1).

Health-status assessment: The Chronic Respiratory Disease Questionnaire (CRDQ) measures health status and was designed for the assessment of change in individuals (7). It comprises four component scores: Dyspnoea, Fatigue, Emotional Function and Mastery measured on a 7-point Likert scale. The dyspnoea component of the questionnaire is individualised to five activities which cause dyspnoea and are assessed in the order of importance and severity to the patient. The higher the score, the better the health status.

Statistical methods

The Average Measure Intra-class correlation coefficient was calculated using SPSS 10. For this analysis, it was required that patients had remained clinically stable over the 4-week period. Therefore, patients who showed a change in exercise tolerance of $>20\%$ at test–retest and/or more than 100 ml in FEV_1 were omitted from reliability analysis. The differences between test and retest for the LCADL were of normal distribution.

In order to determine the sensitivity of the questionnaire, the difference in LCADL scores before and after rehabilitation was analysed using Student's *t*-test. Relationships between change in scores of LCADL and that in other outcome measures was assessed using Spearman's Rank's correlation because many of these differences had skew distributions. For all tests, a probability of $<5\%$ was taken as significant.

RESULTS

Table 1 shows the baseline characteristics of all the patients included in the study.

Reliability of the LCADL

Twenty-two patients were included in this study; however, two patients were unable to attend the reassessment and the data on one patient were excluded as an outlier. This decision was made on the basis that the patient had changed clinically over the 4-week period, the patient showed a reduction in breathlessness as assessed by a change in LCADL from 50 to 20 points with a corresponding increase in FEV_1 of 500 ml (70% improvement) and 20% increase in exercise tolerance. Thus, 19 patients were included in the analysis of reliability. The patients had severe COPD, mean FEV_1 (SD) 0.91

TABLE 1. Baseline characteristics of patients entered into study

n=59	Mean	SD
Age (range) years	66	38–84
FEV_1 (ml)	0.87	0.29
FVC (ml)	2.29	0.73
PaO_2 (kPa)	8.73	1.27
$PaCO_2$ (kPa)	6.16	1.10
SWT (m)	169	102

(0.29) l; PaO_2 mean (SD) 9.16 (1.77) kPa; $PaCO_2$ mean (SD) 6.24 (1.24) kPa.

Table 2 shows the individual scores at test–retest. The Intraclass correlation for the Total LCADL score at test–retest was 0.96, (95% CI 0.90–0.98); for the Self-care component Icc = 0.78 (95% CI 0.70–0.95); for Domestic component Icc = 0.88 (95% CI 0.54–0.91); for the Physical component Icc = 0.89 (95% CI 0.73–0.96); and for the Leisure component Icc = 0.78 (95% CI 0.43 –0.91).

Sensitivity of the LCADL

As can be seen, the patients showed evidence of severe airflow obstruction and mild hypoxaemia. There was a significant improvement in dyspnoea during daily activities after rehabilitation as demonstrated by a reduction in the total score of the LCADL (Table 3). With the exception of the Domestic component, which showed a trend, there were statistically significant reductions in all components of the LCADL scale.

Relationships between changes in outcome measures

There was a weak but statistically significant relationship between the change in LADL score and that in SWT, $\rho = -0.28$, $P = 0.03$ (see Fig. 1(A)).

There was evidence of a moderate relationship between the change in LCADL score and that in CRDQ score, $\rho = -0.37$, $P = 0.004$ (see Fig. 1(B)).

DISCUSSION

This questionnaire was designed as a tool for the evaluation of dyspnoea during daily activities in patients with severe COPD. This study has provided significant evidence that the LCADL is a valid, sensitive and reliable measure of ADL in these patients.

Reliability

Previous work has demonstrated high internal consistency of the LCADL with an α value 0.98 (l). However,

Table 2. Individual LCADL test–retest data

FEV_1 (ml)	LCADL 1	LCADL 2	Self-care 1	Self-care 2	Physical 1	Physical 2	Domestic 1	Domestic 2	Leisure 1	Leisure 2
600	24	24	4	4	5	6	11	10	4	4
1020	55	53	11	12	6	6	30	26	8	9
1600	19	19	8	8	6	6	0	0	5	5
600	38	43	20	8	8	5	0	26	10	4
1100	29	28	7	5	4	5	12	12	6	6
780	45	46	9	9	5	6	25	25	6	6
900	59	53	14	15	6	6	30	25	9	7
600	33	32	8	8	6	6	14	14	5	4
700	35	35	17	18	8	7	2	1	8	9
1000	56	58	13	14	8	8	27	27	8	9
1250	28	29	5	6	5	5	14	14	4	4
900	37	36	8	9	6	6	17	16	6	5
1500	19	15	5	4	2	2	9	6	3	3
500	45	44	8	7	6	6	26	26	5	5
900	44	61	8	18	5	6	23	28	8	9
900	31	29	14	15	8	8	1	0	8	6
700	42	32	12	8	6	6	18	12	6	6
800	64	67	18	19	8	8	30	30	8	10
900	35	38	9	12	6	6	14	15	6	5

Table 3. Change in LCADL scale pre- and post-rehabilitation (n=59)

	Pre-rehabilitation mean (SD)	Post-rehabilitation mean (SD)	Difference (95% CI)
LCADL Total	39.5 (12.7)	33.6 (12.2)	−5.91 (−9.23 to −2.60)
Self-care	9.61 (3.61)	8.10 (3.01)	−1.51 (−2.71 to −0.65)
Domestic	17.6 (10.3)	15.4 (9.43)	−2.20 (−5.75 to 0.08)
Physical	5.66 (1.54)	4.76 (1.30)	−0.90 (−1.44 to −0.49)
Leisure	6.64 (2.32)	5.36 (2.11)	−1.28 (−2.06 to −0.88)

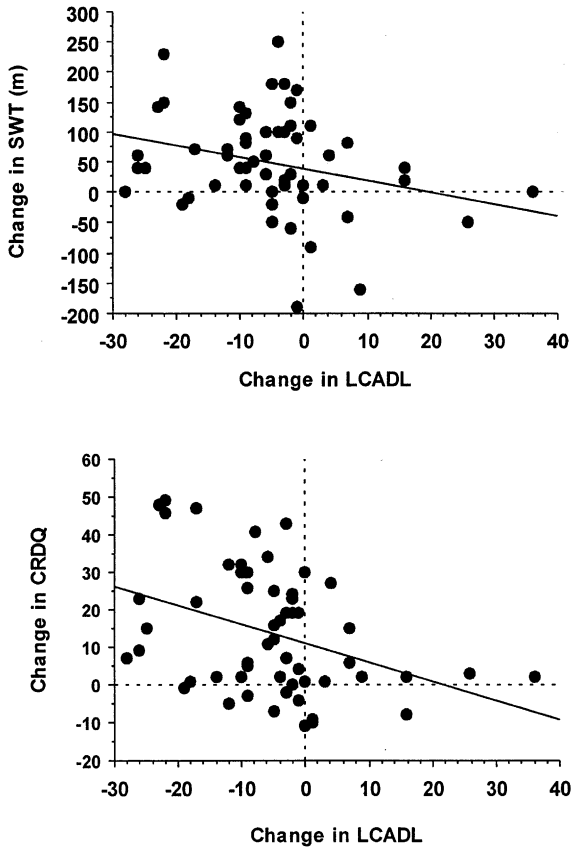

Fig. 1. Scattergram showing the relationship between (A) the change in LCADL and that in shuttle walk test (SWT) after rehabilitation and (B) the change in LCADL and that in Chronic Respiratory Disease questionnaire after rehabilitation.

this merely provides information concerning the relationship between items in the questionnaire and is not evidence of reliability over repeated administrations.

For this information, test–retest analysis was performed on 19 patients and demonstrated high Intraclass correlation coefficients compatible with good reliability (8). The sub-scales of the questionnaire did not demonstrate such good reliability, in particular, Leisure showed the lowest Icc. This being a reflection of the fact that the Leisure component of the questionnaire attempts to address wider issues of disability such as the ability to go out socially. In the developmental stage of the questionnaire, principle components analysis was performed to identify the relevant domains. "Going out socially" loaded high on principle components and identified a separate factor, future work may include modifications of the Leisure component, particularly with reference to this item.

This study has provided strong evidence for instrumental reliability, although it has not been possible to assess inter-rater reliability, since all assessments were made by the same therapist. The LCADL appears to be a responsive and reliable tool for the assessment of dyspnoea during daily activities, future applications warrant further investigation.

Sensitivity

With the exception of the Domestic component, all domains of the LCADL showed a statistically significant reduction in dyspnoea during daily activities after pulmonary rehabilitation. The Domestic component of the LCADL is concerned with household tasks such as changing sheets and making beds, in this study a number of patients were highly disabled: 20/59 were housebound and on long-term oxygen therapy. The maximum score on the disability component of the questionnaire is 30 points, a number of patients prior to rehabilitation received this score indicating that others performed domestic tasks for them. Where social support arrangements are not changed, the scores will remain high after intervention. However, where individual patients choose to return to household tasks, it was represented in a reduction in scores. The LCADL is designed for patients with severe COPD and as such it reflects the extent of limitation in activities of daily living in these patients.

The LCADL demonstrates the ability to detect change in breathlessness after pulmonary rehabilitation programmes, even in patients with very severe limitations; however, it remains untested in other interventions.

There was a moderate association between the change in LCADL score and that in exercise tolerance. This relationship indicates that patients with the greatest improvement in walking showed a corresponding reduction in dyspnoea during daily activities. Causality of this relationship is not known, although it may be surmised that the improvements in ADL were as a result of improvements in exercise tolerance. Similarly, a relationship was evident between the change in health status and that in LCADL after training. Although these associations are moderate, in conjunction with previously published work (1), they provide further support of the validity of the questionnaire. Surprisingly, these relationships have not been identified before (9–11). This may relate to the larger numbers investigated in this study and the fact that these patients with severe COPD were particularly limited in daily activities.

APPENDIX

The London Chest Activity of Daily Living Scale questionnaire is presented in Table AI.

Table A1 THE LONDON CHEST ACTIVITY OF DAILY LIVING SCALE

NAME. . .. .
DATE OF BIRTH. . .. .
DO YOU LIVE ALONE Yes ☐ No ☐
Please tell us how breathless you have been during the last few days whilst doing the following activities.

SELF-CARE						
Drying	0	1	2	3	4	5
Dressing upper body	0	1	2	3	4	5
Putting shoes/socks on	0	1	2	3	4	5
Washing hair	0	1	2	3	4	5
DOMESTIC						
Make beds	0	1	2	3	4	5
Change sheet	0	1	2	3	4	5
Wash windows/curtains	0	1	2	3	4	5
Clean/dusting	0	1	2	3	4	5
Wash up	0	1	2	3	4	5
Vacuuming/sweeping	0	1	2	3	4	5
PHYSICAL						
Walking up stairs	0	1	2	3	4	5
Bending	0	1	2	3	4	5
LEISURE						
Walking in home	0	1	2	3	4	5
Going out socially	0	1	2	3	4	5
Talking	0	1	2	3	4	5

How much does your breathing affect you in your normal activities of daily living?
A lot ☐ A Little ☐ Not at all ☐

The London Chest Activity of Daily Living Scale. (Score sheet)

Please read carefully and circle the relevant number next to each activity.
This questionnaire Is designed to find out whether there are activities that you can no longer do because of your breathlessness, and how breathless the things that you still do, make you. All answers are confidential.
If you do not do an activity because it is not relevant, or you have never done it, please answer;
0 Wouldn't do anyway
If an activity is easy for you, please answer;
1 Do not get breathless
If the activity makes you a bit breathless, please answer;
2 I get moderately breathless
If the activity makes you very breathless, please answer;
3 I get very breathless
If you have stopped doing this **because of your breathlessness** and ***have no one else to do It for you***, please answer;
4 I can't do this anymore.
If someone else does this for you, or helps you, BECAUSE you are too breathless eg. The home help does your shopping, please answer;
5 I need someone else to do this.

REFERENCES

1. Garrod R, Bestall J, Wedzicha JA, *et al.* Development and validation of a standardised measure of activity of daily living in patients with COPD: the London Chest Activity of Daily Living Scale (LCADL). *Respir Med* 2000; **94:** 589–596.
2. Chinn S. Repeatability and method comparison. *Thorax* 1991; **46:** 454–456.
3. Garrod R, Paul EA, Wedzicha JA. Supplemental oxygen during pulmonary rehabilitation in patients with COPD and exercise hypoxaemia. *Thorax* 2000; **55:** 539–543.
4. Garrod R, Mikelsons C, Paul EA, *et al*. Randomised controlled trial of domiciliary non-invasive positive pressure ventilation in

conjunction with physical training in patients with severe COPD. *Am J Respir Crit Care Med*, in press.
5. Pitkin AD, Roberts CM, Wedzicha JA. Arterialised earlobe blood gas analysis: an underused technique. *Thorax* 1994; **49:** 364–366.
6. Singh SJ, Morgan DL, Scott S, *et al*. Development of a shuttle walking test of disability in patients with chronic airways obstruction. *Thorax* 1992; **47:** 1019–1024.
7. Guyatt GH, Townsend M, Berman L, *et al*. A measure of quality of life for clinical trials in chronic lung disease. *Thorax* 1987; **42:** 773–778.
8. Landis JR, Koch GG. The measurement of observer agreement for categorical data. *Biometrics* 1997; **33:** 159–174.
9. Goldstein RS, Gort EH, Stubbing D, *et al*. Randomised controlled trial of respiratory rehabilitation. *Lancet* 1994; **344:** 1394–1397.
10. Wijkstra PJ, Van Altena R, Kraan J, *et al*. Quality of life in patients with COPD improves after rehabilitation at home. *Eur Respir J* 1994; **7:** 269–273.
11. Wedzicha JA, Bestall JC, Garrod R, *et al.* Randomised controlled trial of pulmonary rehabilitation in severe chronic obstructive pulmonary disease patients, stratified with the MRC scale. *Eur Respir J* 1998; **12:** 363–369.