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Development and validation of a standardized measure of activity of daily living in patients with severe COPD: the London Chest Activity of Daily Living scale (LCADL)

R. GARROD*, J. C. BESTALL†, E. A. PAUL*, J. A. WEDZICHA* AND P. W. JONES†

Academic Respiratory Medicine, St Bartholomew's and Royal London School of Medicine and Dentistry, London Chest Hospital, London and †Division of Physiological Medicine, St. George's Hospital Medical School, London, U.K.

Activities of daily living (ADL) may be severely restricted in patients with COPD and assessment requires evaluation of the impact of disability and handicap on daily life. This study is concerned with the development and validation of a standardized 15-item questionnaire to assess routine ADL.

Sixty (33 male, 27 female) patients with severe COPD, mean (SD) FEV_1 0·91 (0·43)1, median (range) age 70 (50–82) years, completed a 59-item ADL list previously generated by open-ended interview and by literature review. Patients also performed the Shuttle Walk Test (SWT), and completed the St George's Respiratory Questionnaire (SGRQ), the Nottingham Extended Activity of Daily Living Questionnaire (EADL) and the Hospital Anxiety and Depression score (HAD).

Criteria for item reduction in the development of The London Chest ADL scale (LCADL) consisted of removal of items where the majority of respondents showed no limitation in the activity ($n=19$), where there was no association with perception of global health ($n=9$), where an association with age or gender was detected ($n=4$), or where items showed poor reliability on test re-test ($n=9$). Fifteen items were identified as core activities of daily living.

The LCADL was then compared with other measures of health status in these patients. There were good correlations with the SGRQ activity and impact components ($\rho=0{\cdot}70$; $P<0{\cdot}0001$) and ($\rho=0{\cdot}58$; $P<0{\cdot}0001$), respectively, and EADL ($\rho=0{\cdot}45$; $P<0{\cdot}001$), and a moderate correlation with HAD anxiety ($\rho=0{\cdot}28$; $P<0{\cdot}03$). There was a significant relationship between the SWT and LCADL ($\rho=0{\cdot}58$; $P<0{\cdot}0001$), suggesting a relationship between impaired exercise performance and lower ADL scores. There was evidence of high internal consistency of the questionnaire with Chronbach's α of 0·98.

These findings suggest that the LCADL scale is a valid tool for the assessment of ADL in patients with severe COPD.

Key words: COPD; London Chest Activity of Daily Living scale.

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Introduction

Chronic obstructive pulmonary disease (COPD) is characterized by progressive airflow limitation leading to disability and handicap, especially with increasing age (1). In a survey of patients with severe COPD, 78% were breathless when walking around at home and had difficulty performing routine activities of daily living (ADL) (2). An approach being increasingly taken in the assessments of COPD is the measure of the health-related quality of life (HRQOL). HRQOL extends to include the social role and perception of the patient of the impact of the disease on his or her life (3). However, there is little assessment of ADL and few tools that will provide a simple measure of limitation in functional disability. Previous assessments of disability have tended to focus on activity limitation in patients with mild or moderate disease and are therefore inappropriate for use in patients with severe COPD (4). The Pulmonary Functional Status and Dyspnoea Questionnaire (PFSDQ) is a 164-item self-administered questionnaire with

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Correspondence should be addressed to: Dr. J. A. Wedzicha, Academic Respiratory Medicine, Dominion House, St Bartholomew's Hospital, West Smithfield, London ECIA 7BE, U.K. Fax: 0207 601 8616. E-mail: j.a.wedzicha@mds.qmw.ac.uk.

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components related to intensity and change on 79 ADL items (5). However, the PFSDQ contains many items that are no longer feasible for patients with severe COPD and is a time-consuming assessment in large population studies.

The Nottingham Extended Activities of Daily Living scale (EADL) (6) was originally designed for assessment of ADL in stroke patients. However, in COPD patients it has been shown to be sensitive in distinguishing between varying levels of disability (7) and correlates well with severity of disease (8). Although useful in baseline assessment, the EADL was unable to detect changes in performance in ADL after a pulmonary rehabilitation programme (9).

An assessment tool is required that is a standardized, validated measure of limitation in ADL in patients with severe COPD. It should be quick to administer and comprehensible to patients.

The purpose of this study is the development of a simple, standardized questionnaire concerned only with the assessment of dyspnoea activities of daily living in patients with COPD.

Methods

PATIENTS

Patients for this study were recruited from those participating in a larger study of pulmonary rehabilitation with a diagnosis of stable COPD. Ethics approval was obtained from the East London and The City Ethics Committee and all patients entering the study gave informed consent and agreed to complete a range of questionnaires and other measures. Patients were instructed that all data would be confidential and for research purposes only.

A list of items were generated by means of:

(1) open-ended interview with 31 patients with moderate to severe COPD, means FEV_1 58% predicted (M = 18; F = 13), who attended an outpatient pulmonary rehabilitation programme;
(2) open-ended interview with six housebound patients with severe COPD, mean FEV_1 38% predicted (M = 4; F = 2);
(3) literature review of previous tools for assessment of health and functional status.

A pilot questionnaire was administered to 22 patients to test for user acceptability. The list contained 59 items concerning ADL with patient responses of 'I wouldn't do this anyway/I do not get breathless/I get moderately breathless/I get very breathless/I have given this up/I need someone else to do this (or help)'.

The list was administered to a further 60 COPD patients in three settings: in clinic at the London Chest Hospital, at education sessions at a pulmonary rehabilitation course and at the patient's home in the case of patients housebound by their dyspnoea. Within a time period of no less than 2 weeks and no more than 1 month the list was re-submitted in 30 of the original 60 patients. The list was also administered to 21 normal subjects of a similar age.

LUNG FUNCTION

Spirometry measurements of FEV_1 and forced vital capacity (FVC) before and after administration of a bronchodilator were made using a P K Morgan rolling seal spirometer. Blood gases (on room air) were obtained from earlobes (10) in all patients.

EXERCISE CAPACITY AND BREATHLESSNESS

Exercise capacity was assessed using the Shuttle Walk Test (SWT) (11), which is a maximal externally paced incremental exercise test. Patients are asked to walk between two cones placed 10 m apart and the speed of the walk is increased by a small increment after each minute; the instructions are standardized from a tape recording. All patients were asked to perform the test twice with a rest of at least 20 min between each walk. Patient sensation of breathlessness was measured using the Borg Dyspnoea score (12) before and immediately after each walk.

ST GEORGE'S RESPIRATORY QUESTIONNAIRE (SGRQ)

The SGRQ is a valid reliable measure of health status in patients with COPD. It has been shown to be sensitive to changes in health status over time (13), particularly within populations. It consists of 50 items with 76 weighted responses and three component scores — symptoms, activity and psychosocial impact. A total score is calculated from all three components with a high score of 100 representing maximal disability.

THE NOTTINGHAM EXTENDED ACTIVITIES OF DAILY LIVING SCALE (EADL)

The EADL is a short self-administered questionnaire consisting of 22 items divided into four sections: mobility, kitchen, domestic, leisure (6).

MEDICAL RESEARCH COUNCIL DYSPNOEA SCORE

This short self-administered questionnaire assesses dyspnoea on walking in patients with COPD and consists of five grades increasing in severity of disease (14) from 'I only get breathless with strenuous exercise' to 'I am too breathless to leave the house'.

HOSPITAL ANXIETY AND DEPRESSION SCALE (HAD)

The HAD scale assesses anxiety and depression and consists of 14 items and is scored from 0–21, with a score of greater than 10 in either anxiety or depression representing symptoms of clinical significance (15).

Criteria used for item reduction

Items were excluded from the questionnaire on the grounds of poor discriminative ability, i.e. those where the majority of respondents did not consider the activity to be a problem in their daily lives.

Items were required to be independent of demographic variables so were excluded where a clear association with age or gender was seen ($P<0{\cdot}05$).

The questionnaire was designed to reflect activities limited by breathlessness as a result of lung impairment. Therefore, items where no relationship with global health was seen were excluded ($P>0{\cdot}05$).

Finally, all items that showed poor repeatability on repeat testing were excluded.

SCORE SYSTEM

It was assumed that items were of similar weighting (17) and the questionnaire was scored from 0, 'I wouldn't do anyway?' to 5 'someone else does this for me (or helps)', representing maximal disability. A value of 0 for 'I wouldn't do anyway' was used to indicate activities that do not represent handicap for the individual.

STATISTICAL ANALYSIS

Kendal Rank correlations and Tau were used to measure the degree of associations between variables. Significance was taken at the 5% level and $\geq 0{\cdot}4$ for Tau, corrected for ties, was taken as representing 'moderate' agreement reliability (18).

Principle components analysis was performed on items that survived the exclusion process to group related items into domains. Chronbach's α (22,23) was used to test internal consistency of the questionnaire.

Associations between the found item set: the London Chest Activity of Daily Living scale (LCADL) and other measures of functional and health status were tested using Spearman's Rho correlations.

Results

Table 1 shows the baseline characteristics of the patients entered into the study. Sixty (33M, 27F) patients with severe COPD, means (SD) FEV_1 0·91 (0·43) 1, % predicted FEV_1 42 (9·20) %, median (range) age 70 (50–82) years

TABLE 1. Baseline parameters ($n=60$)

	Mean ± SD
Age (median)	70 (50–82)
FEV_1(l)	0·91 ± 0·43
FEV_1% predicted	42
FVC (l)	2·31 ± 0·89
PaO_2(kPa)	8·60 ± 1·20
$PaCO_2$(kPa)	5·95 ± 0·77
SGRQ	55·6 ± 14·9
EADL	15·2 ± 4·53
HAD	11·2 ± 6·37
SWT (m)	184 ± 124

completed a 59-item list. The following results provide details of development and validation of a new 15-item ADL questionnaire.

ITEM REDUCTION

(1) Not appropriate

Items that 50% of patients reported as 'wouldn't do anyway' or 'do not get breathless' were excluded ($n=19$).

Non-discriminative items:

Open curtains (72%)
walk in garden (70%)
clean teeth (82%)
shouting (64%)
fishing (83%)
mow lawn (72%)
wash car (72%)
sexual intercourse (52%)
swimming (52%)
singing (70%)
blow balloons (80%)
eat (75%)
go to toilet (60%)
watching sports outside eg football (73%)
make hot drink (73%)
weed lawn (72%)
employment (68%)
cycling (60%)
playing sports e.g. bowls (55%)

(2) Age related

Items associated with age were excluded; the only additional item being cooking (Tau = 0·22; $P=0{\cdot}04$).

(3) Gender related

Items associated with gender were excluded, $n = 3$: moving furniture (0·31; $P = 0·03$), shaving (Tau = 0·86; $P < 0·001$) and brushing hair (Tau = 0·34; $P = 0·04$).

(4) Unrelated to global health

Items that showed no association with general health, $n = 9$: going on holiday (Tau = 0·10; $P = 0·20$), playing with children (Tau = 0·07; $P = 0·20$), having a shower (Tau = 0·07; $P = 0·40$), lying flat (Tau = 0·05; $P = 0·50$), reaching (Tau = 0·12; $P = 0·20$), hurrying (Tau = 0·13; $P = 0·10$), running (Tau = 0·16; $P = 0·07$), dancing (Tau = 0·14; $P = 0·14$) and using public transport (Tau = 0·08; $P = 0·30$).

(5) Test re-test

Items that had shown poor test re-test reliability were removed, $n = 9$: take drink from room to room (Tau = 0·35; $P = 0·81$), decorate (Tau = 0·22; $P = 0·25$), wash walls (Tau = 0·20; $P = 0·57$), going from inside to outside (Tau = 0·24; $P = 0·20$), walking up hills (Tau = 0·10; $P = 0·57$), crossing roads (Tau = 0·30; $P = 0·06$), getting in and out of car (Tau = 0·32; $P = 0·30$).

(6) Principal components analysis

Eighteen items remained; the principle components analysis identified four components: domestic, self-care, physical and leisure. Some items were very closely related and were effectively synonyms so these were collapsed into one question. The components of the final questionnaire were: Domestic, $n = 6$; self-care, $n = 4$; physical, $n = 2$; leisure, $n = 3$: total of 15 items (Appendix).

Factor 1 loaded items $> 0·7$

Change sheets showed a high loading under factor 1 (0·91); as did make bed (0·88), dust (0·86), clean floor (0·87) and sweep (0·91). Wash curtains and wash windows showed the same loading under factor 1 (0·78) and (0·78). Factor 1 was defined as Domestic activities.

Factor 2 loaded items $> 0·7$

Dress body showed a strong association under factor 2 (0·87), drying at (0·80), putting shoes/socks on (0·89) and wash hair (0·72). Factor 2 was defined as self-care activities.

Factor 3 loaded items $> 0·7$

Bending showed a stronger association under factor 3 (0·74), with walking up stairs (0·91). Factor 3 was defined as physical activities.

Factor 4 loaded items $> 0·7$

Factor 4 gave of loading of $> 0·7$ on wash up only (0·71). It was felt that this item was better represented under the domestic component rather than really addressing a new component in the questionnaire.

Factors 5 and 6 loaded items $> 0·7$

Factor 5 gave a high loading on socialize only (0·90) and factor 6 was loaded for talking (0·64) and for walking in home (0·79). These items were defined as leisure activities.

VALIDATION OF THE LCADL

Construct validity

Twenty-one subjects with no history of respiratory disease, median age 69 years (range 62–87 years), completed the LCADL. The total score of the LCADL was over twice as high in the patients, mean (SD) 37·0 (12·7) compared with normal subjects, mean (SD) 17·5 (3·51), demonstrating significantly greater disability in the COPD population compared with healthly older people.

Concurrent validity

The LCADL correlated with other health status measures using the SGRQ total score ($\rho = 0·42$; $P = 0·001$), the SGRQ activity score ($\rho = 0·70$; $P < 0·0001$) and impact component ($\rho = 0·48$; $P = 0·004$) but not with SGRQ symptoms ($\rho = 0·24$; $P = 0·07$). The regression between the LCADL and the other scores was linear. In the case of the regression between SGRQ activity and LCADL, a plateau appeared to be present, although a second order polynomial component to the regression was not significant [Fig. 1(a)]. There were significant correlations between the LCADL and EADL score ($\rho = -046$; $P = 0·0008$), HAD anxiety score ($\rho = 0·28$; $P = 0·03$) and exercise performance ($\rho = -0·58$; $P < 0·0001$). There was a correlation with FVC ($\rho = -0·37$; $P = 0·007$) but not with FEV_1 ($\rho = -0·18$; $P = 0·18$) (Table 2). The LCADL scores were significantly different across the three grades of dyspnoea assessed using the MRC score (ANOVA; $P < 0·0001$), demonstrating the discriminative ability of the questionnaire (Fig. 2).

Internal consistency

The questionnaire showed high internal consistency with Chronbach's α value of 0·98.

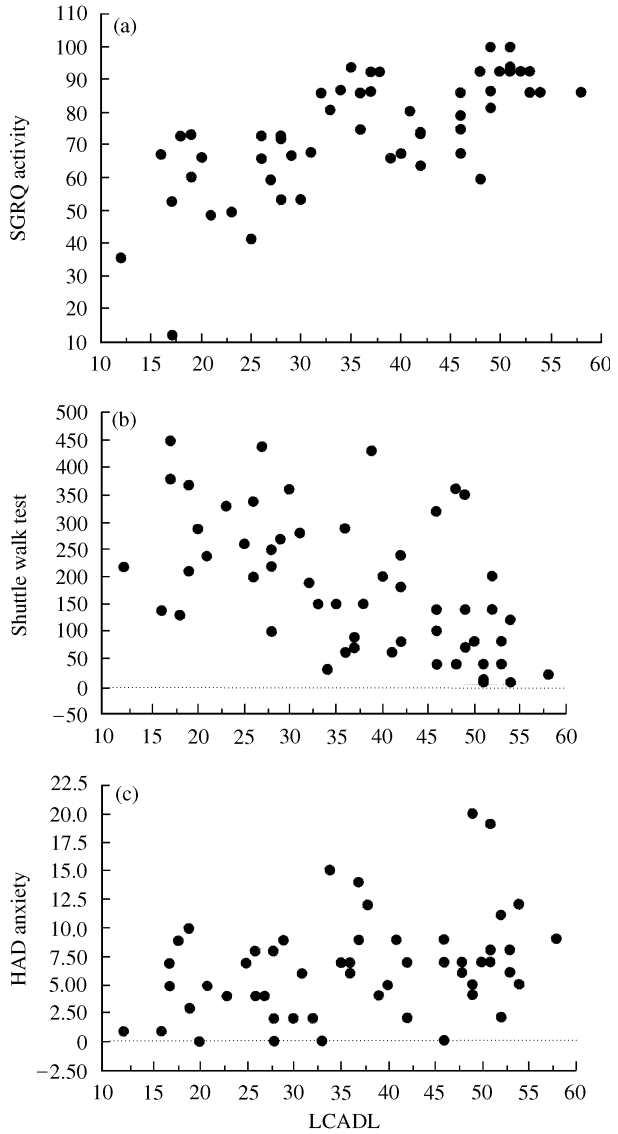

FIG 1. Scattergrams showing relationship between (a) St. George's Respiratory Questionnaire (SGRQ), activity component and the London Chest Activity of Daily Living Questionnaire (LCADL); (b) Shuttle Walk Test and LCADL; (c) Hospital Anxiety and Depression scale and LCADL.

Discussion

This study has shown support for the hypothesis that dyspnoea during routine activities leads to significant disability and handicap in severe COPD. Unlike the ADL questionnaire devised by Kennedy *et al.* (4) the LCADL scale did not include items such as sports, running or heavy work such as shovelling, chopping wood or moving furniture. The patients investigated in this study had significantly poorer airflow obstruction than patients in the study by Kennedy *et al.* (predicted FEV_1, 80%). The nature of chronic disease implies a degree of 'normalization': often what the patient perceives as normal or due to age may be interpreted by the clinician as the result of the disease process. This may lead to inaccurate assessment of disability, particularly in the case of older subjects who tend to view participation in activities as less appropriate with increasing age (19). The intention of this study was to design a questionnaire that would be of value in assessment of ADL in patients with severe COPD, since no other instrument was available.

TABLE 2. Correlation between the London Chest Activity of Daily Living scale (LCADL) and other measures of health status in COPD

	Rho-value	*P*-value
FVC (l)	−0·38	0·007
FEV_1 (l)	−0·18	0·18
SGRQ (activity)	0·70	<0·000
SGRQ (impact)	0·48	0·004
SGRQ (symptoms)	0·24	0·07
SGRQ (total)	0·31	0·02
HAD (anxiety)	0·28	0·03
HAD (depression)	0·25	0·06
Nottingham Extended ADL	−0·46	0·0008
Shuttle Walk Test	−0·58	< 0·000

The statistical methods applied to exclusion criteria on the grounds of age or gender bias were arbitrarily defined at a significance level of $P<0{\cdot}05$ (16). At this level of significance six items were found significant to age or gender. At a tighter significance level of $P<0{\cdot}01$ only two items would have been significant and were therefore excluded: shaving and watching football. This opens up the possibility of a type 1 statistical error, which may have

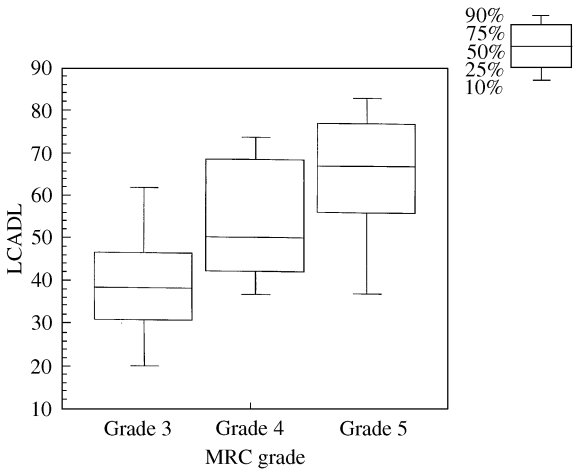

FIG 2. Box plot showing relationship between Medical Research Council Dyspnoea score (MRC) and scores of the London Chest Activity of Daily Living scale (LCADL).

been avoided had a different significance level been chosen. However, this was chosen in order to ensure that the questionnaire was highly unlikely to include items of a demographic bias, although a disadvantage is the possible exclusion of some items that may have been relevant daily activities, such as brushing hair ($P<0{\cdot}03$). In contrast to this, items were included in the questionnaire that showed a significance with the global health assessment at $P<0{\cdot}05$. This implies a weak inclusion criteria which was chosen in order to reflect the rather generalistic and relatively insensitive nature of the health assessment question, i.e. how much does your health affect you in your daily life? A lot/a little/not at all?'

Thus, exclusion criteria were designed to be tight and remove all possible items associated with age or gender whilst inclusion criteria were required to be more generous so as not to exclude too many items of relevance. Test and re-test of each item was provided at no less than 2 weeks and no more than 2 months, and although the majority of patients were re-tested within 1 month, reliability may have been affected for some items due to deterioration in the disease. Many factors will affect item reliability, such as motivation, mood, environmental conditions and frequency of questioned activity. For instance patients who rarely climb stairs may answer differently on retesting if they have recently been required to do so.

Due to practical issues it was not possible to administer the questionnaire to patients in a standardized environment; it is possible that patients answering at home on an individual basis gave different answers than had they been questioned in the hospital. They may therefore have underestimated the extent of their disease due to a more relaxed atmosphere.

To test the validity of the new questionnaire, we hypothesized that the total score of the LCADL would reflect other measures of patient's daily activity or exercise tolerance. There was a good relationship between the SGRQ (activity, impacts and total score) and the LCADL, however there was no relationship between SGRQ symptoms. This is to be expected since the LCADL is predominantly concerned with dyspnoea whereas the SGRQ investigates other symptoms such as cough, sputum production and wheeze. Depression and anxiety are elevated in COPD (20) and in this study a correlation was found between the LCADL and the HAD anxiety score. Patients with the highest levels of impaired activity had the highest levels of anxiety, although the direction of causality cannot be elucidated from this study. The MRC dyspnoea score grades 3–5 showed a strong correlation with the total LCADL score, suggesting that the LCADL can discriminate between different levels of dyspnoea-induced disability. There were no statistical correlations between the physiological measure of FEV_1 and the LCADL score, which is in accordance with other studies (12,21). There was evidence of a high degree of internal consistency of the questionnaire which justifies the use of a scaled measure (22).

This study has shown that patients with severe COPD are dependent upon carers and relatives for assistance with routine activities. Forty two percent of patients needed help with sweeping cleaning floor and 53% needed help to wash windows curtains. Disability was particularly evident when looking at items of self-care such as dressing (68% of patients moderately or very breathless), drying after a bath (60%), washing hair (55%) and putting shoes or socks on (68%). The use of 0 representing 'I wouldn't do any way' was chosen to provide more accurate data regarding the nature of activities patients actually perform at home. Similarly, the separation between 'can't do' and 'need help' enables us to identify patient needs and report on handicap as well as disability. Handicap rather than disability is suggested with scores of '5' i.e. where patients require help but do not receive it.

All the items included in the LCADL (with the possible exception of socializing) are concerned with activities performed in the home. They are activities that patients are required to do on a daily basis and represent basic functional requirements. This study has shown that the LCADL is a valid measurement of dyspnoea during daily activities, which shows a high degree of internal consistency. Further research is required to establish the reproducibility and sensitivity of the LCADL and its role in the evaluation of therapeutic interventions.

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Appendix

LCADL questionnaire and response sheet

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							
1)	Drying	0	1	2	3	4	5
2)	Dressing upper body	0	1	2	3	4	5
3)	Putting shoes/socks on	0	1	2	3	4	5
4)	Washing hair	0	1	2	3	4	5
DOMESTIC							
5)	Make beds	0	1	2	3	4	5
6)	Change sheet	0	1	2	3	4	5
7)	Wash windows/curtains	0	1	2	3	4	5
8)	Clean/dusting	0	1	2	3	4	5
9)	Wash up	0	1	2	3	4	5
10)	Vacuuming/sweeping	0	1	2	3	4	5
PHYSICAL							
11)	Walking up stairs	0	1	2	3	4	5
12)	Bending	0	1	2	3	4	5

LEISURE

13) Walking in home	0	1	2	3	4	5
14) Going out socially	0	1	2	3	4	5
15) 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 ☐

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0) Wouldn't do anyway
1) I do not get breathless
2) I get moderately breathless
3) I get very breathless
4) I can't do this anymore
5) Someone else does it for me