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Quality of life in elderly patients with COPD: measurement and predictive factors

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Chronic obstructive pulmonary disease (COPD) is a major cause of morbidity in old age. It leads to reduced quality of life (QoL), but the factors that contribute to this are less understood. There is no consensus on measurement of QoL in elderly COPD patients. We assessed (a) factors predicting QoL in elderly COPD out-patients and (b) specificity (SP), sensitivity (SEN), positive and negative predictive values (PPV and NPV) and repeatability of two disease-specific QoL instruments, the Chronic Respiratory Disease Questionnaire (CRQ) and the Breathing Problems Questionnaire (BPQ) in elderly people. All subjects also completed an ADL measure [Nottingham Extended ADL (NEADL)] and a measure of psychological well-being [Brief Assessment of Depression Cards [BASDEC)] as well as a 6-min walk test. Subjects comprised 96 (56 men) elderly out-patients with irreversible COPD aged 70–93 years (mean 78) who were clinically stable for ≥ 6 weeks. Controls were 55 (23 men) aged 71–90 years (mean 78) with normal lung function. All were cognitively intact. Mean FEV_1/FVC in COPD subjects was 45·5 (SE=1·4)% and for controls was 71·4 (SE=1·3)%. Repeatability was good for both BPQ and CRQ with no significant difference. There were no significant differences in specificity and positive predictive values between the two questionnaires but BPQ performed better than CRQ with regard to sensitivity ($P=0·02$) and NPV ($P<0·001$). A multiple regression analysis was used to identify variables that best predicted BPQ and CRQ in COPD subjects. For BPQ predictive values were NEADL ($P<0·0001$); BASDEC ($P<0·0001$); age ($P<0·0001$); 6-min walk distance ($P=0·001$); body mass index ($P<0·05$); resting oxygen saturation ($P<0·05$); and household composition (living alone or with relatives, $P=0·05$). In contrast only the following predicted CRQ: NEADL, BASDEC and resting oxygen saturation. Sixteen per cent of the variance in BPQ was accounted for by NEADL score, 9% by BASDEC, 4% by age and 3% by 6-min walk distance (total $r^2=0·70$). It was concluded that: (1) BPQ provides more valid assessment than CRQ of QoL in elderly COPD subjects; (2) severity of disease in terms of its impact on QoL is not predicted by lung function tests; (3) the most important determinants of QoL are ADL score and emotional status.

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Introduction

Chronic obstructive pulmonary disease (COPD) is a major cause of morbidity in old age. Elderly community dwellers themselves rate respiratory disease as a second most common cause of disability (1). COPD is a primary cause of respiratory death in all age groups in the U.K. and four-fifths of all deaths due to COPD occur in individuals aged 70 years or older (2).

Many studies have investigated the relationship between physiological measurements, functional capacity and quality of life (QoL) in middle-aged COPD sufferers (3–7), but little attention has been given to QoL in elderly patients with COPD. Previous studies in younger patients (mean age 60–65 years) have shown that physiological variables such as lung function parameters, oxygenation and even exercise tolerance correlate imperfectly with QoL (8). It is recognised that patients tend not to volunteer problems on standard clinical interview, and that structured 'probes' are needed to elucidate them (9). Others have further suggested that in COPD, impaired QoL is associated with depression (5), cognitive dysfunction (6) and severe hypoxaemia (10), and have shown relationships between QoL and age, social class status, physiological well-being and social networks (6,7).

Quality of life is very subjective to an individual and factors that contribute to this complex concept are poorly understood. However it has at least four aspects: activities of daily living (ADLs), social functioning (relationships, work, home management); psychological functioning: and ability to participate in activities with enjoyment (recreation, hobbies, etc.) (5). Whilst a disease-specific quality of life questionnaire may provide only limited assessment of the impact of the disease to the QoL of an

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individual patient, it can give a reasonable estimate of QoL in a sub-population (11). It is conceivable however that elderly persons may have different desires and expectations of normality in terms of QoL, particularly in the area of ADLs and social functioning. Indeed some authors have reported that increasing age is protective of QoL in COPD (5,9), although others have found no such relationship (6,12), and in a large epidemiological survey of middle-aged and elderly persons we have reported a significant effect of respiratory symptoms on QoL (13). A very recent study has further highlighted the importance of QoL in COPD in old age by revealing a relationship between QoL and hospital re-admission rates (14). However there is no disease-specific QoL questionnaire designed for elderly COPD subjects.

The aims of the present study were to investigate the factors that predict QoL in elderly patients with COPD and in addition to investigate the reproducibility, sensitivity, specificity and positive and negative predictive values of two disease-specific quality of life questionnaires previously validated in subjects with a mean age of 65 years (9,15).

Methods

SUBJECT SELECTION

Ninety-six out-patients (56 men) with irreversible COPD (chronic asthma and smoking related chronic airways obstruction) were recruited. Their age as 70–93 years (mean 78). COPD was defined as best one second forced expiratory volume (FEV_1) less than 70% predicted, and rising by less than 15% after 5 mg nebulised salbutamol. Subjects were included if they were clinically stable with no change in medication for 1 month and no hospital admission in the previous 6 weeks.

Subjects were excluded for the following reasons: acute or chronic confusion [Abbreviated Mental Test Score less than 7/10 (16)]; psychotic disease; limitation of exercise tolerance by factors other than respiratory impairment (e.g. neuromuscular disease, arthritic problems, symptomatic peripheral vascular disease, visual impairment). However subjects with other conditions were not excluded if they considered their respiratory problems to be the major factor limiting their mobility.

Controls comprised 55 community dwellers (23 men), aged 71–90 years (mean 78) with normal lung function. Controls were recruited from subjects participating in a recent epidemiological survey in our department (17). Subjects and controls gave written informed consent. The study was approved by the medical ethics committee of Central Manchester Healthcare Trust and Bury Health Authority.

STUDY DESIGN

The design was single-blinded. History, examination and physiological measurements were performed by a consultant geriatrician and QoL instruments were administered by a research physiotherapist. Investigators were blinded to each other's results during the study. Subjects and controls were seen as out-patients at the geriatrics day hospital. FEV_1 and forced vital capacity (FVC) were measured using the Compact C Spirometer (Vitalograph, Buckingham, U.K.). Three reproducible readings ($\pm 5\%$ FEV_1) were taken at 1 min intervals and the best result recorded. Subjects and controls completed the Breathing Problems Questionnaire (15) and the Chronic Respiratory Disease Questionnaire (9). In addition, COPD subjects and controls completed a measure of extended activities of daily living, the Nottingham Extended ADL scale (18), and a measure of exercise tolerance, the 6-min walk test (19). The researcher administered a psychological well-being questionnaire, the Brief Assessment Schedule Depression Cards (BASDEC) (20) to subjects and controls. Demographic data was extracted from subjects and controls using a structured oral questionnaire.

In order to assess BPQ and CRQ repeatability in COPD in this age group, another blinded investigator repeated both questionnaires in a random sample of 20 COPD subjects on a separate day.

Analyses were performed using the EcStatic Programme (SomeWare in Vermont, U.S.A.). CRQ and BPQ scores were logged to achieve normal distribution. Comparison between geometric means was by grouped *t*-test. Analysis of difference in sensitivity, specificity and predictive values was by Chi-squared test. Inter-investigator variability was assessed by the 95% range for agreement (21). Two separate multiple regression analyses were performed to identify variables predictive of QoL as assessed by both BPQ and CRQ as the dependent variable. Significance was defined at the 5% level.

Results

Mean FEV_1/FVC (SE) for COPD subjects was 44·5 (1·4)% and for controls was 71·4 (1·3)%. Although no subjects had been admitted to hospital in the previous 6 weeks, 65 of the COPD subjects had been admitted for respiratory problems within the previous 12 months. The mean number of admissions for all 96 COPD subjects over that period was 2·3 (SE=0·2). Fifty nine COPD subjects were current smokers, 25 ex-smokers, and 12 had never smoked. The mean number of pack years smoked was 28·6 (range 0–125). Thirty-two of the COPD subjects received home care assistance, 13 attended day centres, 7 received regular meals-on-wheels. Thirty-three of the COPD subjects lived alone. None of the controls were in receipt of any form of Social Service support. None had a current or previous diagnosis of respiratory problems, none was on any respiratory medication and none had been admitted to hospital in the previous 12 months. Twenty-four lived alone.

Table 1 shows geometric mean (range) for CRQ and BPQ for both groups. Total theoretical range of the scores is 0–140 for CRQ and 0–105 for BPQ. 95% confidence limits for repeatability between investigators were: BPQ= $-21·7$ to $+16·0$; CRQ= $-36·1$ to $+28·3$ ($P=0·88$). Table 2 shows sensitivity, specificity and predictive values of CRQ and BPQ scales. We chose a CRQ threshold level of ≥ 100 and a BPQ threshold level of ≤ 17, as these produced the best

TABLE 1. Comparison of geometric mean scores (range limits)

	CAL	Controls	*P*
CRQ	75·2 (42–131)	115·8 (50–140)	<0·0001
BPQ	39·5 (9–83)	4·8 (0–41)	<0·0001

BPQ low scores=good QoL; CRQ low scores=severely disabled.

TABLE 2. Sensitivity, specificity and predictive values of CRQ AND BPQ

	SEN(%)	SP(%)	PPV(%)	NPV(%)
CRQ (thr ≥100)	79	89	92	71
BPQ (thr [\H]17)	91	89	94	85
P	0·024	n.s.	n.s.	<0·001

SEN, Sensitivity; SP, specificity; PPV, positive predictive value; NPV, negative predictive value; n.s., not significant; thr, threshold.

compromise for sensitivity, specificity and predictive values.

There was no significant difference in specificity and positive predictive values between the two questionnaires but BPQ performed better than CRQ with regard to sensitivity and negative predictive value. Reducing the CRQ threshold by 10% (to 90), decreased negative predictive value to 62·1% (χ^2=7·4, $P \leq 0{\cdot}01$ *vs.* BPQ) and sensitivity to 65·5% (χ^2=16·1, P=<0·001 *vs.* BPQ). Specificity and positive predictive values improved (to 96% in both cases) but remained not significantly different from BPQ. Increasing CRQ threshold by 10% (to 110) reduced sensitivity to 72·7% (χ^2=3·8, P=0·05 *vs.* BPQ) without significantly affecting specificity or predictive values. Increasing or reducing BPQ threshold by approximately 10% (to 19 or 15) did not significantly affect sensitivity, specificity or predictive values.

Table 3 shows the results of multiple regression analysis with BPQ as the dependent variable. Low BPQ scores correspond to good QoL. Low scores for the Nottingham Extended ADL Index suggest difficulties in ADL, and high BASDEC scores signify likelihood of depression. The independent variables shown to predict BPQ were age, 6-min walk test, Nottingham Extended ADL score, BASDEC score, body-mass index, oxygen saturation before walk test, and household composition. Further analysis revealed that 16% of the variance was accounted for by Nottingham Extended ADL scores, 9% by BASDEC, 4% by age, 3% by 6-min walk distance, and 2% by oxygen saturation at rest.

Table 4 shows results of multiple regression analysis with CRQ as the dependent variable. High CRQ scores correspond to good QoL. Predictive variables were Nottingham Extended ADL score, BASDEC score, and resting oxygen saturation.

Discussion

The present study has two major aspects. Firstly, the relative merits of the BPQ and CRQ scales in elderly COPD subjects and secondly, an analysis of which demographic physical and psychological variables are most predictive of quality of life in such subjects.

Dealing first with the former point, our data suggests that the BPQ is a better clinical discriminative tool in terms of sensitivity and negative predictive value for 'differentiating' elderly subjects with respiratory disability from age-matched subjects with normal lung function. Both the scales had reasonable inter-investigator repeatability. It could be argued that as both BPQ and CRQ measures were originally designed to assess the effect of interventions upon quality of life in COPD patients, it is not appropriate to attempt to use these scales to differentiate COPDs from normals. However, the aim of any intervention (e.g. drug therapy, respiratory rehabilitation) is to attempt to improve

TABLE 3. Multiple regression analysis: factors predicting BPQ score

Variable	β	SE	*P*	r^2
NEADL	−1·66	0·36	<0·0001	0·16
BASDEC	1·47	0·31	<0·0001	0·09
Age	−0·83	0·21	<0·0001	0·04
6-min walk test	−0·04	0·01	<0·001	0·03
Pre SaO_2	−196·75	94·98	=0·03	0·02
BMI	−0·44	0·21	=0·03	0·005
Household composition	4·83	2·48	=0·05	0·000
Total r^2=0·70				

NEADL, Nottingham Extended ADL score; BASDEC, Brief Assessment Schedule Depression Cards; BMI, body mass index; Pre SaO_2, oxygen saturation before walk test. Household composition: 1, alone, living alone; 2, together, living with partner, child(ren) or brother(s)/sister(s).

TABLE 4. Multiple regression analysis: factors predicting CRQ score

Variable	β	SE	P	r^2
BASDEC	−2·52	0·46	<0·0001	0·16
NEADL	1·24	0·54	0·02	0·06
Pre SaO_2	1·71	0·68	0·01	0·03
Age	0·38	0·33	0·26	0·005
6-min walk test	0·04	0·02	0·12	0·005
BMI	0·33	0·33	0·31	0·000
Household composition	−3·80	3·66	−1·04	0·000
Total r^2=0·56				

Abbreviations as Table 3.

the patient's quality of life and arguably to return it to normal. Thus any questionnaire which differentiates poorly between COPD subjects in their baseline state and normal controls will be of less value in monitoring any response to intervention.

Intervention will of course only be valuable in improving quality of life if the latter is initially impaired and it is of course possible for patients to suffer COPD without significant quality of life impairment. This would not explain the relative inferiority of one scale (the CRQ) over another (the BPQ) as indeed of both revealed impairment in quality of life of the COPD group compared to the control group (Table 1). The greater validity of the BPQ over the CRQ is further evidenced by the results of the multiple regression analysis in that not only were independent variables able to predict a larger proportion of the variability in BPQ (r^2=0·70) than in CRQ (r^2=0·53) but the variables predictive of BPQ included most of the physiological variables previously shown to be predictive of quality of life score in younger populations with COPD. The same was not true in the analysis of variables predictive of CRQ in that age, exercise capacity, household composition, and body mass index, all failed to predict CRQ score.

We would thus advocate the use of BPQ in preference to CRQ in elderly patients disabled by COPD. The present study is in agreement with that of other authors looking at younger COPD patients in revealing that quality of life in elderly COPD patients is dependent upon a complex interaction of psychological well-being, social and physical factors. The most important group of variables proved to be the psychological status (as assessed by BASDEC) and ability to carry out daily activities. This is also consistent with previous studies reporting that those who are physically ill and depressed have a higher morbidity, decreased quality of life, poor treatment compliance, and low self-esteem (22,23), and that even mild COPD produces significant psychological impairment in younger subjects (6).

Our data is also consistent with that of others in revealing no significant relationship between spirometry and quality of life score (5,24), although some studies do report a weak relationship between physiological measures and QoL (6,25). Like Caplan *et al.* (26), we observed a weak association between QoL and oxygen saturation at rest. We also found that the 6-min walking distance independently predicted QoL, but that variability in exercise capacity contributed to only 3% of the variability in BPQ score.

Of perhaps equal import is our finding that advancing age seems to exert a small but significant 'protective' effect on QoL in COPD. This contrasts with the findings of Prigatano *et al.* (6) and of Ketelaars *et al.* (12) but agrees with earlier work by McSweeney *et al.* (5) and by Guyatt *et al.* (9). Such protective effect of age may be a result of an age-related reduction in expectation of activity and of exercise capacity, or may be the result of age-related physiological changes such as impaired appreciation of the severity of bronchoconstriction (27,28). However such a protective effect is unlikely to be of any clinical significance as evidenced by the fact that variability in age contributed to only 4% of the variability in BPQ score in the present study and by the significant effects of respiratory symptomatology on quality of life in epidemiological populations including the elderly (13).

Several studies report weight loss in COPD subjects possibly due to the increased workload of laboured breathing and under-nutrition due to breathlessness from eating (29,30). This in turn reduces both respiratory muscle strength, systemic muscle strength and endurance and participation in social activities. Indeed under-nourished COPD patients might be prone to recurrent infection which may led to increased hospitalisation, reduced exercise capacity and increased mortality (31). However, in the present study, body mass index although significant was only a minor predictor of QoL.

Some authors suggest that there is a link between socio-economic status and quality of life in COPD subjects (5,6). Arguably, those from a higher social class might be able to combat the impact of progressively disabling disease because of greater financial and material resources. Our study found no such relationship between social class status and QoL, although the power of our investigations was limited in that the vast majority of our subjects came from social classes 4 and 5. Household composition (living alone or with relatives) was however predictive of BPQ score, although in a seemingly paradoxical direction in that living alone was associated with a higher QoL. If true this might represent either a survivor effect (those well enough to manage alone are more likely to survive to be studied) or in

effect of migration (those too disabled to live alone have moved to live with relatives). We did not investigate this possibility.

In summary the Breathing Problems Questionnaire appears to be a better discriminatory tool than the Chronic Respiratory Disease Questionnaire in the assessment of quality of life in elderly patients with COPD. Psychological well-being and ability to carry out activities of daily living are the most powerful indictors of quality of life in such patients. The severity of the disease and reduced quality of life is not predicted by lung function tests. A disease-specific quality of life questionnaire provides valuable information which would not be routinely accessible by standard patient interview.

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