

Impact of obstructive airways disease on quality of life in older adults

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Abstract

Background – Obstructive airways disease adversely affects quality of life, although relationships between quality of life and lung function have been shown to be weak. The relationships between the results of a quality of life questionnaire, spirometric tests, and methacholine bronchial challenge were investigated in a population sample of middle aged and elderly people. **Methods** – A random population sample of the white population of Central Manchester, UK were contacted by post. Respondents were invited to undergo bronchial challenge with methacholine (Newcastle dosimeter method) and to complete the St George's Respiratory Questionnaire. This self-completed questionnaire quantifies quality of life as three component scores, with higher scores indicating greater impairment of quality of life.

Results – Two hundred and twenty seven subjects aged 45–86 years completed the St George's Questionnaire and performed spirometric tests; 190 completed the methacholine challenge. All quality of life scores were higher in subjects with a forced expiratory volume in one second (FEV₁)/forced vital capacity (FVC) of <65%, indicating impaired quality of life in subjects with airways obstruction. There was no relationship between quality of life and age. Multiple regression analysis showed independent relationships between quality of life scores and both baseline FEV₁ and bronchial responsiveness. However, the amount of variation in quality of life attributable to variation in FEV₁ or bronchial responsiveness was less than 10%. Subgroup analysis indicated that the quality of life score was independently associated with bronchial responsiveness and not FEV₁ in subjects aged <65 years, but with baseline FEV₁ and not bronchial responsiveness in older subjects.

Conclusions – Obstructive airways disease significantly impairs quality of life in adults. The reduction in quality of life in these patients is related to both baseline pulmonary function and non-specific bronchial responsiveness. The impact of airways obstruction on quality of life does not decrease with advancing age.

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Keywords: quality of life, chronic airways obstruction, bronchial hyperresponsiveness.

Obstructive airways disease is common in the elderly, affecting approximately 16% of people over the age of 65.¹ It has a substantial impact on quality of life, impairing not only physical, but also psychological and social function.^{2,3} The relationship between the degree of quality of life impairment and the severity of airways obstruction as measured by pulmonary function tests has, however, generally been found to be weak.²⁻⁵

It has been suggested that the impact of obstructive airways disease on quality of life may be less in older subjects.^{3,5,6} We have therefore compared the quality of life in subjects with and without chronic airways obstruction and bronchial hyperresponsiveness to assess the effects of chronic obstructive airways disease and asthma on quality of life in a population sample of adults aged 45–86 years.

Methods

Names of adults aged ≥ 45 were taken using random number tables from practice lists of 22 local general practitioners. Those who were confused or housebound were excluded, together with the few unsuitable for other reasons. Non-white subjects were excluded because of interracial differences in bronchial responsiveness.⁷

Subjects were sent an explanatory letter and questionnaire concerning previous asthma, bronchitis, ischaemic heart disease, smoking history, and current medication. Non-responders were sent a reminder, followed by a second reminder with an abbreviated questionnaire. A random sample of persistent non-responders was contacted by telephone or home visit.

Questionnaire responses were used to identify those excluded from methacholine challenge. Exclusion criteria were ischaemic heart disease or medication with β blockers, anticholinergics or oral steroids. Subjects not excluded on this basis were invited to attend. Attendance was delayed for six weeks after a respiratory tract infection or exacerbation of wheezing. Subjects were requested to refrain from caffeine for 12 hours and to omit bronchodilators for 12 hours (inhalers), 24 hours (oral preparations), or 48 hours (sustained release preparations) before attendance.

Written informed consent was obtained from all subjects attending and the study was approved by the Central Manchester Health Authority ethical committee. A resting 12 lead electrocardiograph was performed, and subjects with evidence of myocardial ischaemia were excluded from methacholine challenge.

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Baseline pulmonary function was measured (Compact, Vitalograph, Buckingham, UK) using the mean of six reproducible readings. Methacholine challenge was performed only if baseline forced expiratory volume in one second (FEV_1) was $\geq 60\%$ predicted.

Subjects completed the St George's Respiratory Questionnaire,⁸ which is a self-completed questionnaire validated as a measure of quality of life in subjects with chronic airways obstruction. Three component scores are calculated: Symptoms (frequency and severity), Activities (causing or limited by breathlessness), and Impacts (on employment and emotions, feelings of panic or control), as well as a total score. Higher scores indicate greater morbidity.

Methacholine challenge was performed by the Newcastle dosimeter method.^{9,10} Briefly, doubling doses of nebulised methacholine were inhaled at five minute intervals by the subject while seated and wearing a noseclip. FEV_1 was measured before each subsequent dose; as recommended, three readings reproducible within 10% were performed each time and the mean was used. End points were a 20% decrease in FEV_1 or administration of a maximum cumulative dose of 6.4 mg methacholine. Results were expressed as (a) dose of methacholine producing a 20% fall from baseline FEV_1 (PD_{20}), and (b) the slope of the dose-response curve to methacholine (dose-response slope) which gives a continuous non-censored measure of bronchial responsiveness expressed in units of percentage decline in FEV_1 per μg methacholine.¹¹

DATA ANALYSIS

St George's Questionnaire scores and values for the dose-response slope were log transformed to achieve normal distribution. To allow log transformation of all St George's Questionnaire scores, the value 0.5 was allocated to those subjects with scores of 0. One subject had a slight increase in FEV_1 during methacholine challenge producing a negative dose-response slope; to allow logarithmic conversion of this result a constant of 0.43 was added to all dose-response slope values.¹² Relationships between quality of life scores and pulmonary function were analysed by linear correlation and multiple regression. Subgroups were compared by grouped *t* tests.

To avoid the age and height bias associated with the expression of FEV_1 as a percentage of predicted values, baseline FEV_1 was expressed as standardised residuals (SR) for calculation of correlation coefficients and multiple regression.¹³ These were calculated using the equation $SR = (\text{recorded value} - \text{predicted value})/RSD$, where RSD is the residual standard deviation about the regression equation used to calculate the predicted values.¹⁴ The prediction equations used for the calculation of standardised residuals were derived from urban white UK adults over a wide age range comparable to that of the current study.¹⁵

Chronic airways obstruction was defined as a ratio of FEV_1 to forced vital capacity (FVC)

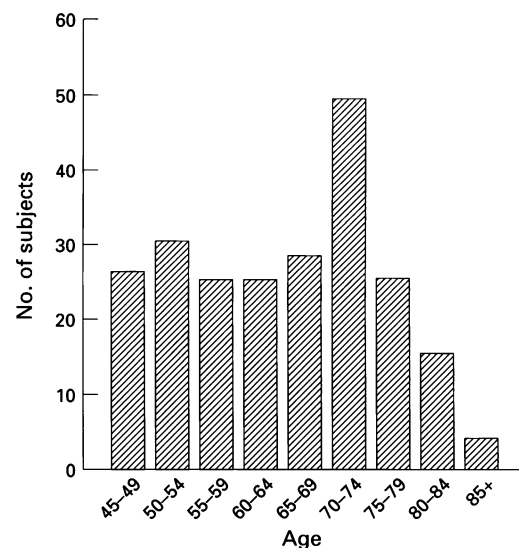


Figure 1 Age distribution of subjects performing spirometric tests.

of $<65\%$ in those aged <65 years; since this ratio decreases with normal ageing, a predicted value and lower limit of normal for FEV_1/FVC was calculated for subjects aged ≥ 65 using equations from the Cardiovascular Health Study.¹⁶

Bronchial hyperresponsiveness was defined as a PD_{20} of $\leq 100 \mu\text{g}$ methacholine; this level has been shown to have a predictive value for current asthma of nearly 100%.¹⁷ In all cases significance was defined at the 5% level.

Results

We contacted 783 eligible subjects; 508 returned the full questionnaire and could be assessed for suitability for methacholine challenge. A further 215 subjects completed abbreviated questionnaires (overall response rate 92.3%). Responders were representative of the population in age and sex distribution; those completing full and abbreviated questionnaires were similar in terms of smoking history and prevalence of diagnosed asthma or bronchitis.

One hundred and thirteen subjects were excluded from methacholine challenge because of heart disease or medication; of the 395 invited to attend, 247 agreed. There was a slight age difference between attenders and non-attenders (mean age of attenders 64.5 years, non-attenders 66.1; $p=0.02$), but attenders were representative in terms of smoking habit, diagnosed asthma and bronchitis, and prevalence of respiratory symptoms.

Two hundred and twenty seven attenders performed reproducible spirometric tests and completed the St George's Questionnaire, of whom 26 had a baseline FEV_1 of $<60\%$ predicted, two had electrocardiographic evidence of ischaemic heart disease, and nine were unable to complete the methacholine challenge. Challenge results were thus available for 190 subjects.

One hundred and twenty eight of the 227 subjects who performed spirometric tests were women. The age distribution is shown in fig 1.

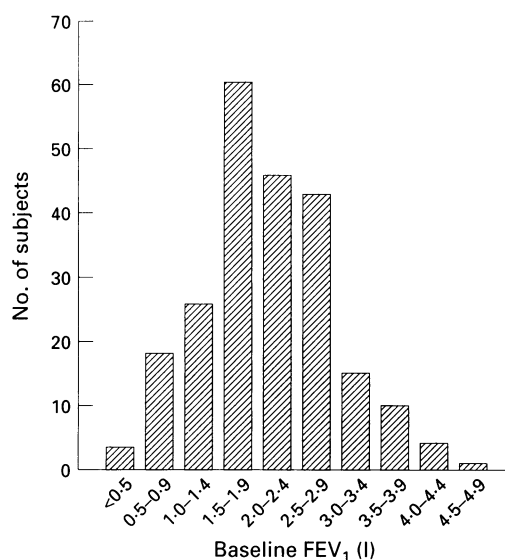


Figure 2 Distribution of baseline forced expiratory volume in one second (FEV₁).

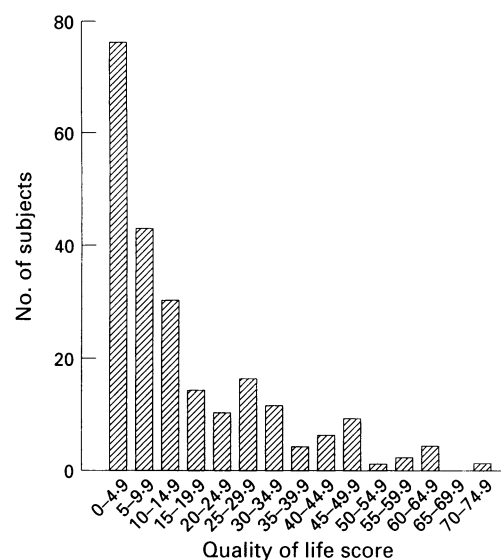


Figure 3 Distribution of total quality of life scores.

Seventy one subjects were current smokers and 91 were ex-smokers. Thirty three reported a previous diagnosis of asthma and 52 "bronchitis"; 33 were using inhaled bronchodilators and/or an inhaled steroid.

Figure 2 shows the distribution of baseline FEV₁. Fifty nine subjects had chronic airways obstruction (FEV₁/FVC of <65% or lower than predicted level)¹⁶; the mean (SD) age of these subjects was 66.2 (10.0) years (range 47-84). There was no age difference between these subjects and the 168 subjects without airways obstruction (mean (SD) age 64.1 (11.2) years, range 45-86; $t = -1.3$, $p = \text{NS}$). Twenty five subjects with chronic airways obstruction were aged <65 years and 34 were aged ≥ 65 years ($\chi^2 = 0.6$, $p = \text{NS}$).

A PD₂₀ value was obtained in 135 subjects of whom 48 had bronchial hyperresponsiveness (PD₂₀ ≤ 100 μg). The mean ages of subjects with and without bronchial hyperresponsiveness were similar (PD₂₀ ≤ 100 μg : mean (SD) age 64.4 (11.2), range 45-86; PD₂₀ > 100 μg : mean (SD) age 63.6 (10.8), range 45-86; $t = -0.4$, $p = \text{NS}$). Twenty three subjects with bronchial hyperresponsiveness were aged <65 years and 25 were ≥ 65 years ($\chi^2 = 0.1$, $p = \text{NS}$).

The distribution of total St George's Questionnaire scores is shown in fig 3; 16 subjects had a score of zero (indicating no quality of life impairment). Geometric mean quality of

life scores were similar for men and women. There was no correlation between quality of life scores and age. However, the mean Activities score was significantly higher for subjects aged ≥ 65 years (geometric mean (SD) 1.04 (0.71)) than for those aged <65 years (0.81 (0.76); $t = -2.34$, $p = 0.02$).

Total quality of life scores were significantly higher in the 59 subjects with chronic airways obstruction, indicating quality of life impairment in subjects with obstructive airways disease. Similarly, all quality of life scores except the Impacts score were significantly higher in those with bronchial hyperresponsiveness (table 1).

For the whole group there was significant negative correlation between log total quality of life score and baseline FEV₁ (expressed as standardised residuals) ($r = -0.47$, $p < 0.001$; fig 4). There was also a significant positive correlation between log total quality of life score and log dose-response slope ($r = 0.20$, $p < 0.005$; fig 5). Similar correlations were seen between baseline FEV₁ (standardised residuals) and log Activities score ($r = -0.38$, $p < 0.001$), log Impacts score ($r = -0.47$, $p < 0.001$) and log Symptoms score ($r = -0.37$, $p < 0.001$), and between the log dose-response slope and log Activities score ($r = 0.18$, $p < 0.01$), log Impacts score ($r = 0.17$, $p < 0.01$), and log Symptoms score ($r = 0.23$, $p = 0.001$).

Table 1 Geometric mean (SD) quality of life scores in subjects with and without chronic airways obstruction and bronchial hyperresponsiveness

	Total score	Activities score	Impacts score	Symptoms score
Subjects with chronic airways obstruction	1.18 (0.49)	1.18 (0.65)	0.76 (0.73)	1.41 (0.56)
Subjects without chronic airways obstruction	0.84 (0.53)	0.85 (0.75)	0.34 (0.69)	0.92 (0.77)
	$t = -4.2$ $p < 0.0001$	$t = -3.0$ $p < 0.005$	$t = -3.9$ $p = 0.0001$	$t = -4.5$ $p < 0.0001$
Subjects with bronchial hyperresponsiveness	0.98 (0.47)	1.03 (0.64)	0.39 (0.70)	1.21 (0.70)
Subjects without bronchial hyperresponsiveness	0.81 (0.51)	0.80 (0.73)	0.29 (0.70)	0.89 (0.74)
	$t = -2.0$ $p = 0.05$	$t = -1.9$ $p = 0.05$	$t = -0.9$ $p = \text{NS}$	$t = -2.6$ $p = 0.01$

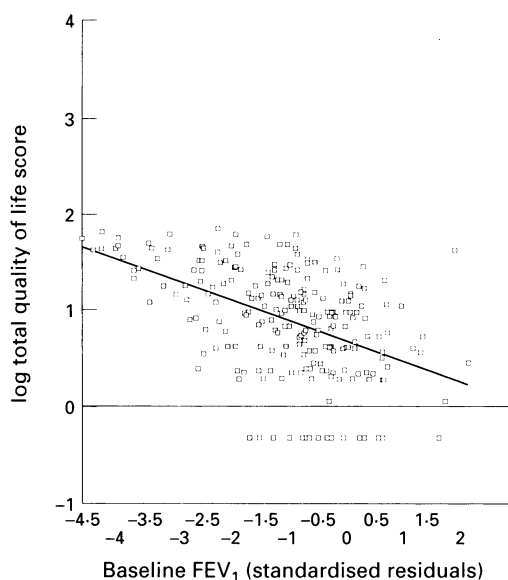


Figure 4 Relationship between total quality of life score and baseline FEV₁ (standardised residuals).

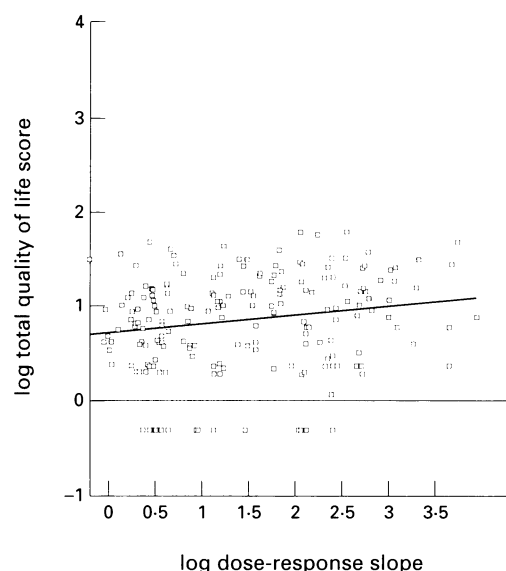


Figure 5 Relationship between total quality of life score and log dose-response slope.

Multiple regression analysis was performed with quality of life score as the dependent variable and baseline FEV₁, log dose-response slope, age, and sex as independent variables. As there was a significant correlation between the baseline FEV₁ and log dose-response slope, an interaction term was included in the regression¹²; this was not significantly related to quality of life in any of the analyses. For the whole subject group, both total and separate component quality of life scores showed independent negative relationships with baseline FEV₁ (standardised residuals); only the Symptoms score showed a significant association with the log dose-response slope (table 2).

The effect of smoking on quality of life was assessed by comparing total St George's Ques-

tionnaire scores of never smokers and smokers (ex-smokers plus current smokers). Quality of life was significantly impaired in smokers (total score 10.3 (3.2) versus 5.6 (3.9); $t = -3.3$, $p = 0.001$). When smoking status (current, ex-smoker, or never smoker) was added to the multiple regression for the whole subject group, the total quality of life score was found to be significantly associated with smoking status as well as baseline FEV₁. However, because of the interrelationship between FEV₁ and smoking status, it was necessary to include an interaction term in the regression. When this was added it was significantly associated with quality of life score, and the relationship between quality of life score and smoking status itself was no longer significant, indicating that the effect of

Table 2 Factors associated with quality of life scores: multiple regression analysis

	Log total score	Log activities score	Log impacts score	Log symptoms score
FEV ₁ (standardised residuals)	B = -0.15 SE = 0.04 p < 0.0001	B = -0.18 SE = 0.05 p < 0.001	B = -0.16 SE = 0.05 p < 0.002	B = -0.13 SE = 0.06 p < 0.05
Log dose-response slope	B = 0.04 SE = 0.04 p = NS	B = 0.06 SE = 0.06 p = NS	B = 0.06 SE = 0.05 p = NS	B = 0.11 SE = 0.06 p = 0.05
Age	B = 0.0003 SE = 0.003 p = NS	B = 0.0003 SE = 0.005 p = NS	B = 0.002 SE = 0.004 p = NS	B = -0.006 SE = 0.005 p = NS
Sex	B = -0.05 SE = 0.07 p = NS R ² = 0.08	B = -0.16 SE = 0.1 p = NS R ² = 0.05	B = 0.02 SE = 0.01 p = NS R ² = 0.05	B = 0.10 SE = 0.1 p = NS R ² = 0.07

Table 3 Correlation between quality of life scores and bronchial responsiveness, and between quality of life scores and baseline forced respiratory volume in one second (FEV₁) in older and younger subjects

	Log total score	Log activities score	Log impacts score	Log symptoms score
Log dose-response slope				
Age < 65	$r = 0.31$ p = 0.001	$r = 0.27$ p < 0.005	$r = 0.33$ p < 0.001	$r = 0.30$ p = 0.001
Age ≥ 65	$r = 0.08$ p = NS	$r = 0.07$ p = NS	$r = 0.01$ p = NS	$r = 0.16$ p = NS
FEV ₁ (standardised residuals)				
Age < 65	$r = -0.42$ p < 0.001	$r = -0.35$ p < 0.001	$r = -0.41$ p < 0.001	$r = -0.31$ p < 0.001
Age ≥ 65	$r = -0.51$ p < 0.001	$r = -0.40$ p < 0.001	$r = 0.51$ p < 0.001	$r = -0.42$ p < 0.001

smoking status on quality of life was the result of the interaction between smoking and FEV₁, rather than an independent effect.

The effect of age on the relationship between quality of life and lung function was assessed by repeating the analysis with the subjects divided into two age groups: <65 years (n = 106) and ≥ 65 years (n = 121). Calculation of linear correlation coefficients for the two groups gave similar results to those for the whole group, except that in the older age group there was no correlation between the log dose-response slope and quality of life scores (table 3). However, multiple regression analysis revealed differences between the age groups: in subjects aged <65 years the total quality of life score was significantly associated with the log dose-response slope (B = 0.17, SE = 0.05, p < 0.001) but not baseline FEV₁ (B = -0.08, SE = 0.06, p = NS), whereas in the older group the opposite was true (log dose-response slope: B = -0.02, SE = 0.05, p = NS; baseline FEV₁: B = -0.18, SE = 0.05, p = 0.0005).

Discussion

Our results confirm that obstructive airways disease impairs quality of life. We have found no relationship between quality of life and age or sex, but have shown significant relationships with baseline FEV₁ and with non-specific bronchial responsiveness. Both chronic airways obstruction and bronchial hyperresponsiveness were relatively common in our population. This may reflect the large numbers of current and ex-smokers in this inner city area. However, smoking status itself was not found to be independently associated with quality of life.

Although the relationships between FEV₁ and quality of life scores were statistically significant, the value of R² for the multiple regression calculations was low, indicating that variation in FEV₁ explains only a small amount of the variation in quality of life. This weak relationship between quality of life and lung function indices in patients with airways obstruction has been previously reported,²⁻⁵ and has led to the suggestion that variability between patients in perception of breathlessness is a more important determinant of disability than the degree of airways obstruction itself.¹⁸ Psychological assessment of patients with obstructive airways disease has shown that illness attitudes and beliefs are stronger predictors of breathlessness and exercise tolerance than are measures of airways obstruction.^{19,20}

Although perhaps under-rated by doctors as a cause of distress, our results show that airways obstruction is associated with significant emotional dysfunction and limitation of activities. This impact of respiratory symptoms on activity was highlighted by a large population survey of elderly people in 1976²¹ in which 17% of housebound individuals or those confined to bed identified "pulmonary conditions" as the cause of their immobility and were second only to "arthritis, rheumatism" as the most common factor reducing independence.

The St George's Questionnaire is a disease-specific quality of life score designed for use in

subjects with airways obstruction. As such, it has not been validated in a general population sample. In the current study subjects with no airways disease tended to record very low quality of life impairment, particularly for the Symptoms score. This produced a skewed distribution of quality of life scores. St George's Questionnaire scores have been shown to be independent of age in subjects aged up to 75 years,⁸ but the questionnaire has not been validated in older subjects. The lack of correlation between quality of life scores and age in the current study suggests that the questionnaire is also valid in the elderly. However, the mean Activities score was higher for older subjects, indicating reduced activity levels with age.

Interestingly, where other studies have shown a change in quality of life with increasing age in subjects with asthma or obstructive airways disease, this has generally been an improvement in quality of life in older subjects.³⁻⁶ This has led to the suggestion that older subjects may be more tolerant of the effects of airways obstruction due to a reduction in their normal activity levels or in their expectations of life. It has been shown that older adults describe less severe symptoms than younger adults when exposed to the same degree of methacholine-induced bronchoconstriction.²² However, there is no evidence for a general decrease in the reporting of distressing symptoms by the elderly – indeed the opposite may be true.²³ The results of the current study do not confirm a reduction in the impact of obstructive airways disease on quality of life in older people.

Our results show that the interrelationships between bronchial responsiveness, baseline FEV₁, and quality of life scores change with age. The reasons for this are not clear. Mortagy *et al* have described a cluster of respiratory symptoms representing "bronchial irritability" which are associated with increased bronchial responsiveness in young adults.²⁴ However, the predictive value of these symptoms for increased bronchial responsiveness is much lower in the elderly.¹ Since respiratory symptoms affect quality of life, the lack of "bronchial irritability" symptoms in older adults with increased bronchial responsiveness may reduce the strength of the relationship between bronchial responsiveness and quality of life in this age group. Alternatively, our results may reflect a change in the interaction between baseline FEV₁ and bronchial responsiveness with age, rather than a change in their interaction with quality of life.

Schrier *et al* have also shown that obstructive airways disease is associated with impairment of quality of life in adults over a wide age range.² However, it is not clear whether quality of life was related to age in this study. The influence of increased bronchial responsiveness on quality of life was studied in young asthmatics by Malo *et al*²⁵ who found the mean quality of life score to be weakly but significantly correlated with baseline FEV₁ and non-specific bronchial responsiveness, as in the current study.

In summary, we have measured quality of life, airways calibre, and non-specific bronchial responsiveness in a population sample over a wide age range and have shown significant correlations between quality of life and both baseline FEV₁ and non-specific bronchial responsiveness. Multiple regression showed a significant independent relationship between quality of life and FEV₁ in older subjects, and between quality of life and non-specific bronchial responsiveness in younger subjects. However, the amount of variability in quality of life attributable to changes in FEV₁ and non-specific bronchial responsiveness is small. The impact of obstructive airways disease on quality of life does not decrease with advancing age.

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- 1 Dow L, Coggon D, Holgate ST. Respiratory symptoms as predictors of airways lability in an elderly population. *Respir Med* 1992;86:27-32.
- 2 Schrier AC, Dekker FW, Kaptein AA, Dijkman JH. Quality of life in elderly patients with chronic nonspecific lung disease seen in family practice. *Chest* 1990;98:894-9.
- 3 Guyatt GH, Townsend M, Berman LB, Pugsley SO. Quality of life in patients with chronic airflow limitation. *Br J Dis Chest* 1987;81:45-54.
- 4 Quirk FH, Baveystock CM, Wilson R, Jones PW. Influence of demographic and disease related factors on the degree of distress associated with symptoms and restrictions on daily living due to asthma in six countries. *Eur Respir J* 1991;4:167-71.
- 5 Quirk FH, Jones PW. Patients' perception of distress due to symptoms and effects of asthma on daily living and an investigation of possible influential factors. *Clin Sci* 1990;79:17-21.
- 6 Juniper EF, Guyatt GH, Epstein RS, Ferrie PJ, Jaeschke R, Hiller TK. Evaluation of impairment of health related quality of life in asthma: development of a questionnaire for use in clinical trials. *Thorax* 1992;47:76-83.
- 7 Sherman CB, Tollerud DJ, Heffner LJ, Speizer FE, Weiss ST. Airway responsiveness in young black and white women. *Am Rev Respir Dis* 1993;148:98-102.
- 8 Jones PW, Quirk FH, Baveystock CM, Littlejohns P. A self-complete measure of health status for chronic airflow limitation. The St. George's Respiratory Questionnaire. *Am Rev Respir Dis* 1992;145:1321-7.
- 9 Connolly MJ, Avery AJ, Walters EH, Hendrick DJ. The relationship between non-specific bronchial responsiveness to methacholine and histamine in asthmatic subjects. *Pulm Pharmacol* 1988;1:53-8.
- 10 Connolly MJ, Kelly C, Walters EH, Hendrick DJ. An assessment of methacholine inhalation tests in elderly asthmatics. *Age Ageing* 1988;17:123-8.
- 11 O'Connor G, Sparrow D, Taylor D, Segal M, Weiss S. Analysis of dose-response curves to methacholine. An approach suitable for population studies. *Am Rev Respir Dis* 1987;136:1412-7.
- 12 Sparrow D, O'Connor GT, Rosner B, Weiss ST. Predictors of longitudinal change in methacholine airway responsiveness among middle-aged and older men. The Normative Aging Study. *Am J Respir Crit Care Med* 1994;149:376-81.
- 13 Miller MR, Pincock AC. Predicted values: how should we use them? *Thorax* 1988;43:265-7.
- 14 Miller MR, Pincock AC, Grove DM. Patterns of spirogram abnormality in individual smokers. *Am Rev Respir Dis* 1985;132:1034-40.
- 15 Roberts CM, MacRae KD, Winning AJ, Adams L, Seed WA. Reference values and prediction equations for normal lung function in a non-smoking white urban population. *Thorax* 1991;46:643-50.
- 16 Enright PL, Kronma RA, Higgins M, Schenker M, Haponik EF. Spirometry reference values for women and men aged 65 to 85 years of age. Cardiovascular Health Study. *Am Rev Respir Dis* 1993;147:125-33.
- 17 Cockcroft DW, Killian DN, Mellon JJA, Hargreave FE. Bronchial reactivity to inhaled histamine: a method and clinical survey. *Clin Allergy* 1977;7:235-43.
- 18 Jones PW. Quality of life measurement for patients with diseases of the airways. *Thorax* 1991;46:676-82.
- 19 King B, Cotes JE. Relation of lung function and exercise capacity to mood and attitudes to health. *Thorax* 1989;44:402-9.
- 20 Morgan AD, Peck DF, Buchanan DR, McHardy GJR. Effect of attitudes and beliefs on exercise tolerance in chronic bronchitis. *BMJ* 1983;286:171-3.
- 21 Hunt A. *The elderly at home. A study of people age sixty five and over living in the community in England in 1976.* OPCS Social Survey Division, London: HMSO, 1976.
- 22 Connolly MJ, Crowley JJ, Charan NB, Nielson CP, Vestal RE. Reduced subjective awareness of bronchoconstriction provoked by methacholine in elderly asthmatic and normal subjects as measured on a simple awareness scale. *Thorax* 1992;47:410-3.
- 23 Woods RT, Britton PG. *Clinical psychology with the elderly.* Beckenham, Kent: Croom Helm, 1985:59.
- 24 Mortagy AK, Howell JBL, Waters WE. Respiratory symptoms and bronchial reactivity: identification of a syndrome and its relation to asthma. *BMJ* 1986;293:525-9.
- 25 Malo JL, Boulet LP, Dewitte JD, et al. Quality of life of subjects with occupational asthma. *J Allergy Clin Immunol* 1993;91:1121-7.