Thorax Online First, published on June 29, 2006 as 10.1136/thx.2006.059071

Smokers with airway obstruction are more likely to quit smoking

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Key words: spirometry, anti-smoking advice, smoking cessation, COPDWord count – 3,165

ABSTRACT

COPD, usually caused by tobacco smoking, is one of the leading causes of morbidity and mortality. Smoking cessation at an early stage of the disease usually stops further progression of the disease. Our aim was to determine if diagnosis of airway obstruction (AO) was associated with subsequent success in smoking cessation, as advised by a physician.

Methods: 4494 current smokers (57.4% males) with a history of at least 10 pack-years of smoking were recruited from 100,000 subjects screened by spirometry for signs of AO. At the time of screening, all received simple smoking cessation advice. 1,177 (26.2%) subjects had AO and were told that they had COPD and that smoking cessation would halt rapid progression of their lung disease. No pharmacological treatment was proposed. After one year, all subjects were invited for a follow-up visit. Smoking status was assessed by history and validated by exhaled carbon monoxide level.

Results: Nearly 70% attended a follow-up visit (n=3,077): 61% were men, mean age was 52±10 years, mean tobacco exposure was 30±17 pack-years, and 33.3% had AO during the baseline exam. The validated quit rate in those with AO was 16.3%, compared to 12.0% in those with normal spirometry (p=0.0003). After correction for age, gender, nicotine dependence, number of

cigarettes smoked daily and lung function success in quitting smoking was predicted by lower lung function, lower nicotine dependence, and lower tobacco exposure.
Conclusions: Simple smoking cessation advice combined with spirometry test resulted in good one-year cessation rates, especially in subjects with AO.

Chronic obstructive pulmonary disease (COPD) in one of the leading causes of morbidity and mortality worldwide, and is increasing in prevalence.[1]

In the United States, between 1966 and 1995, age-adjusted death rate for stroke and coronary artery disease declined by 58% and 45% respectively,[2] whereas the death rate from COPD increased by 71%[1], making COPD the fourth leading cause of death. Direct annual costs for COPD in the U.S. were estimated to be over $18 billion[3] and the economic impact of work loss for additional $10 billion.[4] The morbidity and mortality from cardiovascular diseases have been successfully reduced over the last 40 years due to effective preventive measures. However, the concurrent failure of pharmacological treatment to affect the increasing death rates from COPD should prompt us to seek new methods to reverse this trend.[5]

Tobacco smoke is the main cause of COPD, responsible for 85-90% of all cases.[6-7] Smoking cessation at an early stage of the disease has been proven to slow down the FEV_1 decline to that observed in healthy subjects.[8-9] The diagnosis of COPD at an early stage of the disease may be done by performing spirometry in smokers using case-finding[10] or population screening[11] methods.

We hypothesized that the diagnosis of smoking-related lung disease would increase the efficacy of anti-smoking advice in affected subjects. The aim of this study was to compare effects of spirometry combined with a simple anti-smoking advice on smoking cessation rates in two groups of subjects: those with airway obstruction and those with normal spirometry.

MATERIAL AND METHODS

Investigations were performed as part of the National Program of Early Diagnosis and Prevention of COPD in Poland.[11] The National Program was introduced to promote early diagnosis and secondary prevention of COPD. Written materials were disseminated for local TV, radio and journals. Special posters and leaflets were displayed in health care facilities. Materials included information on causes and symptoms of COPD. In some places it was felt that the term COPD was unfamiliar and was replaced by a better known term "emphysema". Information that not all smokers are susceptible to COPD and that a spirometry is a simple non-invasive method to detect COPD at an early stage of the disease were also included. Smokers aged 40+ years with a history of at least 10 pack-years were invited to outpatient chest clinics all over the country for a free breathing test. However, all subjects who visited the clinic for spirometry whether younger than 40 years of age or non-smokers were also accepted. All investigated subjects were volunteers responding to the offer of free spirometry and antismoking counselling. No patients with chronic chest diseases were included into the study. Screening clinics were held on Saturday mornings and during the late afternoon on working days, facilitating fully employed subjects to attend the test. Outpatient chest clinics are usually located in a town center with an easy access by public transportation.

Simple spirometry with measurements of FVC and FEV_1 were performed by registered nurses additionally trained in spirometry testing at the lung function lab of a chest hospital. Training was

completed with an examination and certificate. A minority of the technologists completed a high school for medical technicians where spirometry testing is a part of the curriculum. Spirometry methods followed American Thoracic Society guidelines.[12] Predicted spirometric values of ECCS/ERS were used.[13] Following the 1995 ERS guidelines,[14] the presence of airway obstruction was defined as an FEV_1/FVC <88% predicted, and the severity of the impairment was classified using the FEV_1 percent predicted as follows: >70% mild, 50-69% moderate, <50% severe.

The physician in charge of the Program discussed the results of spirometry with each subject, relating the results to his/her smoking habit. The subject's percent predicted FEV_1 value was superimposed on a simplified Fletcher's diagram,[15] showing the relationship of the actual result with the predicted value for age and the expected subsequent FEV_1 decline in future if the subject continued to smoke (Fig. 1). All participants were strongly encouraged to stop smoking and received an anti-smoking booklet to take home. The antismoking booklet provided information on the harmful effects of tobacco smoke, the positive health and economic effects of smoking cessation, and useful hints how to stop smoking. On the average antismoking advice together with the discussion on the breathing test result took 5-7 minutes. No pharmacological treatment of smoking addiction was offered. Nicotine replacement therapy (NRT) was available over-the-counter in Poland at the time of this project; however, NRT gum, patches and inhalers are not reimbursed and rather expensive. In subjects with normal spirometry, smoking cessation advice was focused on the risk of developing COPD, lung cancer, coronary artery disease, and the harmful effects of smoke to family members. Fletcher's diagram was also shown.

A total of 110,000 subjects were screened in the Program.[11] Ten of the 60 chest clinics taking part in the Program wit the highest number of subjects enrolled in different regions of the country were chosen to assess the effects of the smoking cessation advice one year after the initial visit. Subjects screened at centres selected for this study did not differ from the subjects in the remaining centres in terms of gender (58.6 vs 58.0% of males), nicotine dependence (4.73 vs 4.76 FTND points), and severity of airflow limitation (FEV_1 % predicted 89.95 ±23.5 vs 86.79 ±27.4), respectively. There was statistically significant difference between subjects in the selected and in the remaining centres in age (54.2 ±12.3 vs 53.3 ±11.3 years), age of smoking initiation (19.9 ±5.0 vs 20.3 ±5.24 years), number of cigarettes smoked daily (19.5 ±9.9 vs 18.9 ±9.4) and cumulative exposure to tobacco smoke (30.1 ±19.3 vs 28.7 ±18.7 pack-years), respectively. Those differences however, disclosed due to the great number of subjects included (n=110,000), were considered clinically not significant.

During the years 2000-2001, 4494 current smoking adults attended the Program at the clinics chosen: 2580 men (57.4%) and 1914 women (42.6%). From this group, 26.2% we found to have airway obstruction: 7.5% mild, 13.5% moderate, and 5.2% severe. The remaining 73.8% had either normal spirometry or mild reductions in FVC without airway obstruction.

A letter of invitation for a follow-up visit was mailed to all subjects of the group during the 11th month from the initial visit. In five centers, the letter of invitation was repeated after a month if the invited person had not yet responded. Some of the subjects (13.2%) were invited for follow-up by a phone call. In one center, a phone call was also repeated after 2-4 weeks if the subject did not respond to the first call.

During the follow-up visit, subjects completed a standardized questionnaire including questions on current smoking status, number of cigarettes smoked, motivation to stop-smoking, and

Fagerström Test for Nicotine Dependence.[16] Those who declared complete abstention from smoking lasting one year were called sustained quitters. Self-reported non-smoking status was validated by an exhaled carbon monoxide (CO) level of less than 10 ppm (Micro CO, Micro Medical Ltd, Rochester, UK).

Statistical analysis

Statistical analyses were performed using Statistica version 6.0 software (StatSoft, Inc., 2001, Tulsa, Oklahoma, US). Tests were considered significant when $p<0.05$. Data distribution was analyzed using the Kologomorov-Smirnov test with Lilliefors correction. Quantitative data were described using mean ±SD. Between groups characteristics were described using analysis of variance. Homogeneity of variance was assessed using Levene's test. If a variable demonstrated normal distribution and homogenous variance, the F ANOVA test was applied. Otherwise, a nonparametric Kruskal-Wallis H test was used. To characterize the strength of relationships between continuous variables, Pearson correlations were used. Categorized qualitative between groups analyses were performed using Pearson chi-square test with appropriate corrections for N. To assess the influence of confounding categorized and continuous variables on smoking cessation rate after one year a logistic regression model was used. Odds ratios (OR), confidence intervals (CI) and p were calculated.

RESULTS

A total number of 3077 subjects, representing 68.5% of those invited, attended a follow-up visit: 1867 men and 1210 women. At the baseline exam, one third (n=1026) had airway obstruction, which was mild in 271 (8.8%), moderate in 545 (17.7%) and severe in 210 (6.8%). There were no statistically significant differences in the smoking history, age or gender of those who attended the follow-up visit and those who did not (non-responders). However, smokers with airway obstruction were more likely to attend a follow-up visit (87.2%) when compared to smokers with normal spirometry (61.6%, $p<0.001$). The follow-up response rate also differed slightly according to the severity of airway obstruction: 80.4% with mild, 89.9% with moderate, and 89.7% with severe impairment ($p=0.025$).

The mean age of the 3077 subjects was 52.1 (±10.5 SD), and the mean smoking exposure was 30.0 (±17.0) pack-years. The mean Fagerström test for nicotine dependence (FTND) score was 4.76 (±2.4) points. See Table 1 for detailed descriptive statistics categorized according to spirometry results and gender.

Table 1. Baseline anthropometrical characteristics, smoking status, and lung function, stratified by gender and spirometry results.

		Normal spirometry		Airway obstruction	
Variable	Total	Males	Females	Males	Females
N (%)	3077 (100)	1192 (38.7)	859 (27.9)	675 (21.9)	351 (11.4)
Age (yr)	52.1 ±10.5	50.1 ±11.1	50.0 ±8.9	56.8 ±9.9	55.0 ±9.6
Age of smoking initiation (yr)	19.8 ±4.9	18.9 ±4.4	21.1 ±5.1	18.7 ±4.0	21.6 ±5.9
Cigarettes per day	18.9 ±8.3	19.8 ±8.7	16.9 ±6.9	20.0 ±8.8	18.8 ±7.9
Pack-years	30.0 ±17.0	30.4 ±17.2	23.9 ±12.5	37.0 ±16.6	31.0 ±15.6
FEV_1/FVC (%)	74.2 ±12.9	81.1 ±7.4	81.9 ±7.3	59.2 ±9.3	60.1 ±7.5
FEV_1 (L)	2.70 ±0.9	3.46 ±0.8	2.45 ±0.5	2.2 ±0.8	1.69 ±0.6
FEV_1 % predicted	88.5 ±22.8	97.2 ±17.8	96.5 ±17.5	66.1 ±20.2	69.0 ±19.9
FTND (points)	4.76 ±2.5	4.85 ±2.4	4.44 ±2.5	4.93 ±2.4	4.99 ±2.4
No. of previous quit attempts	1.69 ±3.5	1.78 ±4.4	1.80 ±3.0	1.47 ±2.5	1.37 ±2.1

means ±SD unless otherwise indicated
FTND = Fagerström test for nicotine dependence

Successful smoking cessation during the one-year follow-up visit was confirmed by a low exhaled CO level in 686 subjects. Mean exhaled CO in sustained quitters was 5.01±3.4 ppm compared to 17.2±7.7 ppm in subjects continuing to smoke ($p<0.001$). Subjects who continued to smoke reported a lower mean number of cigarettes smoked per day: 19.5 (±8.2) at baseline to 16.5 (±8.1) at one year follow-up. The quit rates were 23.3% for men and 20.8% for women ($p=0.11$). Smokers with airway obstruction were more likely to have quit smoking (26.6%) when compared to those with normal spirometry (20.1%, $p<0.001$).

The smoking cessation rate was recalculated using the conservative assumption that all subjects who did not come for the follow-up visit were continuing smokers. The overall recalculated quit-smoking rate was 13.4%, greater in males (14.6%) than in females (11.7%), and \this difference was statistically significant ($p=0.01$). The quit rate for those with airway obstruction remained higher than those with normal spirometry (16.3% versus 12.0%, $p=0.0003$).

Table 2. Baseline age, smoking characteristics, and differences in spirometry results between continuing smokers and quitters.

Variable	Smokers N 2391	Quitters N 686	p value
Age (yr)	51.8 ±10.1	53.2 ±11.7	<0.005
Age at smoking initiation (yr)	19.6 ±4.7	20.3 ±5.4	<0.005
Cigarettes per day	19.5 ±8.2	16.9 ±8.3	<0.001
Pack-years	30.7 ±16.6	27.4 ±18.1	<0.001
FEV_1/FVC (%)	74.7 ±12.6	72.3 ±13.7	<0.001
FEV_1 (L)	2.73 ±0.9	2.62 ±1.1	<0.02
Airway Obstruction, N (%)	753 (31.5)	273 (39.8)	<0.001
FTND (points)	4.98 ±2.4	4.04 ±2.4	<0.001
No. of previous quits	1.60 ±3.5	1.96 ±3.6	0.055

means ±SD unless otherwise indicated
FTND = Fagerström test for nicotine dependence

Independent predictors of successful smoking cessation included: older age, older age at onset of smoking, fewer cigarettes per day, lower cumulative tobacco exposure, a lower Fagerström score, and lower spirometric values (Table 2). Subjects with moderate and severe airway obstruction were more likely to quit (Table 3).

Table 3. Smoking cessation rates after 12 months of follow-up, stratified by baseline spirometry results.

		Airway obstruction			
Spirometry results:	Normal	Mild	Moderate	Severe	Any
All subjects, n	3441	384	939	357	1680
Quitters, n	413	56	151	66	273
Quit Rate	12.0%	14.6%	16.1%	18.5%	16.3%
p value *	-	0.229	0.005	0.003	0.0003

* The p value compares the quit rate in smokers with airway obstruction to smokers with normal spirometry

Although airway obstruction was a strong predictor of success in stopping smoking, other confounding variables could play a role. To assess possible relationships a logistic regression analysis was used, adjusting the model for gender, age, number of cigarettes smoked daily, nicotine dependence (FTND) and airway obstruction (Table 4).

Table 4. Influence of age, gender, number of cigarettes smoked daily, nicotine dependence and airflow obstruction in logistic regression model assessing sustained one-year smoking cessation.

Variable	β	OR	95% CI	p
Age	0.0062	1.0062	0.99-1.02	0.22
No of cigarettes smoked daily	-0.0180	0.9822	0.96-1.00	0.04
FTND	-0.1331	0.8754	0.83-0.92	0.0001
Airflow Obstruction	0.4402	1.5529	1.24-1.95	0.0002
Female Gender	-0.1562	0.8554	0.69-1.06	0.15

FTND = Fagerström test for nicotine dependence; OR – odds ratio, Exp(β); CI – confidence interval

The logistic regression model showed significant effects of nicotine dependence, number of cigarettes smoked daily and airflow obstruction as predictors of smoking cessation. The effect of impaired lung function was the strongest predictor of sustained cessation (OR 1.6).

DISCUSSION

Spirometry combined with simple, short, anti-smoking behavioural support resulted in a 12% sustained (12 month) smoking cessation rate in smokers with normal spirometry and a 16.3% rate in smokers with airway obstruction. These rates exceed the 4-6% quit rates reported after physician advice.[17-19] In Poland in 2005 year antismoking initiative called The Great Polish Smoke-out covered around 10 million smokers. After the action 100,000 (1%) smokers declared quitting smoking, another 600,000 (6%) did try to stop smoking temporarily, and 1,400,000 (14%) smokers reduced the number of cigarettes smoked daily. Those unpublished yet data reflect spontaneous quit rates after repeated smoking cessation appeals in mass-media, on billboard and pickets.

Better sustained cessation rates were reported in smokers with diseases related to or aggravated by smoking. In a large (1,550 subjects), controlled, British Thoracic Society (BTS) study, at the end of one year, 9.7% of investigated patients had successfully stopped smoking. Smoking cessation was verified by carboxyhaemoglobin and thiocyanate measurements.[20] In our study smoking cessation rate in men was higher than in women (14.6 vs 11.7%). The difference between genders was much lower than that observed in the BTS study, where sustained smoking cessation rate in men more than doubled cessation rate in women (12.2 vs 5.3%).[21]

We used spirometry results to demonstrate harmful effects of smoking, and to reinforce smoking cessation advice. Similar type of intervention was applied in another study where carbon monoxide in the exhaled air was used to demonstrate smokers how much of the lethal gas they have accumulated in their bodies. Two hundreds ten smokers were randomly allocated to four groups: control – no intervention group, antismoking advice group, antismoking advice and carbon monoxide in the exhaled air measurement group and advice plus offer of further help group. After one year the highest stop smoking rate (17%) was observed in the exhaled carbon monoxide group compared to 15% in the advice group, 13% in advice plus further help group and 11% in the control group.[22]

Smoking cessation intervention combined with spirometry was applied in the first Lung Health Study (LHS1) in a large cohort of subjects with mild to moderate airway obstruction.[8] Behavioural techniques and nicotine replacement therapy during the first six months for the

intensive intervention group resulted in biochemically verified quit rate of 22% during 5 years of follow-up. The one year quit rate in this group was 35%. In comparison, the 5 years sustained quit rate was only 5% in the usual care group of LHS1. Fully 93% of those who were abstinent throughout 5 years of LHS1 remained non-smokers after a total of 11 years of follow-up.[23]

Other studies of the benefits of combining smoking cessation advice with spirometry have reported much lower cessation rates. A letter with advice to stop smoking sent to workers with workplace exposure to asbestos and low lung function resulted in a 5.6% quit rate at one year, which was not significantly different when compared to the 3.5% quit rate in those who did not receive the letter.[24]

In another study, smoking cessation advice combined with spirometry resulted in 6.5% cessation rate, which was not significantly different from the 4.5% of sustained (12 months) and validated (cotinine in urine) cessation rate in smokers who received only anti-smoking counselling or only minimal smoking cessation intervention.[25] Badgett and Tanaka[26] and a new report of Agency for Healthcare Research and Quality[27] have expressed doubts that spirometry substantially enhances smoking cessation rates when added to traditional techniques (such as physician advice, nicotine replacement therapy, or counselling).

However, a consensus statement from the United States National Lung Health Education Program (NLHEP) recommended spirometry to increase the motivation of smokers to quit.[28] Our results help to confirm that opinion. We believe that results of objective spirometric measurements superimposed on a simplified diagram of FEV_1 decline in non-smokers versus COPD patients was taken very seriously by the middle-aged smokers attending our program. This may explain the higher smoking cessation rate in our study when compared with general practitioner's advice.[17-19]

In contrast to our findings, the Lung Health Study found that smokers with moderate airway obstruction were not more likely than those with borderline to mild airway obstruction to quit smoking.[29] This difference may be because the Lung Health Study excluded smokers with normal lung function, thus their power to show a difference was much lower than in our study, which included over 2,000 smokers with normal spirometry.

Our smoking cessation rates would probably have been even higher if we had been able to offer nicotine replacement therapy[30-31] or bupropion[29, 32-33] for several months at no cost to our study participants.

Molyneux et al. compared effects of NRT, brief counselling and minimal intervention in 274 smokers. Interventions were performed during hospitalisation. At 12 months abstinence rate was significantly higher in NRT plus brief counselling group compared to brief counselling alone, 17% vs. 6% respectively.[30] Short term positive effects of NRT plus counselling but not at 6 or 12 months were recently reported by Hand.[34]

Smoking cessation in COPD patients is of paramount importance. Despite continuation of airway inflammation in COPD ex-smokers[35] the mean annual decline in FEV_1 return to that observed in healthy non-smokers.[23] There is also a definitive reduction of death rate from lung cancer, myocardial infarction, and stroke in sustained non-smokers compared to continuing smokers.[36-37]

The number of previous quit attempts (approx. 2) characterising presented population was rather low. Number of quit attempts in sustained ex-smokers in Poland averaged 7.[38] Probably our program attracted smokers who had not previously been encouraged by their general practitioners to quit.

Our study has limitations. The subjects were all volunteers from Poland and thus may not be representative of all smokers in other countries. They also showed interest in their own health presenting themselves to the Program, and thus probably were more motivated to quit than other smokers. Our follow-up rate was 68%, but our primary findings were unchanged when we conservatively assumed that all non-responders were continuing smokers. Available, very limited data on the "background quit rate" in Poland (The Great Polish Smoke-out) showed that it was very low. Since we did not randomise study participants to spirometry versus no spirometry, unmeasured confounders may have caused the association of abnormal spirometry with better smoking cessation rates. A large randomised clinical trial is needed to more conclusively answer this important question.

In summary, we have demonstrated that spirometry combined with a short smoking cessation advice from a physician resulted in relatively high smoking cessation rates in adult smokers. Smokers with airflow limitation showed significantly higher smoking cessation rate than smokers with normal spirometry. Screening of adult smokers to detect airway obstruction using spirometry performed by trained technologists, combined with strong smoking cessation advice, has the potential to reduce the burden of COPD in entire countries.

ACKNOWLEDGEMENTS

Authors are thankful to Katarzyna Szamotulska, MSc, PhD from the Institute of Mother and Child in Warsaw for help in statistical analysis. Investigations supported by Polish State Committee for Scientific Research Grant No. 6 PO5D 029 21.

REFERENCES

1 Pauwels RA, Buist AS, Calverley PM, *et al*. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease. NHLBI/WHO Global Initiative for Chronic Obstructive Lung Disease (GOLD) Workshop summary. *Am J Respir Crit Care Med* 2001;**163**:1256-1276.

2 National Center for Health Statistics. *Vital Health Stat Series* 1998;**10**:193.

3 Sullivan SD, Ramsey SD, Lee TA. The economic burden of COPD. *Chest* 2000;**117** (Suppl 2):5S-9S.

4 Sin DD, Stafinski T, Ng YC, *et al*. The impact of chronic obstructive pulmonary disease on work loss in the United States. *Am J Respir Crit Care Med* 2002;**165**:704-707.

5 Murray RP, Anthonisen NR, Connett JE, *et al*. Effects of multiple attempts to quit smoking and relapses to smoking on pulmonary function. Lung Health Study Research Group. *J Clin Epidemiol* 1998;**51**:1317-1326.

6 Burrows B, Knudson RJ, Cline MG, *et al*. Quantitative relationships between cigarette smoking and ventilatory function. *Am Rev Respir Dis* 1977;**115**:195-205.

7 Lange P, Groth S, Nyboe GJ, *et al*. Effects of smoking and changes in smoking habits on the decline of FEV1. *Eur Respir J* 1989;**2**:811-816.

8 Anthonisen NR, Connett JE, Kiley JP, *et al*. Effects of smoking intervention and the use of an inhaled anticholinergic bronchodilator on the rate of decline of FEV1. The Lung Health Study. *JAMA* 1994;**272**:1497-1505.

9 Burchfiel CM, Marcus EB, Curb JD, *et al*. Effects of smoking and smoking cessation on longitudinal decline in pulmonary function. *Am J Respir Crit Care Med* 1995;**151**:1778-1785.

10 van Schayck CP, Loozen JMC, Wagena E, *et al*. Detecting patients at high risk of developing chronic obstructive pulmonary disease in general practice: cross sectional case finding study. *BMJ* 2002;**324**:1370-1375.

11 Zielinski J, Bednarek M, Gorecka D, *et al*. Increasing COPD awareness. Early detection of COPD by high-risk population screening. *Eur Respir J* 2006;**27**:833-852.

12 Standardization of Spirometry, 1994 Update. American Thoracic Society. *Am J Respir Crit Care Med* 1995;**152**:1107-1136.

13 Quanjer PH, Tammeling GJ, Cotes JE, *et al*. Lung volumes and forced ventilatory flows. Report Working Party Standardization of Lung Function Tests, European Community for Steel and Coal. Official Statement of the European Respiratory Society. *Eur Respir J Suppl* 1993;**16**:5-40.

14 Siafakas NM, Vermeire P, Pride NB, *et al*. Optimal assessment and management of chronic obstructive pulmonary disease (COPD). The European Respiratory Society Task Force. *Eur Respir J* 1995;**8**:1398-1420.

15 Fletcher CM, Peto R. The natural history of chronic airflow obstruction. *BMJ* 1977;**1**:1645-1648.

16 Heatherton TF, Kozlowski LT, Frecker RC, *et al*. The Fagerstrom Test for Nicotine Dependence: a revision of the Fagerstrom Tolerance Questionnaire. *Br J Addict* 1991;**86**:1119-1127.

17 Gilpin EA, Pierce JP, Johnson M, *et al*. Physician advice to quit smoking: results from the 1990 California Tobacco Survey. *J Gen Intern Med* 1993;**8**:549-553.

18 Russell MA, Wilson C, Taylor C, *et al*. Effect of general practitioners' advice against smoking. *BMJ* 1979;**2**:231-235.

19 Silagy C, Stead LF. Physician advice for smoking cessation. *Cochrane Database Syst Rev* 2001;CD000165.

20 Comparison of four methods of smoking withdrawal in patients with smoking related diseases. Report by a subcommittee of the Research Committee of the British Thoracic Society. *BMJ* 1983;**286**:595-597.

21 Smoking withdrawal in hospital patients: factors associated with outcome. Subcommittee of the Research Committee of the British Thoracic Society. *Thorax* 1984;**39**:651-656.

22 Jamrozik K, Vessey M, Fowler G, *et al*. Controlled trial of three different antismoking interventions in general practice. *BMJ* 1984;**288**:1499-1503.

23 Anthonisen NR, Connett JE, Murray RP. Smoking and lung function of Lung Health Study participants after 11 years. *Am J Respir Crit Care Med* 2002;**166**:675-679.

24 Humerfelt S, Eide GE, Kvale G, *et al*. Effectiveness of postal smoking cessation advice: a randomized controlled trial in young men with reduced FEV1 and asbestos exposure. *Eur Respir J* 1998;**11**:284-290.

25 Segnan N, Ponti A, Battista RN, *et al*. A randomized trial of smoking cessation interventions in general practice in Italy. *Cancer Causes Control* 1991;**2**:239-246.

26 Badgett RG, Tanaka DJ. Is screening for chronic obstructive pulmonary disease justified? *Prev Med* 1997;**26**:466-472.

27 Agency for Healthcare Research and Quality. Use of spirometry for case finding, diagnosis, and management of chronic obstructive pulmonary disease (COPD). AHRQ Publication No. 05-E017-2, 2005. www.ahrq.gov/downloads/pub/evidence/pdf/spirocopd/spiro.pdf (accessed 10 Apr 2006).

28 Ferguson GT, Enright PL, Buist AS, *et al*. Office spirometry for lung health assessment in adults: A consensus statement from the National Lung Health Education Program. *Chest* 2000;**117**:1146-1161.

29 Murray RP, Gerald LB, Lindgren PG, *et al*. Characteristics of participants who stop smoking and sustain abstinence for 1 and 5 years in the Lung Health Study. *Prev Med* 2000;**30**:392-400.

30 Molyneux A, Lewis S, Leivers U, *et al*. Clinical trial comparing nicotine replacement therapy (NRT) plus brief counselling, brief counselling alone, and minimal intervention on smoking cessation in hospital inpatients. *Thorax* 2003;**58**:484-488.

31 Tonnesen P, Paoletti P, Gustavsson G, *et al*. Higher dosage nicotine patches increase one-year smoking cessation rates: results from the European CEASE trial. Collaborative European Anti-Smoking Evaluation. European Respiratory Society. *Eur Respir J* 1999;**13**:238-246.

32 Hurt RD, Sachs DP, Glover ED, *et al*. A comparison of sustained-release bupropion and placebo for smoking cessation. *N Engl J Med* 1997;**337**:1195-1202.

33 Jorenby DE, Leischow SJ, Nides MA, *et al*. A controlled trial of sustained-release bupropion, a nicotine patch, or both for smoking cessation. *N Engl J Med* 1999;**340**:685-691.

34 Hand S, Edwards S, Campbell IA, *et al*. Controlled trial of three weeks nicotine replacement treatment in hospital patients also given advice and support. *Thorax* 2002;**57**:715-718.

35 Rutgers SR, Postma DS, ten Hacken NH, *et al*. Ongoing airway inflammation in patients with COPD who do not currently smoke. *Thorax* 2000;**55**:12-18.

36 Pelkonen M, Tukiainen H, Tervahauta M, *et al*. Pulmonary function, smoking cessation and 30 year mortality in middle aged Finnish men. *Thorax* 2000;**55**:746-750.

37 Anthonisen NR. Smoking, lung function, and mortality. *Thorax* 2000;**55**:729-730.

38Zatonski W. Tobacco smoking in Central European countries: Poland. In: Boyle P, Gray N, Henningfield J, Seffrin J, Zatonski W, eds. *Tobacco and Public Health: Science and Policy.* Oxford: Oxford University Press 2004:235-52.

Figure 1. This Fletcher and Peto[15] diagram was discussed with participants who had airway obstruction. A black dot was placed at the intersection of the participant's FEV_1 % predicted and current age.