Detecting patients at a high risk of developing chronic obstructive pulmonary disease in general practice: cross sectional case finding study

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Abstract

Objectives To investigate the effectiveness of case finding of patients at risk of developing chronic obstructive pulmonary disease, whether the method is suitable for use in general practice, how patients should be selected, and the time required.
Design Cross sectional study.
Setting Two semirural general practices in the Netherlands.
Participants 651 smokers aged 35 to 70 years.
Main outcome measures Short standardised questionnaire on bronchial symptoms for current smokers, lung function with a spirometer, and the quality of the spirometric curve.
Results Of the 201 smokers not taking drugs for a pulmonary condition, 169 produced an acceptable curve (fulfilling American Thoracic Society criteria). Of these, 30 (18%, 95% confidence interval 12% to 24%) had a forced expiratory volume in one second (FEV_1) $<80\%$ of predicted. When smokers were preselected on the basis of chronic cough, the proportion with an FEV_1 $<80\%$ of predicted increased to 27% (17 of 64; 12% to 38%). Chronic cough was a better predictor of airflow obstruction than other symptoms, such as wheeze and dyspnoea. The presence of two symptoms was a slightly better predictor than cough only (odds ratio 3.02 (1.37 to 6.64) *v* 2.50 (1.14 to 5.52)). Age was also a good predictor of obstruction; smokers over 60 with cough had a 48% chance of having an obstruction. The mean time needed for spirometry was four minutes. Detecting one smoker with an FEV_1 $<80\%$ of predicted cost €5 to €10.
Conclusions Trained practice assistants could check all patients who smoke for chronic obstructive pulmonary disease at little cost to the practice. Cough and age are the most important predictors of the disease. By testing one smoker a day, an average practice could identify one patient at risk a week.

Introduction

Chronic obstructive pulmonary disease is a major health problem, and the number of patients with the disease is increasing.[1–5] About 10% of the general population show signs of the disease, and 26% of patients aged 45 years or over have indications of chronic airflow obstruction.[1 3] Only about a quarter to a half of these patients are known to their doctors.[1 4] The decrease in lung function is gradual. The disease is usually diagnosed late because patients may adapt to the condition or doctors may not notice the symptoms.[4 6–8] By then lung function is often poor, sometimes $<50\%$ of normal.[9 10] Patients may also not see the doctor until the disease is advanced.[11]

At least 95% of people who develop the disease are smokers, and their lung function decreases faster than that of non-smokers.[4 10 12] The most effective intervention is to stop smoking, preferably early.[12 13] Smokers who quit will not recover lost lung function, but the rate of decline may revert to that of a non-smoker.[10] Stopping smoking at an early stage improves the prognosis, regardless of how many attempts it takes to quit.[10 12–14] Depending on the number of cigarettes smoked per day, only 24-47% of smokers develop airflow obstruction.[10] Smokers at risk of developing a smoking related disease are more motivated to stop smoking than those not at risk.[14]

Treatment with anti-inflammatory drugs at an early stage of the disease might improve the prognosis.[2] Inhaled corticosteroids can improve lung function to a certain extent, although the long term effects have been disappointing in chronic obstructive pulmonary disease.[15–18]

Forced expiratory volume in one second (FEV_1) is a reliable and valid method for assessing lung function.[4 19 20] Several spirometers are available for use in general practice. Screening the general population for respiratory symptoms and lung function is effective but not feasible in the daily routine of a general practice.[21] Selecting patients on the basis of risk factors should identify those at risk of developing chronic obstructive pulmonary disease.

We investigated the predictive value of bronchial symptoms for airflow obstruction in current smokers. As airflow obstruction is an essential feature of chronic obstructive pulmonary disease, patients with obstruction can be considered at risk of developing the disease. Repeated measurements of FEV_1 and measurement of reversibility after bronchodilation would establish the diagnosis, but this was beyond the scope of our study.

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Questions asked of smokers before spirometry

How many cigarettes do you smoke a day?
Do you have or have you had any allergies? If so, to what?
Have you ever had asthma or bronchitis?
Have you started to get tired more quickly in the past few years?
Have you been short of breath more often in the past few years?
Have you coughed more in the past few years?
Have you started to wheeze in the past few years?
Are there any lung diseases in your family?

Patients with the disease are usually over 40, and the prevalence of the disease increases with age. We therefore investigated whether selecting for age could further increase the probability of detecting smokers with airflow obstruction. We also assessed the feasibility and efficiency of case finding of patients with chronic obstructive pulmonary disease in general practice by time and cost.

Methods

Patient selection

We recruited patients from two semirural practices in the south east of the Netherlands. Each practice had two general practitioners consisting of a total population of around 10 400. The practices were representative of other practices for patients with chronic obstructive pulmonary disease.

We randomly selected patients between 35 and 70 years of age who visited their doctor. We invited them to complete a form about smoking and whether they were taking drugs for a pulmonary condition. We asked smokers who were not taking pulmonary drugs (corroborated by the doctor's register) to complete another short questionnaire on chronic respiratory symptoms, smoking behaviour, allergy, asthma, and family history (box). We also recorded height.

Assessment of lung function

We assessed lung function with a spirometer that displayed and printed out the flow volume curve.[22] The curves were classified according to the criteria of the American Thoracic Society.[23] Curves meeting these criteria were "good."[23] "Acceptable" curves were those where the first part of the spirometric curve concurred with the criteria, allowing accurate assessment of FEV_1. If accurate assessment was not possible the curves were classified as "unacceptable" (table 1). The spirometer was calibrated before and once during the study. The patients had to produce at least three acceptable curves; we chose the one with the highest sum of FEV_1 and forced vital capacity. For analysis we used the FEV_1 as a percentage of the predicted value, standardised for age, height, and sex.[23] We considered the FEV_1 abnormal if it was below 80% of the value predicted by the guidelines of the Dutch College of General Practitioners and the World Health Organization.[24 25] Practice assistants with at least three years' experience assessed the curves. Before the study the assistants were trained by a laboratory assistant qualified in lung function in two sessions lasting four hours each. The first session comprised instruction and training in the use of spirometry, the second evaluation and refresher training. The performance of the practice assistants during the study was evaluated and corrected when needed by JMCL. Patients with an FEV_1 $<80\%$ of predicted were considered to have undiagnosed bronchial obstruction and were advised to see their doctor.

Table 1 Quality of curves produced by spirometry in 201 smokers according to criteria of American Thoracic Society[20]

Quality of curve	No (%) of patients (n=201)	No (%) of patients with FEV_1 <80% (n=34)
Unacceptable	32 (16)	4 (12)
Acceptable	79 (39)	11 (32)
Good	90 (45)	19 (56)

FEV_1=forced expiratory volume in one second.

Power calculation

Data collected previously by our group showed that about 10% of the general population have airflow obstruction.[1] An α of 5% and a power of 80%, and a minimum detectable relevant difference of 10% in lung function, require at least 78 patients who smoke, whereas a detectable difference of 7.5% requires 166 patients who smoke. A difference of less than 7.5% in lung function is difficult to detect because of the many sources of variability in lung function (for example, variability during the day). Assuming (on the basis of national data) that 33% of the study population smoke, we needed to investigate at least 498 people who were not taking pulmonary drugs.

Analysis

We used both univariate and multivariate analyses. We performed logistic regression using both a stepwise forward and a backward procedure (forward procedure not shown). We also used multilevel analysis to assess the intraclass correlation coefficient to detect possible differences between the two practices in the quality of the spirometry.

Results

Patients' characteristics

We excluded 16 of 683 eligible patients because of insufficient data, and 16 refused to participate. Of the 651 patients remaining, 229 (35%) smoked, and 28 (4%) were excluded for taking pulmonary drugs. Overall, 201 patients completed the questionnaires and underwent spirometry.

Women comprised 62% of the group (404 women). The sex of smokers and non-smokers was similar: 38% (94) of the men smoked compared with 34% (137) of the women. The mean age of patients was 46.7 (SD 7.7) years.

Outcome

The two practices did not differ in the quality of testing (tests good in 85% *v* 83%; intraclass correlation coefficient=0). Of the 169 patients with an acceptable or good spirometric curve, 30 (18%, 95% confidence interval 12% to 24%) had an FEV_1 $<80\%$ of predicted (table 1).

Of 64 patients who reported chronic cough, 17 (27%) had an FEV_1 $<80\%$ of predicted, indicating bronchial obstruction; the negative predictive value for

bronchial obstruction was 87% (table 2). Chronic cough was significantly related to lung function (odds ratio 2.50, 1.14 to 5.52). Wheeze, dyspnoea, and tiredness were not related to FEV_1 <80% of predicted (table 2).

Overall, 105 patients had one symptom (chronic cough, dyspnoea, or wheeze), of whom 23 (22%) had an FEV_1 <80% of predicted (table 2). Fifty nine had two symptoms, of whom 17 (29%) had an FEV_1 <80% of predicted. Twenty three patients had all three symptoms, of whom eight (35%) had an FEV_1 <80% of predicted.

The 35-40 year age group (24% of the total group) had the lowest percentage (of patients with an FEV_1 <80% of predicted (fig 1). Of the 127 patients aged over 40 who had spirometry, 26 (21%) had an FEV_1 <80% of predicted. When cough was present there was an increased chance of detecting patients with obstruction with increasing age (fig 2). Smokers with cough who were older than 60 had a 48% chance of having bronchial obstruction (fig 2).

Time and costs

One lung function assessment took a mean time of 4 (SD 1.1) minutes. Thirty patients with an FEV_1 <80% of predicted were detected. Therefore detecting one patient with an FEV_1 <80% of predicted would take about 23 (21 to 26) minutes (table 3). If only smokers with chronic cough were tested, detecting one patient would take 16 (14 to 18) minutes. If patients with more than one symptom were tested, detecting one patient would take 14 (12 to 16) minutes.

The costs of performing spirometry include the time of the practice assistants and the costs of the equipment. At an average salary of €13 (£7.90, $11.60) per hour, one minute of assessment by a practice assistant would cost €0.22. The cost of detecting one smoker with an FEV_1 <80% of predicted would thus be between €2.64 and €3.96. A spirometer of the type used in our study costs €1275, but a range of machines of varying prices and quality is available. A qualified assistant trained the practice assistants in two sessions. In the Netherlands, these courses cost €64. Therefore the direct costs of detecting one smoker with obstruction would be €5 to €10, depending on the number investigated.

Table 2 Bronchial obstruction in smokers with forced expiratory volume in one second (FEV_1) <80% of predicted within different groups of symptoms

Symptom	No of patients reporting symptom	No (%, 95% CI) of patients with FEV_1 <80%	Odds ratio* (95% CI)	Negative predictive value (%)
Family history:				
Asthma	33	6 (18, 7 to 35)	1.03 (0.38 to 2.77)	82
Allergy	28	6 (21, 8 to 41)	1.35 (0.49 to 3.70)	83
Symptom:				
Tiredness	90	19 (21, 13 to 31)	1.77 (0.77 to 4.06)	87
Chronic wheeze	44	12 (27, 15 to 43)	2.15 (0.94 to 4.88)	85
Chronic dyspnoea	79	19 (24, 15 to 35)	2.19 (0.98 to 4.90)	87
Chronic cough	64	17 (27, 16 to 39)	2.50 (1.14 to 5.52)	87
No of symptoms:				
1	105	23 (22, 14 to 31)	2.28 (0.93 to 5.60)	89
2	59	17 (29, 18 to 42)	3.02 (1.37 to 6.64)	88
3	23	8 (35, 16 to 57)	3.01 (1.17 to 7.70)	85

*Estimates of common odds ratio by Mantel-Haenszel test.

Table 3 Time (minutes) needed for detecting one patient with a forced expiratory volume in one second <80% of predicted for selected groups of smokers in general practice

Group	Time for detecting patient (95% CI)
All smokers	23 (21 to 26)
Smokers with cough	16 (14 to 18)
Smokers with 2 symptoms (cough, dyspnoea, or wheeze)	14 (12 to 16)
Smokers with 3 symptoms (cough, dyspnoea, and wheeze)	12 (10 to 14)

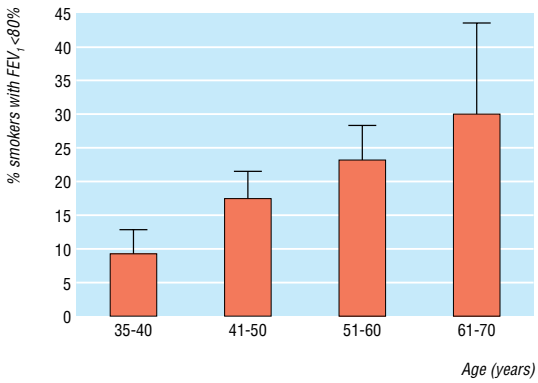

Fig 1 Percentage of smokers with forced expiratory volume in one second <80% of predicted by age group

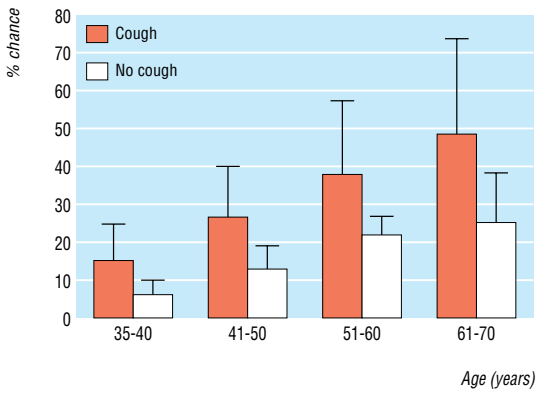

Fig 2 Chance of having bronchial obstruction with increasing age in smokers with or without cough. Bars are 95% confidence intervals

Discussion

Efficient case finding

Case finding of patients with chronic obstructive pulmonary disease in general practice is a more realistic approach than screening. Since smoking is the most important risk factor for developing the disease and smoking cessation is the most effective intervention at any stage of the disease, the first step should be to select smokers. In our study one patient at risk of developing chronic obstructive pulmonary disease was found for every six smokers tested. The positive predictive value of cough for airflow obstruction among smokers was 27%. Therefore for every smoker with cough found to be at risk, about four smokers with cough had to be tested. The positive predictive value of at least two of the symptoms of cough, dyspnoea, or wheeze was only slightly higher (29%), so there is only little additive value in asking about symptoms other than cough. In patients with all three symptoms the prevalence was 35%; among these patients, for every smoker found to be at risk, three smokers had to be tested.

We needed a mean of 4.1 minutes to assess one patient and could detect one patient with an FEV_1 $<80\%$ of predicted in a group of smokers in 12 to 23 minutes, depending on the selection criteria used. We recommend testing all smokers who have chronic cough. It would then take about 15 minutes of the practice assistant's time to find one patient at risk of developing chronic obstructive pulmonary disease. It would be more time efficient to test only smokers with all three symptoms, in which case finding one patient would take about 12 minutes, but more smokers with airflow obstruction would not be detected (in this case 22 out of 30).

In our survey, 35% of a random sample of patients visiting their doctor smoked. Of the women, 34% smoked, compared with 38% of the men. This is comparable to the average smoking rates in Holland.[26] Some recruitment bias may have been present because more women than men visit their doctors. Also, more men currently smoke. Recruitment bias can be regarded as a potential disadvantage of case finding, as the method can be expected to detect a lower proportion of men with airflow obstruction.

A low FEV_1 is an essential feature for a diagnosis of chronic obstructive pulmonary disease, although certainly not the only one. Patients with a low FEV_1 have not yet been diagnosed as having chronic obstructive pulmonary disease, but they are at a high risk of developing it. To find out which of these patients will ultimately be diagnosed as having the disease, the FEV_1 has to be measured repeatedly. In addition, forced vital capacity has to be determined and reversibility after bronchodilation has to be assessed. This was beyond the scope of our study; we aimed to find patients at a high risk of developing the disease. Therefore we assessed the most suitable and efficient examination method for general practice, using practice assistants without directly involving the doctor. Assessing reversibility after salbutamol takes 10-15 minutes and after ipratropium bromide 45 minutes. Moreover, the doctor has to be involved in assessing reversibility (which should be done at least under the supervision of the doctor). Previous studies in the general population have shown that patients have no objections to spirometry but do often object to taking drugs for the assessment of reversibility.[21] Therefore a two step procedure seems logical and efficient: the practice assistant would be responsible for case finding of patients at a high risk of developing chronic obstructive pulmonary disease (including the assessment of lung function if appropriate) and the doctor would make the diagnosis and instigate treatment.

The quality of the spirometric curve depends on the device used and the patient's cooperation as well as on the practice assistants' performance.[27] Of the spirometric curves we obtained, 84% were of sufficient quality to determine FEV_1 according to the criteria of the American Thoracic Society.[20] FEV_1 can be measured in general practice by a practice assistant, after brief instruction and training.[28]

Limitations of the study

Mainly for logistical reasons, our study included only two practices. We aimed to test case finding under real life circumstances over a period long enough to allow the build up of some routine. To this end, the practices kept up this case finding procedure for about six months, operating as much as possible in natural circumstances to imitate real daily practice as closely as possible.

Using only two practices might have hampered the external validity of the study, but this is unlikely as the doctors did not have any special interest either at present or in the past in detecting asthma or chronic obstructive pulmonary disease, nor had they any other research programmes running. Hence, these practices were neither more nor less likely than other practices to have cases of undetected asthma or chronic obstructive pulmonary disease.

Preventive measures

If no effective remedial measures are available, there is no sense in screening or case finding. We believe, however, that such a measure is available. Stopping smoking reverses the development of chronic obstructive pulmonary disease. That smokers are probably more motivated to stop smoking when they know that they are at risk of developing a chronic lung disease is illustrated by a study of a longitudinal cohort in which patients who continued to smoke had a much steeper decline in lung function than those who stopped smoking, whereas smokers who stopped smoking still had a steeper decline than never smokers.[13] The lung health study confirmed that smoking cessation could reverse the steep decline in lung function.[12] Further follow up showed that attempts to quit smoking could prevent loss of lung function, especially in patients with mild disease.[29] Follow up also resulted in fewer respiratory symptoms after prolonged abstinence.[30] It is difficult to get smokers to quit. However, smokers are more motivated to stop smoking if they realise that their respiratory problems are caused by smoking and that they are at risk of developing chronic obstructive pulmonary disease or other smoking related diseases.[14 31]

Screening or case finding?

Detecting one smoker aged between 35 and 70 years with an FEV_1 $<80\%$ of predicted took an average of 23 minutes in our survey. Increasing the detection rate by further selection on cough can reduce the time to about 15 minutes per patient detected. By testing one smoker with cough a day, one or two patients at risk would be found every week. All these patients are at high risk of developing chronic obstructive pulmonary disease. They should be carefully followed and should at least be encouraged to give up smoking. It seems likely that patients who are clearly at risk of the disease are more likely to stop smoking.[14 31]

Considering that chronic obstructive pulmonary disease is one of the main diseases in the Western world and that it is estimated to become the third leading cause of death in the next decade (while mortality from cardiovascular diseases seems to be declining), smoking cessation will become even more important. Because only half, at most, of the patients with an obstructive airflow disease are known to their doctor, the first step should be to detect patients at an early stage and to offer them an effective intervention—namely, to stop smoking at a time when they are motivated to do so.[1 4] Our study shows that this first step can be done in an effective and efficient way by case finding in general practice. Although screening the general population is possible,[1 11 21 31] implementing screening

What is already known on this topic

The number of patients with chronic obstructive pulmonary disease continues to increase

Screening a practice population for the disease is not feasible

Smoking is a known risk factor for patients developing the disease

What this study adds

Case finding of chronic obstructive pulmonary disease by examining smokers is effective and can be implemented in general practice

Cough and age are good predictors of the disease in smokers

Practice assistants can measure lung function at low cost

in primary care is rather difficult,[6 16] and case finding is likely to be a more suitable approach in this setting.

The feasibility of case finding depends on several factors: the way patients are selected, the time needed to perform the assessment, the availability of skilled staff, the quality of the assessment, the availability of a suitable spirometer, the doctor's knowledge, a suitable room, and a cooperative patient. We have shown that case finding for chronic obstructive pulmonary disease is a suitable method in general practice. It can be implemented by practice assistants after a brief training course.

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