Prevalence of undetected persistent airflow obstruction in male smokers 40–65 years old

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Background. Airflow obstruction in smokers is often diagnosed relatively late. Earlier detection of airflow obstruction and smoking cessation may result in significant health gain.

Objective. To determine the prevalence of previously undetected persistent airflow obstruction according to WHO/GOLD criteria in male smokers aged 40 to 65 years and its correlation with age, smoking history and the presence of coughing.

Methods. In a cross-sectional study among 805 male smokers aged 40–65 years spirometry was performed according to ATS recommendations. In participants with low lung function (FEV1 < 85% predicted) a bronchodilator test was performed.

Results. In 702 participants [mean age 50 years (SD 6.6), mean number of pack years 24.7 (SD 9.6)] with acceptable spirometric curves, previously undetected airflow obstruction was found in 210 subjects (29.9%; 95% CI 26.5–33.4): mild airflow obstruction (GOLD stage 1) in 182 subjects (25.9%; 22.7–29.3) and moderate airflow obstruction (GOLD stage 2) in 28 (4.0%; 2.7–5.7). In the older age group (>55 years) airflow obstruction (GOLD 1 or higher) was found in 45% versus 21% in the youngest age group (40–44 years). In subjects with ≥30 pack years the prevalence of airflow obstruction was 45% versus 20% among those with <20 pack years. In smokers reporting coughing the prevalence was 47% versus 25% in those not reporting this symptom.

Conclusion. The prevalence of undetected persistent airflow obstruction in middle-aged smokers is high. Targeted screening therefore, especially in smokers aged 40–65 years needs to be considered.

Keywords. Airflow obstruction, middle age, screening, smokers, spirometry.

Introduction

Chronic obstructive pulmonary disease (COPD) is a major health problem. Of all cases of COPD 80–90% are supposed to be caused by smoking.1,2 However, only 10 to 15% of smokers will develop COPD.2 The estimated prevalence of COPD, defined as a FEV1/FVC ratio <0.7, in the general population in the US varies from about 3% in never smokers to 14% in both male and female current smokers.3 Only a small proportion of patients with COPD is diagnosed as such by their GP. The prevalence of physician-diagnosed COPD in the UK was 1.4% among women and 1.7% among men.4

Persons with unrecognised COPD usually have relatively mild lung function impairment5 but early detection of undiagnosed airflow obstruction is relevant since the benefit of smoking cessation has also been shown in patients with early stages of COPD.6 Using different criteria to define airflow obstruction in the past hampered the comparison of the prevalence rates of different studies. After publication of the WHO Guidelines on COPD (GOLD) in 2001 and the subsequently yearly updates a more uniform classification has been advocated worldwide which is now widely accepted.7,8 Unlike earlier guidelines on COPD, the GOLD classification includes a relatively novel early stage of COPD: GOLD stage I, defined by a decreased FEV1/FVC ratio (<0.7) in combination with a FEV1 within the normal range (≥80% predicted). Classification of more advanced stages is still based on FEV1 measurements. Although knowledge of the magnitude of the prevalence of unrecognised persistent airflow...
obstruction is important, the number of available studies using the GOLD criteria is small.9–11 Several other studies suffer from limitations, such as large differences in the definition of COPD applied12–15 or not using postbronchodilator lung function measurements.13,16,17

The aim of the study was to determine the prevalence of undetected airflow obstruction according to the GOLD classification in a cohort of male smokers aged 40 to 65 years without known obstructive lung disease or any other pulmonary condition.

Methods
This study describes the first part of the IJsselstein Study, a cohort study in a small city in the centre of The Netherlands, aimed to assess the prevalence and determinants of undetected airflow obstruction in middle-aged smokers. The first part of the study was conducted in 1998 and follow-up measurements were performed from 2003 onwards. Our study focussed on a population with a known high risk to develop airflow obstruction, i.e. middle-aged male smokers without lung medication or diagnosed lung disease.

Study population
All men (n = 3985) aged 40 to 65 years enlisted with a GP in IJsselstein were asked by letter if they smoked one or more cigarettes per day during the previous 12 months, and if so, whether they were willing to participate in a study to identify undetected airflow obstruction. Subjects with documented lung disease (222, 5.6%) were excluded. A total of 2596 of the 3763 men without previously documented lung disease returned the form (69%). Among the 2596 respondents 978 (37.7%) subjects reported to be current smokers. Sixty ‘current’ smokers were excluded at the first examination because of smoking cessation since more than 12 months (33), smoking only pipe or cigars (17) or because of reporting a lung disease yet (10). Thus the eligible population consisted of 918 (35.4%) current cigarette smokers without known lung disease. Eventually, 805 of the 918 eligible subjects (87.7%) attended the first survey.

Spirometry
In all participants spirometry was performed using a hand-held spirometer (vitalograph 2170). Each subject had to perform at least three acceptable forced vital capacity manoeuvres while sitting. The results were shown on a computer screen and the procedure was supported by computer software (Spirotrack). When the FEV1 predicted was less than 85% a bronchodilator test was performed by inhalation of two puffs of terbutaline 250 mcg by an inhalation chamber. When the FEV1 predicted, after an interval of 15 minutes, was still less than 85% an additional bronchodilator test (at least 30 minutes after inhalation of two puffs of ipratropium bromide 20 mcg) was performed on another day within a month. All measurements were performed by one experienced and especially trained nurse practitioner. The spirometer was calibrated with a 1-litre syringe at least once a week. Two investigators (RMMG, APES) independently assessed the quality of the flow-volume curves and time-volume curves according to the criteria of the American Thoracic Society.18 In case of disagreement, a final assessment was made by a lung physiologist. The manoeuvres with the largest sum of FEV1 and FVC were used in this analysis.

Airflow obstruction was classified according to the 2003 update of the WHO/GOLD criteria.7,8 According to these guidelines COPD is defined by a FEV1/FVC ratio <0.7. The severity of COPD is distinguished in 4 stages:

- mild (GOLD stage I): FEV1 predicted ≥80%;
- moderate (GOLD stage II): 50% ≥ FEV1 predicted <80%;
- severe (GOLD stage III): 30% ≥ FEV1 predicted <50%;
- very severe (GOLD stage IV): FEV1 predicted <30%.

All cut-off values refer to postbronchodilator measurements. A total of 128 subjects performed a prebronchodilator FEV1 predicted <85%. Among them were 30 of the 158 subjects with prebronchodilator GOLD I. Postbronchodilator GOLD I was found in 25 (83.3%) of the 30 subjects with prebronchodilator GOLD I.

Questionnaire
The Airways Questionnaire (AQ20), a short questionnaire to measure health-related quality of life among patients with chronic obstructive pulmonary disease, was filled in by the participants before the pulmonary function test.19 The item concerning coughing (do you have coughing spells in day-time, yes/no) was included in the current analysis.

Statistical methods
Predicted values of FEV1 and FVC were computed using the regression equations of the European Coal and Steel Community (ECSC).20 Statistical analyses were performed using the statistical package SPSS 10.0.

Results
General characteristics
All participants (805) underwent spirometry. A total of 103 participants (12.8%) produced an unacceptable spirometric curve. Among subjects with and without acceptable curves, no relevant differences in the characteristics listed in Table 1 were found. The data of the 702 participants with acceptable curves were used for the analysis. The characteristics of the 702 participants are shown in Table 1. The mean age was 50.0 years (SD 6.6).
and the mean number of cigarette pack years 24.7 (SD 9.6). The mean FVC predicted and FEV1 predicted was 110% (SD 15) and 99% (SD 14), respectively, and the mean FEV1/FVC ratio was 0.73 (SD 0.07).

Prevalence of airflow obstruction
Airflow obstruction was found in 210 subjects (29.9%; 95% CI 26.5–33.4) (Table 1). In 182 subjects (25.9%; 95% CI 22.7–29.3) the airflow obstruction was mild (GOLD stage I). Prebronchodilator moderate airflow obstruction (GOLD stage II) was found in 53 participants (7.5%; 95% CI 5.7–9.8). Postbronchodilator GOLD stage II was found in 28 subjects (4.0%; 95% CI 2.7–5.7), including one participant who met GOLD stage III criteria. No one met GOLD stage IV criteria.

Determinants of airflow obstruction
The prevalence of previously undetected airflow obstruction was associated with age, smoking history and coughing (Table 2). In participants aged 55 years or over the prevalence rates of GOLD stage I and GOLD stage II were higher than in subjects aged 40–44 years, 38% versus 19% and 7% versus 2%, respectively (Table 2). Correspondingly, in subjects aged 55 years or over, FEV1/FVC ratio and FEV1 (% predicted) were lower than among subjects aged 40–44 years, 0.70 versus 0.75 and 95% versus 100%, respectively.

Among participants who smoked 30 pack years or over, FEV1/FVC ratio and FEV1 (% predicted) were lower than among smokers who smoked less than 20 pack years, 0.69 versus 0.75 and 95% versus 101%, respectively.

In smokers reporting coughing, the prevalence rates of GOLD stage I and GOLD stage II were higher than in smokers not reporting coughing, 37% versus 23% and 10% versus 2%, respectively. Correspondingly, in smokers reporting coughing, the FEV1/FVC ratio and FEV1 (% predicted) were lower than among smokers not reporting coughing, 0.70 versus 0.74 and 95% versus 100%, respectively.

Discussion
In a population of male smokers—40 to 65 years old—not known with obstructive lung disease the prevalence rates of previously undetected COPD stage I and stage II according to the GOLD criteria were 25.9% and 4.0%, respectively. The prevalence rates of both GOLD I and GOLD II were associated with age, the number of pack years and the presence of coughing.

Some limitations of our study should be considered. Firstly, our study included only men because of limited resources and the known higher smoking rate and prevalence rate of airflow obstruction in men. In The Netherlands the smoking rate of men is 40% in those aged 35–49 years and 31% in those aged 50–64 years; in women these figures are 34% and 23%, respectively.21 Because of the increasing smoking rate of Dutch women in recent decades, one may expect that the prevalence rate of airflow obstruction in female smokers will rise and will likely be similar to the prevalence rate of the Dutch male smokers in the near future.13,21 Secondly, only we performed bronchodilator testing in subjects with FEV1 %
predicted <85%. Although our study was designed to assess airflow obstruction according to a widely used clinical criterion (postbronchodilator FEV1 predicted <80%), we have—in retrospect—decided to use the GOLD criteria for COPD, published after we conducted our measurements. The GOLD criteria are currently widely accepted and can be relatively easily applied, although the one-dimensional severity grading—i.e. based on lung function—is discussed. According to the GOLD guidelines, bronchodilator testing should be performed in all subjects with airflow obstruction, i.e. also in subjects with GOLD I (FEV1/FVC <0.7 and FEV1 ≥80% predicted). In 30 of the 157 subjects with prebronchodilator GOLD I a bronchodilator test was performed and only in 5 subjects (5/30; 16.7%) postbronchodilator spirometry was normal. Extrapolating this finding to the 127 subjects with prebronchodilator GOLD I who did not perform a bronchodilator test, implies that 21 of the 127 subjects (16.7%) should have produced postbronchodilator normal spirometry. Thus, 161 rather than 182 subjects would have been diagnosed as GOLD I, giving a slightly lower estimated prevalence rate of GOLD I (22.9% rather than 25.9%).

One of the strengths of our study is that the survey was performed in a population representative for the Dutch population at large. For example, 35% (918) of those who returned the questionnaire on smoking habits were current smokers, a figure comparable to the expected proportion of smokers (35–36%) in men aged 40–65 years in The Netherlands. In addition a rather high proportion (87.7%) of the eligible male smokers participated. Thus, selective response seems unlikely.

In literature the prevalence rates of airflow obstruction vary widely because of differences in the study populations, especially concerning to age, smoking habits and health status, as well as using different reference values or various definitions of airflow obstruction. For example, in several studies pre-bronchodilator FEV1 was used to define COPD, which is not according to GOLD criteria. Notably, in our study the prevalence rate of prebronchodilator GOLD II (7.5%) was 3.5% higher than the prevalence rate of postbronchodilator GOLD II (4.0%). Since publication of the GOLD guidelines, as far as we know, only in 3 studies previously undetected postbronchodilator airflow obstruction defined according to the GOLD guidelines (FEV1/FVC ratio <0.7) in middle-aged male smokers was reported. In a Greek study a prevalence rate of 12% was observed while the prevalence rates in two Swedish studies varied from 8% (46–47 years) and 24% (61–62 years) to 30%, respectively. The latter prevalence rate was similar to the findings of our study.

A clear distinction between COPD and asthma is not possible in all subjects with airflow obstruction, even when the GOLD criteria for COPD are used. We found a significant bronchodilator response, i.e. an improvement of FEV1 both larger than 12% predicted and exceeding 200 ml, in 10 subjects. In 4 of those 10 participants we observed postbronchodilator airflow obstruction, thus fulfilling criteria of both asthma and COPD while 6 subjects performed normal spirometry.

In general practice active detection of airflow obstruction by means of spirometry in smokers should be encouraged and smokers with newly diagnosed airflow obstruction should be offered smoking cessation intervention. However, there are no evidence-based guidelines how GPs can effectively identify airflow obstruction in smokers. Different strategies are advocated such as case finding among smokers attending the GP as well as screening in smokers aged 45 years or over who report smoking during a clinical encounter. When case finding is limited to symptomatic smokers, approximately 70% of the smokers with GOLD I (127/182) and about 50% of the subjects with GOLD II (13/28) will be missed (Table 2). In several countries spirometry in primary care has been advocated and is facilitated in recent years. In The Netherlands most GPs can order lung function testing in diagnostic centres or in hospitals and in a minority of the general practices spirometers and well-trained nurse practitioners are available. In the UK 2004 General Practice contract the focus on respiratory disease is increased and the use of spirometry in order to actively detect airflow obstruction is encouraged.

We conclude that the prevalence of undetected persistent airflow obstruction is high. Targeted screening therefore, especially in smokers aged 40–65 needs to be considered.

Declaration

Funding: the study was funded by the Dutch Asthma Foundation.

Ethical approval: the study has been approved by the ethics committee of the University Medical Centre Utrecht and has conformed to the principles embodied in the Declaration of Helsinki.

Conflicts of interest: none.

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