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ORIGINAL RESEARCH

Low body mass index, airflow obstruction, and dyspnoea in a primary care COPD patient population

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Abstract

Aim: The objective of our study was to explore the existence/co-existence of factors – as per American Thoracic Society (ATS)/European Respiratory Society (ERS) standards – for staging patients in a primary care COPD population.

Method: A representative sample of COPD patients in primary care was studied. Cross-sectional information on airflow obstruction, body mass index (BMI), and dyspnoea (Modified Medical Research Council [MMRC] score) were collected. The existence/co-existence of these prognostic factors is described.

Results: The study sample consisted of 2,023 patients. BMI was low in 11.7%, MMRC score ≥ 2 was found in 28.7%, and 53.9% fulfilled the criteria of relevant airflow obstruction. Only 3.4% of this population scored on all three prognostic factors.

Conclusion: Moderate dyspnoea and moderate airflow obstruction were rather prevalent in this primary care population, but co-existence of factors was low. Therefore, it seems that the assessment of BMI and dyspnoea represent additional information on primary care COPD patients.

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Introduction

Traditionally, the diagnosis and classification of chronic obstructive pulmonary disease (COPD) is based on spirometric assessment only.[1] However, the majority of patients with COPD in primary care are categorised as GOLD (Global Initiative for Obstructive Lung Disease) stages 1 or 2, while their levels of functional impairment and prognosis may differ substantially.[2] Therefore, the American Thoracic Society (ATS)/European Respiratory Society (ERS) guideline for the diagnosis and management of patients with COPD recommends a staging system that presents a composite picture of disease severity.[3] According to these recommendations, assessment of COPD severity comprises measurement of forced expiratory volume in one second (FEV_1), the level of dyspnoea, and Body Mass Index (BMI) in all patients.[3] Multicomponent staging tools for COPD such as the BODE index (BMI, Obstruction, Dyspnoea, and Exercise capacity index), COPD Severity Score (COPDSS), and COPD Prognostic Index (CPI) have recently been developed, all of which consist of some of the disease severity components.[4-6] The BODE index and CPI were found to be better predictors of mortality than FEV_1 alone.[4,5]

However, empirical evidence on disease severity components and multicomponent staging tools comes from studies performed in secondary and tertiary care settings. Only for the COPDSS has its validity been assessed in a

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primary care COPD population, but this particular instrument does not contain staging factors recommended by the ERS/ATS guideline (i.e. BMI and FEV1).[6,7] From a primary care perspective there is a concern that the spectrum of the predominant severity components in the staging tools are strongly skewed towards mild outcomes. If that is indeed the case, the staging tools will not be able to discriminate disease severity levels in primary care COPD patient populations. Only one study has described the prevalence of high dyspnoea scores and low BMIs in primary care COPD patients; however, this study included participants of a trial examining an outpatient disease management program,[8] whereas a large and representative patient sample is needed to study the full spectrum of COPD severity levels in primary care. Moreover, information on the co-existence of severity components is needed to determine the need to collect information on all individual severity components.

Therefore, in this study we investigated (i) the prevalence, and (ii) the co-existence, of low BMI, moderate or severe dyspnoea, and moderate or severe airflow obstruction, in a large representative population of COPD patients managed in Dutch general practices.

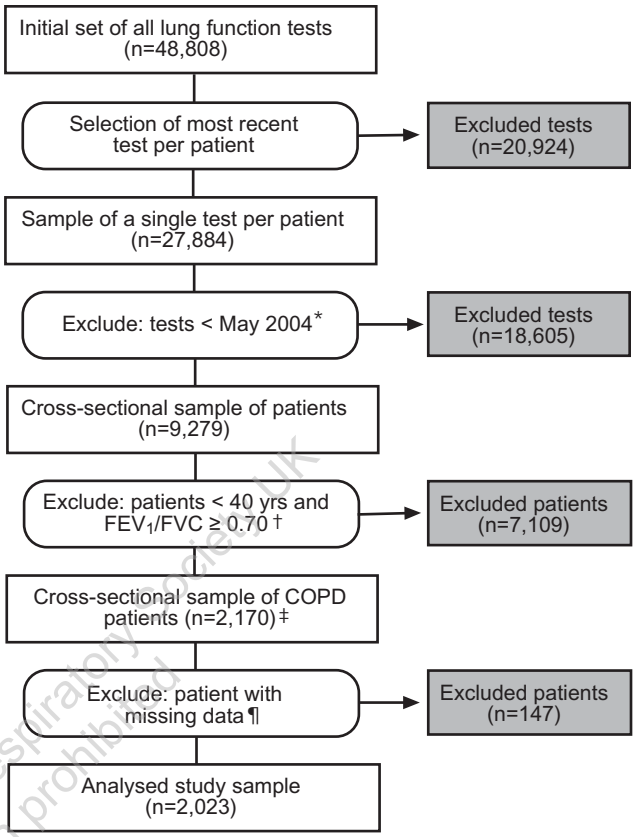
Methods

Study population and selection of patients

Our study was a cross-sectional study based on available data from a regional primary care diagnostic centre in the South-western part of the Netherlands (the 'Stichting Huisartsen Laboratorium Etten-Leur' – SHL), that has provided a range of diagnostic and healthcare services (including spirometry) for more than 330 general practitioners (GPs) in the region since 1997. The region consists of urban and rural districts and practices are representative of Dutch general practices in terms of practice size (single-handed practices versus group practices).[9] Details of the SHL diagnostic centre, procedures, and database are described elsewhere.[10,11] Briefly, lung function technicians of the SHL support GPs' management of patients with COPD through monitoring of respiratory health data and compilation of feedback reports. The monitoring consists of repeated, standardised assessment of lung function, body weight, height, dyspnoea and other symptoms, smoking status, medication use, and exacerbation history.

We used all respiratory health data from the SHL. Figure 1 describes the selection procedure of patients with COPD from the SHL database. We selected data from May 2004 until May 2006. In case a patient had more than one test in the database, the most recent test was selected. Patients < 40 years of age and patients with a post-bronchodilator FEV_1/forced vital capacity (FVC) ratio ≥ 0.70 were excluded, as were cases with missing data.

Figure 1. Flow chart of patient selection in the study.



* To assure a current population and uniform collection of information

† Post-bronchodilator, 15 min after administration of 400 mcg aerosolised salbutamol through spacer

‡ Patients ≥ 40 years of age with a post-bronchodilator FEV_1/FVC ratio < 0.70

¶ 98 missing values BMI; 13 missing values MMRC; 12 missing values smoking; 29 missing values pack-years; 12 missing values exacerbations; 25 missing values medication use (Some patients were excluded based on multiple missing values)

Measurements and outcomes

Pre- and post-bronchodilator FEV_1 and FVC were measured with an electronic spirometer (SpiroPerfect®, WelchAllyn, Delft, The Netherlands). FEV_1 as a percentage of the predicted value (FEV_1% predicted) was calculated using reference equations from the European Community for Coal and Steel (ECCS).[12] Lung function technicians assessed patients' height and weight at every visit. BMI was defined as the patient's body weight divided by the squared height. Dyspnoea symptoms were elicited using the Modified Medical Research Council (MMRC) Questionnaire.[13]

Analysis

The characteristics of the study population and prevalence of

low BMI, level of dyspnoea, and airflow obstruction classified according to the ATS/ERS guideline criteria were described.[3] Since the ATS/ERS guideline does not provide information on prognostic thresholds of MMRC score and airflow obstruction, we used the empirical model for computing the BODE score to calculate interaction between the severity components.[4] We used an area-proportional Venn diagram to visualise the (co-)existence of a low BMI (<21 kg/m^2), dyspnoea (MMRC score ≥ 2), and airflow obstruction (FEV_1 ≤ 64 % of predicted) in our study sample. The best fitted area-proportional Venn diagram was designed using 3Venn Applet software (http://www.cs.kent.ac.uk/people/staff/pjr/EulerVennCircles/ EulerVennApplet.html).[14] Correlations between the three prognostic factors (BMI, MMRC score, airflow obstruction) were tested with the Kendall tau-b test. r < 0.3 was considered a weak correlation, r between 0.3 and 0.7 a moderate correlation, and r > 0.7 a strong correlation. P-values used in the analyses are two-tailed and differences with p < 0.05 were considered statistically significant. The Statistical Package for Social Sciences (SPSS version 14.0.0, Chicago, USA) was used for the analysis.

Results

Patients

The final study population consisted of 2,023 patients. The characteristics of the study sample are given in Table 1. Overall, 61.8% of all patients were males and 43.7% were current smokers.

Severity components

Of the total population, 76.4% had mild to moderate severe airflow obstruction (i.e., FEV_1 ≥ 50 % predicted) and 46.1% did not fulfil the prognostic "obstruction" criteria (i.e., FEV_1 ≤ 64 % predicted). Only 2.5% of the sample was classified as GOLD stage IV. Table 1 shows that BMI was low (≤ 21) in 11.7% of the population. An MMRC score of 2 or higher was found in 28.7% of the sample; prevalence of MMRC scores 3 and 4 were very low (MMRC score 3: n=58, 2.9%; MMRC score 4: n=14, 0.7%). Overall, 64.4% of all patients showed a limitation in one severity component (either airflow obstruction, or low BMI, or dyspnoea according to the MMRC), while 23.1% scored on two components, and 3.4% scored on all three components. The overlap of severity components is visualised in Figure 2. Correlations between BMI and FEV_1 categories and between MMRC score and BMI were weak (r=0.03 and r=0.08, respectively). The correlation between the FEV_1% of predicted categories and MMRC scores just reached the lower limit of a moderate correlation (r = 0.30).

Table 1. Characteristics and disease severity components of the COPD patient study sample (number with percentage, except when stated otherwise).

	COPD-population (n = 2,023)	
Age[1]	62.8	(10.8)
Gender (male)	1250	(61.8)
Airflow obstruction		
(Post-bronchodilator FEV_1 % predicted)		
≥ 80	289	(14.3)
50 – 80	1256	(62.1)
30 – 50	427	(21.1)
< 30	51	(2.5)
Dyspnoea (MMRC score)		
0	623	(30.8)
1	819	(40.5)
2	509	(25.2)
3 or 4	72	(3.6)
Low weight (BMI)		
< 21 kg/m^2	237	(11.7)
>= 21 kg/m^2	1786	(88.3)
Cigarette smoking		
never	261	(12.9)
former smoker	878	(43.4)
current smoker	884	(43.7)
Packyears[1]	26.8	(18.8)
Use of respiratory medication		
None	490	(24.2)
Short-acting bronchodilator	767	(37.9)
Long-acting bronchodilator	965	(47.7)
Inhaled corticosteroids	1115	(55.1)
Post-bronchodilator lung function		
FEV_1[1]	1.95	(0.7)
FEV_1% of predicted[1]	62.5	(16.4)
FEV_1/FVC %[1]	58.8	(9.5)
Exacerbations in past 12 months		
Yes	727	(35.9)
No	1296	(64.1)
Number of exacerbations		
1	538	(26.6)
≥ 2	189	(9.3)

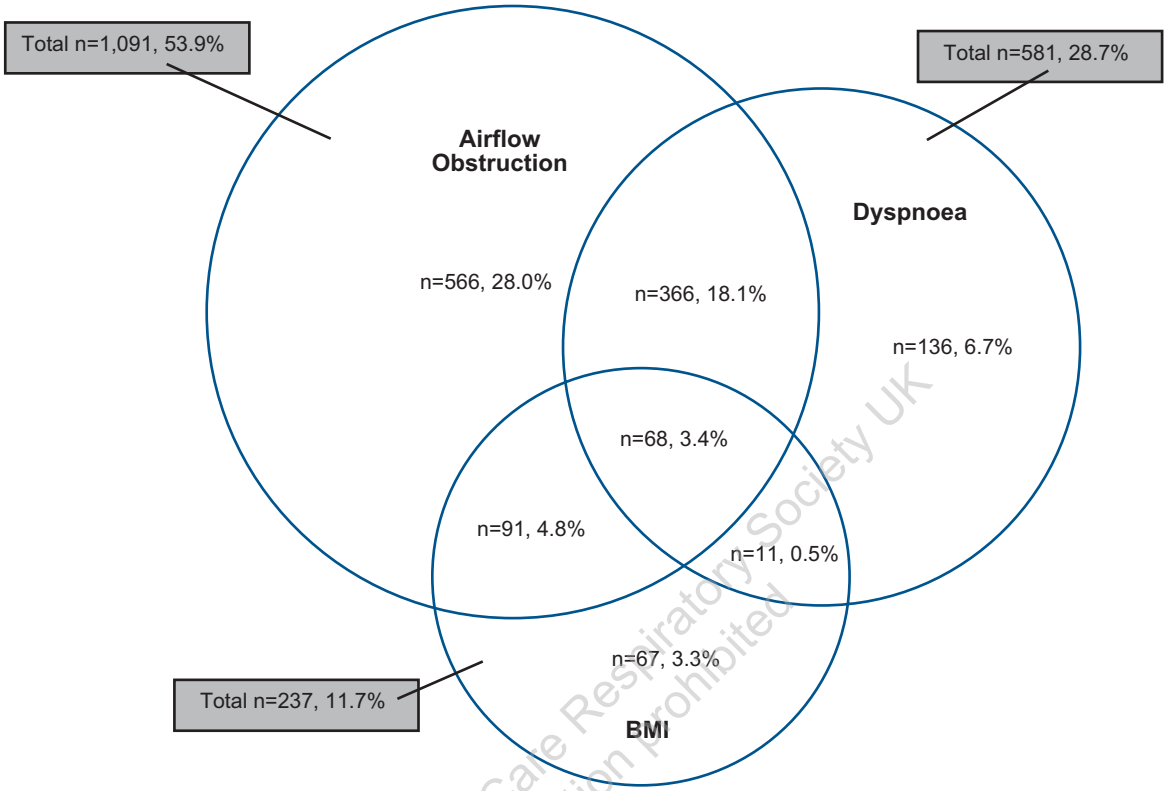
[1] mean (SD)

Discussion

Summary of findings

In order to explore the usefulness of factors recommended by the ATS/ERS guideline for prognostic staging of patients with COPD we have described the (co-) existence of three components of disease severity in a large and representative primary care COPD patient sample. Some of the individual components, especially an FEV_1 between 50 and 80% of

Figure 2. Venn diagram of percentages of primary care COPD patients (n=2,023) that fulfilled the severity component criteria for Body Mass Index (<21), Airflow Obstruction (FEV_1% of predicted < 65%), and / or Dyspnoea (MMRC ≥ 2) resulting in increased mortality risk according to the BODE index



predicted and an MMRC score of 2, were prevalent. The co-existence of severity components was low.

Comparison with previous studies

In this study, 76% of the patients with COPD were classified as mild to moderate COPD according to airflow obstruction criteria, which is comparable to the findings of Hoogendoorn[1] (82%) and Steuten[8] (78%). Also, the prevalence of MMRC score 2 and low BMI were quite comparable with the study by Steuten *et al* (30%, 12% in their sample[8]).

Prognostic thresholds

We used BODE index thresholds to examine the co-existence of prognostically-relevant underweight, dyspnoea, and airflow obstruction. The BODE index has become widely accepted as a staging/classification tool to predict prognosis in patients with COPD in secondary and tertiary care,[4] and has been found to be a strong predictor for mortality in COPD patients with advanced disease.[4] Another multidimensional grading system for COPD, the CPI, was suggested by Briggs *et al*;[5] their instrument includes other prognostic factors such as health-related quality of life, history of exacerbations, cardiovascular comorbidity, age and gender. The CPI was not only able to predict mortality, but also hospitalisations and exacerbations.[5] Another recently published instrument, the COPDSS, incorporates clinical aspects of the disease including respiratory symptoms, oral corticosteroid use, other COPD medication use, previous hospitalisation and intubation, and home oxygen therapy.[6,7] Not surprisingly, the COPDSS score was associated with the degree of dyspnoea and number of exacerbations,[6] but since it was developed for use in a telephone survey, it does not contain components such as BMI and FEV_1 that need biomedical measurement.

From a primary care perspective, all these instruments have pros and cons. The inclusion of health-related quality of life scores and prognostic factors predicting outcomes like exacerbations is an attractive aspect of the CPI. The COPDSS is the only instrument that has been validated in a primary care COPD population and was associated with outcomes relevant for primary care patients. Nevertheless, we chose the BODE index thresholds for use in our study for two reasons: firstly, the BODE index is the only instrument which includes all three factors as recommended by the ATS/ERS standard; and secondly, the cut-off value for underweight in the BODE index (<21 kg/m²) fits the ATS/ERS guideline recommendations, whereas the CPI cut-off value (BMI < 20) does not. In addition, the CPI has a more stringent cut-off value for airflow obstruction (FEV_1 < 60 % of predicted). Had

we used the CPI cut-off values, a smaller number of patients would have fulfilled the severity component criteria: n=148 (7.3%) for the CPI underweight criterion, and n=886 (42.8%) for the CPI airflow obstruction criterion.

Multicomponent staging tool

The ATS/ERS guideline suggests that a staging system which offers a composite picture of disease severity is highly desirable.[3] The BODE index has been suggested as a practicable evidence-based staging system for all patients with COPD.[4] In this study, we examined three of the four BODE components and in this population the overall mean BODE-score of these three components was 1.27 (95%CI, 1.22-1.33 on a scale from 0-7). We found that high scores on the BODE index are rare and variation in score is low in primary care COPD patients. Therefore, the BODE index seems to be of little value for discriminating between disease severity levels in primary care. However, without information on the fourth component of the BODE index (exercise tolerance assessed by the six minute walking distance [6MWD] test) this remains an assumption that needs to be verified. Observations on what distance patients with relatively mild disease (as seen in primary care) can walk in six minutes have not been published yet. Therefore, information on the 6MWD from a representative primary care COPD patient sample is urgently needed. Moreover, it would be interesting to look at the correlation between the 6MWD and the MMRC score. Both instruments represent exercise limitation, though the MMRC score is a subjective measure (i.e., patients are asked to grade their breathlessness according to the level of exercise) while the 6MWD is an objective measure (i.e., how far a patient can walk in 6 minutes). Do these components truly represent different aspects of COPD or are they both indicators of the same characteristic?

COPD severity staging tool for primary care

Our results underline the multidimensionality of COPD with relevant numbers of patients that fulfil the individual criteria for COPD in primary care. However, conclusions about the prognostic value of these factors for primary care COPD patients cannot be inferred from our findings, and several questions remain. First, we need to know which outcomes are vital for patients with COPD. Usually, severity components are chosen that predict mortality risk in COPD patients. Although COPD is one of the leading causes of mortality worldwide, for patients it is first and foremost an incapacitating disease that can have a strong negative impact on their daily life.[15,16] Therefore, it may well be that other outcomes, like health-related quality of life, exacerbations, or hospitalisations, are just as relevant as mortality risk. Moreover, there should be sufficient variation in the selected outcomes within the population of COPD patients; the mortality rate in patients with mild to moderate severe COPD, for example, is very low in general.[17] Secondly, the selected severity components should be prevalent in primary care COPD patient populations and should be able to predict the relevant outcome(s) in those patients. None of the current multicomponent tools were developed based on information from primary care COPD patients and the predictive capacity of the instruments for primary care patients has not been established. However, a study protocol of an international collaboration that aims at developing such an instrument has recently been published.[18]

Strengths and limitations of our study

We used the definition of COPD proposed by GOLD and the ATS/ERS guideline – a post-bronchodilator FEV_1/FVC ratio below 0.70.[3,19] The formal diagnosis of COPD could not be verified since we did not have access to the patients' medical records. Therefore, we may have included some asthma patients with fixed airflow obstruction. We did have information on characteristics and symptoms of asthma-like respiratory symptoms, self-reported bronchial hyperresponsiveness, and allergies, but did not exclude patients on the basis of this information since asthma and COPD can co-exist within the same patient.[20] An important strength of our study was the large representative sample of primary care patients. This is an advantage of using information which has been obtained for routine medical care. GPs refer the patients they suspect of having COPD or asthma to the SHL for diagnostic spirometry, and patients with asthma and COPD for regular monitoring visits. This population was not restricted by various exclusion criteria nor by the willingness of patients to participate in a trial.

Conclusions and implications for primary care practice

Relevant numbers of patients fulfilled the individual ATS/ERS staging criteria in our primary care COPD patient sample. This is especially true for 'moderate' levels of dyspnoea according to the level of exercise required and moderate airflow obstruction. The weak correlation between the various severity components underlines the multidimensionality of COPD and the need to collect uniform information even when the patient's disease severity is only considered mild in terms of airflow obstruction. In other words, it seems that the assessment of BMI and dyspnoea represent additional information on COPD patients. However, the prognostic value of this information in primary care warrants further investigation. In our view, the development of a COPD severity staging model that takes into account all aspects relevant for COPD patients that can be used in primary care should be a research priority in the coming years.

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Conflict of interest

There are no conflicts of interest for any of the authors

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