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ORIGINAL RESEARCH

Chronic obstructive pulmonary disease in Brazilian primary care: diagnostic competence and case-finding

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Abstract
Aims: The developing world is particularly at risk of an increasing health burden due to an increased prevalence of Chronic Obstructive Pulmonary Disease (COPD) secondary to increasing tobacco consumption. However, research is scarce. The objectives of this study were to assess the current competence for diagnosing COPD in primary care in a resource-limited setting in Brazil, and to develop a local patient profile for case-finding.
Methods: 34 general practitioners (GPs) in five areas of northern Brazil recruited adult patients with principal complaints of cough and/or shortness of breath who then had spirometry ($n = 142$).
Results: For the dichotomous variable 'COPD' the degree of agreement between GP diagnosis ($n = 64$, 18.3%) and spirometric outcome ($n = 36$, 25.4%) was poor, with Kappa = 0.055 (SE 0.087) and DOR = 1.35. False-positive and false-negative diagnosis proportions were 19.8% and 75%, respectively. Independent risk factors were 'smoking history of more than five pack years' and 'presence of both dyspnoea and cough'. It requires the testing of 2.2 smokers with more than five pack years to detect one patient at risk.
Conclusions: COPD is a common yet underdiagnosed disease in Brazilian primary care. Spirometry improves diagnostic competence and case-finding substantially. If applied in a pre-selected high-risk population, we believe spirometry can be a cost-effective diagnostic tool for case-finding in the resource-limited setting. This study provides important baseline information for effective guideline implementation.

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Introduction

Chronic Obstructive Pulmonary Disease (COPD) is an important cause of chronic morbidity and mortality throughout the world [1]. It is the fifth leading cause of death worldwide [2] and its burden is expected to increase further in the coming decades [3]. In the developing world public health has traditionally focussed on infectious diseases. However, the transition towards a burden of non-communicable diseases is ongoing [3]. The developing world is particularly at risk of a COPD epidemic, due to increased tobacco consumption which can be partly attributed to the efforts of tobacco companies to target the yet unexplored markets within these areas [4]. COPD is estimated to be the fourth leading cause of disability for males and the third leading cause of disability for females in developing countries by the year 2020 [3]. In addition, other associated factors such as low socio-economic status, outdoor and indoor air pollution, and frequent respiratory infection, contribute to the increasing burden of respiratory disease [1,5]. Moreover, the lack of diagnostic facilities and adequately trained physicians working at a community level constitute a great obstacle in establishing early diagnoses.

A recent study reported significant COPD prevalences throughout Latin America, demonstrating that COPD is already an important health problem there [6]. However, research in resource-limited settings is scarce, whilst COPD remains an underdiagnosed und undertreated disease [1].

Brazil is a developing country ranked 63rd on the United Nations Human Development Index 2003 [7]. It is characterised by marked regional differences, the north and northeast regions being the two least-developed regions accounting for the poorest socio-economic and health statistics [8]. COPD prevalence estimates in the general population range from 4.1% [9] to 15.8% [6], whereas smoking prevalences are recorded at 31.0% (35.4% among men and 26.9% among women), with great regional variability [4].

The need for spirometry to establish a diagnosis of COPD is acknowledged by leading international guidelines [10,11], including those specifically designed for primary care [12]. General practitioners (GPs) and their practice assistants have been shown to be capable of performing adequate spirometric measurements in the office and interpreting obstructive patterns, provided that they are well-trained [13,14]. Studies that have used spirometry to detect airflow obstruction at an early stage have reported considerable rates of previously unknown COPD cases [15—18]. To the best of our knowledge no reports have been published that have used and applied spirometry in a resource-limited setting with the aim of increasing case-finding.

The first objective of this study was to measure the prevalence of (chronic) respiratory diseases at a primary care level in the north and northeast regions of Brazil. Secondly, we aimed to assess the current diagnostic competence of GPs in terms of their ability to diagnose COPD. To this end, a comparison was made between GP diagnosis and the diagnostic 'gold standard' of spirometry. Ultimately, our final aim was to develop a local patient profile for efficient case-finding.

Methods

Study setting and participants

Thirty-four volunteering GPs were recruited from the Family Health Program (FHP) in five distinct urban and rural areas in the north and northeast regions of Brazil (Ceará and Roraima states) (Table 1). The FHP professionals are organised in health teams which consist of one GP, one nurse, one auxiliary nurse, and six health agents, taking responsibility for the identification of local health risks in a well-defined area [19]. The study period consisted of two six-month episodes between April 2002 and March 2004. The target population included all adults (≥15 years) who attended the GP principally with symptoms of shortness of breath and/or cough, irrespective of the cause, smoking history, previous diagnosis, and duration of symptoms. All eligible patients who were encountered, both in the 'health post' clinic setting and during family visits, were sent to see the GP. A standardised one-page format subject form was filled out by the GP for each subject who matched inclusion criteria.

Spirometry

All enrolled patients were systematically invited to undergo spirometry. They either returned to the 'health post' or they were visited in their residence on an agreed day. Spirometric testing was performed by two field researchers (RH, SB), who had received extensive training on the execution of spirometry and the assessment of flow-volume loop (FVL) quality at the lung function laboratory of Maastricht University Hospital, the Netherlands. We used MicroLab 3300® spirometers (MicroMedical Limited, UK) which had been calibrated before the

Table 1 Characteristics of participating general practitioners[a] (GPs) ($n = 34$[b])

Male/female	21/13
Rural/Urban	17/17
Years of GP working experience[c] (median, range)	4.0 (14.0)
Post-graduate training in public health/primary care[d] (% of GPs)	14.3%
No. of patients included per GP (mean ± SD)	13.9 (±11.8)
No. of spirometries per GP (mean ± SD)	4.6 (±6.6)

[a] GPs were from the following municipalities: Fortaleza ($n = 4$), Pedra Branca ($n = 7$), Tianguá ($n = 8$), Ubajara ($n = 2$), and Boa Vista ($n = 13$). None of them had received any additional specific training on COPD, peak flow or spirometry.
[b] Two GPs were kept out of the study due to the exclusion of their patients (insufficient data).
[c] Based on data of 13 GPs.
[d] Based on data of 21 GPs.

study. Spirometric testing followed the American Thoracic Society recommendations [20], and included baseline and reversibility testing. Subjects were tested on one occasion, at least six weeks after a possible period of exacerbation. The attempt with the highest baseline FEV_1, out of a minimum of three reproducible attempts, was selected for analysis. Irreversible obstruction was defined as post-bronchodilation $FEV_1/FVC < 70\%$, according to GOLD criteria [10]. Since reference values for the Brazilian population are not available, we used those for Caucasians [21].

Outcome measures

For descriptive purposes, GP diagnoses were classified in the following six outcome categories: (1) respiratory infection; (2) asthma; (3) tuberculosis; (4) restrictive condition, including both parenchymal (e.g. fibrotic disease) and extraparenchymal (e.g. chest wall, respiratory muscles and pleura) disorders; (5) COPD; and (6) other pathology (i.e. rare and non respiratory). Spirometry readings were scored on the basis of both visual inspection of the FVL and values of FEV_1 and FVC (NC). Spirometry results were classified into the following six outcome categories: (1) incorrect test manoeuvre; (2) normal lung function; (3) reversible obstruction (e.g. asthma); (4) suggestive of restriction (restrictive pattern, $FVC < 80\%$ and normal FEV_1); (5) irreversible obstruction (i.e. COPD); and (6) other pathology (i.e. rare and non respiratory). The GP diagnoses and spirometric outcomes were also dichotomised as 'COPD yes or no'.

Statistical analysis

We performed bivariate analysis to investigate the degree of agreement (Kappa statistic and diagnostic odds ratio, DOR) between 'GP diagnosis' and 'spirometric outcome' for the dichotomous variable 'COPD' and to test risk factors for predicting COPD. Results were expressed as odds ratios (OR) with 95% confidence intervals (95%CI) and positive predictive values (PPV). Multiple logistic regression analysis with stepwise backward procedure was performed to test risk factors for predicting the spirometric outcome of COPD. Independent variables were: sex; age groups; symptoms (only dyspnoea, only cough and both); pack year groups; ever smoker; current smoker; and setting (rural/urban). For statistical analysis we used the SPSS® software package (Version 8.0 for Windows).

Results

Participation and distribution

Seven (2.0%) of 357 subjects were excluded from analysis due to insufficient data. Of the remaining 350 subjects, men comprised 45.1%. Mean age for all was 46.8 (SD ± 18.7) years. Lifetime prevalence of smoking was 57.7%, with a mean of 9.4 (SD ± 16.4) pack years. 64 subjects (18.3%) had a GP diagnosis of COPD (Table 2). One hundred and fifty-seven subjects (44.9%) underwent spirometry (SPIRO group). SPIRO and NONSPIRO subjects did not differ in terms of sex distribution, pack years, and proportion of presence of both cough and dyspnoea (as opposed to only one respiratory symptom). GP diagnoses were also equally distributed between the two subgroups with the exception of respiratory infection, which was less prevalent in the SPIRO group. In the SPIRO group, age over 55 years, and education level beyond secondary school, were over-represented (Table 2). Fifteen (9.6%) spirometries did not meet quality criteria and were rejected. Outcome of the 142 valid spirometries was as follows: COPD in 25.4% ($n = 36$); normal lung function in 43.7%; reversible obstruction in 19.0%; and restriction in 12.0%.

Table 2 Patient characteristics for all enrolled patients ($n = 350$), for those who had spirometry (SPIRO, $n = 157$), and for those did not have spirometry (NONSPIRO, $n = 193$)

	Total	SPIRO	NONSPIRO	OR (95% CI)
Total	350	157 (44.9%)	193 (55.1%)	
Men/Women	158/192	76/81	82/111	1.27 (0.83—1.94)
Mean age[a] ± SD ($n = 347$)	46.8 ± 18.7	49.4 ± 18.7	44.7 ± 18.5	$p = 0.021$[b]
15—34 yrs	93 (26.6)	34 (21.7)	59 (30.6)	1.00
35—54 yrs	131 (37.4)	57 (36.3)	74 (38.3)	1.34 (0.77—2.31)
≥55 yrs	123 (35.1)	66 (42.0)	57 (29.5)	2.00 (1.16—3.49)
Education level ($n = 319$)				$p = 0.145$[c]
Illiterate	121 (34.6)	49 (31.2)	72 (37.3)	1.00
Literate	83 (23.7)	43 (27.4)	40 (20.7)	1.57 (0.90—2.77)
Primary complete	79 (22.6)	26 (16.6)	53 (27.5)	0.72 (0.40—1.30)
At least secondary complete	36 (10.3)	26 (16.6)	10 (5.2)	3.82 (1.69—8.63)
Urban/Rural	117/233	95/62	22/171	11.9 (6.89—20.6)
Cough and dyspnoea (vs. 1 symptom)	214 (61.1)	103 (65.6)	111 (57.5)	1.41 (0.91—2.18)
Current smokers	102 (29.1)	38 (24.2)	64 (33.2)	0.64 (0.40—1.03)
Ever smokers	202 (57.7)	93 (59.2)	109 (56.5)	1.12 (0.73—1.72)
Mean pack years[a] ± SD	9.4 ± 16.4	10.3 ± 15.2	8.6 ± 17.3	$p = 0.363$[b]
GP Diagnosis				
COPD	64 (18.3)	34 (21.7)	30 (15.5)	1.00
Infection	113 (32.3)	25 (15.9)	88 (45.6)	0.25 (0.13—0.49)
Asthma	84 (24.0)	54 (34.4)	30 (15.5)	1.59 (0.82—3.08)
TB	18 (5.1)	6 (3.8)	12 (6.2)	0.44 (0.15—1.32)
Restriction	46 (13.1)	23 (14.6)	23 (6.7)	0.88 (0.41—1.88)
Other	29 (8.3)	15 (9.6)	10 (5.2)	1.32 (0.52—3.38)

Data are presented as Number (% of total) and odds ratio (95% confidence interval), unless stated otherwise.

[a] For men and women respectively mean age was 49.2 (SD ± 18.8) and 44.9 (SD ± 18.5) years ($p = 0.031$), and mean pack years were 13.1 (SD ± 19.5) an 6.3 (SD ± 12.5) ($p < 0.001$).

[b] Independent Sample T test.

[c] Mann-Whitney test.

GP diagnostic competence

The degree of agreement between GP diagnosis and spirometric outcome was poor, with Kappa = 0.055 (SE 0.087) and DOR = 1.35 (Table 3). Spirometric outcome was 'COPD' in 36 (25.4%) subjects; 27 (75.0%) of these cases were previously unrecognised by the GP (false-negative group). The (incorrect) GP diagnoses for these 27 subjects were: infection ($n = 2$); asthma ($n = 11$); restriction ($n = 11$); and other pathology ($n = 3$). Conversely, spirometric outcome was 'non-COPD' in 106 (74.6%) subjects; 21 (19.8%) of these cases were incorrectly diagnosed as COPD by the GP (false-positive group). Spirometric outcomes for this group were: normal lung function ($n = 12$); asthma ($n = 3$); and restriction ($n = 6$). Spirometric outcomes corresponded with GP diagnosis for 9 (25%) 'COPD' (true-positive group) and 85 (80.2%) 'non-COPD' (true-negative group) cases.

The false-positive and false-negative groups contained an over-representation of subjects over 55 years ($p = 0.001$) and of subjects with a smoking history of more than five pack years ($p < 0.001$). The rate of newly-detected COPD cases (the false-negative group) did not differ significantly between men and women, and between rural and urban origin. 43.8% of subjects with a GP diagnosis of COPD were current smokers; of these, 64.3% were advised to stop smoking.

Table 3 Cross-table presenting the degree of agreement between GP diagnosis [GP] and spirometric outcome [SPIRO] for the presence [+] or absence [—] of COPD (Kappa = 0.055, SE ± 0.087; DOR = 1.35) for all valid spirometries ($n = 142$)

		SPIRO		
		+	—	Total
GP	+	9	21	30
	—	27	85	112
	Total	36	106	142

The GP sensitivity is 9/36 = 25% and specificity is 85/106 = 80.2%. The proportion of false-positives is 21/106 = 19.8%, and of false-negatives 27/36 = 75%.

Table 4 Predictors for spirometric outcome of COPD (SPIROCOPD, $n = 36$)

	Submitted to spirometry ($n = 142$)	SPIROCOPD ($n = 36$)	OR (95%CI)	PPV (%)
Male sex[a]	69	24 (34.8)	2.71 (1.23—5.99)	34.8
Rural setting	57	18 (31.6)	1.72 (0.80—3.69)	31.6
Dyspnoea and cough (vs. 1 symptom)	93	30 (32.3)	3.41 (1.31—8.90)	32.3
Only dyspnoea (vs. dyspnoea and cough)	25	2 (8.0)	0.18 (0.04—0.83)	8.0
Only cough (vs. dyspnoea and cough)	24	4 (16.7)	0.42 (0.13—1.34)	16.7
Current smokers (vs. never + past smokers)	37	9 (24.3)	0.93 (0.39—2.21)	24.3
Ever smokers	85	30 (35.3)	4.64 (1.78—12.1)	35.3
≥5 pack years (vs. 0)	61	28 (45.9)	8.65 (3.04—24.7)	45.9
Age ≥55 yrs (vs. 15—34)	59	22 (37.2)	8.62 (1.87—39.7)	37.2
Indoor wood fire	47	11 (23.4)	0.86 (0.38—1.93)	23.4

Results are expressed in odds ratio (OR) with 95% confidence interval (95% CI) and positive predictive values (PPV).

[a] For men and women mean, age was 56.2 (SD ± 15.8) and 55.0 (SD ± 14.7), respectively ($p = 0.832$); mean pack years was 16.6 (SD ± 12.8) and 16.6 (SD ± 16.3), respectively ($p = 0.992$); and rate of 'both cough and dyspnoea' 83.3% and 83.3% ($p = 1.0$), respectively.

Case finding

Bivariate analysis showed that spirometric outcome of COPD was more prevalent among men (34.8%) than women (16.4%), whereas there was no difference between sexes for mean age and mean pack years. Patients with 'only dyspnoea' were less at risk than patients with 'both cough and dyspnoea'. Age over 55 years, and a history of smoking, increased the odds. Odds were increased to a significant level from five pack years onwards, with a PPV of 45.9%. Multiple logistic regression analysis showed that only 'presence of both cough and dyspnoea' and 'more than five pack years' were independent risk factors (Table 4).

Discussion

In adult patients with respiratory complaints who attended primary care facilities in northern Brazil, we found considerable rates of COPD, diagnosed both by the GP and by spirometry (18.3% and 25.4%, respectively). This corresponds with findings from an urban prevalence study from Latin America (which included Brazil), which demonstrated that COPD is indeed already a significant health problem in these areas [6]. From our study it seems that, even though specific training on chronic respiratory diseases is largely lacking, a significant COPD prevalence is already acknowledged. However, at the same time, it appears that the current diagnostic competence of GPs to label and exclude COPD correctly is rather poor. Providing spirometry resulted in a four-fold increase in COPD case-finding and, conversely, a 70% falsification rate of the GP diagnosis of 'COPD'. Several studies in the industrialised setting have found similar rates when using spirometry for case-finding [15—18]. However, to our knowledge, this is the first time that spirometry has been used in a primary care setting in a developing area with the aim of improving case-finding.

The 'traditional' diagnoses of asthma and restrictive lung disease cover a large proportion of the actual COPD patient population. It is important to provide the diagnostic tools to discriminate between them, given the important differences in management strategies. Relatively many errors were made amongst patients over 55 years of age and those with a smoking history, indicating that there is considerable room for improvement in these categories.

It should be noted that only a minority of the GPs who participated in the study had received any specific training in public health and/or primary care (Table 1). Most have been trained within specialist settings; GPs may not be aware of disease prevalence on the population level and they may not have developed the skills to adapt to transitions from communicable to non-communicable diseases — thus contributing to an underestimation of the problem.

The proportion of unacceptable spirometry results in the study (9.6%) appears to be comparable to previous studies, in which proportions ranged from 10 to 18% [13,15,22].

Efficient case-finding of patients with COPD in primary care is probably a more realistic approach than screening, especially for the developing world [15]. The first step in establishing an efficient case-finding process is to identify patients who are at risk for developing COPD. In this study, bivariate analysis showed that male sex, a history

of smoking, age over 55 years, and the presence of two respiratory symptoms, increased the odds significantly. These findings correspond with a case-finding study among smokers by Van Schayck et al., who found that chronic cough, the presence of two symptoms, and the age of the patient, were the strongest predictors [15]. In this study, a smoking history was found to be the strongest risk factor, and an interesting additional finding was that the odds for those with a smoking history were increased significantly from five pack years onwards, suggesting that the studied population might have been exposed to some other significant risk factor such as indoor biomass pollution. A report from China reported that combined exposure to biomass burning and smoking increased the risk of COPD more than four-fold, suggesting a synergistic effect [23]; this phenomenon would put women particularly at risk.

In the group with more than five pack years smoking, COPD prevalence was 45.9%, requiring the testing of 2.2 such patients (adults with cough and/or dyspnoea) to detect one at risk. Multiple regression analysis showed that a smoking history of more than five pack years, and the presence of two (instead of one) principal respiratory symptoms, were the only two independent risk factors. Age became less relevant, probably due to its relation to 'pack years', which was the strongest independent predictor of COPD. In addition, these findings suggest that males are not more susceptible than women for developing COPD when other features like pack years are taken into account, which is in contrast to earlier studies from the industrialised setting which have labelled male sex as a risk factor [24]. Moreover, it has been suggested that adverse smoking effects on pulmonary function are greater in women than in men [25]. Our study, therefore, provides an incentive for further studies on susceptibility and the impact of combined exposure to biomass burning and smoking in non-Western populations.

In order to implement spirometry in practice, office spirometers (one for an estimated population of 50,000), and well-trained technicians and physicians are required. Time needed for an adequately performed baseline and reversibility measurement is ~2x7 minutes (with a 15-minute break for salbutamol administration). In a population-based screening program, the costs of detecting one COPD case was estimated to be between US$469 and US$953 [26]. Although these costs might seem high for a resource-limited setting, COPD is in fact ranked amongst the cheaper diseases, just behind hypertension, when similar screening approaches for common diseases are compared [26]. Costs are mainly driven by manpower, which is considerably cheaper in developing countries. Therefore, provided that it is applied to a preselected high-risk population, we believe that implementation of spirometry in a resource-limited general practice can be cost-effective. The process of preselection could be aided by a simple self-administered questionnaire to identify high-risk patients, as has been proposed by Price et al. [27]. Before starting up case-finding programs it is essential to assess the burden of disease, and the needs and resources on a local level. Ongoing research will determine the long-term sustainability of spirometry in this setting.

Smoking cessation is the most effective intervention available for reversing the development of COPD. In current practice less than two thirds of smokers with a diagnosis of COPD are advised to stop smoking, leaving considerable room for improvement. Although the Brazilian government has recently taken some actions to discourage smoking [4], attention from local health policymakers and health workers should also prioritise raising awareness of the consequences of smoking and counselling individuals on smoking cessation. Future action should be directed towards building capacity on counselling skills and towards services by investigating the sustainability of smoking cessation strategies in a resource-limited setting that have already proved to be cost-effective in an industrialised setting [28].

Three possible limitations of this study should be noted. Firstly, the study approach, in which symptomatic patients were selected for spirometry, does not allow for measuring prevalence figures on a population level. Secondly, the volunteering GPs probably represent a young and enthusiastic subset of physicians. However, as they had not received any specific additional training on chronic respiratory disease and spirometry, we estimate that the results regarding their diagnostic competence can be generalized. Thirdly, only 44.9% of enrolled subjects underwent spirometry. This relatively large drop-out rate was mainly due to logistical reasons, as it was difficult to track down those who did not show up. Overall, patient characteristics did not differ between those tested and those who were not, except for age and education level. A GP-driven selection bias might have occurred if the relevance of spirometry was aimed more at those patients who had a clinical suspicion of chronic respiratory disease, possibly leading to an overestimation of results. In contrast, one can also argue that difficulties with mobility and respiration might have kept the more severely ill out of reach.

The Global Alliance against Chronic Respiratory Diseases (GARD) has recently been launched by the World Health Organization in order to increase awareness and to develop global action to reduce the burden of chronic respiratory disease in low- and middle-income countries [29]. In addition, GARD and the International Primary Care Respiratory Group Guidelines for Management of Chronic Respiratory Diseases in Primary Care [12], which are also appropriate for the resource-limited setting, emphasize the key role for primary care providers in the global management of respiratory disease. Partnership between these three institutions aims to establish a large health care improvement at relatively low cost by implementing guidelines in a local context. The current study serves as a baseline measurement in order to tailor this process optimally. In the light of scarce existing data, this study adds important new information on current diagnostic competence and strategies to improve COPD case-finding. Although many barriers exist, we believe developed countries can learn a great deal from innovative approaches in resource-limited countries [30].

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