

Influence of Demographic and Lifestyle Factors on the Spectrum of Obstructive and Restrictive Lung Diseases

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ABSTRACT

Introduction: Chronic respiratory diseases (CRDs) are a leading international burden of disease, however information about disease patterns and risk factors in Bangladesh is scarce. This study sought to characterise the spectrum of lung diseases in patients with dyspnoea and examine the impact of important demographic and lifestyle factors. **Methods & Materials:** We conducted a cross-sectional study of 200 dyspnoeic patients attending a tertiary hospital in Bangladesh from January 2013 to June 2013 in both the Departments of Medicine and Respiratory Medicine at Dhaka Medical College Hospital Dhaka, Bangladesh. The total study duration was 6 months. All patients underwent clinical examination and spirometry. Demographic and lifestyle factors were profiled and analyzed according to their association with obstructive (COPD, asthma) and restrictive lung disease phenotypes. **Results:** The prevalence of COPD was 20.5%, asthma 35.0% and a restrictive pattern 24.5%. Patients with COPD were significantly older (mean 57.1 years, $p<0.001$), and more frequently former smokers (48.8%, $p<0.001$). There was a strong relationship with asthma in their family (60.0%, $p<0.001$) and prevalence of underweight patients in restriction group was high (36.7%, $p=0.05$). Severe lung disease was common, occurring in 82.9% of COPD, 57.1% of asthma and 53.1% of restrictive patients. **Conclusion:** Our study demonstrates a substantial burden of severe lung disease in Bangladesh, with clear demographic and lifestyle risk profiles for different conditions. The results underscore the need for better diagnostic algorithms, such as greater utilization of spirometry, that would facilitate early detection and treatment.

Keywords: Dyspnoea, Spirometry, COPD, Bangladesh, Risk Factors

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INTRODUCTION

Chronic respiratory diseases (CRDs) such as chronic obstructive pulmonary disease (COPD) and asthma are a critical international health problem which cause over 4 million deaths annually [1]. Such a burden is unequal sharing and low- to middle-income countries (LMICs) as suffering the highest morbidity and mortality. The economic burden is a similar story, with COPD alone expected to set back the global economy by approximately INT\$4.3 trillion in 2020–2050, largely from massive healthcare costs and catastrophic productivity impacts, especially on the less developed world [2]. Dyspnoea-perhaps the most frequent chief complaint in patients with CRDs-is a subjective, unpleasant sensation indicating underlying disease and is usually the main motivator for seeking care [3,4]. Clinical history and physical examination are the first, but inadequate two steps to an accurate diagnosis. Gold-standard non-invasive investigation Spirometry remains the test that investigators require to confirm there are ventilatory defects and to distinguish between obstructive patterns, such as COPD or asthma, and restrictive diseases. At the core of this strategy is the ratio between the forced expiratory volume in 1 second and forced vital capacity (FEV1/FVC), which is the best physiological marker of airflow

obstruction [5]. Not only is this ratio diagnostic but also it is a strong prognostic marker for COPD hospitalization and death [6], highlighting its immense clinical importance and the requirement for accurate evaluation [6]. While spirometry is the gold-standard test, it is greatly underused, most notably in primary care where patients with respiratory symptoms often first present [7]. This “diagnostic gap” underlies the high rate of undiagnosed and untreated disease which leads to poor patient prognosis, as well as unreliable epidemiologic data. The problem is particularly evident in low- and middle-income countries (LMICs) where a high-risk environment intersects with constrained health systems and diagnostic capacity [8]. These resource-limited settings have benefited much from multi-country studies and chronic lung disease burden has been consistently high due to tobacco use, biomass fuel exposure, poverty, but the ability of accurate diagnosis and management is abysmally low [9]. As a highly populated LMIC in the South Asian region, Bangladesh is more susceptible to this catastrophe. The country is experiencing a double jeopardy from high prevalence of tobacco smoking and exposure to indoor air pollution from biomass fuels for cooking; causing risk of COPD development more than two times higher as demonstrated in regional meta-

analysis [10]. In addition, previous history of tuberculosis (TB), which is an important comorbid disease in our setting, has been independently found to have higher odds for COPD both in studies involving Bangladeshi population increasing the complexity of the disease conglomerate [11]. However, despite these well established and documented risk factors it is a dearth of the strong population-based data regarding an array of obstructive and restrictive lung diseases in Bangladesh. This critical lack of knowledge is further aggravated by the absence of large-scale, standardized spirometry surveys and region-specific reference equations for South Asian countries including Bangladesh, which results in poor accuracy of diagnosis and classification [12]. A knowledge of the local disease patterns, their severity and demographic and lifestyle determinants is essential for appropriate public health planning, resource allocation and campaigning for routine spirometry in primary care. Thus the study was undertaken to fill this crucial knowledge gap. The first goal was to study the lung diseases prevalent in patients with dyspnoea and ascertain demographic and lifestyle risk factors associated with prevalence and severity of these diseases.

METHODS & MATERIALS

This cross-sectional observational study was carried out from January 2013 to June 2013 in both the Departments of Medicine and Respiratory Medicine, Dhaka Medical College Hospital (DMCH), Bangladesh. Two hundred patients with pulmonary-related dyspnoea were enrolled into this study, using non-randomized purposive sampling. Patients were considered for inclusion if they were aged 8-80 years and had dyspnoea attributable to a pulmonary cause or had occupational exposure(s) associated with an increased risk of lung disease. Exclusion criteria were nonpulmonary origin of dyspnoea, acute or emergency department (ED) presentation, extreme age (95 years), acute confusion, recent thoracic, abdominal or eye surgery, unexplained hemoptysis within the last 3 months (except transient subsegmental PE9), history of pneumothorax, aortic aneurysm or other severe acute conditions that may preclude testing due to discomfort (such as nausea and vomiting). After written informed consent was received, all participants were interviewed for a detailed medical history that focused on age, sex, occupation (if any), smoking habits and family background. A detail physical examination was then carried out. Baseline studies including CBC, chest x-ray, ECG, blood sugar estimation, and ABG were done in all patients. Other appropriate studies, including sputum examination and high-resolution computed tomography (HRCT),

were performed when clinically indicated. All participants underwent spirometry as the initial diagnostic evaluation. Spirometry was performed with a calibrated spirometer to obtain the values for Forced Vital Capacity (FVC), FEV1, and the ratio of FEV1/FVC. The FEV1/FVC ratio was considered a gold standard in diagnosing airflow obstruction, and based on the GOLD recommendation, a value of less than 0.70 was indicative of an obstructive pattern. For obstructions, a reversible test with a bronchodilator was conducted based on the criteria of the American Thoracic Society (ATS)16 to distinguish COPD and asthma (post-bronchodilator increase in FEV1 12% vs values greater than or equal to 200 mL from baseline). A restrictive breathing pattern was characterized by low FVC despite a normal or high FEV1/FVC ratio. Subjects with normal FEV1, FVC, and FEV1/FVC were considered to have a normal spirometry. Ethical Consideration The research follows the principles contained in the official Statement of Patient's Right according to Helsinki and written informed consent was taken from each participant. SPSS software (IBM Corp., Armonk, NY) was employed for all operations. Continuous variables are expressed as mean $\pm$ SD, and categorical data are presented as number (percentage). Means of continuous variables across the four diagnostic groups were compared by One-way Analysis of Variance (ANOVA) and the association between categorical

variables was tested using Chi-square (χ^2) test. Differences were considered significant if $P < 0.05$.

RESULTS

Two hundred patients were recruited and divided into four groups based on the diagnosis: 41(20.5%) patients with COPD, 70 (35.0%) with BA, 49(24.5%) with RD, and 40 (20.0%) who had normal spirometry. As shown in Table 1, there was a statistically significant difference in the mean age ($p < 0.001$) between groups and COPD patients had higher mean age (57.1 ± 10.0 years) whereas normal spirometry had lower (40.0 ± 17.7 years). A male preponderance was noted in all disease categories, same as above however it failed to reach a statistical significance ($p = 0.213$). Smoking habits also differed significantly ($p < 0.001$): about half of the COPD subjects were ex-smokers (48.8%) and most subjects in other groups, particularly the normal group were not smokers (80.0%). An association was indicated between family history and disease type ($p < 0.001$), and 60.0% of asthmatics had positive familial history of respiratory diseases, which was much more prevalent than others. Finally, body mass index (BMI) was also borderline significant among the groups ($p = 0.05$), with increasing proportion of underweight patients in restrictive disease group (36.7%) and more normal weight patients in COPD group (65.8%) *Table I*.

Table I
Demographic and Baseline Characteristics of Study Population ($n = 200$).

Characteristic	COPD (n=41)	Bronchial Asthma (n=70)	Restrictive Disease (n=49)	Normal (n=40)	P-value
Age Group (years), n (%)					
<30	1 (2.4)	23 (32.9)	14 (28.6)	13 (32.5)	<0.001
30-40	2 (4.9)	13 (18.6)	5 (10.2)	8 (20.0)	
41-50	7 (17.1)	12 (17.1)	14 (28.6)	6 (15.0)	
51-60	20 (48.8)	16 (22.9)	12 (24.5)	8 (20.0)	
61-70	8 (19.5)	5 (7.1)	3 (6.1)	4 (10.0)	
>70	3 (7.3)	1 (1.4)	1 (2.0)	1 (2.5)	
Mean ± SD	57.1 ± 10.0	40.8 ± 15.5	43.7 ± 15.2	40.0 ± 17.7	<0.001
Sex, n (%)					
Male	32 (78.0)	43 (61.4)	29 (59.2)	24 (60.0)	0.213
Female	9 (22.0)	27 (38.6)	20 (40.8)	16 (40.0)	
Smoking Status, n (%)					
Non-smoker	16 (39.0)	50 (71.4)	32 (65.3)	32 (80.0)	<0.001
Ex-smoker	20 (48.8)	17 (24.3)	14 (28.6)	3 (7.5)	
Current Smoker	5 (12.2)	3 (4.3)	3 (6.1)	5 (12.5)	
Family History of Respiratory Disease, n (%)					
Yes	13 (31.7)	42 (60.0)	6 (12.2)	7 (17.5)	<0.001
No	28 (68.3)	28 (40.0)	43 (87.8)	33 (82.5)	
Body Mass Index (kg/m²), n (%)					
Underweight (<18.5)	10 (24.4)	16 (22.9)	18 (36.7)	9 (22.5)	0.05
Normal (18.5-24.9)	27 (65.8)	41 (58.6)	13 (26.5)	19 (47.5)	
Overweight (25-0-29.9)	4 (9.8)	13 (18.6)	16 (32.7)	9 (22.5)	
Obese I (30-34.9)	0 (0.0)	0 (0.0)	2 (4.1)	3 (7.5)	
Mean ± SD	20.2 ± 3.7	21.9 ± 3.6	21.8 ± 4.9	22.8 ± 4.7	0.05

The analysis of spirometric patterns revealed a highly significant difference in the distribution of the FEV1/FVC ratio across the four diagnostic groups ($p<0.001$), as shown in Table 2. Most COPD patients (56.1%) and a large part of bronchial asthma patients (41.4%), whose ratio of

FEV1/FVC was below 70%, showed obstructive pattern. In contrast, the N/obstructive ratio ($NFEV1/FVC \geq 70\%$) was not present in most patients with restrictive wood disease (87.8%), normal spirometry value (80.0%). This dichotomous classification was also reinforced by the

mean FEV1/FVC, which were significantly lower in the obstructive groups (68.66 ± 13.0 for COPD and 72.49 ± 11.2 for asthma) in comparison with restrictive (81.33 ± 9.9) and normal (79.78 ± 15.5) ($p=0.001$) Table II.

Table II
Distribution of the study patients by FEV1/ FVC (n=200).

FEV1/ FVC (%)	COPD (n=41)		Br. Asthma (n=70)		Restrictive (n=49)		Normal (n=40)		P value
	n	%	n	%	n	%	n	%	
<70 Obstructive	23	56.1	29	41.4	6	12.2	8	20	<0.001
≥70 non-obstructive	18	43.9	41	58.6	43	87.8	32	80	
Mean±SD	68.66±13.0		72.49±11.2		81.33±9.9		79.78±15.5		0.001s

Classification of severity (FEV1 and FVC % predicted) showed a high prevalence of more severe obstruction, with significant differences between every pair of groups (Table III). The most notable figure was observed in the COPD group, where 82.9% of patients were diagnosed with severe airflow obstruction ($FEV1\% \text{ pred} < 50\%$) and 63.4% had severe FVC reduction.

Patients with bronchial asthma and restrictive syndrome also had a high frequency of moderate-to-severe disorders: 57.1% asthmatics and severe bronchial obstruction according to the level of predicted FEV1% was found in 53.1 % of restrictors. Normal spirometry group had predominantly mild or moderate. These category differences in severity distribution

were extremely significant, for both FEV1% / FVC%, ($p<0.001$). In addition, the average FEV1% and FVC% were significantly lower in all disease groups in comparison with the normal group ($p<0.001$ for FEV1%, $p=0.014$ for FVC%), which indicated significant physical restriction.

Table III
Severity of Lung Dysfunction Based on FEV1 and FVC % Predicted Values.

Disease Group	Severity Grading	FEV1 % Predicted, n (%)	FVC % Predicted, n (%)
COPD (n=41)	Mild	0 (0.0)	0 (0.0)
	Moderate	7 (17.1)	15 (36.6)
	Severe	34 (82.9)	26 (63.4)
	Mean ± SD	36.8 ± 16.7	43.1 ± 18.2
Bronchial Asthma (n=70)	Mild	2 (2.9)	5 (7.1)
	Moderate	28 (40.0)	39 (55.7)
	Severe	40 (57.1)	26 (37.1)
	Mean ± SD	46.6 ± 18.4	53.1 ± 18.3
Restrictive (n=49)	Mild	3 (6.1)	2 (4.1)
	Moderate	20 (40.8)	24 (49.0)
	Severe	26 (53.1)	23 (46.9)
	Mean ± SD	48.6 ± 20.5	50.0 ± 19.8
Normal (n=40)	Mild	20 (50.0)	18 (45.0)
	Moderate	12 (30.0)	17 (42.5)
	Severe	8 (20.0)	5 (12.5)
	Mean ± SD	71.6 ± 24.0	74.4 ± 17.6
P-value (Severity Distribution)		<0.001	<0.001
P-value (ANOVA for Means)		<0.001	0.014

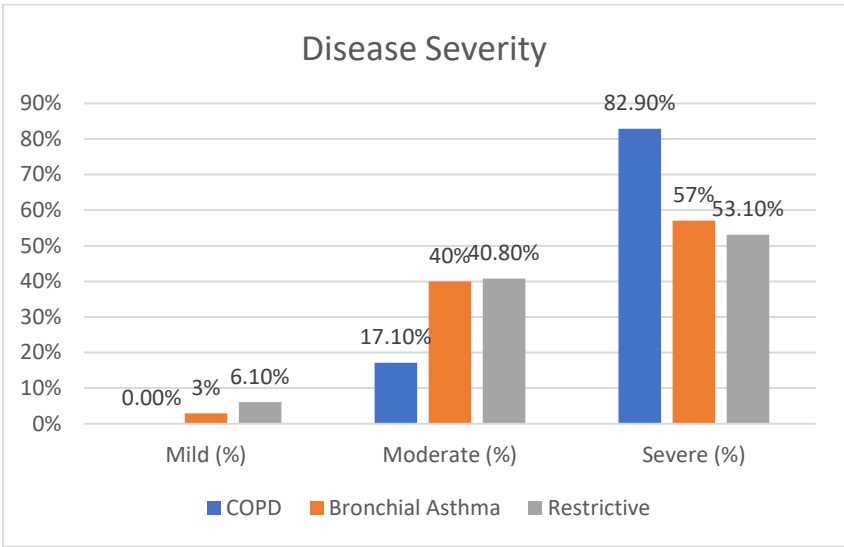


Figure 1 Distribution of Disease Severity by Diagnostic Group (Based on FEV1 % Predicted)

Figure 1 visually illustrates the proportion of disease severity distribution by FEV1%pred and confirms the observations from Table 3. The most notable characteristic is the overexpression of severe disease in the patients with COPD, 82.9% being classified as severe. Both bronchial asthma and restrictive disease groups also showed a high proportion of advanced diseases as 57.1% and 53.1% of the patients belonged to severe stage in each group.

DISCUSSION

Principal findings of this study are: there is a high burden of advanced lung disease, most notably for COPD, with a specific phenotype that mirrors known patterns from LMICs. The average age of COPD patients who were diagnosed was 57.1 years and it is higher than for the other diagnoses, consistent with international literature that shows advanced age as one of the major risk factors [13,14]. Additionally, the smoking history in this cohort was revealing: only 12.2% of subjects were still active smokers and more than a third (48.8%) had quit, indicating that the process of disease may continue to progress for many years before being diagnosed after quitting. This is in line with data from a number of LMICs, where smoking plays a significant role as cause of severe late presenting disease [15]. The main finding was the high prevalence of morbid disease, with 82.9% of COPD patients presenting severe airflow obstruction. This profound degree of impairment, consistent with reports in ACO populations from similar settings, probably reflects a failure to diagnose early and intervene before development of established and irreversible lung damage in both conditions such as is seen here [14]. In bronchial asthma, a different risk profile was observed compared to the COPD phenotype, with a particularly strong effect of genetics. A

positive family history of respiratory disease was found in 60.0% of asthma patients, which was much higher than that in any other group and supported the inherent nature of an asthmatic trait [16]. The mean age of this group was younger (40.8 years) but their stage, severe obstruction was also surprisingly high at 57.1%. This indicated that even with a possible younger age of symptom onset, an appreciable proportion of asthma subjects also develop into severe disease without having a definite spirometry diagnosis. Specifically, the analysis of the restrictive disease cohort led to a second unique profile that strongly represented nutritional status. A remarkably high number of this cohort (36.7%) were underweight - in keeping with studies from throughout the region and worldwide which emphasize the strong association between chronic malnutrition and restrictive lung mechanics [13,17]. Another interesting point in our series was no statistically significant relationship between sex and disease entity, despite a clear male predominance for all of the diseases on numerical analysis we have found. This is not an isolated finding, but it is commonly observed in sound LMIC studies, where many sex differences are no longer statistically significant after adjustment for stronger covariates such as age, smoking and BMI (17,18). This result differs with findings in a recent study conducted in rural Bangladesh suggesting male gender as a strong risk factor and might indicate differences between individuals attending hospital that may represent the more severe form of disease versus general persons living in community (14). Overall, the demographic and spirometry trends seen in this Bangladeshi population are not unique but reflect a strong trend from over 280 studies across LMICs demonstrating that older age, smoking, and low nutritional status were the most important and

consistent associations with CRD [18]. The repeated evidence supports the critical demand for enhanced public health approaches, such as implementation of spirometry in primary care that allows an early diagnosis and management from these highly prevalent and disabling conditions.

LIMITATIONS

The sample size of the study was relatively small and limited to a single institution. So the findings may not be representative of the entire population.

CONCLUSION

This study shows a substantial prevalence of advanced obstructive and restrictive lung diseases among patients with dyspnea in Bangladesh. Specifically, COPD was defined as an distinct phenotype of advancing age, smoking history and a high proportion of severe airflow obstruction. By contrast, asthma was significantly related to positive family history and restrictive disease to lower BMI. The extensive disease severity in all groups implies a systemic problem with early identification and the substantial underuse of spirometry in primary care. These results highlight the need for public health interventions addressing early case-finding as well as incorporating spirometry into standard medical practice, to facilitate diagnosis and treatment and thus improve patient outcomes in this high-risk population.

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CONFLICT OF INTEREST

None declared

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee

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