ORIGINAL RESEARCH

OPEN ACCESS

Prevalence of preserved ratio impaired spirometry (PRISM) in patients undergoing spirometry in a medical college hospital

Bansal KL[1,*], Shubham Bansal S[2], Shivam Bansal[3] and Sanjay Sahay[4]

[1]Department of TB & Respiratory Diseases, GS Medical College & Hospital, Pilkhuwa, District Hapur, Uttar Pradesh – 245304, India
[2]Department of Medicine, Atal Bihari Vajpayee Institute of Medical Sciences & Dr. Ram Manohar Lohia Hospital, New Delhi-110001, India
[3]Department of Radiology, Kempegowda Institute of Medical Sciences, Bengaluru – 560004, India
[4]Department of TB & Respiratory Diseases, GS Medical College & Hospital, Pilkhuwa, District Hapur, Uttar Pradesh – 245304, India

Abstract

Background: Many patients come with respiratory symptoms of cough, expectoration and shortness of breath. They also exhibit history of risk factors like smoking etc. but on spirometry they do not meet spirometric criteria of chronic obstructive pulmonary disease (COPD). GOLD 2023 updates have considered such patients in the category of pre-COPD and preserved ratio impaired spirometry (PRISm) and advised to treat and follow these patients and try to prevent them from progressing to COPD. With this objective we tried to look for PRISm and its characteristics in our area.

Material and methods: We analyzed the spirometric pattern of all the patients who underwent spirometry in our institution (GS Medical College & Hospital, Pilkhuwa) from January 2022 to December 2022. After applying inclusion and exclusion criteria, the patients were divided into three groups: (I) Normal Group: Patients having post bronchodilator FEV1/FVC ratio ≥ 0.7 and normal FEV1 and FVC. (II) PRISm Group: Patients having post bronchodilator FEV1/FVC ratio ≥ 0.7 but decreased FEV1 (< 80 %) and / or FVC (< 80 %). (III) Unrevealed COPD Group: Patients having post bronchodilator FEV1/FVC ratio < 0.7 irrespective of FEV1 and FVC. Data observed was compared among various groups and analyzed for various parameters.

Results: A total of 986 patients underwent spirometry between 1st January 2022 and 31st December 2022. Of this, 302 patients were not considered for study because of exclusion criteria. 684 patients were considered for the study, of whom 261 (38.16%) had normal spirometry, 207 (30.26%) were in the PRISm group and 216 (31.58%) were found to have unrevealed COPD.

Conclusion: Occurrence of PRISm is quite high (30.26%) in patients undergoing spirometry for various reasons in our area. Higher age and higher BMI may have contributed to the observations. Additionally, a considerable number of patients (31.58%) were found to have unrevealed COPD. Another finding is that smoking history is seen in more than 70% of male subjects in both PRISm and unrevealed COPD groups. However, the results need confirmation in more studies from different geographical areas.

Keywords: spirometry; PRISm; COPD; pulmonary disease

Introduction

Chronic obstructive pulmonary disease (COPD) has been recognized as a third leading cause of mortality globally [1]. It is second leading cause of mortality and death and Disability-Adjusted Life Years (DALYs) in India [2]. It is often diagnosed late because of various reasons. One of the most important reasons is that symptoms start much earlier than the actual diagnosis of COPD is made on spirometry. One study in the UK has shown that the average duration of start of symptoms and diagnosis of COPD is five years. It takes even more

time in India. The actual changes in the lung may start even fifteen years before a spirometric diagnosis can be made. It is for this reason that it is important to recognize conditions like pre-COPD and preserved ratio impaired spirometry (PRISm) early. On an average 50% of the patients in PRISm category turn into frank COPD. If we take preventive measures early and avoid risk factors, a lot of patients could be saved from developing COPD.

Spirometry is an important part of pulmonary function tests. It is the most standardized objective and dependable test for the diagnosis and management of diseases having airflow limitation [3]. We have been using spirometry to diagnose obstructive lung diseases for long. It is also used to categorize the severity of COPD and asthma. But sometimes the spirometric pattern is such that FEV1/FVC is normal i.e., equal to or greater than 0.7 (post bronchodilator) but FEV1 and/or FVC are less than 80 %. These patients in whom post bronchodilator FEV1/FVC ratio is ≥ 0.7 but FEV1 and/or FVC less than 80% are termed as patients having PRISm. This is also called restrictive or unclassified pattern. But only 20-30% of these actually develop restrictive lung disease. The majority of them develop obstructive lung disease.

Although PRISm patients do not meet spirometric criteria of COPD, they have a lot of COPD symptoms and associated increased respiratory symptoms, comorbidities and mortality [4]. PRISm patients with restrictive pattern of spirometry are known to have lower quality of life even when they are asymptomatic [5]. A lot of PRISm patients are actually missed [6].

Patients with PRISm, when followed up for long duration, have three consequences: (I) About one-third of the patients develop COPD stage 0 to 4 [7], (II) Some patients account for increased cardiovascular disease burden [6], (III) Some patients recover and have normal spirometry.

Prevalence of PRISm is different in different communities and different geographical areas depending upon the risk factors. The PRISm patients may have some specific characteristics responsible for their PRISm status. By finding out the prevalence and the specific characteristics of PRISm patients, we would be able to make out, if needed, a screening strategy to identify PRISm patients and help them avoid progressing to COPD.

In this context we carried out a retrospective observational study in all patients who underwent spirometry in our institute for various reasons.

Material and methods

All patients who underwent spirometry in our institution (GS Medical College & Hospital, Pilkhuwa) from January 2022 to December 2022 for different reasons were considered for study. HELIOS 401 spirometer from Recorders and Medicare was used for spirometry. The study has been approved by the ethical committee of the institute. Informed consent was obtained from each patient.

Those patients who were less than forty years of age or were already diagnosed cases of COPD or asthma or any other respiratory disease were not considered. Data of each patient included age, sex, weight, height, smoking history, biomass fuel exposure and the comorbidities.

Inclusion criteria: All patients more than 40 years of age, patients not already diagnosed cases of COPD or asthma or any other respiratory disease so far.

Exclusion criteria: All patients less than 40 years of age. Already diagnosed cases of COPD or asthma or any other respiratory disease.

All patients were divided into three groups: (I) Normal Group: Patients having post bronchodilator FEV1/FVC ratio ≥ 0.7 and normal FEV1 and FVC. (II) PRISm Group: Patients having post bronchodilator FEV1/FVC ratio ≥ 0.7 but decreased FEV1 (< 80 %) and / or FVC (< 80 %). (III) Unrevealed COPD Group: Patients having post bronchodilator FEV1/FVC ratio < 0.7 irrespective of FEV1 and FVC.

Data observed was compared among various groups and analyzed for various parameters.

Results

A total of 986 patients underwent spirometry from 1st January 2022 to 31st December 2022. Of these, 302 patients were not considered for study because of exclusion criteria. 684 patients were considered for the study, of whom, 261 (38.16%) had normal spirometry, 207 (30.26%) were in the PRISm group and 216 (31.58%) were found to have unrevealed COPD (Figures 1 and 2).

Mean age of the patients in three groups were 53.55, 54.58 and 65.46 years in normal, PRISm and unrevealed COPD group respectively. Male and female patients were 115 (44.06%) & 146 (55.94%) in normal group; 104 (50.24%) & 103 (49.76%) in PRISm group and 156 (72.22%) & 60 (27.78%) in unrevealed COPD group respectively (Table 1).
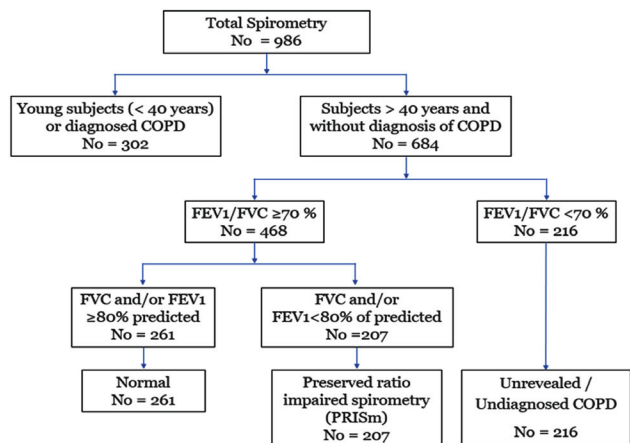
Bansal KL et al. J Med Sci Res. 2023; 11(4):296-300

298

Figure 1: Demographics of study subjects.
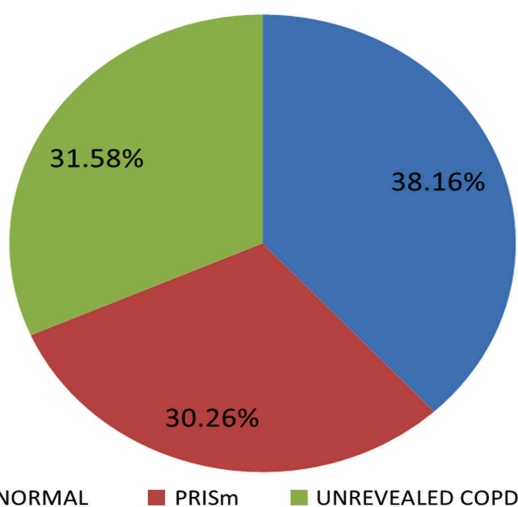
Figure 2: Results of spirometry.

Table 1: Based on demography.

	Normal	PRISm	Unrevealed COPD
No. of patients = 684	261 (38.16%)	207 (30.26%)	216 (31.58%)
Mean age (Years)	53.55	54.58	65.46
No. of males	115 (44.06%)	104 (50.24%)	156 (72.22%)
No. of females	146 (55.94%)	103 (49.76%)	60 (27.78%)

Average BMI in male patients was 25.73 kg/m^2, 26.59 kg/m^2 and 19.47 kg/m^2 in normal, PRISm and unrevealed COPD groups respectively. In females average BMI was 29.39 kg/m^2, 26.60 kg/m^2 and 23.91 kg/m^2 in normal, PRISm and unrevealed COPD groups respectively (Table 2).

Male patients gave smoking history in 55 (47.82%), 76 (73.07%), 113 (72.43%) in normal, PRISm and unrevealed COPD groups respectively. Females gave smoking history in 4 (2.73%), 4 (3.88%), 5 (8.33%) in normal, PRISm and unrevealed COPD groups respectively (Table 3).

Table 2: Based on height, weight and BMI.

	Normal	PRISm	Unrevealed COPD
Mean height of males (cms)	165.90	168.50	168.82
Mean weight of males (kgs)	71.52	75.56	63.53
Mean BMI (Males) in kg/m^2	25.73	26.59	19.47
Mean height of females (cms)	155.65	154.60	153.50
Mean weight of females (kgs)	71.14	63.60	56.51
Mean BMI (Females) in kg/m^2	29.39	26.60	23.91

Table 3: Based on smoking history.

Smoking history	Normal	PRISm	Unrevealed COPD
Males	55 (47.82%)	76 (73.07%)	113 (72.43%)
Females	4 (2.73%)	4 (3.88%)	5 (8.33%)

No biomass exposure was reported in males. Biomass fuel exposure history in females was 65 (44.52%), 48 (46.60%), 28 (46.66%) in normal, PRISm and unrevealed COPD groups respectively (Table 4).

Table 4: Based on biomass fuel exposure history.

History of biomass fuel use	Normal	PRISm	Unrevealed COPD
Males	00 (0 %)	00 (0 %)	00 (0 %)
Females	65 (44.52%)	48 (46.60)	28 (46.66%)

Lung function test in males showed mean FVC of 87.70%, 68.37%, and 61.22% predicted in normal, PRISm and unrevealed COPD groups respectively. FEV1 was 84.80%, 58.75% and 35.43% predicted respectively in the three groups. Mean FEV1/FVC % predicted was 96.90, 86.00, 58.11 in normal, PRISm and unrevealed COPD groups respectively. (Table 5, Figure 3)

Table 5: Based on lung function test (Males).

Lung function test	Normal	PRISm	Unrevealed COPD
Mean FVC % predicted	87.70	68.37	61.22
Mean FEV1 % predicted	84.80	58.75	35.43
MeanFEV1/ FVC % predicted	96.90	86.00	58.11

299

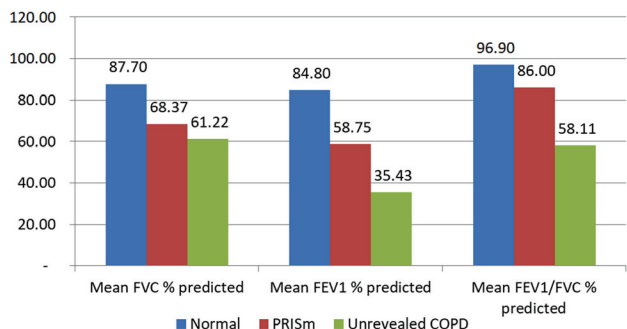Bansal KL et al. J Med Sci Res. 2023; 11(4):296-300

Figure 3: Lung function test (males).

Lung function test in females showed mean FVC of 94.57%, 65.20%, and 54.45% of predicted in normal, PRISm and unrevealed COPD groups respectively. FEV1 was 90.65%, 57.11% and 36.32% of predicted respectively in the three groups. Mean FEV1/FVC percentage predicted was 95.85, 88.39, 65.81 in normal, PRISm and unrevealed COPD groups respectively (Table 6, Figure 4).

Table 6: Based in lung function test (Females).

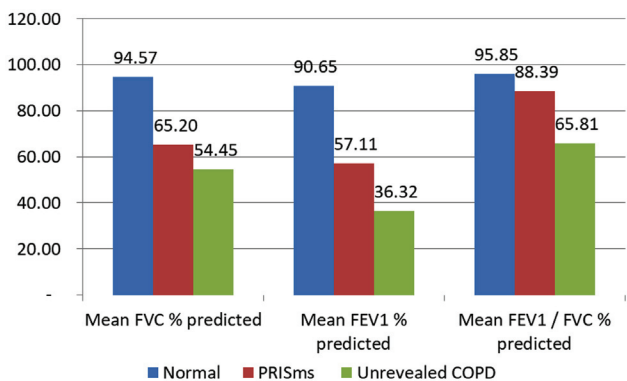| Lung function test	Normal	PRISm	Unrevealed COPD
Mean FVC % predicted	94.57	65.2	54.45
MeanFEV1 % predicted	90.65	57.11	36.32
Mean FEV1/FVC % predicted	95.85	88.39	65.81

Figure 4: Lung function test (females).

Discussion

There has been some variability in the definition of PRISm itself. Some studies have considered FVC < 80% along with FEV1/FVC ≥70% as PRISm criterion [8, 9]; whereas others used FEV1 < 80% with FEV1/FVC ≥70% as PRISm criterion [10, 11], but it has been observed that isolated fall in FVC or FEV1 is rare and both usually fall concomitantly [12, 13]. In our study we have considered the definition of PRISm as; if either FVC or/and FEV1 were less < 80% and FEV1/FVC was ≥70%.

Some studies have used pre bronchodilator spirometry as database and others have used post bronchodilator spirometry. Schwartz et al while analyzing the data in a Spirometry Database considered pre bronchodilator values [14], Park et al [15] has also done his research on the basis of pre bronchodilator values. But Labaki et al used post bronchodilator values in his study [16]. We have conducted our study on post bronchodilator spirometry.

Patients who have been seen to be having combined pulmonary fibrosis with emphysema (CPFE) on HRCT usually have PRISm pattern on spirometry [15]. Pre COPD is the term used for patients who have structural and functional changes along with history of risk factors like smoking but normal spirometry. We found that more than 70% of males in both PRISm and Unrevealed COPD groups had smoking history, which may have contributed to the observation of abnormal spirometric pattern in these patients. Patients who have a history of smoking or frequent childhood infection are more prone to develop COPD or cardiovascular diseases.

Wan et al has estimated occurrence of PRISm in 6.6 to 17.6% of general population [17]. Quanjer et al also shared similar views [18]. Our study showed a much higher prevalence (30.26%), which is because we considered patients in a higher age group i.e., above forty years of age. PRISm patients had much higher BMI both in male and female group (26.59 and 26.60 respectively) than the unrevealed COPD group (19.47 and 23.91 respectively). This higher body mass index might have been the reason for decreased FVC and consequently lower FEV1 also, thus resulting in a higher number of PRISm patients in this study. Similar views have also been shared by Adibi et al in their study [19]. Further, Unrevealed COPD patients belonged to a higher age group (mean age 65.46 years) than normal and PRISm group (mean age 53.55 years and 54.58 years respectively). Similar observations were made by Park et al [15] Thus, higher age and higher BMI may have contributed to an increased occurrence of PRISm in our study.

Lung functions in males showed lower values of mean FVC (68.37% predicted) and mean FEV1 (58.75% predicted) in PRISm group than normal group (mean FVC 87.70 and mean FEV1 84.80% predicted). In females also, PRISm patients had lower values of mean FVC (65.20% predicted) and mean FEV1 (57.11% predicted) than normal group (mean FVC 94.57 and mean FEV1 90.65% predicted). Similarly, in males Unrevealed COPD group has lower values of mean FVC and mean FEV1 (FVC 61.22 and FEV1 35.43 % predicted) than PRISm group (FVC 68.37 and FEV1 58.75% predicted).

In female patients also Unrevealed COPD group has lower values of mean FVC and mean FEV1 (FVC 54.45 and FEV1 36.32% predicted) than PRISm group (FVC 65.20 and FEV1 57.11 % predicted).

Similar observations were made by Park et al [15] who observed FVC was lower in the PRISm (72.55% predicted) group than the normal group (92.96 %). Similar results were seen in FEV1 values also on comparison of the groups. Thus, patients in both PRISm and unrevealed COPD groups had lower mean spirometric values of FEV1, FVC and FEV1/FVC respectively as compared to those of the patients in the normal group.

Expectedly, the mean values of FVC, FEV1, and FEV1/FVC of the unrevealed COPD group were lower than those of the PRISm patients on account of the very nature of the disease categories with PRISm patients basically preserving FEV1/FVC ratio and the COPD patients having a variable element of airflow obstruction.

Strength of the study

Not many studies on PRISm have been conducted in our country. This study highlights the need for appropriate treatment of patients who present with symptoms suggestive of COPD but lack spirometric proof of COPD. It may help ignite interest for further studies on this aspect as GOLD 2023 updates also have put an emphasis on identification of PRISm patients.

Limitations of the study

The study has been conducted in one Medical College and needs to be substantiated from different institutions across the country. Further follow up of these patients is needed to understand how many of these patients progress into COPD or revert back to normal spirometry. Emphasis should be put on knowing the factors influencing the progression of PRISm patients.

Conclusion

Occurrence of PRISm is quite high (30.26%) in patients undergoing spirometry for various reasons in our area. Higher age and higher BMI may have contributed to the observations. In addition, a considerable number of patients (31.58%) were found to have Unrevealed COPD. Another finding is that smoking history is seen in more than 70% of male subjects in both PRISm and Unrevealed COPD groups. However, the results need confirmation in more studies from different geographical areas.

Conflicts of interest

Authors declare no conflicts of interest.

References

[1] GBD 2015 Chronic Respiratory Disease Collaborators. Global, regional, and national deaths, prevalence, disability-adjusted life years, and years lived with disability for chronic obstructive pulmonary disease and asthma, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet Respir Med. 2017; 5:691–706.

[2] Salvi S, Kumar GA, Dhaliwal RS, Paulson K, Agrawal A, et al. The burden of chronic respiratory diseases and their heterogeneity across the states of India: the Global Burden of Disease Study 1990–2016. Lancet Global Health. 2018; 6:e1363–e1374.

[3] Global Initiative for Chronic Obstructive Lung Disease (GOLD) Global strategy for the diagnosis, management and prevention of chronic obstructive pulmonary disease, 2009. Available from: http://www.goldcopd.org.

[4] Vogelmeier CF, Criner GJ, Martinez FJ, Anzueto A, Barnes PJ, et al. Global strategy for the diagnosis, management, and prevention of chronic obstructive lung disease 2017 report: GOLD executive summary. Arch Bronconeumol. 2017; 53:128–149.

[5] Guerra S, Carsin AE, Keidel D. Health-related quality of life and risk factors associated with spirometric restriction. Eur Respir J. 2017; 49:1602096.

[6] Fragoso CAV, Gill TM, McAvay G, Yaggi HK, Van Ness PH, et al. Respiratory impairment and mortality in older persons: a novel spirometric approach. J Investig Med. 2011; 59:1089–1095.

[7] Amariei DE, Dodia N, Deepak J, Hines SE, Galvin JR, et al. Combined pulmonary fibrosis and emphysema: pulmonary function testing and a pathophysiology perspective. Medicina (Kaunas). 2019; 55:580.

[8] Guerra S, Sherrill DL, Venker C, Ceccato CM, Halonen M, et al. Morbidity and mortality associated with the restrictive spirometric pattern: a longitudinal study. Thorax. 2010; 65:499⬚504.

[9] Mannino DM, Doherty DE, Buist AS. Global Initiative on Obstructive Lung Disease (GOLD) classification of lung disease and mortality: findings from the Atherosclerosis Risk in Communities (ARIC) study. Respir Med. 2006; 100:115–122.

[10] Wan ES, Fortis S, Regan EA, Hokanson J, Han MK, et al. Longitudinal phenotypes and mortality in preserved ratio impaired spirometry in the COPDGene study. Am J Respir Crit Care Med. 2018; 198:1397–1405.

[11] Wijnant SRA, De Roos E, Kavousi M, Stricker BH, Terzikhan N, et al. Trajectory and mortality of preserved ratio impaired spirometry: the Rotterdam Study. Eur Respir J. 2020; 55:1901217.

[12] Fortis S, Corazalla EO, Jacobs DR, Kim HJ. Persistent empiric COPD diagnosis and treatment after pulmonary function test showed no obstruction. Respir Care. 2016; 61:1192–1200.

[13] Iyer VN, Schroeder DR, Parker KO, Hyatt RE, Scanlon PD. The nonspecific pulmonary function test: longitudinal follow-up and outcomes. Chest. 2011; 139:878–886.

[14] Schwartz A, Arnold N, Skinner B, Simmering J, Eberlein M, et al. Preserved ratio impaired spirometry in a spirometry database. Respir Care. 2021; 66:58–65.

[15] Park HJ, Byun MK, Rhee CK. Significant predictors of medically diagnosed chronic obstructive pulmonary disease in patients with preserved ratio impaired spirometry: a 3-year cohort study. Respir Res. 2018; 19:185.

[16] Labaki WW, Rosenberg SR. Chronic obstructive pulmonary disease. Ann Intern Med. 2020; 173: ITC17–ITC32.

[17] Wan ES, Castaldi PJ, Cho MH, Hokanson JE, Regan EA, et al. Epidemiology, genetics, and subtyping of preserved ratio impaired spirometry (PRISm) in COPD gene. Respir Res. 2014; 15:89.

[18] Quanjer PH, Brazzale DJ, Boros PW, Pretto JJ. Implications of adopting the global lungs initiative 2012 all-age reference equations for spirometry. Eur Respir J. 2013; 42:1046–1054.

[19] Adibi A, Sadatsafavi M. Looking at the COPD spectrum through "PRISm". Eur Respir J. 2020; 55:1902217.