Prevalence of Preserved Ratio Impaired Spirometry Among Smokers in an Urban Population of Chennai: A Cross-Sectional Spirometric Screening Study

Dr. Arunan P[1], Dr. Meenakshi N[2*], Dr. Chandrasekar S[3], Dr. Jayamol Revendran[4], Dr Nisha Ganga[5]
1Postgraduate, Email: arunanarunan7@gmail.com
*2Professor and HOD, Email: paddy_2020@yahoo.com
3Assistant Professor, Email: schandrasekar3232@gmail.com
4Associate Professor, Email: drjayasujith@gmail.com
5Assistant Professor, Email: nishaprejit@gmail.com
[1,2*,3,4,5]Department of Respiratory Medicine, Chettinad Hospital and Research Institute, Chettinad Academy of Research and Education, Kelambakkam-603103, Tamil Nadu, India.

ABSTRACT

Background: Preserved ratio impaired spirometry (PRISm) is an increasingly recognized spirometric phenotype characterized by reduced forced expiratory volume in one second (FEV_1 <80% predicted) with a preserved FEV_1/FVC ratio ≥0.70. Although individuals with PRISm do not fulfill the diagnostic criteria for chronic obstructive pulmonary disease (COPD), several studies have demonstrated that this phenotype is associated with respiratory symptoms, impaired quality of life, and increased risk of progression to airflow obstruction. The prevalence of PRISm among smokers in the Indian population remains insufficiently studied.

Objective: To determine the prevalence of preserved ratio impaired spirometry among smokers undergoing spirometric screening in an urban tertiary care population.

Methods: A hospital-based cross-sectional study was conducted in the Department of Respiratory Medicine at a tertiary care teaching hospital. A total of 753 smokers underwent spirometry during the study period. Spirometry was performed using standardised procedures according to international guidelines. PRISm was defined as post-bronchodilator FEV_1 <80% predicted with FEV_1/FVC ≥0.70. Demographic characteristics and smoking exposure were recorded. The prevalence of PRISm was calculated using the screened population as the denominator.

Results: Among the 753 smokers screened, 142 individuals fulfilled the spirometric criteria for PRISm, corresponding to a prevalence of 18.9%. The remaining participants demonstrated other spirometric patterns. Individuals with PRISm frequently reported respiratory symptoms despite the absence of classical airflow obstruction.

Conclusion: PRISm was identified in nearly one-fifth of smokers undergoing spirometric screening. Routine spirometry among smokers may facilitate early identification of lung function impairment and provide an opportunity for preventive intervention before the development of COPD.

Keywords: PRISM, spirometry screening, smoking, lung function impairment, COPD
How to cite this article: Arunan P, Meenakshi N, Chandrasekar S, Revendran J, Ganga N. Prevalence of Preserved Ratio Impaired Spirometry Among Smokers in an Urban Population of Chennai: A Cross-Sectional Spirometric Screening Study. Int J Drug Deliv Technol. 2026;16(33s):1014-1019. DOI: 10.25258/ijddt.16.33s.121
Source of support: Nil., **Conflict of interest:** None

INTRODUCTION

Smoking remains the leading preventable cause of chronic respiratory disease worldwide. Chronic exposure to tobacco smoke leads to airway inflammation, oxidative stress, and progressive structural damage to the lung parenchyma, ultimately resulting in chronic airflow limitation and the development of chronic obstructive pulmonary disease (COPD)[1]. COPD represents a major cause of morbidity and mortality globally and imposes a significant burden on healthcare systems.

Traditionally, the diagnosis of COPD has relied on spirometric evidence of airflow obstruction defined by a reduced FEV_1/FVC ratio. However, increasing evidence suggests that lung injury associated with smoking may occur long before classical spirometric obstruction becomes apparent[2]. Several intermediate spirometric phenotypes have therefore been described in smokers who demonstrate abnormal lung function despite preserved airflow ratios.

One such phenotype is preserved ratio impaired spirometry (PRISm), defined by reduced FEV_1 with a preserved FEV_1/FVC ratio[3]. Although this pattern does not fulfill the spirometric criteria for COPD, individuals with PRISm frequently experience respiratory symptoms, reduced exercise tolerance, and impaired health-related quality of life. Furthermore, longitudinal studies have demonstrated that individuals with PRISm may progress to overt COPD over time[4].

The prevalence of PRISm has been reported to range between 6% and 20% in population-based studies depending on the population studied and the diagnostic criteria used[5]. The phenotype is particularly common among smokers and individuals with metabolic comorbidities such as obesity and diabetes. PRISm has also been associated with increased systemic inflammation and higher mortality compared with individuals with normal spirometry[6].

Despite its clinical relevance, PRISm often remains underrecognized in clinical practice. Many

smokers undergo spirometric testing only when they develop advanced respiratory symptoms, and intermediate spirometric patterns may be overlooked or interpreted as nonspecific abnormalities. As a result, opportunities for early intervention are frequently missed.

Spirometry screening among high-risk populations such as smokers may facilitate early detection of lung function impairment before the development of irreversible airflow obstruction. Identification of individuals with PRISm may allow implementation of preventive strategies such as smoking cessation and pulmonary rehabilitation aimed at modifying disease progression.

Data regarding the prevalence of PRISm among smokers in the Indian population are limited. Understanding the magnitude of this phenotype is important for planning preventive strategies and improving early detection of smoking-related lung disease.

The present study was therefore conducted to determine the prevalence of preserved ratio impaired spirometry among smokers undergoing spirometric screening in a tertiary care hospital in an urban population.

AIM AND OBJECTIVES

To determine the prevalence of PRISm among smokers undergoing spirometric screening in a tertiary care center in Chennai.

MATERIALS AND METHODS

Study Design

A hospital based cross sectional analysis was performed using spirometry data obtained during the screening phase of a prospective clinical study.

Study Setting

The study was carried out in the Department of Respiratory Medicine at a tertiary care teaching hospital in Chennai,India.

Study Population

Smokers presenting to the respiratory medicine outpatient department who underwent spirometry during the study period were included in the analysis.A total of 753 smokers underwent spirometric evaluation .

Inclusion Criteria

Participants were eligible for inclusion if they met the following criteria:

- Current smokers
- Age 25-55 years
- Underwent spirometry during the study period and acceptable according to standard guidelines

Exclusion Criteria

Participants were excluded if they had:

- Incomplete spirometric data
- Active pulmonary pathology interfering with spirometry
- Previously diagnosed Interstitial lung diseases or other restrictive lung disorders

Spirometry Procedure

Spirometry was performed using calibrated spirometers according to standard guidelines. Participants performed forced expiratory manoeuvres under trained supervision to ensure accuracy and reproducibility. Post-bronchodilator spirometry values were used for analysis.

Definition of PRISm

Preserved ratio impaired spirometry was defined as post-bronchodilator FEV_1 <80% predicted and preserved FEV_1/FVC ratio ≥0.70.

Participants who met these criteria were categorised as having PRISm.

Data Collection

Demographic information and smoking exposure were recorded for all participants. Smoking index was calculated based on the number of cigarettes or bidis smoked per day and duration of smoking.

Statistical Analysis

Descriptive statistics were used to summarise demographic and spirometric characteristics. The prevalence of PRISm was calculated as the proportion of individuals with PRISm among the total screened population.

Ethical Considerations

This study was conducted using data derived from participants who had been enrolled in a previously approved institutional research protocol in the Department of Pulmonary Medicine. The present study represents secondary analysis of previously collected data. All procedures were performed in accordance with institutional ethical guidelines. Patient confidentiality was strictly maintained throughout the study, and all personal identifiers were removed prior to data analysis to ensure anonymity and protection of participant privacy.

RESULTS

A total of **753 smokers** underwent spirometric evaluation during the study period.Among them,**142** individuals fulfilled criteria for PRISm, while 611 individuals demonstrated other spirometric patterns

Prevalence of PRISm

The overall prevalence of PRISm among smokers in the screened population was: **18.9%.** This indicates that nearly one in five smokers demonstrated impaired lung function despite preserved airflow ratio.

Table 1. Baseline Characteristics of Screened PRISm Population (n = 142)

Variable	Value
Total participants screened	142
Mean age (years)	41.35 ± 7.00
Male (%)	142 (100%)

Smoking index	326.62 ± 191.16

Table 1 summarises the baseline Demographic characteristics of the screened PRISm population. A total of 142 participants underwent spirometric screening, all of whom were male smokers, reflecting the smoking demographics of the study setting. The mean age of the participants was 41.35 ± 7.00 years, indicating that the majority of individuals were in the middle-aged adult group. The mean smoking index was 326.62 ± 191.16, demonstrating substantial cumulative tobacco exposure among the PRISm population. These findings suggest that the screened cohort largely consisted of middle-aged individuals with considerable smoking exposure, a population at increased risk for early smoking-related pulmonary function abnormalities.

Figure 1: Age Distribution of PRISm Participants

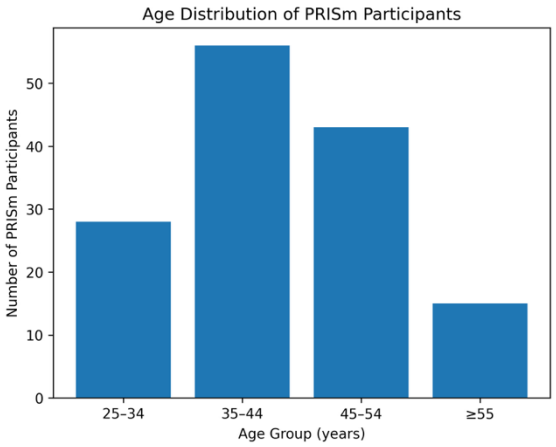

Figure 1 shows the age distribution of participants diagnosed with preserved ratio impaired spirometry (PRISm). The highest number of PRISm cases was observed in the **35–44 year age group (n = 56)**, followed by the **45–54 year age group (n = 43).** A smaller proportion of cases was noted among participants aged **25–34 years (n = 28),** while the **lowest frequency was observed in individuals aged ≥55 years (n = 15).** These findings indicate that PRISm was most commonly identified among **middle-aged smokers**, suggesting that early lung function impairment may begin to manifest during this age period in individuals with significant smoking exposure.

Figure 2: Smoking Index Distribution Among PRISm Participants

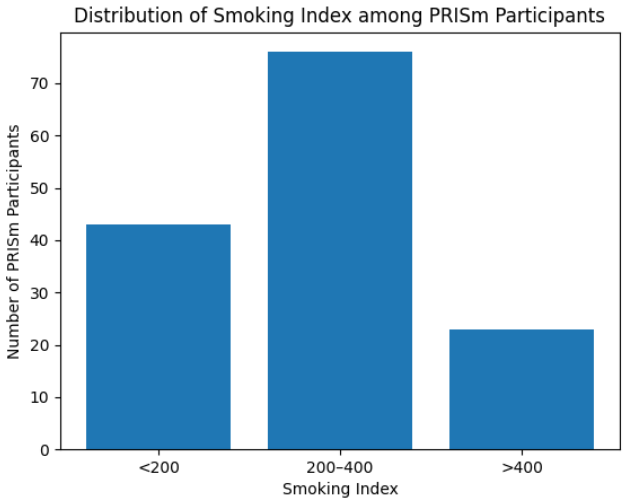

Figure 2 illustrates the distribution of smoking index among participants diagnosed with preserved ratio impaired spirometry (PRISm). The largest proportion of PRISm cases was observed among individuals with a smoking index between 200 and 400 (n = 76), followed by those with a smoking index less than 200 (n = 43). A smaller number of participants with PRISm had a smoking index greater than 400 (n = 23). These findings indicate that PRISm was more frequently observed among individuals with moderate smoking exposure, suggesting that cumulative tobacco exposure may contribute to early lung function impairment even before the development of overt airflow obstruction.

Table 2. Distribution of Spirometric Patterns

Spirometry Pattern	Number	Percentage (%)
PRISm	142	18.9
Normal Spirometry	498	66.1
Airflow obstruction	113	15
Total	753	100

Table 2 presents the distribution of spirometric patterns among the screened population. Out of the 753 smokers who underwent spirometric evaluation, 142 individuals (18.9%) were identified with preserved ratio impaired spirometry (PRISm),498 individuals (66.1%) were identified with normal spirometric outcomes, 113 individuals (15%) were identified with airflow obstruction. These findings indicate that nearly one-fifth of the screened smokers exhibited PRISm, highlighting a considerable burden of early spirometric impairment in this population. The results emphasise the importance of spirometric screening among smokers for the early identification of lung function abnormalities before the development of overt airflow obstruction.

Figure 3: Participant flow diagram of the screened study population

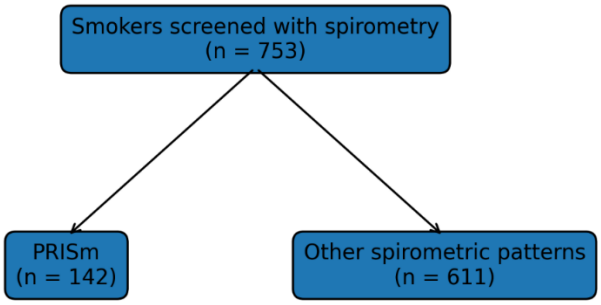

Figure 3 illustrates the participant flow of the spirometric screening conducted in the study. A total of 753 smokers underwent spirometry during the study period. Among them, 142 individuals were identified with preserved ratio impaired spirometry (PRISm), while the remaining 611 participants demonstrated other spirometric patterns. This flow diagram highlights the classification of the screened population into PRISm and non-PRISm groups based on spirometric criteria, providing a clear overview of the study population included in the analysis.

Figure 4: Distribution of Spirometric Patterns (n = 753)

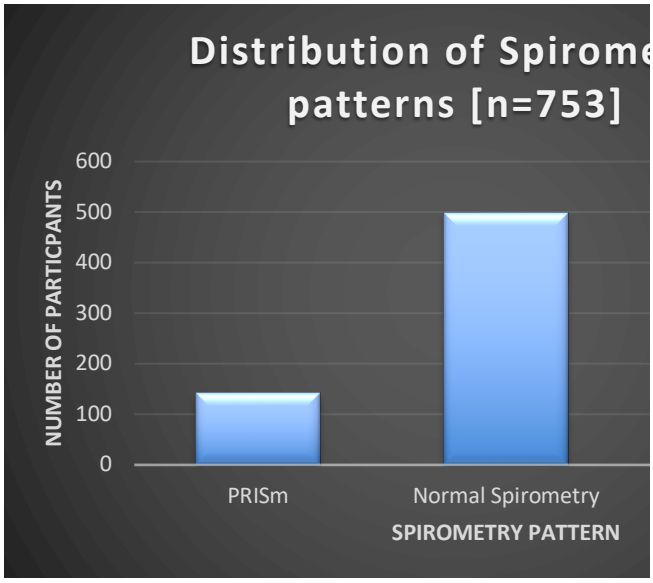

Figure 4 illustrates illustrates the distribution of participants according to spirometry patterns among a total of 753 individuals. The X-axis represents the different spirometry categories—PRISm, Normal Spirometry, and Airflow Obstruction—while the Y-axis denotes the number of participants.

Among the three groups, Normal Spirometry has the highest number of participants (498; 66.1%), indicating that more than half of the study population had normal lung function. This is followed by Airflow Obstruction with 113 participants (15%), representing a significant proportion with obstructive lung disease.

The PRISm group comprises 142 participants (18.9%) ,athough smaller in number, this group is clinically important as it represents individuals with impaired spirometry despite a preserved FEV_1/FVC ratio.

Overall, the diagram clearly demonstrates that while normal spirometry predominates, a considerable proportion of the population exhibits abnormal spirometry patterns, with PRISm accounting for nearly one-fifth of the total study population.

Table 3. Comparison Between PRISm, Normal Spirometric and Airflow Obstruction Patterns

Variable	PRISm (n = 142)	Normal Spirometry (n = 498)	Airflow Obstruction (n = 113)	p-value
Age (years)	41.35 ± ± 7.00	40.12 ± 6.84	42.08 ± 7.21	0.08
Smoking index	326.62 ± 191.16	298.44 ± 168.32	371.50 ± 182.41	0.04*
FEV_1 % predicted	65.04 ± ± 6.38	96.28 ± 7.91	59.72 ± 8.64	<0.001*
FVC % predicted	63.47 ± ± 7.80	95.41 ± 8.12	72.65 ± 9.83	<0.001*

***Statistically significant**

Table 3 compares the demographic and spirometric characteristics among participants with preserved ratio impaired spirometry (PRISm), normal spirometry, and airflow obstruction. The mean age of participants with PRISm was 41.35 ± 7.00 years, which was comparable to that of individuals with normal spirometry (40.12 ± 6.84 years) and airflow obstruction (42.08 ± 7.21 years). The difference in age between the groups was not statistically significant (p = 0.08). The mean smoking index was 326.62 ± 191.16 in the PRISm group, 298.44 ± 168.32 in the normal spirometry group, and 371.50 ± 182.41 in the airflow obstruction group, showing a statistically significant difference between the groups (p = 0.04).

In contrast, spirometric parameters demonstrated marked differences across the three groups. Participants with PRISm had a mean FEV_1 % predicted of 65.04 ± 6.38, which was considerably lower than that observed in individuals with normal spirometry

(96.28 ± 7.91), while those with airflow obstruction

showed an even lower mean FEV_1 % predicted of 59.72 ± 8.64 ($p < 0.001$). Similarly, the mean FVC % predicted was 63.47 ± 7.80 in the PRISm group, compared with 95.41 ± 8.12 in the normal spirometry group and 72.65 ± 9.83 in the airflow obstruction group ($p < 0.001$). These findings demonstrate that individuals with PRISm exhibit significant reductions in lung function compared with those with normal spirometry, although the impairment is less pronounced than in individuals with established airflow obstruction, highlighting PRISm as an intermediate spirometric phenotype associated with early pulmonary functional impairment.

Table 4. Spirometric Characteristics of PRISm Participants (n = 142)

Parameter	Mean ± SD
POST FEV_1 % predicted	65.04 ± 6.38
POST FVC % predicted	63.47 ± 7.80
POST FEV_1/FVC %	80.30 ± 4.98

Table 4 summarises the spirometric characteristics of participants diagnosed with Preserved Ratio Impaired Spirometry (PRISm). The mean FEV_1 % predicted was 65.04 ± 6.38, indicating a reduction in expiratory airflow among individuals in this group. Similarly, the mean FVC % predicted was 63.47 ± 7.80, reflecting a decrease in overall lung volume. Despite these reductions in spirometric parameters, the mean FEV_1/FVC ratio remained preserved at 80.30 ± 4.98%, which is consistent with the defining spirometric criterion for PRISm. These findings highlight that individuals with PRISm demonstrate reduced lung function with a preserved airflow ratio, suggesting the presence of early functional impairment prior to the development of overt airflow obstruction.

Figure 5: Prevalence of PRISm Among Screened Smokers

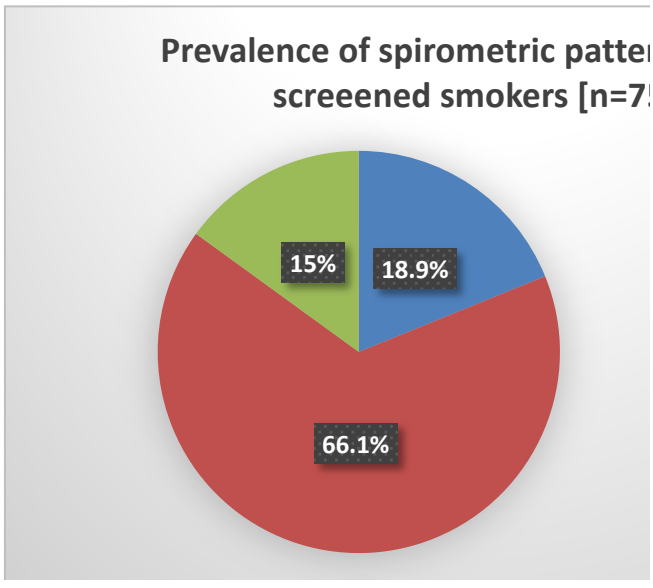

Figure 5 illustrates the distribution of spirometric patterns among the screened smokers. Out of the 753 participants who underwent spirometric screening, 142 individuals (18.9%) were identified with preserved ratio impaired spirometry (PRISm). Among the remaining participants, 498 individuals (66.1%) demonstrated normal spirometry, while 113 participants (15%) showed airflow obstruction. This distribution indicates that although the majority of smokers had normal spirometric findings, a substantial proportion exhibited either PRISm or airflow obstruction, reflecting varying degrees of smoking-related lung function impairment. These findings highlight the importance of spirometric screening among smokers for the early detection of both intermediate spirometric phenotypes such as PRISm and established airflow limitation.

DISCUSSION

The present hospital based cross-sectional screening study demonstrates that preserved ratio impaired spirometry was identified in approximately one-fifth of smokers undergoing spirometric evaluation. This prevalence of 18.9% falls within the range reported in international epidemiological studies and underscores the growing recognition of PRISm as a clinically relevant spirometric phenotype.

Historically, spirometric evaluation of smokers has focused primarily on identifying airflow obstruction indicative of COPD. However, increasing evidence suggests that smoking-related lung injury often begins long before classical obstruction becomes apparent. PRISm represents one such intermediate phenotype characterised by impaired lung function despite preservation of the FEV_1/FVC ratio.

Several large cohort studies have reported comparable prevalence rates of PRISm among smokers. The COPDGene and SPIROMICS cohorts have demonstrated that PRISm is present in a substantial proportion of smokers and is associated with respiratory symptoms, metabolic abnormalities, and increased mortality risk. The findings of the present study align with these observations and highlight the potential importance of PRISm in early detection of smoking-related lung disease.

The relatively high prevalence observed in this study suggests that a considerable proportion of smokers may have early lung function impairment that remains unrecognised in routine clinical practice. Because individuals with PRISm frequently do not meet the spirometric criteria for COPD, they may not receive targeted interventions aimed at preventing disease progression.

Early identification of PRISm may therefore provide an opportunity for preventive strategies. Smoking cessation remains the most effective intervention for reducing the risk of lung function

decline. In addition, pulmonary rehabilitation programs may improve physical conditioning and respiratory symptoms in individuals with early spirometric impairment.

Another important implication of these findings is the potential role of spirometry screening among high-risk populations. Routine spirometry among smokers may facilitate early detection of abnormal lung function patterns before the development of irreversible airway obstruction. Such screening strategies could help identify individuals who would benefit from targeted lifestyle interventions.

LIMITATIONS

The study has certain limitations that should be considered. The study was conducted in a single tertiary care centre and may therefore not fully represent the general population. Additionally, detailed longitudinal follow-up of participants was not performed within the scope of the screening component of the study.

Despite these limitations, the present study provides valuable data regarding the burden of PRISm among smokers in an urban population. The findings highlight the importance of recognising PRISm as an early stage of smoking-related lung disease and support the implementation of spirometry screening programs among high-risk individuals.

Future studies involving larger populations and longitudinal follow-up are needed to better understand the natural history of PRISm and to determine the most effective strategies for early intervention.

CONCLUSION

Preserved ratio impaired spirometry was identified in nearly one-fifth of smokers undergoing spirometry screening in this study. The findings suggest that PRISm represents a common and clinically important spirometric phenotype among smokers. Routine spirometry screening may facilitate early detection of lung function impairment and provide an opportunity for preventive interventions aimed at reducing the burden of smoking-related respiratory disease.

REFERENCES

Wan ES, Fortis S, Regan EA, Hokanson JE, Han MK, Casaburi R, et al. Clinical predictors of preserved ratio impaired spirometry in smokers. *Chest*. 2018;153(4):909–920.

Wijnant SRA, De Roos E, Kavousi M, Stricker BH, Terzikhan N, Lahousse L, et al. Prevalence and clinical implications of preserved ratio impaired spirometry in a population-based cohort of smokers. *Respir Res*. 2020;21(1):1–10.

Guerra S, Sherrill DL, Venker C, Ceccato CM, Halonen M, Martinez FD. Morbidity and mortality associated with the restrictive spirometric pattern: a longitudinal study. *Thorax*. 2010;65(6):499–504.

Brusselle GG, Riemann SG. Preserved ratio impaired spirometry: a heterogeneous and potentially treatable phenotype. *Lancet Respir Med*. 2021;9(10):1114–1116.

Zhang Y, Wang L, Mutlu GM, Cai H. Molecular mechanisms of smoking-related lung disease. *Chest*. 2018;154(3):608–618.

Dharmage SC, Faner R, Agustí A. Treatable traits in pre-COPD and early COPD. *Lancet Respir Med*. 2018;6(9):671–682.