

Patterns of Pulmonary Function in Patients Undergoing Spirometry at a Tertiary Referral Hospital in West Java, Indonesia

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Abstract

Spirometry is a fundamental tool for assessing pulmonary function, as it provides critical insights into respiratory health. This study aimed to explore pulmonary function abnormalities among patients undergoing spirometry at Dr. Hasan Sadikin General Hospital, Bandung, Indonesia. Conducted in May 2024 with 206 participants, the study employed a descriptive, observational design. The average patient age was 45.86 years, with a majority being female (64.1%) and unemployed (62.1%). Comorbidities were present in 25.67% of patients, with hypertension being the most common (50.87%). The primary indications for spirometry in this hospital were preoperative risk assessment (75.2%) and evaluation following treatment for multidrug-resistant tuberculosis. The study demonstrated that 67.5% of patients had restrictive lung disorders, 31.6% had normal lung function, and 1% had obstructive patterns. Restrictive lung disorders were more prevalent in older adults and females, with most cases being mild (64.02%). These findings underscore the necessity of spirometry in preoperative assessments, and highlights the dominance of restrictive lung disorders in the hospital's patient population. Future research should incorporate larger sample sizes, longer study durations, and add additional variables such as respiratory risk factors to enhance understanding of pulmonary function trends in this setting.

Keywords: Comorbidity, pulmonary disease, spirometry, tertiary care centers

Introduction

Spirometry is one of the most commonly used pulmonary function tests for assessing lung function.¹ This procedure enables the identification and classification of various pulmonary function abnormalities, including obstructive, restrictive, and mixed patterns.² Spirometry plays a critical role in evaluating disease severity, monitoring disease progression, assessing treatment response, performing preoperative risk evaluations, and determining prognosis in various pulmonary conditions.² It measures forced vital capacity (FVC) and forced expiratory volume in one second (FEV₁), with reductions in these values and their ratio (FEV₁/FVC) indicating the presence and type of pulmonary impairment.³

Obstructive lung diseases are characterized

by airflow limitation, with chronic obstructive pulmonary disease (COPD) and asthma being the most common forms. In Indonesia, the prevalence of COPD is estimated at 3.7%, making it one of the country's leading causes of mortality from non-communicable diseases.^{4,5} Cigarette smoking represents the primary risk factor, contributing to approximately 90% of COPD cases, while additional risk factors include air pollution and occupational exposure.⁵ Indonesia ranks among the countries with the highest smoking prevalence. This pattern is also observed regionally where West Java is one of the provinces with the highest risk factor burden for COPD.^{6,7}

In contrast, restrictive lung diseases are marked by reduced lung volume with relatively preserved airflow, commonly resulting from conditions that limit lung expansion, including parenchymal, pleural, neuromuscular, or thoracic cage disorders.⁸ Spirometric findings in restrictive disease typically show a reduced FVC without airflow obstruction. In epidemiological terms, the global estimated prevalence of

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restrictive patterns is around 12%, and this condition is strongly associated with increased cardiovascular mortality.⁹

Despite the clinic importance and widespread use, epidemiological data describing the patterns of pulmonary function among patients undergoing spirometry at Dr. Hasan Sadikin General Hospital (RSHS) in Bandung, remain limited. As one of Indonesia's major national referral hospitals, the absence of local spirometric data represents an important gap in respiratory health surveillance. Therefore, this study aimed to describe the patterns of pulmonary function among patients undergoing spirometry at a tertiary referral hospital in West Java, Indonesia. Identification of the distribution of spirometric abnormalities and their association with demographic and clinical factors, this research provides new insights into pulmonary function trends in a major Indonesian hospital setting.

Methods

This descriptive study employed a prospective approach and was conducted in the Spirometry Examination Room of Dr. Hasan Sadikin General Hospital, a tertiary referral hospital located in Bandung, West Java, Indonesia. The study was carried out in May 2024 and received ethical approval from the Health Research Ethics Committee of Dr. Hasan Sadikin General Hospital Bandung (Reference number: DP.04.03/D. XIV.6.5/110/2024).

The study population consisted all patients undergoing spirometry examinations at the hospital during the study period. Participants were included if they were aged ≥ 18 years, provided written informed consent, and were able to perform acceptable and reproducible spirometry maneuver. Patients were excluded if they were unable to complete the spirometry test or produced invalid test results. A non-probability consecutive sampling method was applied, whereby all eligible patients presenting during the study period were enrolled sequentially until the required sample size was.

Based on hospital records, the average monthly number of patients undergoing spirometry testing in 2022 and 2023 was approximately 865. The minimum required sample size was calculated using Isaac and Michael's formula, assuming a population proportion (P) of 0.5, a 95% confidence level, and a 10% margin of error.¹⁰ A wider margin of error was selected to ensure feasibility given the exploratory nature

of the study and the constraints of the available study period, while still maintaining acceptable statistical precision.¹⁰ The calculated minimum sample size was 206 participants. All participants were recruited from the target population and satisfied the predetermined inclusion criteria.

Data were collected through direct observation and spirometry results recorded by trained personnel. Each patient underwent a standardized spirometry procedure using calibrated equipment, and testing was performed in accordance with the operational standards of the American Thoracic Society/European Respiratory Society (ATS/ERS).³ Collected variables included demographic characteristics (age, gender, and occupation), clinical data (comorbidities and referral diagnosis), and spirometry parameters, including forced vital capacity (FVC), forced expiratory volume in one second (FEV₁), and the FEV₁/FVC ratio.

Interpretation of spirometry results was performed using the Global Initiative for Obstructive Lung Disease (GOLD) 2024 guidelines for identifying obstructive disorders and the local guidelines of Dr. Hasan Sadikin General Hospital for restrictive disorders.¹¹ An obstructive pattern was defined as an as a post-bronchodilator FEV₁/FVC ratio of less than 0.7, in accordance with the GOLD criteria.¹¹ A restrictive pattern was indicated by a reduced FVC (<80% predicted) with a normal or elevated FEV₁/FVC ratio. Results not meeting either criterion were categorized as normal pulmonary function.

All data were analyzed using Statistical Product and Service Solutions (SPSS) software version 26.0. Univariate descriptive analysis was employed to characterize the distribution patterns of demographic variables, clinical characteristics, and spirometry parameters. Data were presented as frequencies and percentages to summarize the variables studied.

Result

Data for this study were collected in May 2024 and included 206 patients who underwent spirometry examinations at Dr. Hasan Sadikin General Hospital, Bandung. Descriptive analysis showed that the mean age of the participants was 45.8 ± 15.19 years, with the ages ranging from 18 to 81 years. The majority of participants were female (64.1%), and most were not working (62.1%).

Comorbid conditions were identified in 57 participants (27.7%), while 149 participants

Table 1 Characteristics of Patients (n=206)

Variables	n (%) or Mean \pm SD
Age (years)	45.8 \pm 15.19
Gender	
Male	74 (35.9%)
Female	132 (64.1%)
Occupation	
Not working	128 (62.1%)
Civil servant	9 (4.4%)
Private sector	50 (24.3%)
Entrepreneur	13 (6.3%)
Others	6 (2.9%)

(72.3%) had no comorbidities. Among patients with comorbidities, hypertension was the most common condition (50.9%), followed by asthma (19.3%) and diabetes mellitus (17.5%).

All participants had referral diagnosis prior to spirometry examination. Diagnostic were classified according to the 10th version of the International Classification of Diseases (ICD-10).

Table 2 Comorbidity Distribution Among Patients

Presence of Comorbidity	(n=206) (%)
No comorbidity	149 (72.3%)
With comorbidity	57 (25.7%)
Type of Comorbidity*	
Hypertension	29 (50.9%)
Asthma	11 (19.3%)
Diabetes Mellitus	10 (4.9%)
Gastritis	2 (1.0%)
Tuberculosis	2 (1.0%)
Coronary Heart Disease	1 (0.5%)
Arrhythmia	1 (0.5%)
Epilepsy	1 (0.5%)

*Percentages are calculated based on the 57 patients with comorbidities

Descriptive analysis indicated that neoplasms represented the most common diagnostic category (37.9%), followed by diseases of the digestive system (13.1%), and diseases of the genitourinary system (11.7%).

Table 3 Referral Diagnoses Among Patients (n=206)

Diagnostic Category	n (%)
Neoplasms	78 (37.9%)
Diseases of the Digestive System	27 (13.1%)
Diseases of the Genitourinary System	24 (11.7%)
Injury, Poisoning, and Certain Other Consequences of External Causes	24 (11.7%)
Certain Infectious and Parasitic Diseases	13 (6.3%)
Diseases of the Circulatory System	6 (2.9%)
Diseases of the Musculoskeletal System and Connective Tissue	6 (2.9%)
Congenital Malformations, Deformations, and Chromosomal Abnormalities	6 (2.9%)
Diseases of the Respiratory System	5 (2.4%)
Endocrine, Nutritional, and Metabolic Diseases	4 (1.9%)
Diseases of the Skin and Subcutaneous Tissue	4 (1.9%)
Diseases of the Ear and Mastoid Process	3 (1.5%)
Diseases of the Eye and Adnexa	2 (1.0%)
Diseases of the Nervous System	2 (1.0%)
Symptoms, Signs, and Abnormal Clinical and Laboratory Findings, Not Elsewhere Classified	2 (1.0%)
Related to restrictive lung disease	33 (16.0%)
Related to obstructive lung disease	7 (3.4%)
Not related	166 (80.6%)

Table 4 Distribution of Spirometry Examination Indications

Indication	Normal (n=65)	Obstructive (n=2)	Restrictive (n=139)	Total (n=206)
Pre-operative	51 (32.9%)	1 (0.6%)	103 (66.5%)	155 (75.2%)
Diagnosis	0 (0%)	0 (0%)	1 (100%)	1 (0.5%)
Evaluation	4 (26.7%)	1 (6.7%)	10 (66.7%)	15 (7.3%)
Others	10 (28.6%)	0 (0%)	25 (71.4%)	35 (17.0%)

Table 5 Distribution of Spirometry Results

Variables	n (%) (n=206)
Lung Abnormality Patterns	
Normal	65 (31.6%)
Obstructive	2 (1.0%)
Restrictive	139 (67.5%)
Mixed	0 (0%)
Severity of Restrictive Abnormality	
Mild	89 (64.0%)
Moderate	43 (30.4%)
Severe	7 (5.0%)
Severity of Obstructive Abnormality	
Mild	0 (0%)
Moderate	1 (50.0%)
Severe	0 (0%)
Very Severe	1 (50.0%)

Another variable investigated in this study was the indication for spirometry examination. This study classified the indications into pre-operative risk assessment (pre-operative), diagnosis, evaluation, and other preparations categorized as “others”. The distribution of examination indications among participants is presented in Table 4.

Descriptive analysis of spirometry results revealed that restrictive patterns were the most common abnormality, identified in 139 patients (67.5%), followed by normal spirometry results in 65 patients (31.6%). Only 2 patients (1.0%) demonstrated obstructive patterns.

The distribution of spirometry results based on the participant demographics are presented in Table 6. Descriptive analysis revealed that the most prevalent age cohort comprised the late adulthood group (45–59 years) with 72 participants (34.9%). However, the highest proportion of participants with restrictive patterns was found in the elderly group (60–81 years) at 75.6%, while participants with obstructive patterns was evenly distributed among the young adult and late adulthood groups. Regarding gender distribution, the proportion of participants with obstructive patterns was

Table 6 Overview of Spirometry Results Distribution Based on Subject Characteristics on This Study

Variables	Normal (n = 65)	Obstructive (n = 2)	Restrictive (n = 139)	Total (n = 206)
Age Group				
18–29	19 (46.3%)	1 (2.4%)	21 (51.2%)	41 (19.9%)
30–44	14 (26.9%)	0 (0%)	38 (73.0%)	52 (25.2%)
45– 59	22 (30.6%)	1 (1.4%)	49 (68.0%)	72 (34.9%)
60–81	10 (24.4%)	0 (0%)	31 (75.6%)	41 (19.9%)
Gender				
Male	26 (35.1%)	2 (2.7%)	46 (62.2%)	74 (35.9%)
Female	39 (29.5%)	0 (0%)	93 (70.5%)	132 (64.1%)

higher among males, while restrictive patterns were more prevalent among females.

Discussion

The findings provide an epidemiological overview patterns in a of current spirometry trends in Indonesian clinical setting that serves a diverse patient population with various diagnostic indications. By identifying the distribution of restrictive, obstructive, and normal spirometry patterns, this study offers insights into the respiratory health profile of patients undergoing spirometry at Dr. Hasan Sadikin General Hospital and provide a basis for comparison with previous studies.

The high prevalence of restrictive lung disorders (67.5%) identified in this study represents an important finding. This pattern differs from earlier international studies. From example, a hospital-based study conducted in South Korea reported a substantially higher proportion of normal spirometry results (73%), followed by obstructive patterns (18.1%), while restrictive patterns accounted for only 8.9% of cases.¹² However, that study was conducted prior to 2020, limiting its direct comparability in a contemporary clinical contexts.

More recent regional data provide additional perspective on restrictive pulmonary patterns. A 2025 study conducted in Pakistan among patients recovering from COVID-19 reported that 32.8% of individuals had abnormal pulmonary function tests, of which 81.6% demonstrated restrictive patterns and 18.3% showed obstructive patterns.¹³ These findings highlight the potential impact of recent infectious diseases, including COVID-19, on the development of restrictive pulmonary abnormalities in several Asian healthcare setting.

Pulmonary impairment related to tuberculosis (TB) also remains an important consideration, particularly in high-burden countries such as Indonesia. A 2025 systematic review and meta-analysis reported that individuals recovering from pulmonary TB often experience persistent reductions in lung function, frequently presenting with a mixed obstructive and restrictive pattern, although airflow obstruction tends to be more dominant.¹⁴ In the present study, this phenomenon was reflected in subgroup of patients who underwent spirometry for post-treatment evaluation following tuberculosis therapy. Fifteen participants (7.3%) were referred from the Tuberculosis Directly

Observed Treatment Short-Course (TB-DOTS) clinic after completing treatment for multidrug-resistant tuberculosis (TB-MDR). Spirometry was performed to assess residual pulmonary function impairment. This referral pattern reflects routine clinical practice in Indonesian tertiary hospitals, where spirometry is commonly used to evaluate post-treatment pulmonary sequelae among TB survivors. The presence of this subgroup highlights the clinical relevance of TB-related pulmonary damage within the study population and supports previous findings on the long-term respiratory consequences of drug-resistant tuberculosis.

A higher proportion of restrictive patterns was observed among older adults. This distribution is consistent with know physiological changes associated with aging. Previous research highlight that the prevalence of restrictive conditions increases significantly with age, escalating from 2.7 cases per 100,000 persons in individuals aged 35–44 years to over 175 cases per 100,000 in those older than 75 years.¹⁵ These findings reflect cumulative structural and functional changes in pulmonary tissue and thoracic mechanics that occur with advancing age.

In addition to age distribution patterns, patient comorbidities also represent an important clinical context that may influence pulmonary function outcomes. The study found that 25.7% of patients had comorbidities, with hypertension being the most common (50.9%), followed by asthma (19.3%) and diabetes mellitus (4.9%). These findings indicate a substantial burden of chronic non-communicable diseases within the study population, which can profoundly impact respiratory health. Research conducted in South Korea on comorbidities in spirometry patients with restrictive lung disease reported that the most common comorbid condition was hypertension (51.5%), followed by obesity (45.4%) and diabetes mellitus (24.0%).¹² Another study focusing on patients with COPD similarly found that hypertension was the most prevalent comorbidity, with a wide reported range of 17% to 64.7%, followed by diabetes mellitus (10.2–45%) and asthma (14.7–32.5%).¹⁶ These consistent patterns across different studies underscore the close relationship between cardiovascular and metabolic comorbidities and impaired pulmonary function, suggesting the need for integrated management approaches, particularly in high-risk populations.

The indications for spirometry examination also provide insight into clinical utilization

patterns. Preoperative risk assessment was identified as the predominant indication, accounting for 75.2% of spirometry examinations. This finding reflects a growing recognition of spirometry's utility beyond primary pulmonary diagnosis, extending to comprehensive patient risk stratification before surgical procedures. The very low obstructive patterns (1.0%) among patients undergoing spirometry is noteworthy. This contrasts with the broader epidemiological understanding of COPD and its high prevalence in Indonesia.⁵ Differences between study populations may partially explain this discrepancy. Differences between study populations may partially explain this discrepancy. National prevalence estimates reflect community-based populations, whereas the present study involved patients referred for spirometry in a tertiary hospital setting. Referral patterns at the hospital may favor patients undergoing preoperative evaluation or individuals with suspected restrictive pulmonary conditions, which could contribute to the lower proportion of obstructive findings observed in this cohort.

Several limitations should be considered when interpreting these results. First, the single-center design may limit the generalizability of the finding to other healthcare settings or regions within Indonesia. Second, the study's relatively short data collection period also limits the ability to observe long-term trends or the progression of lung abnormalities. Third, although comorbid conditions were documented, a detailed analysis of their specific impact on lung function patterns was not the primary focus.

Future research incorporating broader multicenter sampling, longer observation periods, and more comprehensive respiratory risk factor analyses may provide a more complete understanding of pulmonary function trends within Indonesian clinical populations.

In conclusion, this study provides a descriptive overview of pulmonary function patterns among patients undergoing spirometry at a tertiary referral hospital in West Java, Indonesia. Restrictive lung disorders were the predominant spirometric abnormality particularly among older adults and female patients, with most cases classified as mild in severity. The low prevalence of obstructive patterns in this cohort contrasts with national COPD estimates and may reflect specific referral trends or patient selection. The high proportion of examinations performed for preoperative risk assessment further highlights the expanding role of spirometry in perioperative

evaluation and clinical decision-making.

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