

Spirometry at a Tertiary Hospital in South-South, Nigeria: Indications, Referral Patterns, and Ventilatory Function Outcomes

* EHONDOR OT, *OJEH-OZIEGBE OG

*Department of Medicine, University of Benin/University of Benin Teaching Hospital, Benin City, Edo State.

ABSTRACT

Background: Spirometry is an essential diagnostic tool in respiratory medicine, widely used for assessing lung function and diagnosing respiratory disorders. Despite its clinical significance, its utilization in low-resource settings remains suboptimal. Understanding the indications for spirometry and referral patterns can help optimize its use in patient management. The objective of the study was to evaluate indications, referral patterns, and ventilatory function outcomes among patients undergoing spirometry at a tertiary hospital in South-South Nigeria.

Methods: A cross-sectional study was conducted involving 90 patients who underwent spirometry. Data on demographic characteristics, referral sources, and ventilatory function outcomes were collected and analyzed using descriptive statistics.

Results: The most common indication for spirometry was asthma (46.7%), followed by chronic obstructive pulmonary disease (COPD) and chronic cough (25.6%). Other indications included post-chemotherapy pulmonary assessment (11.1%), pulmonary fibrosis (4.4%), bronchiectasis (4.4%), and pleural effusion (3.3%). The respiratory unit accounted for most referrals (68.9%), followed by cardiology (13.3%), cardiothoracic surgery (12.2%), and maxillofacial surgery (5.6%). Obstructive ventilatory impairment was the most frequently observed pattern (51.1%), followed by mixed (23.3%) and restrictive (17.8%) impairments, while 7.8% of patients had normal spirometry results.

Conclusion: This study highlights the high burden of chronic respiratory diseases and the critical role of spirometry in their assessment. Despite its diagnostic utility, limited access remains a challenge, emphasizing the need for improved availability, clinician awareness, and integration into routine clinical practice for better respiratory health outcomes.

Correspondence

Dr. Ogie T. Ehondor
Department of Medicine
University of Benin/University of Benin Teaching Hospital
Benin-City, Edo State
Email: ogie.ehondor@uniben.edu

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INTRODUCTION

Spirometry is an essential diagnostic tool in respiratory medicine, widely used to assess lung function by measuring airflow limitation and lung volumes (Graham et al., 2019). As a non-invasive pulmonary function test, it provides crucial data for diagnosing, monitoring, and managing respiratory diseases, by measuring parameters such as forced expiratory volume in one second (FEV₁) and forced

vital capacity (FVC), helping to distinguish between obstructive, restrictive, and mixed ventilatory patterns, and aiding in clinical decision-making as well as disease prognosis (Graham et al., 2019; Agusti et al., 2021).

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Chronic obstructive pulmonary disease (COPD) is one of the most common conditions evaluated using spirometry. It is a progressive and potentially life-threatening lung disease that affects over 380 million adults worldwide and is associated with an estimated global economic cost exceeding \$2 trillion (Adeloye et al., 2015; Soriano et al., 2017). In 2021, COPD accounted for 3.5 million deaths, representing approximately 5% of all global deaths and the fourth leading cause of death worldwide, with over 90% occurring in low- and middle-income countries (LMICs) (WHO, 2025). The primary risk factor for COPD is tobacco smoke exposure, including both active smoking and second-hand smoke, with other contributors including indoor and outdoor air pollution, occupational dust and fumes, and long-term asthma (Jordan et al., 2011; van Koeveerden et al., 2015; American Lung Association, 2025). In Nigeria and across sub-Saharan Africa, COPD is an underrecognized but growing public health concern. The prevalence of tobacco smoking is increasing, particularly among younger populations, further fueling the disease burden (Oyewole et al., 2018). Additionally, worsening outdoor air pollution in urban areas, coupled with indoor smoke exposure from unclean cooking and heating fuels, poses significant risks, particularly for women and children in rural communities (Odame & Amoah, 2023). Other contributing factors include low income, poor nutrition, childhood respiratory infections, tuberculosis, and HIV infection, all of which have been linked to increased COPD risk in African settings (Ale et al., 2022; Kirenga et al., 2023). Beyond COPD, spirometry is also essential in diagnosing and monitoring asthma, interstitial lung diseases, bronchiectasis, and post-infectious lung damage, all of which contribute significantly to respiratory morbidity in Nigeria (Umoh et al., 2013; Ndukwu et al., 2021). The test classifies ventilatory function into obstructive, restrictive, and mixed patterns, each indicative of different underlying pathologies. Obstructive lung diseases, such as COPD and asthma, are characterized by airflow limitation due to airway narrowing, leading to a decreased FEV₁/FVC ratio. Restrictive lung diseases, including pulmonary fibrosis and pleural disorders, result in reduced lung volumes with a proportionate reduction in FEV₁ and FVC but a preserved or increased FEV₁/FVC ratio. A mixed pattern, seen in conditions like combined COPD and interstitial lung disease, presents with both airflow limitation and lung volume reduction (Martinez-Pitre et al., 2023; MSD Manual Consumer Version, 2025).

Despite its clinical utility, spirometry use in Nigeria remains suboptimal due to limited availability of equipment, a shortage of trained personnel, and low awareness among healthcare providers. Integrating spirometry into routine clinical practice is essential for early detection and proper management of respiratory diseases. Expanding access to diagnostic tools, coupled with targeted public health interventions to reduce smoking rates, improve air quality, and strengthen respiratory healthcare services, is vital to addressing Nigeria's growing respiratory disease burden. Without these efforts, the prevalence and impact of chronic lung diseases will continue to rise, placing an increasing strain on the healthcare system and the wider population. The objective of this study was to evaluate indications, referral patterns, and ventilatory function outcomes among patients undergoing spirometry at a tertiary hospital in South-South Nigeria.

MATERIAL AND METHODS

This study was conducted at the University of Benin Teaching Hospital (UBTH), a tertiary healthcare center that serves as a referral hospital for patients from both urban and rural communities. UBTH is a major center for respiratory medicine, providing specialized diagnostic and therapeutic services, including spirometry, which remains an essential tool for evaluating pulmonary function in patients with suspected or established respiratory diseases. The hospital caters to a diverse population, including patients referred from peripheral hospitals, primary healthcare centers, and other units within the tertiary facility.

A cross-sectional study design was employed, involving 90 patients who underwent spirometry at UBTH over the study period. A structured approach was used to collect data on sociodemographic characteristics (age, sex), clinical indications for spirometry, referral sources, and ventilatory function outcomes. Spirometry assessment was performed in accordance with standard guidelines, with pre- and post-bronchodilator tests conducted where necessary. Descriptive statistical analysis was used to evaluate the findings, allowing for an understanding of spirometry utilization patterns and key disease indicators in the study population. Ventilatory function was classified based on forced expiratory volume in one second (FEV₁) and forced vital capacity (FVC) ratios. Normal function was defined as FEV₁/FVC equal to or above 70%, with FEV₁ and FVC each equal to or above 80% of the predicted value. Obstructive impairment was defined as FEV₁/FVC below 70%, while restrictive

impairment was classified as FEV₁/FVC equal to or above 70% with FEV₁ and FVC below 80% of predicted values. Mixed ventilatory impairment was defined as FEV₁/FVC below 70% and FVC below 80% of predicted values. Spirometry reference values were based on European Respiratory Society (ERS) and American Thoracic Society (ACS) standards (Stanojevic et al., 2022). Patients with unacceptable spirometry results were excluded from the final analysis. Ethical clearance was sought and obtained from the Ethical Department of the University of Benin Teaching Hospital.

RESULTS

Sociodemographic characteristics of participants (Table 1)

In terms of age, 15 respondents (16.7%) were aged 18 - 20 years, 19 (21.1%) were in the 21–30-year range, 15 (16.7%) were in the 31–40-year range, 8 (8.9%) were in the 41–50-year range, 9 (10.0%)

were aged 51-60 years, and 24 (26.7%) were aged >60 years. The gender distribution was almost balanced, with 44 (48.9%) male and 46 (51.1%) female participants. Regarding body mass index (BMI), 1 (1.1%) participant was underweight, 27 (30.0%) had a normal weight, 33 (36.7%) were overweight, and 29 (32.2%) were obese.

Indication for spirometry (Figure 1)

Asthma accounted for the highest proportion of referrals, with 42 participants (46.7%) undergoing spirometry for this condition. The second most frequent indication was chronic obstructive pulmonary disease (COPD) or chronic cough, which collectively accounted for 23 cases (25.6%). Other indications included post-chemotherapy pulmonary assessment in 10 participants (11.1%), dyspnea in 4 participants (4.4%), pulmonary fibrosis in 4 participants (4.4%), bronchiectasis in 4 participants (4.4%), and pleural effusion in 3 participants (3.3%).

Table 1: Sociodemographic characteristics of the participants

Variable	Frequency (n=90)	Percentage (%)
Age (years)		
≤20	15	16.7
21-30	19	21.1
31-40	15	16.7
41-50	8	8.9
51-60	9	10.0
>60	24	26.7
Sex		
Male	44	48.9
Female	46	51.1
BMI (kg/m ²)		
Underweight	1	1.1
Normal weight	27	30.0
Overweight	33	36.7
Obese	29	32.2

Source of referral among the participants (Table 2)

The majority of referrals originated from the respiratory unit, accounting for 62 cases (68.9%). Cardiology contributed 12 referrals (13.3%), likely reflecting the overlap between respiratory and cardiovascular conditions that present with similar symptoms such as dyspnea. Cardiothoracic surgery accounted for 11 referrals (12.2%), mainly for preoperative assessment and post-surgical monitoring of lung function. The maxillofacial surgery department referred 5 patients (5.6%).

Ventilatory function of the participants (Figure 2)

The ventilatory function patterns observed in the study population align with the distribution of respiratory conditions requiring spirometry. Obstructive impairment was the most common pattern, observed in 46 participants (51.1%), reflecting the high prevalence of asthma and COPD among those undergoing pulmonary function testing. Mixed ventilatory impairment was noted in 21 participants (23.3%), suggesting the presence of combined obstructive and restrictive pathologies, which may be seen in conditions such as chronic lung infections, interstitial lung disease with

concurrent airway obstruction, or overlap syndromes involving both asthma and COPD. Restrictive ventilatory impairment was found in 16 participants (17.8%), likely corresponding to patients with pulmonary fibrosis, pleural effusion, and post-chemotherapy lung changes. Only 7

participants (7.8%) had normal spirometry results, indicating that most referrals were clinically justified, with significant pulmonary function abnormalities detected in the majority of cases.

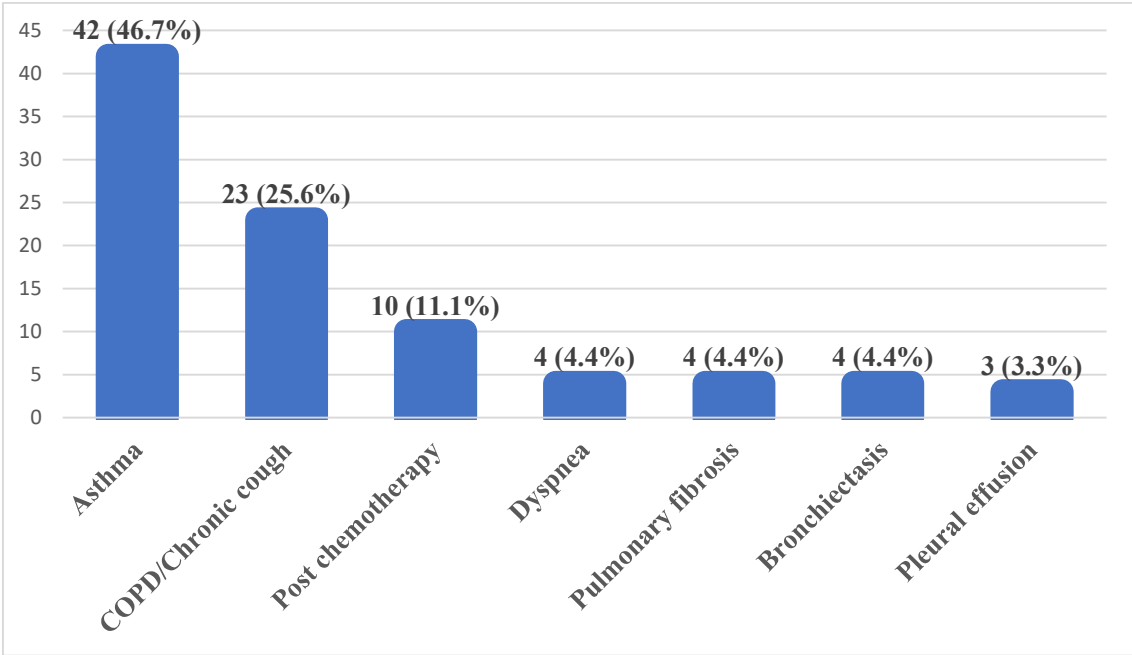


Figure 1: Indications for spirometry among participants

Table 2: Source of referral among the participants

Source	Frequency (n=90)	Percentage (%)
Respiratory	62	68.9
Cardiology	12	13.3
Cardiothoracic Surgery	11	12.2
Maxillofacial surgery	5	5.6

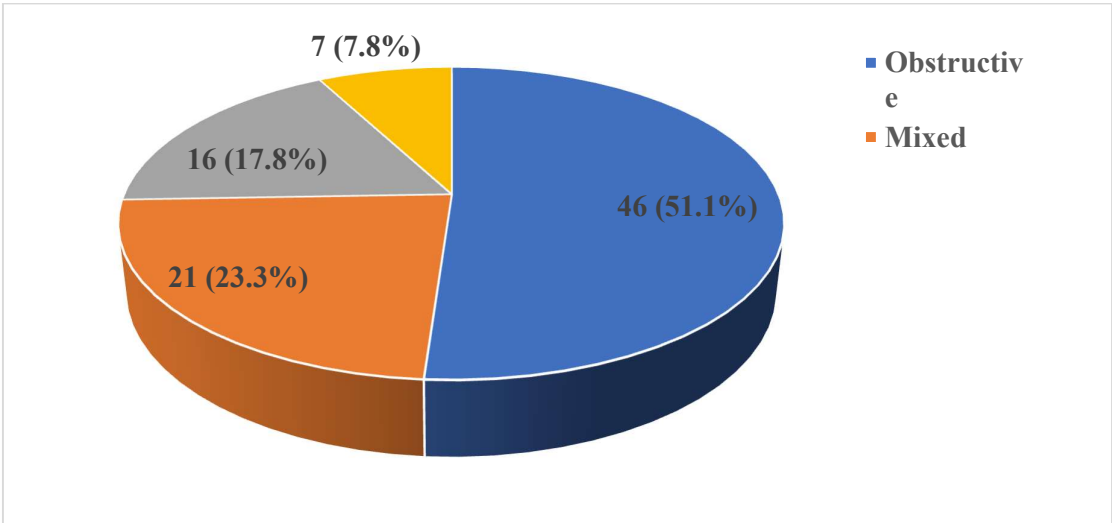


Figure 2: Distribution of ventilatory function among the participants

DISCUSSION

The findings of this study provide valuable insights into the indications for spirometry at a tertiary hospital in South-South Nigeria. The most common indication for spirometry was asthma, accounting for nearly half of all referrals. This aligns with global and regional trends, as asthma remains one of the leading chronic respiratory diseases requiring pulmonary function testing (GBD Chronic Respiratory Disease Collaborators, 2020; Global Alliance against Chronic Respiratory Diseases, 2025). Studies conducted in similar settings, such as in Nigeria, Ghana and Kenya, have similarly reported asthma as the predominant reason for spirometry referrals (Kibirige et al., 2019; Oyenuga et al., 2024). This aligns with findings from Ozoh et al. (2019), who reported an asthma burden of 9.1% -10.5% among the Nigerian populations, with the highest rates in Lagos, Nigeria, emphasizing the role played by urbanization, environmental pollution, and allergen exposure in contributing to the rising incidence of asthma. Adeyeye et al. (2012) in Lagos also had similar findings, with over half of the indications for spirometry being for the diagnosis, monitoring and treatment of asthma.

Given the significant morbidity associated with asthma, timely and accurate diagnosis through spirometry is crucial for effective disease management. Public health interventions should emphasize early detection, patient education, and improved access to inhaled therapies, particularly in resource-limited settings where underdiagnosis and undertreatment remain major concerns.

Chronic obstructive pulmonary disease (COPD) and chronic cough were the second most common indications, accounting for over a quarter of cases. This finding is consistent with studies from other sub-Saharan African countries, where COPD is increasingly being recognized as a major public health issue (Awokola et al., 2022; Alemayohu et al., 2023). Jumbo et al. (2021) recorded similar findings in his study in Delta State, Nigeria, showing that over half of spirometry cases had obstructive airway findings, mostly due to COPD. Also, Ojuawo et al. (2020) in Ilorin reported a high prevalence of COPD in their study, and its association with environmental and occupational exposure to biomass fuel smoke. The growing prevalence of COPD in Nigeria and other low- and middle-income countries accentuates the need for strengthened preventive measures, including smoking cessation programs, policies to reduce indoor air pollution, and occupational health regulations to minimize exposure to hazardous fumes. Additionally, healthcare providers should

be encouraged to routinely perform spirometry in individuals with chronic respiratory symptoms to facilitate early diagnosis and intervention.

A notable proportion of spirometry referrals were for post-chemotherapy pulmonary assessment, accounting for approximately one in ten cases. Zeien et al. (2022) also emphasized the necessity of pulmonary function monitoring in cancer patients receiving cytotoxic agents such as bleomycin, methotrexate, and alkylating agents. The increasing use of spirometry for this indication shows its utility in the early detection of chemotherapy-related lung damage, allowing for timely intervention and treatment modifications when necessary. Given the rising cancer burden in Nigeria and the expansion of oncology services, there is a need to incorporate routine pulmonary function testing into chemotherapy protocols to optimize patient outcomes.

Bronchiectasis, and pleural effusion were also identified as indications for spirometry, although they accounted for smaller proportions of referrals. These conditions typically result in restrictive or mixed ventilatory impairments, which can significantly impact respiratory function and quality of life. The relatively lower proportion of referrals for these conditions may be due to a combination of underdiagnosis, limited access to advanced diagnostic imaging, and a lack of awareness among healthcare providers regarding the role of spirometry in disease assessment. Strengthening training programs for physicians and respiratory therapists on the indications for pulmonary function testing could help address this gap and improve patient care.

Regarding referral patterns, the majority of patients were referred from the respiratory unit, followed by cardiology, cardiothoracic surgery, and maxillofacial surgery. Similar referral patterns were observed in a study by Onyedum & Chukwuka (2009), with majority of their patients being referred from the respiratory unit, cardiothoracic and orthopaedic units. Oloyede et al.³⁰ (2023) also found that cardiology referrals frequently occur due to the overlap between respiratory and cardiovascular conditions, as symptoms like dyspnea may indicate both cardiac and pulmonary pathologies.

The predominance of referrals from the respiratory unit is expected, given its specialization in pulmonary diseases and the central role of spirometry in evaluating conditions managed in this department. Similarly, referrals from cardiothoracic surgery likely reflect the need for preoperative assessment and postoperative monitoring of lung function, particularly in patients

undergoing thoracic procedures. The involvement of maxillofacial surgery may be linked to cases requiring airway evaluation due to structural abnormalities or surgical interventions affecting respiratory mechanics. These referral patterns reinforce the multidisciplinary nature of spirometry and its broad utility across various medical specialties. To enhance its application, there is a need for continued advocacy and training to ensure that spirometry is routinely integrated into clinical decision-making across different departments.

The ventilatory function distribution among the study population revealed that obstructive impairment was the most common pattern, followed by mixed and restrictive impairments, with a small proportion of patients exhibiting normal spirometry results. This distribution is consistent with the high prevalence of asthma and COPD among the study participants, both of which are characterized by obstructive ventilatory patterns. The presence of mixed impairment in a significant proportion of patients suggests the coexistence of obstructive and restrictive processes, which may occur in conditions such as COPD with concurrent interstitial lung disease or chronic lung infections leading to airway and parenchymal damage. The restrictive ventilatory pattern observed in a quarter of cases aligns with the indications of pulmonary fibrosis, post-chemotherapy lung changes, and pleural effusion, conditions that predominantly affect lung compliance and total lung volumes. The low proportion of normal spirometry results suggests that the majority of referrals were clinically justified, indicating appropriate use of the test in the patient population. However, ensuring that all spirometry tests are performed according to standardized guidelines remains crucial for accurate interpretation and clinical decision-making.

Given these findings, several recommendations can be made to optimize spirometry use in Nigeria. First, there is a need to improve access to spirometry equipment and training for healthcare professionals to enhance diagnostic capacity and promote its routine use in respiratory disease management. Public health interventions should also focus on reducing risk factors for COPD and other chronic lung diseases, particularly through policies aimed at curbing tobacco use, improving indoor air quality, and minimizing occupational exposures. Also, integrating spirometry into oncology care pathways will facilitate early detection of chemotherapy-related pulmonary toxicity, ensuring that patients receive appropriate

monitoring and interventions. Increasing awareness of spirometry's role beyond asthma and COPD will encourage its use in evaluating other respiratory conditions, thereby improving patient outcomes.

Finally, further research should be conducted to explore barriers to spirometry utilization and develop targeted strategies to address them, ensuring that this essential diagnostic tool is fully leveraged in clinical practice. Addressing these gaps will be instrumental in strengthening respiratory healthcare services and mitigating the growing burden of lung diseases in Nigeria and similar settings.

CONCLUSION

This study highlights the predominant indications for spirometry at a tertiary hospital in South-South Nigeria, with asthma and COPD emerging as the most frequent reasons for referral. The findings emphasize the growing burden of chronic respiratory diseases and the critical role of spirometry in their diagnosis and management. Despite its importance, access to spirometry remains suboptimal, necessitating increased investment in equipment, training, and awareness to enhance its utilization. Addressing key risk factors such as tobacco smoking and air pollution through public health interventions is essential to mitigating the rising incidence of respiratory diseases. Strengthening the integration of spirometry into routine clinical practice will improve early detection, facilitate appropriate treatment, and ultimately enhance patient outcomes in Nigeria and similar settings.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

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