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Prevalence of Chronic Obstructive Lung Disease and Factors Associated with its Clinical Outcomes among Patients Hospitalized on the Pulmonology Wards at Kiruddu and Mulago National Referral Hospitals

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ABSTRACT

Background: *Chronic Obstructive Pulmonary Disease (COPD) is a significant public health issue in low- and middle-income countries (LMICs), driven by increasing risk factors such as cigarette smoking and air pollution. Patients with COPD experience a wide range of short-term outcomes during their hospital admissions. However, there is a paucity of information regarding these short-term outcomes in most LMICs. This study sought to determine the prevalence of COPD, identify short-term clinical outcomes, and assess the factors associated with these outcomes among hospitalized COPD patients at Kiruddu and Mulago National Referral Hospitals.*

Methods: *A prospective cohort study was conducted over six months, screening all patient admissions on the pulmonology wards. COPD patients were followed up to assess clinical outcomes, including symptom resolution, length of hospital stay, and mortality. Modified Poisson regression was used to identify risk factors for these outcomes.*

Results: *Of the 896 patients screened, 10.04% (n=90) had COPD, with a mean age of 68 years. The average length of hospital stay following admission was 7 days (SD, 5.7 days). 68.9% (n=62) of patients had their COPD symptoms resolved in less than 8 days, while 8% (n=7) died within 30 days after admission. Delayed symptom resolution and a longer duration of hospitalization were associated with a history of smoking (P=0.014), low-income status (P= 0.016), and oxygen therapy on admission (P<0.001).*

Conclusion: *This study highlights a relatively high burden of COPD among patients admitted to pulmonary wards in Uganda, with a significant portion experiencing quick symptom resolution. However, adverse outcomes, including prolonged hospital stays and mortality, were notably associated with risk factors such as smoking, low socioeconomic status, and oxygen therapy requirements, highlighting the need for targeted interventions in high-risk groups.*

Keywords: *Chronic Obstructive Pulmonary Disease (COPD); Prevalence; Clinical Outcomes; Length of Hospital Stay; Symptom Resolution; Uganda.*

Introduction

Globally, over 210 million people suffer from COPD, a heterogeneous lung disease characterized by chronic respiratory symptoms such as dyspnea, cough, and mucus production due to airway and alveolar abnormalities [1]. COPD is projected to be the third leading cause of death worldwide, claiming the lives of over 3 million people per year [2, 3]. In Uganda, the prevalence of COPD ranges from 1.5% to 16.1%, with higher rates in rural areas [4].

Cigarette smoking has been established as the most significant risk factor for COPD in high-income countries; however, non-traditional risk factors such as household air pollution or biomass exposure have since been identified as key risk factors in low- and middle-income countries (LMICs) [5, 6]. The identified risk factors for COPD in Uganda are the use of biomass fuel (wood, dung, crop residues, and charcoal) for cooking and domestic heating, kerosene-based lighting, and socioeconomic factors, including poverty and malnutrition [7].

COPD presents with episodes of exacerbations, characterised by worsening symptoms of the disease. Whereas some patients may be asymptomatic with the disease, a portion of patients seek medical care when a lot of damage has been done, and a significant proportion seek untargeted COPD care because many are not aware [2]. As a result, many of the patients end up being admitted for further management [8].

When admitted, depending on disease severity and management, COPD patients might experience a range of clinical outcomes. Evidence from previous studies, mostly from high-income countries, has revealed varying outcomes of COPD admission, including symptom resolution, prolonged in-hospitalization, and death. It has been further demonstrated that the most important attributable factors for mortality include low forced expiratory volume in 1 second (FEV1), low forced vital capacity, and the presence of comorbidities like cardiovascular diseases and cancer [9-11]. However, there is scant data on COPD admissions and patient outcomes in LMICs. This study aimed to assess the prevalence of COPD, its short-term clinical outcomes, and their associated factors at Kiruddu and Mulago National Referral Hospitals,Uganda.

Materials and methods

Study design and setting

This was a prospective cohort study conducted on the pulmonology wards of Kiruddu and Mulago National Referral Hospitals, Kampala, Uganda.

Study population

The study population included patients admitted to the pulmonology wards during the study period. These were assessed for the presence of COPD using spirometry, and patients with a confirmed diagnosis of COPD were recruited and followed for 30 days. The study, however, excluded patients who were unable to undergo the spirometry procedure and had no spirometry test done before.

Study outcomes

The primary outcome was the resolution of symptoms within seven days of follow-up during the study, length of stay, and mortality due to COPD. Secondary outcomes were the factors influencing COPD outcomes, including smoking history, socioeconomic status, the need for oxygen therapy at admission, and others.

Sample size and sampling procedure

The sample size of the study was 90, determined using the Kish and Leslie formula of sample size determination. Total population sampling was used to determine the prevalence of COPD, as all patients admitted to the pulmonology wards during the study period were screened for COPD. The consecutive sampling technique was then used to obtain the required sample size of 90 COPD patients identified during the screening phase.

Data collection methods and procedures

Patients who met the inclusion criteria and were confirmed with a diagnosis of COPD were consecutively enrolled into the study. These were interviewed using an interviewer-administered questionnaire to ascertain their demographics and clinical characteristics. Participants were then followed up daily using a study questionnaire to determine the primary outcome of symptom resolution after 7 days of admission and thereafter, weekly for 30 days to determine the length of hospitalization and death. For patients who had been discharged before 30 days, a follow-up phone call was conducted at the end of each week to monitor their disease progress and resolution of symptoms.

Spirometry procedure

Spirometer machine, Vitalograph Model 6600 Compact, SN: CO 69075, was used. The identified patients were informed of the procedure's purpose and technique, and consent was obtained. The patient's biodata, weight, and height were taken and fed into the system programme. Patients were then asked to take a deep breath and hold it, followed by a steady maximum exhalation into the machine's mouthpiece. This was done as the curves on the system screen are monitored to observe the quality of the technique and the outcome. A good curve was dependent on a good, steep ascending and descending smooth slope, followed by a plateau on the graph. 3 curves were considered, and the best curve was chosen. The participant was then asked to inhale Ventolin 400mcg and rested for 15 minutes before repeating the procedure, to determine the post-bronchodilator curves of the procedure. COPD was diagnosed using post-bronchodilator spirometry values. Specifically, FEV_1, FVC, and the FEV_1/FVC ratio were measured after bronchodilator administration. COPD was confirmed by a post-bronchodilator FEV_1/FVC ratio of <0.70, consistent with persistent airflow limitation. A lack of significant reversibility, defined as an increase in FEV_1 of $<12\%$ following bronchodilator use, was used to differentiate COPD from reversible obstructive airway diseases such as asthma.

Data quality control

Spirometers were regularly calibrated, and all procedures were in compliance with ATS/ERS standards. All spirometer results were reviewed by a pulmonologist, and periodic audits were conducted on a random sample of spirometry tests by another expert pulmonologist.

Data management and analysis

Data was entered into Epidata version 4 and exported to STATA Corp V 15.0 (StataCorp, College Station, TX, USA) for analysis. Double data entry was done to minimize entry errors, and the final dataset was regularly cleaned for missing information and incomplete entries. Descriptive statistics were used to describe the prevalence of COPD, patient demographics, and clinical outcomes of COPD. Modified Poisson Regression analysis was used to assess the relationship between potential risk factors (such as smoking history, income level, and oxygen therapy) and clinical outcomes (e.g., prolonged hospitalization, delayed symptom resolution, and mortality). All variables with P<0.2 on bivariate analysis and those with known biological plausibility were considered for multivariate analysis. The final model was constructed using forward selection and backward elimination of variables. Variables with P<0.05 were considered statistically significant.

Ethical Approval

Permission to conduct the study was sought from the Makerere University College of Health Sciences Department of Internal Medicine Scientific Review Committee (SRC), and administrative clearance was also sought from KNRH and MNRH. Ethical approval was sought from the School of Medicine Research Ethics Committee (SOMREC) of Makerere University with an approval number of Mak-SOMREC-2023-756. Written informed consent was sought from the study participants before recruitment into the study. For confidentiality reasons, the identities of study patients were not included in the study data.

Results

Study profile, prevalence of COPD, and clinical outcomes of COPD.

A total of 896 patients admitted to the pulmonology wards of Mulago and Kiruddu National Referral Hospitals between September 2023 and February 2024 were screened. The proportion of Patients with COPD was 10.04% (90/896). Their average age was 68 (±13) years, the majority were males (62.2%), residing in rural areas (60%), and unemployed (56.2%). A significant portion had smoked (69.7%), chewed tobacco (14.6%), and used firewood for cooking (72.2%). The average length of hospital stay following admission was 7 days (SD, 5.7 days). 68.9% (n=62/90) of patients had their COPD symptoms resolved in less than 8 days of admission, while 8% (n=7/90) died within 30 days after admission. Figure 1 and Table 1.

Table 1: Sociodemographic and clinical characteristics of participants.

Variable	Frequency (n=90)	Percentage
Age (Years)	**Average 68 (SD=13)**	
35-55 years	14	15.6
56-93 years	76	85.4
Sex		
Male	56	62.2
Female	34	37.8
Place of residence		
Rural	54	60
Urban	36	40
Level of formal education		
None	43	47.8
Primary	36	40
Secondary & above	11	12.2
Household monthly income (UgX)		
No Income	29	32.2
50,000- 100,000	37	41.1
101,000-250,000	14	15.6
251,000 & above	10	11.1
Able to buy medications prescribed		
No	72	80
Yes	18	20
Received oxygen therapy on admission		
No	86	95.6
Yes	4	4.4
Ever smoked tobacco/ cigarettes? (n=89)		
No	27	30.3
Yes	62	69.7
Comorbidities		
No	42	46.7
Yes	48	53.3
Ever had any exacerbations before (n=88)		
No	15	17
Yes	73	83
Ever chewed tobacco (n=89)		
No	76	85.4
Yes	13	14.6
Major cooking energy source		
Charcoal	25	27.8
Firewood	65	72.2
Employment Status (n=89)		
Employed	5	5.6
Not employed	50	56.2
Self- employed	34	38.2

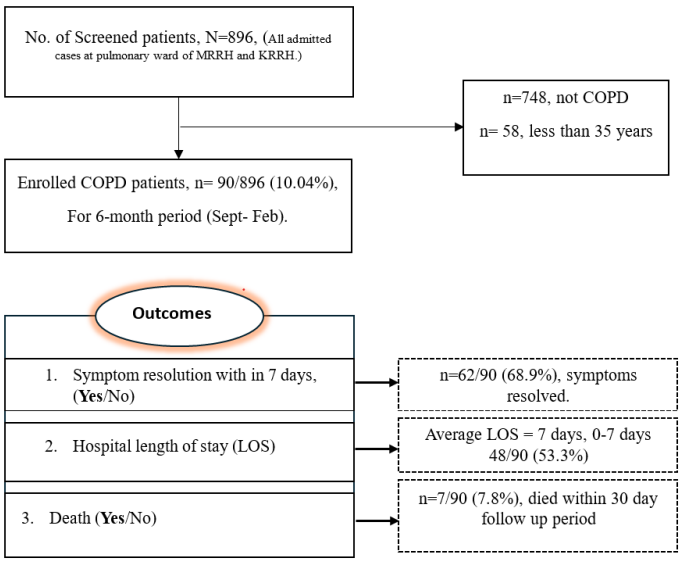

Figure 1. *Study profile*

Factors associated with symptom resolution and hospital length of stay among COPD patients

On multivariate analysis, delayed symptom resolution was found to be significantly associated with use of tobacco products eg cigarette smoking (APR=2.37, 95% CI 1.13-4.96, p-value=0.022) while prolonged hospital stays were significantly associated with smoking history (APR=2.11, 95% CI 1.16-3.85, p-value=0.014), low-income status (APR=4.09, CI 1.30-12.87, p-value=0.016), and oxygen therapy on admission (APR=2.80; CI 1.71-4.60, p-value<0.001). Table 2.

Discussion

This study aimed to determine the prevalence of COPD admissions on the pulmonology wards of MNRH and KNRH and assess the clinical outcomes of COPD. The study revealed a notable burden of COPD among patients admitted to pulmonary wards in Uganda, with a significant proportion of patients experiencing rapid symptom resolution. However, adverse outcomes, including prolonged hospital stays and mortality, were notably associated

Table 2: Modified Poisson Regression analysis model of factors associated with delayed symptom resolution and prolonged hospital length of stay among Patients with COPD.

Variables	Delayed symptom resolution (>7 days)				Prolonged hospital length of stay (>7 days)			
	CPR (95% CI)	P-value	APR (95% CI)	P-Value	CPR (95% CI)	P-value	APR (95% CI)	P-value
Age								
Below 68 years	1		1		1		1	
68 years & above	1.61 (0.63-4.09)	0.321	1.98 (0.79-4.97)	0.144	1.34(0.71-2.53)	0.371	1.64 (0.91-2.96)	0.1
Sex								
Male	1		1		1		1	
Female	1.61 (0.63-4.09)	0.321	1.66 (0.86-3.18)	0.129	1.52(0.90-2.55)	0.115	0.69 (0.42-1.13)	0.138
Ever smoked tobacco/ cigarettes?								
No	1		1		1		1	
Yes	1.6(0.73-3.50)	0.243	2.37 (1.13-4.96)	0.022*	1.8(0.96-3.37)	0.068	2.11 (1.16-3.85)	0.014 *
Comorbidities								
No					1		1	
Yes					1.45(0.86-2.43)	0.161	1.44 (0.86-2.42)	0.168
Income Level								
251,000 & above					1		1	
101,000-250,000					0.89(0.32-2.53)	0.831	1.62 (0.59-4.45)	0.347
50,000-100,000					1.22(0.53-2.80)	0.645	3.04 (0.98-9.41)	0.053
No income					1.29(0.56-3.00)	0.549	4.09 (1.30-12.87)	0.016 *
Able to buy medications prescribed								
No					1		1	
Yes					0.92(0.54-1.56)	0.747	2.24 (0.95-5.30)	0.066
Received oxygen therapy								
No					1		1	
Yes					2.24(1.76-2.84)	P<0.001*	2.80 (1.71-4.60)	P<0.001 *

*CPR- Crude prevalence ratio, APR- Adjusted prevalence ratio, CI- Confidence interval

with risk factors such as smoking, low socioeconomic status, and oxygen therapy requirements. These findings are crucial for guiding COPD inpatient care and preventative strategies in LMIC.

In this study, COPD was identified in 10% of admitted patients, a rate consistent with the global prevalence of 10.3% reported by Adeloye et al. (2022) [12]. However, studies from Uganda and Morocco report lower rates, between 1.7% and 6.7% [6, 13]. In contrast, population-based studies from Uganda and Tanzania showed higher rates of 16.2% and 17.5% [14]. Variations in prevalence may result from differences in study settings, with hospital-based studies reflecting selected patient populations, while population-based studies capture community-level disease burden, including undiagnosed cases. Additional variation may also arise from differences in sample sizes, COPD definitions, and diagnostic criteria. Higher rates from population-based studies in Uganda and Tanzania highlight the need for larger-scale screenings to capture undiagnosed cases.

In this study, the average hospital length of stay was 7 days, a duration that compares with that reported in Nepal (6.69 days) [15], Europe (7.7 days) [16], and China (7.1 days) [17]. The relatively short duration to symptom resolution observed among many patients may suggest timely clinical improvement following hospitalization. However, the study did not directly assess the effectiveness of COPD management practices. Therefore, no conclusions can be drawn regarding the efficiency of care provided at Mulago and Kiruddu National Referral Hospitals. However, prolonged stays were associated with smoking history, low-income status, and oxygen therapy at admission. These findings are consistent with research indicating that these risk factors often complicate COPD management, leading to longer hospitalization durations and poorer outcomes. The study also found that 68.9 % of COPD patients had their COPD symptoms resolved in less than 8 days of admission, while 8% died within 30 days after admission. This rate of symptom resolution is promising and reflects the efficacy of the interventions provided, such as bronchodilators, corticosteroids, and oxygen therapy, which are common treatments for COPD exacerbations. However, the mortality rate of 8% within 30 days post-admission is concerning, as it highlights the severe nature of COPD in a subset of patients, particularly those with more advanced disease, comorbidities, or delayed treatment.

Study limitations

The study was conducted in a hospital-based setting and could have missed undiagnosed COPD cases in the community, affecting the generalizability of the results. In addition, because mortality events were relatively few, the findings related to mortality should be interpreted with caution due to limited statistical power to detect meaningful differences. Large population-based studies are recommended.

Conclusion

This study demonstrates that COPD remains an important contributor to admissions on pulmonary wards in Uganda, with a significant proportion of patients experiencing rapid symptom resolution. However, adverse outcomes, including prolonged hospital stays and mortality, were notably associated with risk factors such as smoking, low socioeconomic status, and oxygen therapy requirements, highlighting the need for targeted interventions in high-risk groups.

List of abbreviations

ATS/ERS:	American Thoracic Society/European Respiratory Society
COPD:	Chronic Obstructive Pulmonary Disease
FEV1:	Forced Expiratory Volume in one second
FEV1/FVC ratio:	Ratio of Forced Expiratory Volume in one second to Forced Vital Capacity
FVC:	Forced Vital Capacity
KNRH:	Kiruddu National Referral Hospital
LMIC:	Low- and Middle-Income Countries
MNRH:	Mulago National Referral Hospital
SOMREC:	School of Medicine Research and Ethics Committee
PR:	Prevalence Ratio
CPR:	Crude Prevalence Ratio
APR:	Adjusted Prevalence Ratio
SD:	Standard Deviation
GOLD:	Global Initiative for Chronic Obstructive Lung Disease
UgX:	Uganda Shillings

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Data Availability

The dataset used and analyzed during this study is available from the corresponding author upon reasonable request.

Author Contributions

- Peter Senfuka: Principal investigator.
- William Worodria: Supervisor.
- Lydia Nakiyingi: Supervisor.
- Denis Mawanda: Biostatistician.

Conflicts of Interest

The authors declare no conflict of interest and received no specific funding for this work.

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