ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCE SCHOOL OF MEDICINE

DEPARTMENT OF INTERNAL MEDICINE

CLINICAL AND FUNCTIONAL ASSESSMENT OF COPD PATIENTS AND CORRELATION OF THEIR 6MWT WITH SPIROMETRY AND HRQL MEASURES. A CROSS SECTIONAL STUDY IN THE LARGEST CHEST REFERRAL CLINIC IN TASH, ADDIS ABABA ETHIOPIA, 2025

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MARCH, 2025

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A thesis to be submitted to Addis Ababa university college of medicine and health science, department of internal medicine for the partial fulfillment of the requirements for certificate of specialty in internal medicine

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MARCH, 2025

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Declaration

I, Haymanot Abebe, do hereby declare that this research thesis is a result of the works of my own making except where due is made in a review of previous literature in the content and by my knowledge, has never been submitted for any prior academic award or qualification in this Institution.

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APPROVAL OF THESIS SUBMISSION

I hereby certify that I have read this thesis prepared under my direction and recommend that it can be accepted as fulfilling the thesis requirement.

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Name of Head of Department	Signature	Date
_____	_____	_____

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ABBREVIATIONS AND ACRONYMS

6MWD	Six-Minute Walk Distance
6MWT	Six-Minute Walk Test
ABG	Arterial Blood Gas
ATS	American Thoracic Society
BMI	Body Mass Index
CAT	COPD Assessment Test
CDC	Centers for Disease Control and Prevention
COPD	Chronic Obstructive Pulmonary Disease
FEV_1	Forced Expiratory Volume in One Second
FEV_1/FVC	Ratio of Forced Expiratory Volume in One Second to Forced Vital Capacity
FMOH	Federal Ministry of Health
FVC	Forced Vital Capacity
GOLD	Global Initiative for Chronic Obstructive Lung Disease
HRQoL	Health-Related Quality of Life
HSDP	Health Sector Development Program
mMRC	Modified Medical Research Council Dyspnea Scale
PFT	Pulmonary Function Test
SD	Standard Deviation
SPSS	Statistical Package for the Social Sciences
TASH	Tikur Anbessa Specialized Hospital
UNMET	Unmet Six-Minute Walk Distance
WHO	World Health Organization

ABSTRACT

Background: Chronic obstructive pulmonary disease (COPD) is a progressive respiratory condition characterized by airflow limitation and reduced exercise capacity, often assessed using the Six-Minute Walk Test (6MWT) and spirometric indices. The 6-minute walk test (6MWT) is easy to perform, well-tolerated, and more reflective of activities of daily living. Spirometry is unavailable in many areas of Ethiopia, where 6MWT can be done easily. The purpose of this study is to assess the relationship between Distance covered by 6MWT and other physiologic parameters of COPD with Spirometry result.

Objectives: To assess 6MWT and its correlation with spirometry variable as a predictor of COPD severity and to assess the health -related quality of life (HRQL) with various COPD related variables of COPD patients visiting TASH-chest follow-up clinic in Addis Ababa Ethiopia, a cross-sectional Analytical study from July to December 2024.

Methods: COPD patients diagnosed using spirometry and Chest CT imaging. Participants were selected from consecutive patients with confirmed chronic COPD. The 6MWT and Spirometry test conducted as per American Thoracic Society (ATS) guidelines, and percent predicted 6MWD was calculated. Quality of life assessed by health-related quality of life (HRQoL) questionnaires, including modified Medical Research Council dyspnea scale (mMRC) and COPD Assessment Test (CAT). Distance in meters and Exercise induced desaturation measured following 6-minute walk test (6MWT). Data were collected, checked, and analyzed using SPSS V26. Chi-square and t-tests assessed associations, with significance set at $P < 0.05$.

Results: Nighty Five COPD patients were included, almost half (48.4%) were classified as GOLD 2, with 37.9% were GOLD ABE Group B, and 75.8% had poor functional status. The mean 6MWD was 364.46 meters (SD = 112.78). older age, worse HRQoL, higher (mMRC) and greater CAT were significantly associated with reduced walking capacity. Significant predictor of unmet 6MWD were having age 56-75 years (64.9%), being overweight/ obesity, biomass smoke exposure, active smoking, and poor treatment adherence. Regarding HRQoL, worse dyspnea, higher CAT scores, and lower lung function (FEV_1%) correlated with greater impairment, while better 6MWD ($r = -0.366$, $P < 0.001$) was correlated with improved HRQoL.

From spirometric parameters FEV_1% predicted (mean = 54.74, SD = 19.05; $r = 0.221$, $P = 0.032$), strongly correlated with 6MWD. While FVC% predicted (mean = 68.56, SD = 21.09; $r = 0.194$, $P = 0.059$) slightly failed to reach significance. The ratio FEV_1/FVC (mean = 62.97, SD = 13.42; $r = 0.023$, $P = 0.821$) had no significant correlation with 6MWD.

A strong positive correlation between pre- and post-walk heart rate ($r = 0.817$, $p < 0.001$) and pre- and post-walk SpO_2% ($r = 0.773$, $p < 0.001$)

Conclusions: this study shows in COPD, 6MWD significantly correlated with the spirometry parameters (FEV1). COPD patients with greater symptom burden, worse lung function, and unhealthy lifestyle factors have reduced exercise capacity and poorer quality of life. Unmet six-minute walk distance was more common in those with obesity, biomass smoke exposure, smoking, and poor treatment adherence. 6MWD correlate with decline in the pulmonary function, it can potentially be used to follow patients where spirometry is not feasible to perform.

Keywords: COPD patients, 6MWT distances, Spirometry, TASH, Addis Ababa, Ethiopia

CHAPTER 1- INTRODUCTION

1.1. Back ground

Chronic Obstructive Pulmonary Disease (COPD) is a progressive respiratory disorder characterized by persistent airflow limitation, significantly affecting patients' quality of life (1). The disease is commonly assessed using spirometry, with Forced Expiratory Volume in one second (FEV_1) serving as a key parameter for diagnosing and staging COPD severity (2). Spirometry, particularly Forced Expiratory Volume in one second (FEV_1), is the standard method for diagnosing and staging COPD severity, but it may not fully capture the functional limitations patients experience in daily activities (3). The Six-Minute Walk Test (6MWT) is a simple, cost-effective, and reproducible sub-maximal exercise test used to assess functional capacity, monitor disease progression, and predict prognosis in chronic respiratory diseases, including COPD (4). However, the studies have shown a strong correlation between Six-Minute Walk Distance (6MWD) and spirometry parameters, as well as arterial blood gases, in COPD and other pulmonary conditions (3, 5, 6).

Recognizing the growing burden of COPD and other non-communicable diseases (NCDs), the World Health Organization (WHO) has developed the Global Action Plan for the Prevention and Control of NCDs by 2030, which aims to reduce premature mortality from NCDs by 30% through improved diagnosis and management (7). Similarly, the United Nations Sustainable Development Goals (SDGs) emphasize universal health coverage and the reduction of NCD-related mortality by 2030 (8). At the national level, the Ethiopian Federal Ministry of Health (FMOH) has integrated COPD management into its National Strategic Action Plan for Non-Communicable Diseases, focusing on early detection, improved access to diagnostic tools, and enhancing functional assessments such as the 6MWT (6). These efforts underscore the importance of comprehensive COPD assessment beyond spirometry, particularly in resource-limited settings like Ethiopia (5, 6, 9).

FEV_1, obtained through spirometry, remains the gold standard for assessing airflow limitation in COPD patients (10). It provides an objective measure of lung function and is crucial for staging the disease according to the Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines (11). However, FEV_1 alone may not fully reflect the functional impairment and exercise intolerance experienced by COPD patients. This limitation has led to increased interest in the correlation between spirometric values and functional exercise capacity as measured by the 6MWT (12, 13).

Several studies have demonstrated a significant relationship between 6MWT performance and spirometric indices, particularly FEV_1, in COPD patients (9, 14). A strong correlation between these two measures could provide additional insights into disease severity and prognosis, allowing clinicians to better tailor treatment plans. However, the extent to which the 6MWT correlates with FEV_1 in COPD patients within the Ethiopian healthcare context remains unclear (15, 16).

In Ethiopia, COPD remains an underdiagnosed and undertreated condition, with limited access to pulmonary function tests (5, 17). Many patients are diagnosed at advanced stages when the disease has already caused significant functional impairment. Integrating the 6MWT into routine COPD assessment at follow-up clinics, such as the Tikur Anbessa Specialized Hospital (TASH) chest clinic, could provide a more comprehensive evaluation of disease severity and treatment response. This approach may help bridge the gap in COPD management and improve patient outcomes. While research has validated the 6MWT's reliability and physiological significance in different populations, data on its application remain limited in some regions, including Ethiopia (17). Understanding the relationship between 6MWT and spirometry could provide a more comprehensive assessment of COPD severity and guide better disease management strategies.

This study aims to assess the correlation between the 6MWT and FEV_1 as a predictor of COPD severity among patients attending the TASH chest follow-up clinic. By determining whether the 6MWT can serve as a reliable functional marker alongside spirometry, this research could contribute to better clinical decision-making, optimizing patient care in Ethiopia.

1.2. Statement of the problem

Chronic obstructive pulmonary disease (COPD) is a significant global health concern, recognized as a leading cause of both disability and mortality all over the world. It is the fourth and the only leading cause of death showing increase in prevalence worldwide (18). 5-year mortality rate for patients with COPD ranges from 40% to 70% (19). The factors, including forced expiratory volume in 1 second (FEV1), airway hyperresponsiveness, severity of dyspnea, gas exchange disturbances, lung hyperinflation, pulmonary hypertension, malnutrition-impaired exercise capacity and health-related quality of life, anemia, and other co morbidities have been identified as individual predictors of mortality in COPD (20, 21).

COPD, characterized by airflow obstruction which leads to air trapping and hyperinflation due to which patient is unable to exhale forcefully which causes decline in FEV1 values. Also, respiratory muscle weakness contributes to loss in FEV1. FEV1/FVC ratio is used to define the presence or absence of airflow limitation. An impaired exercise tolerance is the main feature in COPD. [6,7]

Impaired exercise tolerance occurs because of hypoxia in the peripheral muscles and other factors such as increased systemic inflammation, cardiovascular diseases, weight loss, loss of fat free mass combined with muscle dysfunction, osteoporosis, hypoxemia, and depression. Although the Global Initiative for Lung Diseases (GOLD) international guidelines recommend spirometry as the gold standard for accurate and repeatable measurement of lung function, its role has been debated for the objective evaluation of functional exercise capacity.[11]

According to GOLD international COPD guidelines, spirometry is the gold standard for accurate and repeatable measurement of lung function. The severity of this disease is graded according to the forced expiratory volume in 1 second (FEV1). [17]

A community-based study done at Abeshge District, Ethiopia, reveling spirometry-based COPD prevalence was 17.8%. The identified risk factors such as age above 50 years, being a smoker, being exposed to biomass smoke, and poorly ventilated kitchens were significantly associated with COPD (17). Another study done in Arba Minich, Ethiopia which was a community based cross sectional study the prevalence of spirometry diagnosed COPD was 10.6% (22).

The 6-min walk distance (6MWD) test is a sub maximal exercise test, used to assess the functional status of patients with COPD. This test is reliable, inexpensive, safe and easy to apply (23). The 6MWT is a valuable tool used as a one-time measure of functional status of patients, as well as a predictor of morbidity and mortality (24).

Spirometry is recommended by the Global Initiative for Chronic Obstructive Lung Disease (GOLD) for the diagnosis of COPD (11). However, it is a poor predictor of disability and health related quality of life (HRQoL) in patients with COPD, and correlates weakly with dyspnea, exercise capacity, and health status (25, 26).

Parameters obtained from 6MWT offer significant prognostic information for patients with COPD (27). These parameters, such as the distance walked, oxygen saturation levels, and perceived exertion can help to assess the severity of the disease, monitor progression and evaluate the effectiveness of interventions. However, the test is performed only once or a few times per year in most cases (28). Since changes in patient's status can occur any time between these measurements, a continuous monitoring system able to predict major 6MWT outcomes (29).

1.3. Justification of the study

Chronic obstructive pulmonary disease (COPD) is a significant global health concern, characterized by symptoms such as breathlessness and markedly reduced exercise capacity. The assessment of health-related quality of life (HRQoL), functional performance and breathlessness in COPD patients is crucial for effective management and treatment planning.

Patient reported outcome (PRO) measures play a vital role in capturing the subjective experiences of patients providing insights in to their quality of life and the impact of COPD on daily activities. These measures complement objective assessments, such as exercise testing, which is essential for evaluating functional performance.

The Six-Minute Walk Test (6MWT) is a widely utilized sub-maximal exercise test that serves as a clinical indicator of functional capacity in patients with cardiopulmonary diseases, including COPD. However, it is important to note that spirometry, which measures lung function, relies heavily on patient effort and cooperation. This can pose challenges, particularly for patients with very severe COPD, who may experience significant limitations in their ability to perform the test. On the other hand, 6MWT test is easy to perform as it is representing daily activity (17). If there is correlation between 6MWT and FEV1, 6MWT test can be used for assessing the severity of COPD where spirometry cannot be done. There is no published data in Ethiopia in this respect. In this study, the relation between 6MWT test and spirometric parameters [FEV1] in patients with COPD was investigated (9).

The spirometry is not available in many areas of Ethiopia. The research conducted in Liverpool on the burden of Chronic Obstructive Pulmonary Disease (COPD) in Africa involved a comprehensive literature review and a prospective survey aimed at assessing the availability and accessibility of spirometry for diagnosing and managing COPD in various African countries showed that from a total of 132 articles yield 22 relevant articles, of which only six used spirometry-based data (5). A total of 106 physician in 34 countries were contacted and only 23 reported satisfactory used and availability of spirometry (30).

Therefore, in this study, we aimed to correlate 6MWT with different demographic, clinical, and spirometric indices, and thus to evaluate whether 6MWT can be used to assess the severity of COPD. This study could help provide general insight into the burden of the disease in our setup and help to establish baseline data for further studies.

1.4. Significance of the study

This study assessed clinical and functional assessment of COPD patients and correlation of their 6 MWT with spirometry and HRQoL measures among patients visiting chest follow-up clinic at Tikur Anbesa Specialized Hospital.

Understanding the correlates of the main variables associated with the six Minute Walk test (6MWT) is crucial for predicting low performance in individuals with COPD. The 6-MWT is a widely used assessment tool that measures exercise tolerance and functional capacity in patients with respiratory conditions.

To date, little done in our community about the prognostic value of the 6 MWT-derived variables in patients with COPD. We determined the prognostic value of the 6MWT derived variables and its correlation with FEV1 and will exploring further data from this study.

The results of the study will available for physicians and relevant health authorities to be used as a background for further studies in the area.

CHAPTER 2- LITERATURE REVIEW

According to AECLIPSE a 3-year, multicenter, longitudinal, prospective study to identify novel end points in COPD, measured 6MWD at baseline and annually. It involved in 2110 clinically stable COPD patient classified under GOLD stage II-IV and recorded exacerbation-related hospitalizations and all-cause mortality the key finding was Out of the patients studied, 200 died, and 650 were hospitalized, indicating significant morbidity and mortality associated with the condition.

The study identified critical thresholds for 6MWD using receiver operating characteristic (ROC) analysis: A 6MWD of 334 meters was associated with an increased risk of death. A 6MWD of 357 meters was linked to exacerbation-related hospitalization.

The mean decline in 6MWD varied significantly across different GOLD stages:

GOLD II: A decline of 1.6 meters per year (SE 1.2).

GOLD III: A decline of 9.8 meters per year (SE 1.3).

GOLD IV: A decline of 8.5 meters per year (SE 2.4).[2]

The Canadian Cohort Obstructive Lung Disease (CanCOLD) study: a healthy cohort (n=291; mean±SD age 67.5±9.4 years; 54% male) with normal 6MWD and lung function, and a COPD cohort (n=156; age 66.2±9.0 years; 56% male; forced expiratory volume in 1s (FEV1)/forced vital capacity 56.6±8.2%; FEV1 74.4±18.6% pred) abnormal breathlessness and leg discomfort (mBorg/6MWD>upper limit of normal) showed strong concurrent validity with worse airflow limitation, Medical Research Council breathlessness and COPD Assessment Test scores (31).

A study done in Brazil involving 50 COPD patients result showed that there was moderate-to severe airflow obstruction (mean FEV1 = 41 ± 12% of predicted) and the mean 6MWD was 469 ± 60 m (86 ± 10% of predicted). Over the study period, 25 patients (50%) experienced acute exacerbations of COPD. patients in whom the 6MWD was ≤ 80% of predicted were more likely to have exacerbations than were those in whom the 6MWD was > 80% of predicted ($p = 0.01$) (32).

The Cox regression model showed that the patients in whom the 6MWD was ≤ 80% of predicted were 2.6 times as likely to have an exacerbation over a 2-year period as were the latter (p = 0.02) (33).

Cross sectional study done in tertiary center India, involving 50 patients diagnosed with chronic obstructive pulmonary disease (GOLD criteria) was found correlation between 6MWT and spirometry is statistically significant. There is significant strong positive correlation between percent predicted 6MWD and FEV1 (r=0.850 and p< 0.001). And also, there is significant moderate correlation between percent predicted 6 MWD and FVC (r=0.554 and p=<0.001), FEV1/FVC (=0.509 and p=<0.001) and MVV (r=0.615 and p=<0.001) (34).

Hospital-based cross-sectional study in India, 45 patients included in the study, all patients were males.18 patients (40%) had smoking score of ≤20 pack years and 27 (60%) patients had a score of > 20 pack years. All patients (100%) had shortness of breath, 91.1% patients had cough, 66.6% patients had sputum production and only 4% had wheeze at the time of presentation. 49% patients had systemic hypertension, 29% have more than one co morbid illness and nearly 27% had DM. (62.2%) had resting PaO2 between 60-80 mm Hg (35).

Mean forced expiratory volume in first second (FEV1) was 0.9153±0.31228 liters. Moderate COPD: 7 patients (15.6%), Severe COPD: 24 patients (53.3%) and very severe COPD: 14 patients (31.1% according to GOLD spirometry criteria. 6 patients (13.3%) had complication of Pulmonary artery hypertension (36).

Mean 6MWD of study was 333.11 ± 82.015 meters. 41 patients (91.1%) have walked > 200 meters and 64.5% walked more than 300 meters distance. A drop-in saturation ≥ 4% from baseline was considered as significant desaturation. 8 (21.1%) patients had severe COPD (FEV1<50%). There was low positive correlation with no statistical significance between FEV1 and 6 MWD (r= 0.280, p= 0.062) and between FVC and 6-minute walk distance (r= 0.289, p= 0.055) (37).

A study done at a tertiary care hospital in Nellore India Total of 154 patients were included from these 122 were males and 32 were females. 49(31.81%) walked a distance of ≥ 350 meters, 91(59.09%) walked ≥ 250 to 349 meters, and 14(9.09%) walked < 250meters. 6MWW correlated better with FEV1 and FVC (38).

According to ECLIPSE cohort a total of 1795 individuals with a diagnosis of COPD, found that severe airflow limitation by GOLD stage, degree of emphysema by CT, oxygen use during/after the 6MWT, presence of depressive symptoms and moderate to severe symptoms of dyspnea (mMRC grade >2) are significant clinical determinants of poor 6MWD performance (<350 M) (16).

The French COPD cohort study provides valuable insights into the predictors of 6-minute walking distance (6MWD) and oxygen desaturation among patients with COPD. The multivariate analysis indicated that a lower 6MWD was positively associated with age and the mMRC dyspnea scale, while it was negatively associated with resting oxygen saturation (SpO2) and forced vital capacity (FVC) percentage predicted, yielding a rescaled R^2 of 0.34. Notably, no specific comorbidities were linked to a low 6MWD.Additionally, exercise-induced desaturation (EID) was observed in 35% of the cohort (115 patients). The analysis revealed that EID was positively associated with hypertension and negatively associated with age, obesity, forced expiratory volume in one second (FEV1) percentage predicted, and resting SpO2, with a rescaled R^2 of 0.37 (39).

Prospective cross-sectional study done in North-Africa metabolic-equivalent-task (MET) walking, moderate, and vigorous activities, anthropometric, spirometric and 6-Min walk-test (6MWD, heart-rate, oxy-hemoglobin-saturation) data were measured in 200 healthy Algerian subjects aged 16–40 years (100 women). The mean ± SD of 200 included subjects' age, height, weight, body-mass-index (BMI), lean-mass, first-second-forced-expiratory-volume (FEV1) and MET moderate activity were, respectively, 27.5 ± 6.7 years, 169 ± 9 cm, 69.3 ± 11.5 kg, 24.1 ± 3.6 kg/m2, 16.7 ± 7.4 kg, 3.70 ± 0.74 L and 370 ± 686 min/week. Their 6MWD mean ± SD (minimum–maximum) was 680 ± 70 (540–888) m (1).

A study done in Egypt, ΔSpO2/distance ratio from the six-minute walk test in evaluation of patients with COPD, 57 stable COPD patients who attended the outpatient clinic of chest found that ΔSpO2/distance ratio was moderately correlated with DLCO%, FVC % and GOLD classification. However, strong correlation was found with FEV1% and RV%. mMRC was weakly correlated with ΔSpO2/distance ratio. significant moderate correlation was noticed between the ΔSpO2/distance ratio and 6MWD ($r = –0.5$, $P < 0.001$). a significant strong correlation was observed between the ΔSpO2/distance ratio and ΔSpO2 ($r = 0.87$, $P < 0.001$) (40).

2.1. Conceptual framework

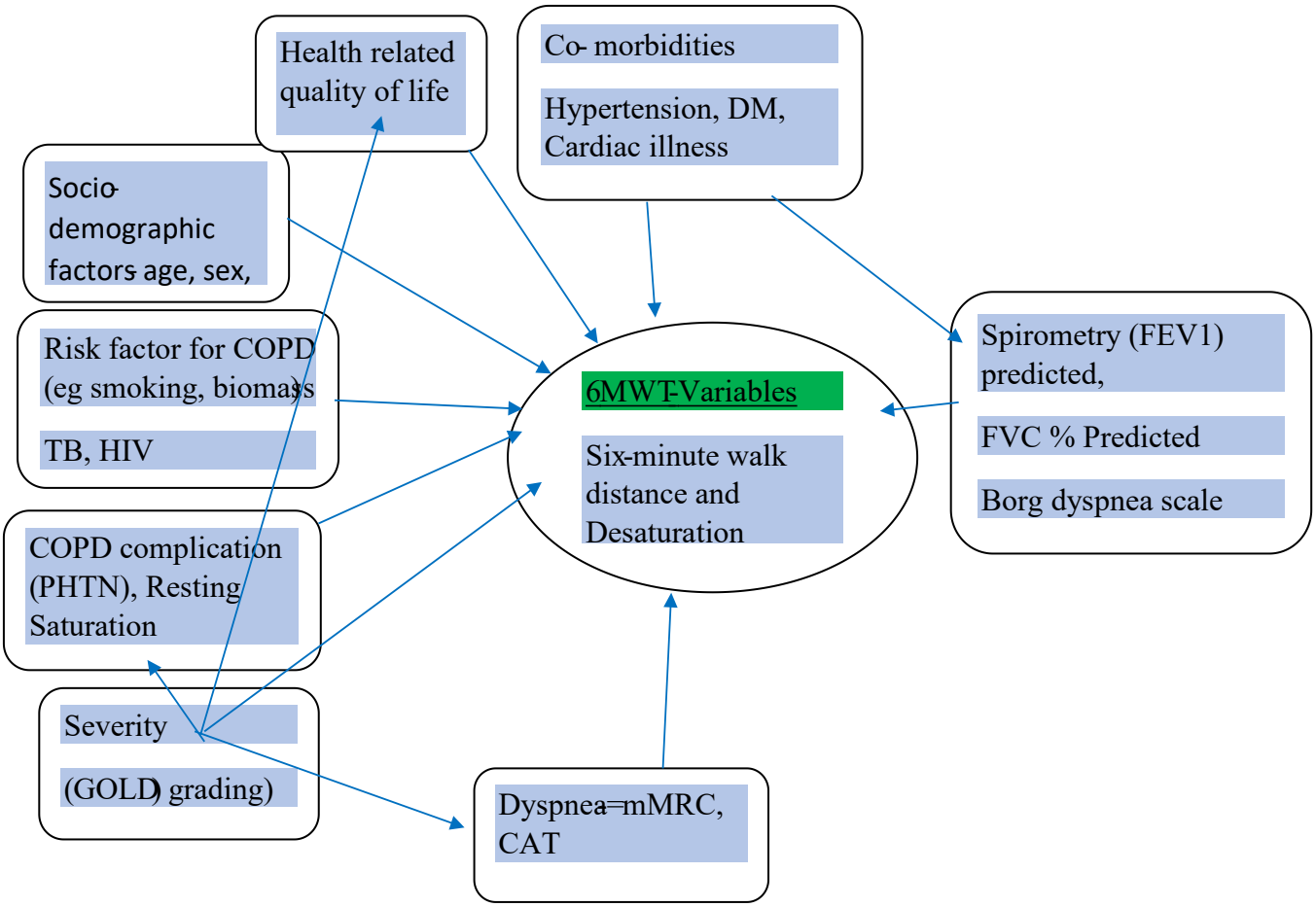

Figure 1: Conceptual frame work of the study

CHAPTER 3- OBJECTIVES

3.1. General Objective

Clinical and functional assessment of COPD patients and correlation of their 6 MWT with spirometry and HRQoL measures at TASH, A.A from July 2024 to December 2024.

3.2. Specific objectives

3.2.1 primary specific objective

- To assess the clinical characteristics including spirometry results of COPD patients the functional status of COPD patients at TASH Chest clinic.
- To assess the functional status of COPD patients through dyspnea scales
- To identify the possible correlation between clinical characteristics, spirometry results and functional status with six-minute walk test variables among patients with COPD at TASH.

3.2.2 secondary specific objective

- To assess health related quality of life among patients with COPD at TASH.
- To identify association of HRQL with COPD related variables

CHAPTER 4- RESEARCH DESIGN, METHODS AND MATERIALS

4.1. Study Design

The study was an institution based prospective cross- sectional study at Tikur Anbessa specialized hospital (TASH), in Addis Ababa, Ethiopia:

4.2. Study Period

The study was conducted from July to December 2024. It will include all adult patients with COPD attending the chest clinic at TASH.

4.3. Study area

The study was conducted in Addis Ababa, Ethiopia Tikur Anbessa specialized hospital. Tikkur Anbessa specialized hospital is found in the capital city of Ethiopia, Addis Ababa. It is the largest specialized hospital in Ethiopia and referral center from all over the country. The inpatient department has over 700 beds. The Internal Medicine department provides services in different subspecialties in both outpatient and inpatient department.

Patients with COPD receive treatment in the medical ward and other similar wards based on their Co- morbid conditions and mainly are followed in the Chest Referral Clinic. The clinic is open three times per week and patients are initially evaluated by second year medical residents followed by Pulmonary fellow and senior pulmonologist. Spirometry is performed by a trained and certified nurse using EasyON-PC ndd spirometry which was proved to be the preferred machine in Sub-Saharan Africa. The result is checked by the senior consultant for clinical interpretation.

4.4. Populations

4.4.1. Source population

All spirometry confirmed adult COPD patients.

4.4.2. Study population

All spirometry confirmed adult COPD patients diagnosed by physician/pulmonologist with a follow-up in the outpatient chest Clinic at TASH and meeting the inclusion criteria.

4.5. Sample size and sampling procedures

By sample size formula of single population proportion.

$$n = \frac{(Z_{\alpha/2})^2 p(1-P)}{d^2}$$

Where: n = the sample size ;(Zα/2)2 = at 95% confidence interval Z value (α = 0.05) P= 17.8 %

D = Margin of error = 5% = 0.05

P= taken from a community-based study done at Abeshge District Ethiopia by Gashew Garedew, et.al reported that the prevalence of spirometry-based COPD was 17.8% (17)

n=224

Since the source population size is <10,000 the following correction (finite fine population correction) formula was used to correct the sample size. The estimated number of patients treated and on follow up for COPD at chest clinic was taken as 150 after revision of health management information system (HMIS) registry at TASH.

The fine population correction (FPC) formula is suggested by statisticians when the sample size includes a significant percentage of the source population (in our case, 95, or 63 %, of COPD patients was included in the study). By modifying the estimate's standard error, the FPC formula improves its accuracy. When the sample size is a significant portion of the total population, as it is in our case, the standard error would be unnecessarily high without this adjustment, producing results that are less accurate. Narrower confidence intervals are also

obtained when the FPC is used, suggesting more accurate population parameter predictions. In general, when selecting study participants from a source population of less than 10,000, it is recommended to employ the FPC. In our example, the source population is approximately 150, which is significantly below 10,000, supporting the use of the FPC (41).

$$n = \frac{n_0}{1 + \frac{n_0}{N}}$$

Where, n = Final sample size no = Initial sample size =224

N= 150 (total number of COPD patients at TASH, source population)

The sample size after taking N as 150 is 90 adding ten percent non-response rate final sample size was 99.

4.6. Eligibility criteria

4.6.1. Inclusion factors

- Patients with stable COPD who had regularly followed up at out-patient chest clinic Providing written informed consent

4.6.2. Exclusion factors

- Patients with a history or clinical evidence of pulmonary disease other than COPD.
- Patients based on ATS criteria not eligible to perform 6 MWT including:
- COPD patients with a resting heart rate of more than 120 beats per minute, systolic blood pressure of more than 180 mm Hg, and/or diastolic blood pressure of more than 100 mm Hg.
- COPD patients with co-morbidities such as pulmonary hypertension, obstructive sleep apnea, central sleep apnea, cardiovascular disease, a renal disease that lead to hypoxemia.
- COPD patients with a history of unstable angina or myocardial infarction during the previous 1 month.
- COPD patients with a comorbid illness that limit their capacity to perform 6MWT.

Study variable

4.6.3. Dependent variable

Primary objective

- Six-minute Walk distance

Secondary objective

- HRQOL

4.6.4. Independent variables

Socio-demographic Variables

- Age
- Sex
- Residency and occupation

Clinical factors

- Type of risk factor for COPD
- Forced expiratory volume in one second (FEV1) in COPD patient
- Severity of obstruction
- FVC
- FVC/FEV1 ratio
- Functional assessment of COPD patient by 6 MWT.
- Presence of co- morbidities
- recent exacerbation

Anthropometric data: Hight, weight, and body mass index

4.7. Operational definition

COPD- Chronic obstructive pulmonary disease is a heterogenous lung condition characterized by chronic respiratory symptom (dyspnea, cough, sputum production, exacerbation) due to abnormalities of the air way (bronchitis, bronchiolitis) and/or alveoli (emphysema) that cause persistent, often progressive, air way obstruction.

Diagnostic criteria-the presence of non-fully reversible air flow limitation (i.e FEV1/FVC <0.7 post bronchodilation) measured by spirometry in the appropriate clinical context.

Air flow obstruction severity- FEV**1**-Is the primary measure used to grade the physiologic severity of obstructive or mixed obstructive-restrictive process based on post bronchodilator value of FEV1 (% reference)

- GOLD 1: mild FEV1 >/= 80% predicted
- GOLD 2: moderate 50% < FEV1<80% predicted
- GOLD 3: Sever 30% </= FEV1 < 50 % predicted
- GOLD 4: Very sever FEV1 < 30 % Predicted

Exacerbation of COPD: is defined as an event characterized by dyspnea and /or cough and sputum that worsen over <14 days. And it often associated with increase local and systemic inflammation caused by air way infection, pollution or other insult of the lungs.

Six-minute-walk test (6MWT): is a common exercise or stress test. This test measures how far a person can walk in 6 minutes in meters while reporting how they feel. They report how hard it is and if they feel any shortness of breath. The test looks at the level of exertion and oxygen saturation level during exercise.

Spirometry: the most readily available and useful pulmonary function test measures the volume of air exhaled at specific time points during a forceful and complete exhalation after a maximal inhalation. The total exhaled volume is known as FVC (Forced vital capacity) while the volume exhaled in the first second, known as FEV1 (Forced expiratory volume in one second). The clinical diagnosis of COPD is a ratio of postbronchodilator FEV1/FVC ,70% according to the GOLD 2024 guidelines.[17]

Functional status – defined here by the score on the mMRC score.

- **Poor functional status** -defined as a score of mMRC of more than or equal to two.
- **Good functional status** - defined as a score of less than two of mMRC

4.8. Patients and methods

This cross-sectional study was conducted in TASH, AAU-MF, Ethiopia. Patients with stable COPD was enrolled consecutively in the study between July 2024-December 2024.

Participants with an exacerbation within 4 weeks prior to the tests or any severe comorbidity including unstable cardiac or pulmonary disease were excluded. Participants were required to continue with their regular therapy before performing the tests of the study. Spirometry results and resting saturation were documented before the 6MWT. Results of walking distance and oxygen saturation were measured again at the end of the 6MWT.

4.8.1. Pulmonary function tests

Pulmonary function tests were performed according to the guidance's of European Respiratory Society/American Thoracic Society (ATS) using EasyOn-PC.

4.8.2. Quality of life

Health-related quality of life (HRQoL) questionnaires was applied in the assessment of quality of life. We used two different questionnaires in all, including modified Medical Research Council dyspnea scale (mMRC) & Chronic Obstructive Pulmonary Disease Assessment Test (CAT)

The mMRC utilizes a scale with a grade ranging from 0 to 4 to evaluate the degree of dyspnea in patients with COPD (42). The CAT, consisting of eight items, is a short questionnaire designed to measure symptoms and impacts of COPD.

Range of CAT scores from 0–40. Higher scores denote a more severe impact of COPD on a patient's life (42). Participants was asked to choose the description most consistent with their dyspnea symptoms or rate how strongly they agreed with each statement. For both the questionnaires, higher grade or score represented lower quality of life and worse health status.

4.8.3. 6MWT

6MWT was carried out in a flat, 30-m-long corridor. Participants were asked to walk back and forth as far as possible on the corridor in a period of 6 minutes. They were allowed to rest if extremely fatigue and encouraged to continue the walking as soon as possible. Encouraging phrases recommended by the official statement of ATS was given by a researcher who counted the lap number at the same time. Oxygen was given for those who require supplement to achieve 90% saturation.

6 MWD was also calculate as the product of walk distance and body weight. since we have no local data to date regarding normal age-based reference value for six-minute walk test for this purpose we will use the following formula to get predicted six-minute walk distance.

MEN- 6MWD= (7.57 X height in cm)- (1.76 x weight in kg)- (5.02 x age)-309 meter

Subtract 150 to get lower limit of normal.

WOMEN- 6MWD= (2.11 X height in cm)- (2.29 x weight in kg)- (5.78 x age) + 667 meter
Subtract 140 to get lower limit of normal.

4.9.4- Unmet six- minute walk distance- </= 80% from expected distance covered by the individuals (from actual distance)

4.9. Data Quality Assurance

A one-day training was given for data collecting medical student on How to perform six-minute walk test, how to fill the check list and the data collecting process before starting Data collection. Pretest was conducted to check and clear out any queries on the questionnaires, and also to assess for consistency and accuracy. The results and comments from the pretest were revised and communicated to the data collectors before starting the actual data collection. The primary investigator supervised data collection process on daily basis for precision and provided comments for the data collectors.

4.10. Data analysis

After Data is revised and checked for correctness and consistency it was entered to SPSS Version 26 program. Data was summarized by tables and graphs for each variable. For continuous variables, descriptive statistics, including frequency, mean, and standard deviation, or median and interquartile range, was estimated as appropriate. To estimate the association between our categorical independent variables and categorical dependent variable, the Chi-square test (parametric) was used. On the other hand, the possible associations between our continuous independent variables and our dependent variable were estimated using the independent samples t-test. Further Pearson's correlation coefficient(r) was used for normally distributed continuous variable and was used to find correlation between FEV1 and 6 MWD. A p-value <0.05 with a 95% confidence interval was considered statistically significant.

4.11. Ethical consideration

Ethical clearance was obtained from the Institutional review board (IRB) of Tikur Anbessa Specialized Hospital and a formal letter of permission was obtained from the hospital's administration before starting the study. Before starting the data collection process, informed consent was obtained from all study participants. The collected data was kept confidential and was used for the study purpose only.

4.12. Data dissemination

The final result of the research was submitted to Addis Ababa University School of Medicine. The results will be presented during defense. The copies of the result will be available to the Internal Medicine Department in TASH and the hospital's administration. Publication in scientific journals will be attempted.

CHAPTER 5- RESULTS

5.1. Socio-demographic characteristics and patient information

A total 95 of participants fulfilled the inclusion criteria during the study period. The mean age was 63.3 with SD± 10.96). The majority, 63 (66.3%), were aged 56–75 years, while 61 (64.2%) were male. Most participants, 78 (82.1%), resided in urban areas. The majority of patients were employed 43 (45.3%), followed by retired individuals 21 (22.1%). In terms of BMI, 46 (48.4%) had a normal BMI (18.5–24.9 kg/m²), 28 (29.5%) were overweight (25–29.9 kg/m²), 7 (7.4%) were obese (BMI >30 kg/m²), and 14 (14.7%) were underweight (BMI <18.5 kg/m²). (Table 1).

Table 1: Socio -demographic characteristics and patient information of COPD patients at TASH Addis Ababa, Ethiopia, 2025.

Variables	**Category**	**No.**	**(%)**
Sex	Male	61	(64.2)
	Female	34	(35.8)
Age	≤ 35 years	3	(3.2)
	36- 55 years	17	(17.9)
	56- 75 years	63	(66.3)
	> 75 years	12	(12.6)
Residency	Urban	78	(82.1)
	Rural	17	(17.9)
Occupation	Farmer	7	(7.4)
	Housewife	14	(14.7)
	Merchants	10	(10.5)
	Employed	43	(45.3)
	Retired	21	(22.1)
BMI (Kg/m²)	25-29.9	28	(29.5)
	18.5- 24.9	46	(48.4)
	>30	7	(7.4)
	< 18.5	14	(14.7)

Clinical Characteristics and sub-classifications of COPD

A total of 95 COPD patients were assessed. The majority, 46 (48.4%), were in GOLD 2. In terms of GOLD ABE assessment tool, 36 (37.9%) were classified under Group B and 27(28.4%) were group E. Most patients, 90 (94.7%), had an obstructive disease pattern. The most common COPD etiotypes was smoking-related COPD (COPD-C) in 31 (32.6%) of patients. Exacerbations in the last year were reported in 37 (38.9%) of cases, with 18 (48.6%) experiencing one exacerbation. Hospitalization due to COPD occurred in 16 (16.8%) of patients in the last one year. The majority, 42 (44.2%), had COPD for 1–5 years. Functional status assessment showed that 72 (75.8%) had poor functional status (Table 2).

Table 2: Clinical Characteristics and sub-classification of COPD patients at TASH Chest clinic of Addis Ababa, Ethiopia, 2025.

Variables	Category	No.	(%)
GOLD stage of COPD	GOLD 1	18	(18.9)
	GOLD 2	46	(48.4)
	GOLD 3	20	(21.1)
	GOLD 4	11	(11.6)
GOLD ABE assessment tool	A	32	(33.7)
	B	36	(37.9)
	E	27	(28.4)
Nature of Disease			
	Obstructive	90	(94.7)
	Mixed (both obstructive-restrictive pattern)	5	(5.3)
COPD Etiotypes	Genetically determined COPD (COPD-G)	1	(1.1)
	Environmental COPD if yes Cigarette smoking (COPD-C)	31	(32.6)
	COPD of unknown cause (COPD-U)	16	(16.8)
	COPD due to infection (COPD-I)	8	(8.4)
	COPD & Asthma (COPD- A)	26	(27.4)
	Biomass/pollution exposure (COPD-P)	13	(13.7)
History of COPD Exacerbation in	Yes	37	(38.9)
the Last Year	No	58	(61.1)
Frequency of COPD	3x/year	9	(24.3)

Exacerbation in the Last Year	2X/year	10	(27.0)
	1x/year	18	(48.6)
History of Hospitalization in the Last Year	Yes	16	(16.8)
	No	79	(83.2)
Duration of Illness (Years)	6-10 yrs	20	(21.1)
	2 months	1	(1.1)
	11-20 yrs	15	(15.8)
	1-5 yrs	42	(44.2)
	> 20 yrs	17	(17.9)
Functional status	Poor	72	(75.8)
	Good	23	(24.2)

5.2. Risk Factors and Comorbidities

The most common identified risk factor for COPD was active smoking in 31 (32.6%) patients, followed by biomass/fuel exposure in 22 (23.2%), while 27 (28.4%) had idiopathic causes. The most common comorbidities were diabetes with hypertension in 22 (23.2%) and hypertension alone or with other conditions in 18 (18.9%). Cardiac diseases were present in 12 (12.6%) patients, while retroviral infections (RVI) were reported in 4 (4.2%). Other comorbidities, including chronic kidney disease (CKD), chronic lymphocytic leukemia (CLL), ischemic stroke, gastrointestinal disease, epilepsy, thyrotoxicosis, and pulmonary hypertension, were seen in 11 (11.6%) patients. A total of 27 (28.4%) patients had no reported comorbidities (Table 3).

Table 3:Risk factors and co-morbidities of COPD patients at TASH chest clinic of Addis Ababa, Ethiopia, 2025.

Variables	**Category**	**No.**	**%**
Any identified Risk Factors for COPD	Poorly ventilated kitchens	6	(6.3)
	Infection	**8**	(8.4)
	Idiopathic	27	(28.4)
	Factory	1	(1.1)
	Biomass/fuel	22	(23.2)
	Active smoker	31	(32.6)
Co-morbidities	Hypertension (HTN) ± Other Conditions	18	18.9%
	Diabetes (DM) ± HTN/Renal	22	23.2%
	Cardiac Diseases ± Other Conditions	12	12.6%
	Retroviral infection (RVI)	4	4.2%
	Others	11	11.6%
	No Reported Comorbidities	27	28.4%

5.3. Comparison of pre-6MWT and post-6MWT

Treatment adherence was good in 68 (71.6%) of patients. The most common treatment was LABA + ICS, used by 70 (63.1%). Among the 95 COPD patients assessed, during the test, supplemental oxygen was used by 11 (11.6%) patients, whereas 84 (88.4%) did not require oxygen support. The majority of patients, 90 (94.7%), completed the 6-minute walk test without stopping, while 50 (52.6%) experienced exercise-induced desaturation (SpO_2 drop by ≥4%) (Table 4).

Table 4:Test and medication details of COPD patients at TASH chest clinic of Addis Ababa, Ethiopia, 2025.

Variables	**Category**	**No.**	**%**
Treatment adherence	Poor	27	(28.4)
	Good	68	(71.6)
Treatment modality	SABA only	15	(15.8)
	LABA + ICS	70	(63.1)
	Beclomethasone + SABA	20	(21.1)
Medications taken before the test	Salbutamol	11	(11.6)
	None	84	(88.4)
Supplemental oxygen during the test	Yes	11	(11.6)
	No	84	(88.4)
if Yes, flow _____ L/min, type _____	3 L/min	2	(18.2)
	2 L/MIN	6	(54.5)
	1L/min	3	(27.3)
Stopped or Paused Before 6 Minutes?	Yes	5	(5.3)
	No	90	(94.7)
Exercise induced desaturation (SpO_2 drops ≥4%)	Yes	50	(52.6)
	No	45	(47.4)

5.3.1. Comparison of pre-and post-6MWT

As a table shows below; the paired samples test showed a significant increase in heart rate post-walk, with a mean difference of 12.10 ± 8.23 ($p < .001$). Conversely, SpO_2% significantly decreased post-walk by -4.56 ± 3.98 ($p < .001$). However, 11 (11.6%) of patients received supplemental oxygen during the test, which may have influenced the extent of desaturation in some individuals (Table 5).

Table 5: Paired samples test for physiological changes pre- and post-6MWT of COPD patients at TASH chest clinic of Addis Ababa, Ethiopia, 2025.

	Paired Differences					***t***	***df***	***Sig.***
	Mean	***SD***	***Std. Error Mean***	***95% CI of Difference***				
				Lower	***Upper***			
Post-Walk Heart Rate – Baseline Heart Rate	12.095	8.231	.844	10.418	13.771	14.322	94	.001
Post-Walk SpO_2% - Pre-Walk SpO_2%	-4.558	3.978	.408	-5.368	-3.748	-11.168	94	.001

Correlation of Six-Minute Walk Test (6MWT) with COPD related variables

The 6-minute walk distance (6MWD) in COPD patients was significantly correlated with multiple clinical factors. Older age (mean = 63.32 years, SD = 10.96; r = -0.374, P < 0.001) was correlated with a shorter 6MWD, indicating a decline in functional capacity over time. Greater impairment in health-related quality of life (HRQoL) (mean = 2.25, SD = 0.85; r = -0.366, P < 0.001), higher dyspnea severity on the mMRC scale (mean = 2.05, SD = 0.80; r = -0.370, P < 0.001), and greater breathlessness reported on the Borg Dyspnea Scale (mean = 1.45, SD = 1.21; r = -0.212, P = 0.040) were all significantly correlated with reduced walking distance, suggesting that breathlessness and poor perceived health status limit physical activity. Similarly, a higher COPD symptom burden, as measured by the CAT score (mean = 11.06, SD = 6.03; r = -0.343, P = 0.001), was correlated with poorer walking performance. In addition, FEV_1% predicted (mean = 54.74, SD = 19.05; r = 0.221, P = 0.032), was positively correlated with 6MWT, indicating that Impaired pulmonary function test (reduced FEV1) contributes to declines in functional endurance and reduced 6MWD, both of which are

strong predictor of COPD severity. However, FVC% predicted (mean = 68.56, SD = 21.09; r = 0.194, P = 0.059) showed only a weak correlation, and FEV_1/FVC (mean = 62.97, SD = 13.42; r = 0.023, P = 0.821) had no significant correlation with 6MWD, suggesting that this spirometric measure may not directly impact walking performance. The overall mean 6MWD was 364.46 meters (SD = 112.78), further highlighting the variability in functional capacity among COPD patients (Table 6).

Table 6: Correlation Between 6MWD and clinical variables of COPD patients at TASH chest clinic of Addis Ababa, Ethiopia, 2025.

Correlation 6MWD vs	***Mean***	***SD***	***(r)***	***P-value***
Age (in full years)	63.32	10.96	-0.374	<0.001*
Health-related quality of life (HRQoL) score	2.25	0.85	-0.366	<0.001*
mMRC scale	2.05	0.80	-0.370	<0.001*
CAT score	11.06	6.03	-0.343	<0.001*
Modified Borg Dyspnea Scale	1.45	1.21	-0.212	0.040*
FEV_1% Predicted	54.74	19.05	0.221	0.032*
FVC% Predicted	68.56	21.09	0.194	0.059
FEV_1/FVC Actual	62.97	13.42	0.023	0.821
Total Distance Walked in 6 Minutes (6MWT, meters)	364.46	112.78	—	—

As a figure shows below; the analysis of COPD patients' 6-minute walk distance (6MWD) revealed a significant correlation with lung function. Specifically, FEV_1% predicted (Mean = 54.74, SD = 19.05; r = 0.221, P = 0.032) showed a positive association with 6MWD (Figure 2).

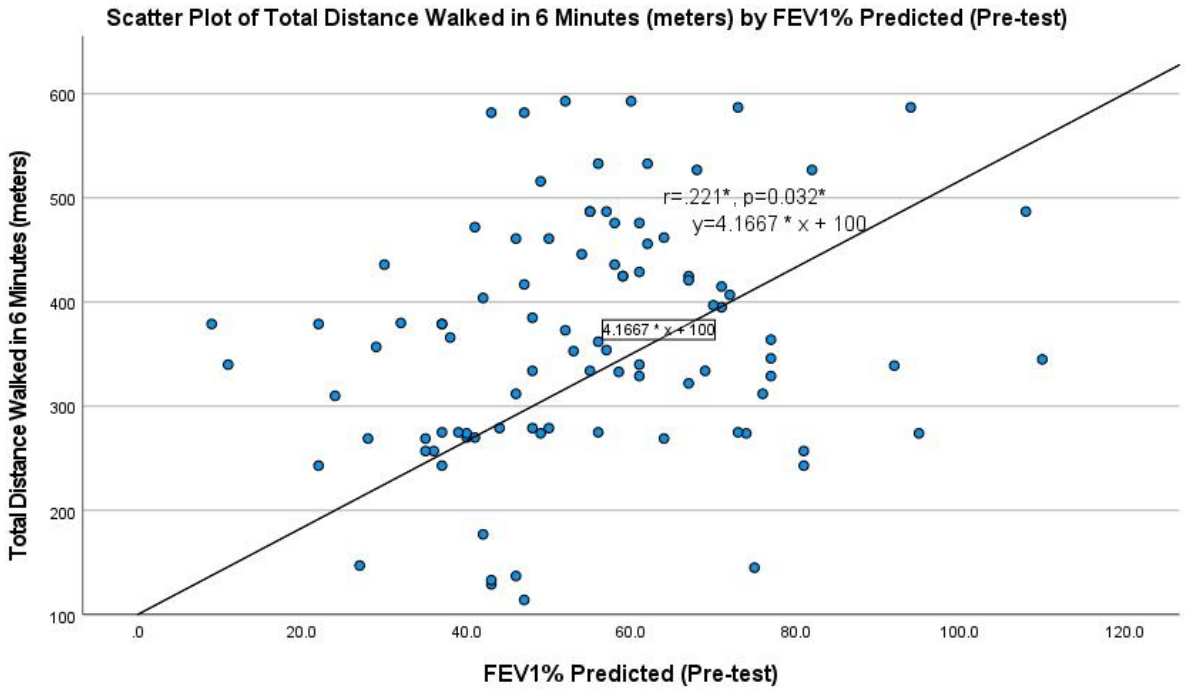

Figure 2: The correlation between FEV_1% predicted and 6MWT distance of COPD patients at TASH chest clinic of Addis Ababa, Ethiopia, 2025.

Table 7: The correlation of physiological changes pre- and post-6MWT of COPD patients at TASH chest clinic of Addis Ababa, Ethiopia, 2025.

Correlation 6MWT vs	***Pearson correlation (r)***	***P value***
Post-Walk Heart Rate & Pre-Walk Heart Rate	.817	< 0.001
Post-Walk SpO_2% & Pre-Walk SpO_2%	.773	< 0.001

5.3.2. Association of UNMET Six-Minute Walk Test with COPD related variables

The analysis of UNMET six-minute walk distance (6MWD) in COPD patients highlighted key factors associated with reduced exercise capacity. A majority of the UNMET group (64.9%) were aged 56-75 years, though age was not significantly associated with walking performance (P = 0.701). Similarly, residency (urban vs. rural) did not show a significant impact (P = 0.880). However, a BMI of 25 or higher (overweight/obese) was significantly linked to a higher prevalence of UNMET status (P = 0.049), suggesting that excess weight negatively affects walking ability. Exposure to biomass smoke was also significantly

associated with UNMET status (P = 0.031), indicating that indoor air pollution contributes to reduced physical capacity. Furthermore, active smoking was correlated with a higher proportion of UNMET 6MWD (P = 0.038), reinforcing the detrimental effects of smoking on functional performance. Lastly, poor treatment adherence was more common among those with UNMET status, emphasizing the importance of consistent disease management in maintaining mobility (P = 0.037) (Table 9).

Table 8: Association of UNMET Six-Minute Walk Test with COPD related variable among patients at TASH chest clinic of Addis Ababa, Ethiopia, 2025.

	6MWD in COPD		
Category	**UNMET**	**MET/≥ 80%**	**P-value**
Age	Frq. (%)	Frq. (%)	0.701
≤ 35 years	2 (2.6)	1 (5.6)	
36-55 years	14 (18.2)	3 (16.7)	
56-75 years	50 (64.9)	13 (72.2)	
> 75 years	11 (14.3)	1 (5.6)	
Residency			0.880
Urban	63 (81.8)	15 (83.3)	
Rural	14 (18.2)	3 (16.7)	
BMI (Kg/m²)			0.049 *
< 25	45 (58.4)	15 (83.3)	
≥ 25	32 (41.6)	3 (16.7)	
Biomass smoke exposure			0.031 *
No	43 (55.8)	15 (83.3)	
Yes	34 (44.2)	3 (16.7)	
Poorly ventilated kitchens			0.155
No	62 (80.5)	17 (94.4)	
Yes	15 (19.5)	1 (5.6)	
Active smoker			0.038 *
No	49 (63.6)	16 (88.9)	
Yes	28 (36.4)	2 (11.1)	
Treatment adherence			0.037 *
Poor	38 (49.4)	4 (22.2)	
Good	39 (50.6)	14 (77.8)	

5.4. Health-related quality of life

As Table 9 shows below, the analysis of correlations with Health-Related Quality of Life (HRQoL) score reveals the older age (mean = 63.32, SD = 10.96) showed a weak positive correlation with HRQoL impairment (r = 0.211, P = 0.040), indicating that advancing age may contribute to worsening quality of life. Greater dyspnea severity, as measured by the Modified Borg Dyspnea Scale (mean = 1.45, SD = 1.21, r = 0.633, P < 0.001) and the mMRC scale (mean = 2.05, SD = 0.80, r = 0.997, P < 0.001), was strongly correlated with poorer HRQoL, suggesting that increased breathlessness significantly limits daily functioning.

Similarly, a higher COPD symptom burden, reflected by the CAT score (mean = 11.06, SD = 6.03, r = 0.530, P < 0.001), was associated with greater HRQoL impairment. In contrast, better lung function, particularly higher FEV_1% predicted (mean = 54.74, SD = 19.05, r = -0.486, P < 0.001) and FVC% predicted (mean = 68.56, SD = 21.09, r = -0.432, P < 0.001), was significantly correlated with better HRQoL, indicating that preserved pulmonary capacity contributes to improved well-being. However, FEV_1/FVC (mean = 62.97, SD = 13.42, r = -0.155, P = 0.133) showed no significant correlation, suggesting it may not be a key determinant of HRQoL in COPD patients. Additionally, greater physical capacity, as measured by the 6-minute walk test (mean = 364.46 meters, SD = 112.78, r = -0.366, P < 0.001), was moderately correlated with better HRQoL, reinforcing the importance of functional endurance in maintaining quality of life (Table 9).

Table 9: The Correlation of HRQoL Score with clinical parameters of COPD patients at TASH chest clinic of Addis Ababa, Ethiopia, 2025.

Correlation of HRQoL Score Vs	**Mean**	**SD**	**(r)**	**P-value**
Age (in full years)	63.32	10.96	.211*	.040
Modified Borg Dyspnea Scale	1.45	1.21	.633**	<0.001
mMRC scale	2.05	0.80	.997**	<0.001
CAT score	11.06	6.03	.530**	<0.001
FEV1% Predicted	54.74	19.05	-.486**	<0.001
FVC% Predicted	68.56	21.09	-.432**	<0.001
FEV1/FVC Actual	62.97	13.42	-.155	.133
Total Distance Walked in 6 Minutes (meters)	364.46	112.78	-.366**	<0.001

CHAPTER 6- DISCUSSIONS

This institutional-based cross-sectional study revealed that most COPD patients 75.8% had poor functional status, with nearly half 48.4% classified as GOLD 2 and 37.9% GOLD ABE assessment tool in Group B. These findings are consistent with studies conducted in Ethiopia and other African settings by Getenet Melaku et.al,Halpin DMG ,salvi S,et al, GOLD 2 remains the predominant stage among COPD patients (43, 44). Similarly, a study in Nigeria done by Adetiloye et al, reported a high prevalence of GOLD 2 classification among COPD patients, emphasizing moderate disease severity (45).

The majority (94.7%) exhibited an obstructive disease pattern, which aligns with previous research in Ethiopia done by Woldeamanuel G et al (17) and South Africa done by Nkhom Kennedy et al, (46), where spirometric assessments confirmed obstructive airway disease as the dominant pattern in COPD cases. Exacerbations (38.9%) and hospitalizations (16.8%) were common, mirroring reports from a Ugandan study that found nearly 40% of COPD patients had at least one exacerbation per year (47).

A decline six-minute walk distance (6MWD) in COPD patients was significantly associated with worsening clinical factors, including older age, greater impairment in HRQoL, higher mMRC and CAT score. This study results finding was consistent with previous study findings have been reported globally, with studies from Columbia (48), and Africa; in Uganda (47), highlighting that older age, severe symptoms, and impaired HRQoL are key determinants of reduced functional capacity in COPD patients (Global Initiative for Chronic Obstructive Lung Disease [GOLD], 2024 (22, 49, 50). This study results also consistent with The French COPD cohort study Out of 440 patients studied, 33% (146 patients) exhibited a 6MWD of less than 350 meters. The multivariate analysis indicated that a lower 6MWD was positively associated with age and mMRC dyspnea scale while it was negatively associated with resting oxygen saturation (SpO2) and forced vital capacity (FVC) percentage predicted, yielding a rescaled R^2 of 0.34. (39). This may be due to the progressive decline in pulmonary function, reduced muscle strength, and increased perception of breathlessness, which collectively limit exercise tolerance in COPD patients.

In addition, FEV_1% predicted (mean = 54.74, SD = 19.05; r = 0.221, P = 0.032), was positively correlated with 6MWT, indicating that Impaired pulmonary function test (reduced FEV1) contributes to declines in functional endurance and reduced 6MWD. This finding

coincides with previously done in india (50 patient) found that there is significant strong positive correlation between percent predicted 6MWD and FEV1 (r=0.850 and p< 0.001). unlike our study, they also found there is significant moderate correlation between percent predicted 6 MWD and FVC (r=0.554 and p=<0.001), FEV1/FVC (=0.509 and p=<0.001) and MVV (r=0.615 and p=<0.001) (34). Studies from both high-income and low-income countries have consistently shown that better lung function is associated with greater exercise capacity, reinforcing the importance of pulmonary rehabilitation and medication adherence in maintaining physical function (43, 51-53). This may be because better lung function leads to improved oxygen exchange, reduced airway obstruction, and enhanced cardiovascular performance, all of which contribute to greater physical endurance and functional mobility.

The analysis of UNMET six-minute walk distance (6MWD) in COPD patients revealed several key factors contributing to reduced exercise capacity. While age and residency did not significantly affect walking performance, overweight or obesity was strongly linked to UNMET status, suggesting that excess weight may impair mobility and respiratory efficiency. Similarly, exposure to biomass smoke and active smoking were significantly associated with lower walking capacity, consistent with studies from global, African, and Ethiopian settings that highlight the negative impact of air pollution and tobacco use on lung function and physical endurance (54-56). This may be due to increased airway inflammation, reduced oxygen uptake, and overall respiratory burden caused by pollutants and smoking.

Additionally, poor treatment adherence was more common among patients with UNMET status, further emphasizing the role of proper disease management in maintaining mobility and functional capacity. Research from different regions has consistently shown that regular medication use and pulmonary rehabilitation significantly improve exercise tolerance in COPD patients (53, 57). This may be because optimal treatment helps control symptoms, reduce exacerbations, and improve overall lung function, allowing patients to maintain better physical activity levels.

The analysis of correlations with Health-Related Quality of Life (HRQoL) in COPD patients showed that older age was associated with greater impairment, aligning with global and African studies that report declining physical function and worsening symptoms in aging populations (48, 49, 51). Greater dyspnea severity, as measured by the Modified Borg Dyspnea Scale and the mMRC scale, was strongly linked to poorer HRQoL, suggesting that increased breathlessness significantly limits daily functioning. Similarly, a higher COPD

symptom burden, reflected by higher CAT scores, was associated with worse HRQoL, consistent with findings from previous studies in Ethiopia and other regions indicating that symptom severity directly affects overall well-being (48, 51, 53, 56). This may be due to the progressive nature of COPD, where worsening symptoms reduce the ability to perform daily activities, leading to a lower quality of life.

CHAPTER 7- Strength and Limitation of the Study

This is the only study to our knowledge which tries to correlate the various clinical characteristics, spirometric variables and functional status with objective measurement of 6MWT in Ethiopia. The practice of assessing functional status, 6MWT and HRQL is not only limited to COPD patients but has relevance in various chronic lung and cardiovascular diseases. However, even though this cross-sectional study offers valuable insights and important correlations it cannot establish causality. The lack of prior Ethiopian studies also limits comparisons, and findings from a single hospital may not be generalizable. Despite these limitations, it provides a foundation for future COPD research.

CHAPTER 8- CONCLUSION

The findings of this study show, in chronic obstructive pulmonary disease, 6MWT/D significantly correlated with the spirometry parameters (FEV1). 6MWD decreases as there is decline in the pulmonary function. 6MWT can be a useful replacement of spirometry in assessment of COPD severity. COPD patients with greater symptom burden, worse lung function, and unhealthy lifestyle factors have reduced exercise capacity and poorer quality of life. Unmet six-minute walk distance was more common in those with obesity, biomass smoke exposure, smoking, and poor treatment adherence- Targeted interventions in symptom management, smoking cessation, and treatment adherence are crucial to enhancing mobility and overall health related quality of life.

Recommendations

Based on the study results, the following recommendations are made:

- For TASH & Addis Ababa Health Bureau: Strengthen early COPD screening, expand pulmonary rehabilitation, and enhance patient education on smoking and biomass exposure. Ensure consistent medication access and promote treatment adherence through regular follow-ups.
- For Health Officials & Clinicians: Prioritize routine 6MWT and spirometry, integrate smoking cessation and weight management into care, and advocate for policies improving air quality to reduce COPD risk factors.
- For COPD Patients at TASH: Follow prescribed treatments, attend regular check-ups, and engage in pulmonary rehabilitation. Avoid smoking and biomass exposure while maintaining physical activity to improve Quality of life.
- For Future Researchers: Expand studies to multiple hospitals to assess regional differences in COPD care. Investigate treatment adherence barriers, pulmonary rehabilitation benefits, and alternative interventions for better outcomes.

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LIST OF ANNEXES

Addis Ababa University College of Health Science

School of Medicine Department of internal medicine

Annex 1: Informed Consent Form

Title: six -minute walk test and its correlation with spirometry (FEV1) as a predictor of COPD severity among patients visiting TASH-chest follow-up clinic in Addis Ababa Ethiopia, 2024

– a cross-sectional analytical study

I have been well aware of the fact that this study is fully supported and coordinated by Addis Ababa University College of Health Sciences and the designated principal investigator is Dr. Haymanot Abebe. I have been fully informed in the language I understand that the objective of the research project. I have also been informed that all the information I shall provide was kept confidential. I understood that the research doesn't have any risk and no compensations. I also know that I have the right to withhold information, skip questions to answer or to withdraw from the study any time I have acquainted nobody will impose me to explain the reason of withdrawal. I have been assured that the right to ask information about the research before and or during the research work and to contact

Dr. Haymanot Abebe: Addis Ababa University, College of Health Sciences, School of Medicine Tel: +251 913663364. E-mail: 0913663364ha@gmail.com

I have read this form, or it has been read to me in the language I comprehend and understood the condition stated above, therefore, I am willing and confirm my participation by signing the consent.

Name of the participant _____

Signature _____

Name of researcher _____

Signature _____

Date _____

Annex 2: Questionnaire

Date: (DD/MM/YYYY) _____/_____/_____.

Section 1: Sociodemographic factors

1.1 Sex: Male Female

1.2 Age (in full years): _____.

1.3 Residency: urban rural

- 1.4 BMI of the patient in Kg/m2
- a, < 18.5 b, 18.5- 24.9 c, 25-29.9 d, >30

Section 2: base line patient characteristics.

2.1 Base line Spirometry result and its severity

A-GOLD 1 C-GOLD 3

B-GOLD 2 D-GOLD 4

2.2 Nature of disease

2.2.1 A-Obstructive B- Mixed (both obstructive-restrictive pattern)

2.2.2 COPD Etiotypes?

A. Genetically determined COPD (COPD-G)

B. COPD due to abnormal lung development (COPD-D)

C. Environmental COPD if yes Cigarette smoking (COPD-C) or Biomass/pollution exposure (COPD-P)

D.COPD due to infection (COPD-I)

E- COPD & Asthma (COPD- A)

F- COPD of unknown cause (COPD-U)

2.3 Resting Saturation of the patient?.....%

A. > 95 % B.>88-92 % C. 85- 88 D. <85%

2.4 Does the patient has COPD exacerbation in the last one year? YES or NO

if yes how frequent?

A- 1x/year B-2X/year C- 3x/year D- More than 3x/year

2.5 Any history of hospitalization for exacerbation? YES or NO

2.6 Duration of illness in years. A 1-5 yrs 6-10 yrs C- 11-20 yrs D > 20 yrs E others please specify

2.7 treatment adherence A. good adherence B- poor adherence

2.8 Treatment Modality?

A. only bronchodilator B- LABA+LAMA C-LABA +Steroid D-LABA + LAMA + steroid

2.9 Spirometry parameters

A- FEV1% Predicted-------

B- FVC % Predicted--------

C-FEV1/FVC actual ---------

Section 3: Questions to **Assessment of risk factor and co morbidities.**

3.1 Did the patient had any identified risk factors for COPD? If yes

A-active smoker B- Passive smoker C- biomass/fuel

D- poorly ventilated kitchens E- idiopathic F- others if any ……

3.2 Does the patient has any Co morbidities

A- DM B- HTN C- Cardiac disease D- Others E- none

Annex 3: Checklist

3.1 Six Minute Walk test (6MWT)

6MWT worksheet and report (adopted and modified from the American Thoracic Society):

Lap counter: __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __

Patient name: _____ Patient ID# _____

Occupation----------

Walk # _____ Tech ID: _____ Date: _____ Gender: M F

Age: ____ Height: ____ meters Weight: _____kg

Blood pressure: _____ / _____

Medications taken before the test (dose and time): _____

Supplemental oxygen during the test: No Yes, flow _____ L/min, type _____

Base line End of Test Time ___:___ ___:___

Heart Rate _____ _____ Dyspnea ____ ____ (Borg scale)

Fatigue ____ ____ (Borg scale)

SpO2 ____ % ____%

Stopped or paused before 6 minutes? No Yes, reason: _____

Other symptoms at end of exercise: angina dizziness hip, leg, or calf pain

Number of laps: ____ (60 meters)

final partial lap: _____ meters

Total distance walked in 6 minutes: _____ meters

Predicted distance: _____ meters Percent predicted: _____

- ❖ Medical history checked

❖ Medical clearance provided for the patient to participate in exercise testing

Contraindications to 6 MWT: circle it

Resting heart rate > 120 beats / min after 10 minutes rest (relative contraindication)

- Systolic blood pressure > 180 mm Hg +/- diastolic blood pressure > 100 mm Hg (relative contraindication)
- Resting SpO2 < 85% on room air or on prescribed level of supplemental oxygen
- Physical disability preventing safe performance
- No contraindications identified

6MWT					Date	Time
Supplemental oxygen					Mobility Aid	
	BP	SPO2	HR	Distance walked	Rests/Comments	
Rest						
After six -minute walk						
Recovery 1						
Recovery 2						

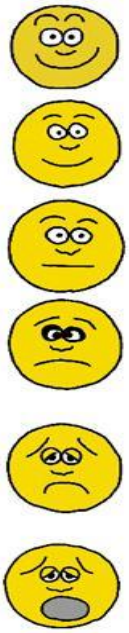
Total distance: ---------Symptom recovery: ---------- HR recovery: ----------
Limiting factor: ----------
Was test Terminated? Yes / No if yes: when?
6MWT Termination Criteria:
Chest pain or angina-like symptoms
Heart rate > Predicted HR max.
Evolving mental confusion, light-headedness or incoordination
Physical or verbal severe fatigue
Intolerable dyspnea, unrelieved by rest
Persistent SpO2<85% (Note: pending clinical presentation)
Abnormal gait pattern (leg cramps, staggering, ataxia)
Other clinically warranted reason

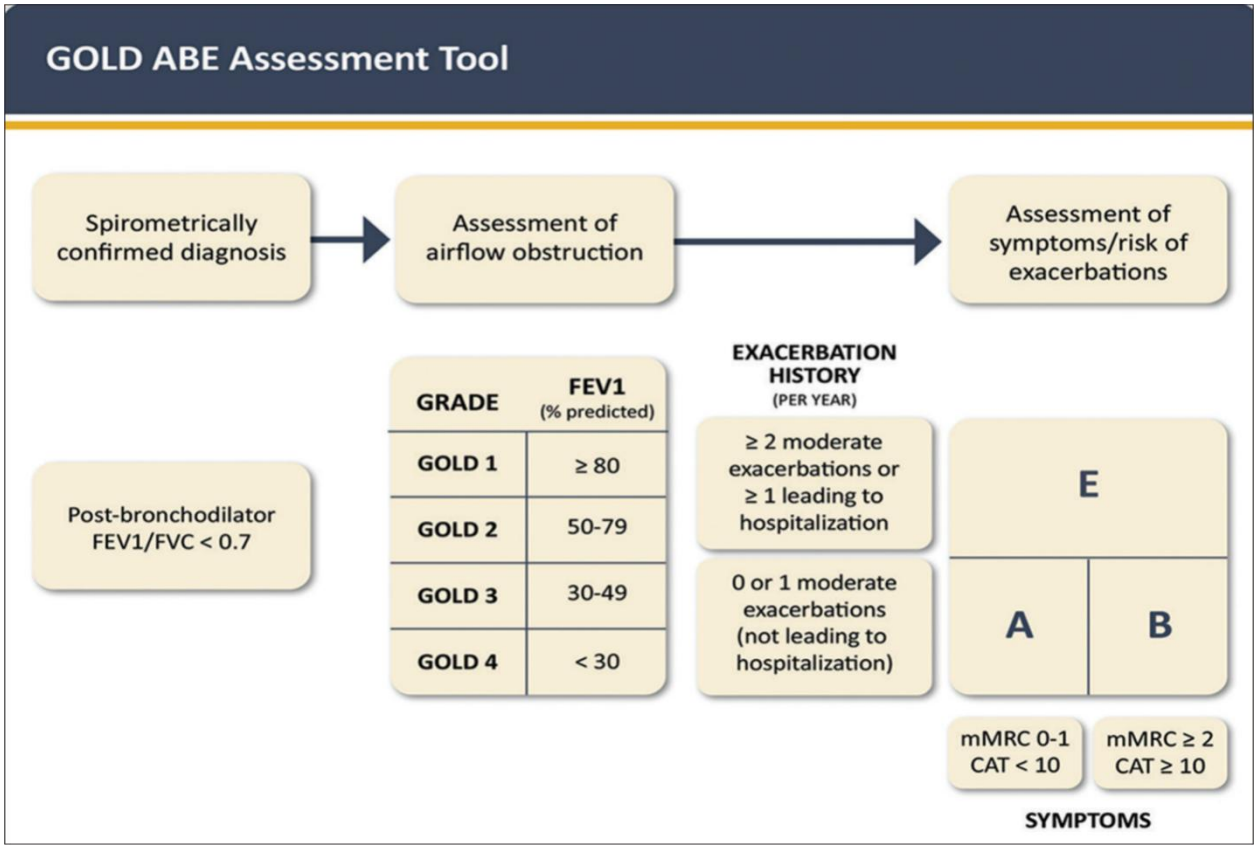
3.2 Modified Borg Dyspnea Scale

NB- Exercise induced desaturation (> or equal to -4%) ----yes or No

Modified Borg Dyspnoea Scale

0	NOTHING AT ALL
0.5	VERY, VERY SLIGHT (just noticeable)
1	VERY SLIGHT
2	SLIGHT
3	MODERATE
4	SOMEWHAT SEVERE
5	SEVERE
6	
7	VERY SEVERE
8	
9	VERY, VERY SEVERE (almost maximal)
10	MAXIMAL




GOLD ABE Assessment Tool
Spirometrically confirmed diagnosis
Assessment of airflow obstruction
Assessment of symptoms/risk of exacerbations
Post-bronchodilator FEV1/FVC < 0.7
GRADE
FEV1 (% predicted)
GOLD 1
≥ 80
GOLD 2
50-79
GOLD 3
30-49
GOLD 4
< 30
EXACERBATION HISTORY (PER YEAR)
≥ 2 moderate exacerbations or ≥ 1 leading to hospitalization
0 or 1 moderate exacerbations (not leading to hospitalization)
E
A
B
mMRC 0-1 CAT < 10
mMRC ≥ 2 CAT ≥ 10
SYMPTOMS

Modifiable medical research council (mMRC) scale	
Grade	Description
Grade 0	I only breathlessness with strenuous exercise
Grade 1	I get shortness of breath when hurrying on level ground or waking up on a slight hill
Grade 2	On level ground, I walk slower than people of the same age because of breathlessness, or I have to stop for breath when walking at my own pace on the level
Grade 3	I stop for breath after walking about 100 yards or after a few minutes on level ground
Grade 4	I am too breathlessness to leave the house or I am breathlessness when dressing

3.3.2 mMRC grade---------- 3.3.3 CAT score ---------

Your name:	Today's date:

How is your COPD? Take the COPD Assessment Test™ (CAT)

This questionnaire will help you and your healthcare professional measure the impact COPD (Chronic Obstructive Pulmonary Disease) is having on your wellbeing and daily life. Your answers, and test score, can be used by you and your healthcare professional to help improve the management of your COPD and get the greatest benefit from treatment.

For each item below, place a mark (X) in the box that best describes you currently. Be sure to only select one response for each question.

Example: I am very happy 0 X 2 3 4 5 I am very sad

			SCORE
I never cough	0 1 2 3 4 5	I cough all the time	
I have no phlegm (mucus) in my chest at all	0 1 2 3 4 5	My chest is completely full of phlegm (mucus)	
My chest does not feel tight at all	0 1 2 3 4 5	My chest feels very tight	
When I walk up a hill or one flight of stairs I am not breathless	0 1 2 3 4 5	When I walk up a hill or one flight of stairs I am very breathless	
I am not limited doing any activities at home	0 1 2 3 4 5	I am very limited doing activities at home	
I am confident leaving my home despite my lung condition	0 1 2 3 4 5	I am not at all confident leaving my home because of my lung condition	
I sleep soundly	0 1 2 3 4 5	I don't sleep soundly because of my lung condition	
I have lots of energy	0 1 2 3 4 5	I have no energy at all	
		TOTAL SCORE	