



**St. Paul's Hospital
Millennium Medical College**
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SAINT PAUL'S HOSPITAL MILLENNIUM MEDICAL COLLEGE

DEPARTMENT OF INTERNAL MEDICINE

**DETERMINANTS OF BRONCHIECTASIS AMONG PATIENTS
ATTENDING CHEST CLINIC OF ST. PAUL'S HOSPITAL
MILLENNIUM MEDICAL COLLEGE, ADDIS ABABA, ETHIOPIA**

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A THESIS SUBMITTED TO THE DEPARTMENTS OF INTERNAL
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THE REQUIREMENT FOR SPECIALTY CERTIFICATE IN INTERNAL
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ADDIS ABABA, ETHIOPIA

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ADDIS ABABA, ETHIOPIA

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ABBREVIATIONS AND ACRONYMS

AOR.....	Adjusted Odds Ratio
COPD.....	Chronic Obstructive Pulmonary Disease
COR.....	Crude Odds Ratio
COVID.....	Corona Virus Disease
CT.....	Computed Tomography
DC.....	Data Collector
G.C.....	Gregorian Calendar
HRCT.....	High-Resolution Computed Tomography
PI.....	Principal Investigator
PTB.....	Pulmonary Tuberculosis
SPHMMC.....	Saint Paul's Hospital Millennium Medical College
UK.....	United Kingdom
USA.....	United States of America
WHO.....	World Health Organization

ABSTRACT

Background: Bronchiectasis is a chronic lung disease characterized by cough and purulent sputum, recurrent infections, and airway damage. It affects people of all ages, and is associated with considerable morbidity and mortality.

Objective: To assess factors associated with bronchiectasis among patients attending chest clinic at St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia.

Methods: A case-control study was conducted among 230 patients (77 cases and 153 controls) who attended chest clinic at SPHMMC from April 1, 2022 to June 30, 2022. Data was collected using a chart review and questionnaire. Then, data was entered and cleaned using Epi Info version 7.2 statistical software and then transferred to SPSS version 25 Statistical software for further analysis. Frequencies and cross-tabulations were used to summarize descriptive statistics of the data. Chi-square test was used to determine the associations between dependent and independent variables and variables having P- value of less than or equal to 0.05 were considered as having association with the dependent variable. Binary logistic regression was done to establish association for variables with computed p value < 0.05.

Results: Among patients with bronchiectasis 38 (49.35%) are male and 39 (50.65%) are female. Among patients with no bronchiectasis 79 (51.63%) are male and 74 (48.37%) are female. The median age is 52 for patients with bronchiectasis and 53 for those without bronchiectasis. The research has identified significant association between bronchiectasis and pulmonary tuberculosis (adjusted odds ratio = 6.182; 95% confidence interval = 3.163 – 12.083, $P < 0.001$), chronic obstructive pulmonary disease (adjusted odds ratio = 2.896; 95% confidence interval = 1.460 – 5.746, $P = 0.002$), bronchial asthma (adjusted odds ratio = 2.124; 95% confidence interval = 1.086 – 4.154, $P = 0.028$) and COVID-19 (adjusted odds ratio = 2.786; 95% confidence interval = 1.454 – 5.340, $P = 0.002$).

Conclusion and Recommendations: Pulmonary tuberculosis, COVID-19, Chronic obstructive pulmonary disease and bronchial asthma are associated with the development of bronchiectasis. Attention should be given to early identification of bronchiectasis among patients with these lung diseases.

Key words: Bronchiectasis, Determinants, Case-control, Saint Paul's Hospital Millennium Medical College, Ethiopia

1. INTRODUCTION

1.1. Background of the study

Bronchiectasis is a chronic lung condition marked by cough, infection and inflammation (1).

Radiologically it is defined by the presence of irreversible bronchial wall dilatation (2).

Bronchiectasis affects an estimated 340,000 to 522,000 individuals in the United States, with a prevalence of 139 cases per 100,000 people and an annual incidence of 29 cases per 100,000 people (3).

There were estimated 211,598 people in the United Kingdom living with bronchiectasis in 2012, according to a national non-cystic fibrosis bronchiectasis survey conducted from 2004 to 2013. There was a 20 percent increase in the prevalence of bronchiectasis between 2008 and 2012, with an estimated 40,000 persons living with the disease. The rate of bronchiectasis first diagnoses in primary care increased from 20 per 100,000 in 20004 to 33 per 100,000 in 2012 (4).

In a population-based evaluation of disease prevalence in Germany, the prevalence of bronchiectasis was 67 per 100,000 people in 2013. Females had a higher prevalence of bronchiectasis than males, according to this study (68 versus 65 per 100,000 population) (5).

In a population-based study of prevalence and associated comorbidities in South Korea, an estimated prevalence of bronchiectasis per 100,000 population in each year was 464 cases per 100,000 population in 2012, 441 in 2013, 455 in 2014, 474 in 2015, 468 in 2016, and 480 in 2017 (6).

According to a retrospective cohort study evaluating the prevalence of bronchiectasis among patients admitted to the Chest Department in Egypt over ten years (2008–2018), the prevalence of bronchiectasis was 9.04 percent throughout this time (7).

The prevalence of bronchiectasis was found to be 5% in a hospital-based cross-sectional study in patients > 15 years of age with Chest CT confirmed bronchiectasis followed at Tikur Anbessa Specialized Hospital chest unit between September 2018 and August 2019 (8).

Patients with bronchiectasis suffer from recurrent respiratory infections, exacerbations of respiratory symptoms and repeated hospital admissions (9).

1.2. Statement of the problem

Chronic obstructive pulmonary disease, asthma, untreated chronic infection, recurring respiratory infections, can all cause bronchiectasis (8,10–12).

The development of bronchiectasis in these groups of patients may be influenced by the age, sex, environmental factors such as smoking (4,5,13).

Bronchiectasis is a significant health and economic burden to the patient, family, and the health care system. It is still a significant cause of morbidity and mortality in resource-limited settings (10,14,15).

Patients with bronchiectasis use extensive healthcare resources (e.g, frequent ambulatory visits, antibiotic usage, chest computed tomography, hospitalization), and bronchiectasis-associated healthcare usage has increased (15,16). Bronchiectasis is associated with decreased physical activity (17), increased morbidity and mortality (18–20).

Despite the high burden of risk factors, there is scarcity of data about factors associated with bronchiectasis in Ethiopia. To appropriately address this increasing clinical condition, bronchiectasis research must be conducted. To the knowledge of the investigator, there is no study done in SPHMMC to assess factors that are associated with bronchiectasis. The goal of this study is to determine factors that are associated with bronchiectasis among patients who visit the Chest Clinic at St. Paul's Hospital Millennium Medical College.

1.3. Significance of the study

Knowing factors associated with bronchiectasis among patients attending chest clinics is critical for identifying the disease burden, emphasizing the need for prevention, and developing strategies to battle the disease's burden in our community and the country at large. This study will provide insight into factors associated bronchiectasis among patients attending chest clinic at SPHMMC, as well as motivate clinicians to conduct early investigations and intervene as needed. It will also be a useful supplement to the limited local information on the disease and will aid in the formulation of recommendations.

2. LITERATURE REVIEW

2.1. Factors Associated with Bronchiectasis

During the years 2004–12, more women than men were diagnosed with bronchiectasis in a national non-cystic fibrosis bronchiectasis survey conducted in the United Kingdom; around 35% more women than men are diagnosed with bronchiectasis each year. About 60% of bronchiectasis diagnoses are made in adults over the age of 70 (4).

In the population-based study in Germany, 58% of patients with bronchiectasis had the concomitant diagnosis of COPD. Females had a higher prevalence rate than males (68 versus 65) per 100 000 population) (5).

In a population-based study in South Korea, asthma was diagnosed in 17.2% of subjects with bronchiectasis, and COPD was diagnosed in 19.3%. In 2.4 percent of bronchiectasis patients in South Korea, pulmonary tuberculosis and nontuberculous mycobacterial infection were found (6).

In a multicenter, prospective, observational cohort study of bronchiectasis in India, tuberculosis was the most common etiology (35.5%), followed by post-infection (22.4%), idiopathic bronchiectasis (21.4%), chronic obstructive pulmonary disease (5.3%) and asthma (2.5%) (11).

From January 2002 to December 2016, a longitudinal cohort study in Taiwan investigated the etiology and clinical features of newly diagnosed non-cystic fibrosis bronchiectasis patients. Idiopathic bronchiectasis was the most common cause (32%), followed by post-pneumonia (24%). Post-tuberculosis (12%), chronic obstructive pulmonary disease (14%), and asthma (10%), were among the other causes (2%) (21).

In a systematic review done in China to determine the etiologies of bronchiectasis, chest infection was found in 29.9% of patients and chronic obstructive pulmonary disease in was found in 3.9% (22).

COPD was the most common etiology in the Egyptian retrospective cohort research (54.1%), followed by post-tuberculous bronchiectasis (17.1%). Bronchial asthma was observed in 2.2% of patients.

In a retrospective cohort study done to evaluate post-tuberculosis lung damage in Malawi, 170 patients out of 385 (44.2%) had moderate to severe airway dilatation, or bronchiectasis (23).

In a hospital-based cross-sectional study in patients > 15 years of age with Chest CT confirmed bronchiectasis followed in the Chest Unit of Tikur Anbessa Specialized Hospital between September 2018 and August 2019, pulmonary tuberculosis was identified in as risk factor in 92.5 of patients. (8).

Another cross-sectional study of 22 patients who underwent surgery for bronchiectasis in Tikur Anbessa Specialized hospital (TASH) during the period 2012–2017 has shown pulmonary tuberculosis as the most common etiology (91%) followed by recurrent childhood infections (24).

2.2. Bronchiectasis and COVID – 19

COVID -19 has been shown to be an emerging cause of bronchiectasis , and the onset of bronchiectasis associated with COVID-19 tends to be more rapid (25). CT interpretations of a retrospective analysis of 120 patients from Wuhan city, China, reported 14 cases of bronchiectasis (12%) (26).

In a retrospective study of 81 patients with COVID-19, radiological findings consistent with bronchiectasis was described in nine (11%), and its prevalence was higher in patients who had followed up for more than two weeks after symptom onset in comparison to those followed for less than two weeks (27).

In a systematic review and meta-analysis of 13 studies published between December 2019 and February 2020 to provide a summary of evidence on detection of COVID-19 by chest CT and the expected CT imaging manifestations, bronchiectasis was detected in 5.42% of the patients (28).

COVID-19 is not only associated with the development of bronchiectasis but also with an increased rate of exacerbation among known bronchiectasis patients. In a nation-wide cohort study in Korea, the proportion of patients with severe COVID-19 was significantly higher patients with bronchiectasis than in those without bronchiectasis (29).

2.3. Conceptual Framework

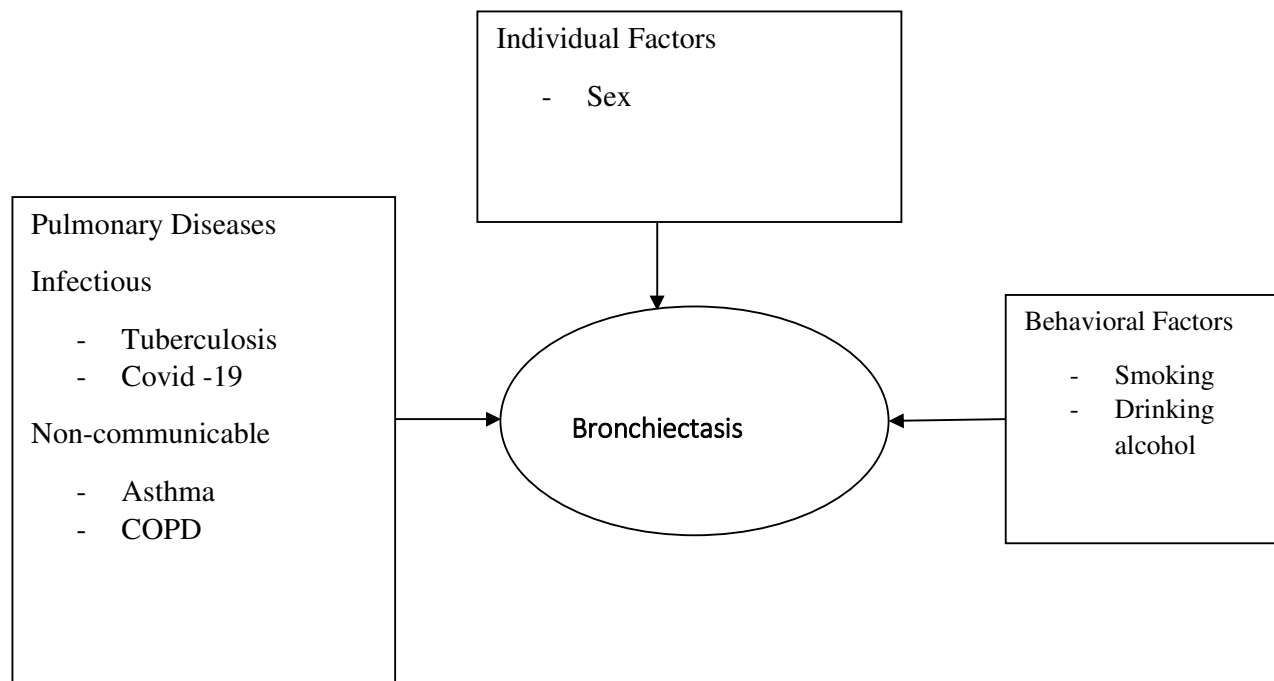


Figure 1: A conceptual framework for showing the relationship between independent variables and dependent variable

3. STUDY OBJECTIVES

3.1. General Objective

To assess factors associated with bronchiectasis

3.2. Specific Objectives

To determine individual, behavioral and clinical factors that are associated with development of bronchiectasis among patients on follow up at chest clinic of SPHMMC during the period of April 1, 2022 to June 3, 2022 G.C.

4. METHODS

4.1. Study Design

Unmatched case-control study

4.2. Study Area

This research was done at St. Paul's Hospital Millennium Medical College, Ethiopia's second-largest governmental tertiary care hospital, which is located in Addis Ababa's Gulele sub-city. It serves a population of more than 5 million people as a medical facility. Daily, the hospital serves approximately 1,200 patients (30).

4.3. Population

4.3.1. Source Population

All patients attending chest follow up clinic of SPHMMC during the study period.

4.3.2. Study Population

Cases - patients with radiologic (HRCT) evidence of bronchiectasis as commented by a radiologist

Controls - patients with HRCT not showing any evidence of bronchiectasis

4.3.3. Inclusion Criteria

All patients who have completed and documented chest HRCT findings within the study period

Age > 18 years

4.3.4. Exclusion Criteria

Patients with chest CT findings not commented by a radiologist is not included in this study
Patients with incomplete information about the independent variables and not accessible for interview are also excluded from the study.

4.4. Sample Size and Sampling Method

4.4.1. Sample Size

Sample size was calculated using the formula for unmatched case-control study taking 95% two-sided confidence interval, 80% power, control to case ratio of 2, and prevalence of bronchiectasis among patients with previous chest infection 76.4% from Tikur Anbessa Hospital, and assumption that 20% difference among cases and controls to be clinically significant. Accordingly, the calculated sample size for cases = 74, controls = 147 and total of 221. Considering 10% nonresponse rate, final sample size will be = 244.

4.4.2. Sampling Method

During the study period, from April 1 to June 30, 2022, each patient with bronchiectasis who visits chest clinic was selected as a case and the next two cases without bronchiectasis were selected as controls till the required sample size was reached. Chart review was done and for missing data, questionnaire was used to collect further data.

4.5. Data Collection Tools and Techniques

Data were collected from April 1 to June 30, 2022 G.C. The data collecting checklist that included components such as the patient's age and sex, the indication for a chest HRCT scan, and radiographic findings was used. It was based on a review of records previous to the study period and similar literatures used in this investigation. For this study, records of patients who had HRCT scan and came to chest clinic of SPHMMC between April 1, 2022 and June 30, 2022, was collected. Eight data collectors (SPHMMC Internal Medicine residents) got an hour-long instruction on the components of the checklist and how to enter the data into a computer. The study population's records were checked for completeness before they were used.

4.6. Data Quality

To ensure the quality of data, preceding data collection, training of the data collectors was carried out for one day by the principal investigator on the objective, relevance of the study and confidentiality of information. The checklist was pre-tested to learn about appropriateness of the questions which was done at St. Paul's outpatient chest clinic.

4.7. Data Analysis

Epi Info version 7.2 statistical software was used for data entry. Then data was transferred to the Statistical Package of Social Sciences (SPSS) version 25.0 for Microsoft Windows for analysis. Frequencies and cross tabulations were used to summarize descriptive statistics of the data, tables and figures were used for data presentation. Chi-square test was used to determine the associations between dependent and independent variables, and variables having P value of less than or equal to 0.05 were considered as having association with the dependent variable. Binary logistic regression was done to establish association for variables with computed p value ≤ 0.05 . Graphs and charts were created using Microsoft Excel 2019.

4.8. Study Variables

4.8.1. Dependent Variables

Bronchiectasis

4.8.2. Independent Variables

- Tuberculosis
- Covid-19
- COPD
- Asthma
- Smoking
- Alcohol
- Sex

4.9. Operational Definition

Bronchiectasis: is defined by combination clinical features and radiologic abnormalities. Clinical features indicative of bronchiectasis include cough on most days of the week, sputum production on most days of the week, and a history of exacerbations (31)

Radiologic criteria for the diagnosis of bronchiectasis include (32):

- 1) Airway-to-arterial ratio ≥ 1.5 (internal airway lumen diameter/adjacent pulmonary artery diameter)
- 2) Lack of tapering of bronchi (tram track appearance)
- 3) Airway visibility within 1 cm of a costal pleural surface or touching the mediastinal pleura

Smoker: is defined as any person who has smoked at least 100 cigarettes in his/her lifetime (33).

4.10. Ethical Considerations

Ethical clearance was obtained from the Institutional Review Board of St. Paul's Hospital Millennium Medical College, and then authorization was requested from the school management through the academic provost of the school to conduct the study. A standardized checklist was used to collect information from each patient. The information gathered was used exclusively for this study and will be kept private.

5. RESULTS

5.1. Socio-demographic profile of the studied population

Chart review of a total of 230 patients who have visited chest clinic at SPHMMC from April 1, 2022 to June 30, 2022 was done and missing information was filled by interview. Among the patients, 77 have been diagnosed with bronchiectasis and 153 have no bronchiectasis. 117 (50.9%) are male and 113 (49.1%) are female. Among patients with bronchiectasis 38 (49.35%) are male and 39 (50.65%) are female. Among patients with no bronchiectasis 79 (51.63%) are male and 74 (48.37%) are female. The minimum age is 18 and maximum 86 with median of 52 and mean of 51 years. The minimum age of a patient with bronchiectasis is 19 and the maximum is 80 with mean of 51 and median of 53. The minimum age of a patient without bronchiectasis is 18 and the maximum 86 is with mean of 51 and median of 52 years.

5.2. Presenting Symptoms

The following symptoms are assessed among patients with bronchiectasis based on the patients status within 2 weeks prior to data collection.

2 (2.60%) of them have had coughing bouts every day, 6 (7.79%) on most days, 32 (41.56%) on several days, 24 (31.17%) on some days, 6 (7.79%) occasionally, 3 (3.90%) rarely and 4 (5.19%) never.

2 (2.60%) of the patient's phlegm contained blood most of the times, 10 (12.99%) several times, 17 (20.08%) sometimes, 11 (14.29%) occasionally, 9 (11.69%) rarely and 28 (36.36%) never.

8 (10.39%) have felt shortness of breath all of the time, 13 (16.88%) most of the time, 19 (24.67%) a good bit of time, 8 (10.39%) some of the time, 7 (9.10%) a little of the time, 6 (7.79%) hardly any of the time and 16 (20.78%) none of the time.

7 (9.10%) were feeling tired almost all the time, 9 (11.69%) most of the time, 5 (6.49.78%) a good bit of time, 18 (23.38%) some of the time, 16 (20.78%) a little of the time, 10 (12.99%) hardly any of the time and 12 (15.58) none of the time.

At all times 4 (5.19%) of the patients have been much slower at doing things than other people of their age, 9 (11.67%) most of the time, 16 (20.78%) a good bit of time, 17 (22.08%) some of the time, 11 (14.29%) a little of the time 6 (7.79%) hardly any of the time and 14 (18.18%) none of the time.

2 (2.60%) of them have felt anxious all the time in the prior two weeks, 9 (11.69%) most of the time, 23 (29.87%) a good bit of time, 13 (16.88%) some of the time, 10 (12.99%) a little of the time, 12 (15.58%) hardly any of the time and 8 (10.39%) none of the time.

11 (14.29%) of the patients clear their chest all time, 19 (24.67%) most of the time, 13 (16.88%) a good bit of time, 16 (20.78%) some of the time, 4 (5.19%) a little of the time, 8 (10.39%) hardly any of the time and 6 (7.79%) none of the time.

2 (2.60%) of the patients have been embarrassed all the time because of their phlegm, 8 (10.39%) most of the time, 22 (28.57%) a good bit of time, 15 (19.48%) some of the time, 7 (9.10%) a little of the time, 9 (11.69%) hardly any of the time and 14 (18.18%) none of the time. 2 (2.60%) of the patient's sleep has been disrupted because of their bronchiectasis every night, 7 (9.10%) most nights, 23 (29.87%) several nights, 28 (36.36%) some nights, 6 (7.79%) occasionally, 3 (3.90%) rarely and 8 (10.39%) never.

5.3. HRCT Findings

Among patients with bronchiectasis, 63 (81.82%) have dilated bronchi, 3 (3.90%) have fibrosis, 7 (9.10%) signet ring, 8 (10.39%) lack of tapering and 56 (72.72%) other findings on HRCT.

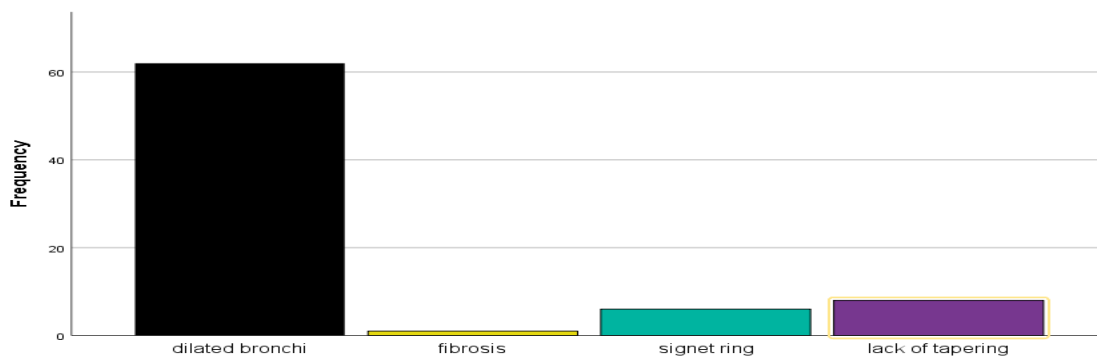


Figure 2: Radiologic (HRCT) Findings in patients with bronchiectasis

Table 1: Age frequency distribution table

Age Range	Bronchiectasis	
	Yes	No
≤ 20	2 (2.60%)	1 (0.70%)
21-30	8 (10.40%)	29 (19.0%)
31-40	9 (11.70%)	22 (14.40%)
41-50	18 (23.40%)	22 (14.40%)
51-60	20 (26.00%)	30 (19.60%)
61-70	11 (14.30%)	30 (19.60%)
71-80	9 (11.70%)	16 (10.50%)
>80	0 (0%)	3 (2.00%)
Total	77 (100%)	153 (100)

Table 2: Frequency of independent variables among Cases and Controls

Independent variables		Bronchiectasis		
		Yes	No	Total
Tuberculosis	Yes	53	52	105
	No	24	101	125
	Total	77	153	230
COPD	Yes	40	41	81
	No	37	112	149
	Total	77	153	230
Asthma	Yes	45	59	104
	No	32	94	126
	Total	77	153	230
Covid-19	Yes	39	49	88
	No	38	104	142
	Total	77	153	230
Smoking	Yes	15	18	33
	No	62	135	197
	Total	77	153	230
Drinking alcohol	Yes	30	49	79
	No	47	104	151
	Total	77	153	230
Sex	Female	39	74	113
	Male	38	79	117
	Total	77	153	230

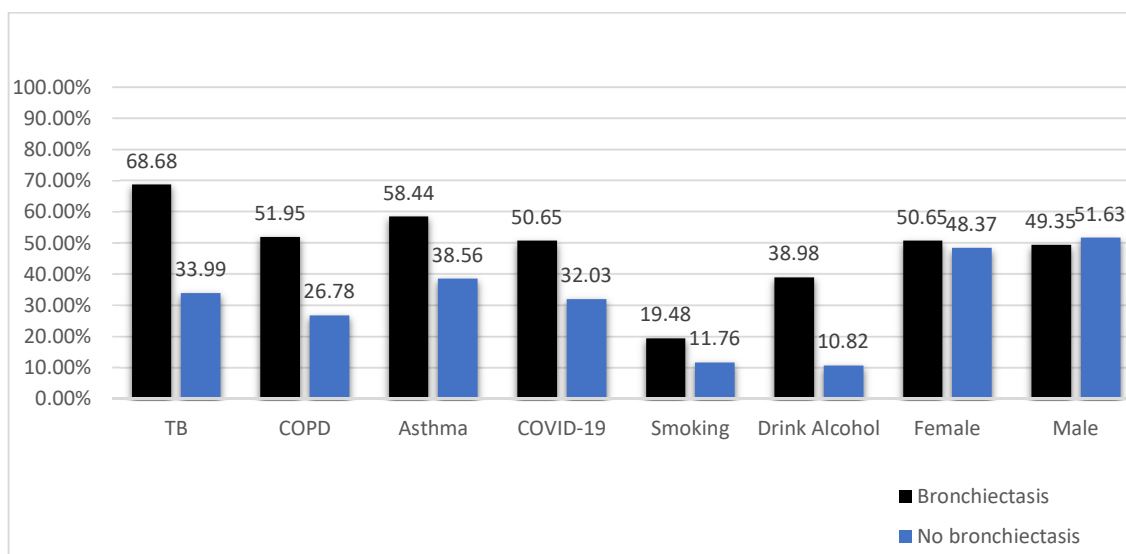


Figure 3: Frequency of independent variables among cases and controls

5.4. Statistical Analysis

Chi square test was performed to identify if there is significant association between the dependent variable and independent variables. Based on the p value computed, pulmonary tuberculosis (< 0.001), COPD (< 0.001), bronchial asthma (0.004) and COVID-19 (0.006) have shown significant association with bronchiectasis, while there is no significant association found between smoking (0.115), drinking alcohol (0.296) and female sex (0.744).

Binary logistic regression was performed to determine how pulmonary tuberculosis, COPD, bronchial asthma and COVID-19 affect patient's probability of having bronchiectasis. A total of 230 patients were included in the analysis.

The study has shown association between bronchiectasis and pulmonary tuberculosis (COR = 4.289; 95% CI = 2.385 - 7.714, $P < 0.001$; AOR = 6.182; 95% CI = 3.163 - 12.083, $P < 0.001$), COPD (COR = 2.953; 95% CI = 1.666 - 5.236, $P < 0.001$; AOR = 2.896; 95% CI = 1.460 - 5.746, $P = 0.002$), bronchial asthma (COR = 2.240; 95% CI = 1.282 - 3.915, $P = 0.005$; AOR = 2.124; 95% CI = 1.086 - 4.154, $P = 0.028$) and COVID-19 (COR = 2.178; 95% CI = 1.243 - 3.818, $P = 0.007$; AOR = 2.786; 95% CI = 1.454 - 5.340, $P = 0.002$).

Table 3: Determinants of bronchiectasis among patients visiting chest clinic

	COR (95% CI)	P -value	AOR (95% CI)	P -value
Tuberculosis	4.289 (2.385 - 7.714)	< 0.001	6.182 (3.163 – 12.083)	< 0.001
COPD	2.953 (1.666 - 5.236)	< 0.001	2.896 (1.460 – 5.746)	0.002
Asthma	2.240 (1.282 - 3.915)	0.005	2.124 (1.086 – 4.154)	0.028
COVID-19	2.178 (1.243 - 3.818)	0.007	2.786 (1.454 – 5.340)	0.002

6. DISCUSSION

This research was conducted in SPHMMC chest clinic from April 1, 2022 to June 30, 2022 to assess factors associated with bronchiectasis. 230 patients among whom 77 have bronchiectasis and 153 have no bronchiectasis were enrolled in the study. 50.9% were male and 49.1% were female. 45.65% of the patients have been treated for TB, 35.21% have COPD, 45.21% of the patients have been diagnosed with bronchial asthma, and 38.26% of the patients were diagnosed with COVID 19 among whom 50.48% , 49.38%, 43.27% and 44.31% have been diagnosed with bronchiectasis respectively. 14. 34% have smoked cigarette and 34. 34% of them drink alcohol.

The research has identified significant association between bronchiectasis and pulmonary tuberculosis (COR = 4.289; 95% CI = 2.385 - 7.714, P < 0.001; AOR = 6.182; 95% CI = 3.163 – 12.083, P < 0.001), COPD (COR = 2.953; 95% CI = 1.666 - 5.236, P < 0.001; AOR = 2.896; 95% CI = 1.460 – 5.746, P = 0.002), bronchial asthma (COR = 2.240; 95% CI = 1.282 - 3.915, P = 0.005; AOR = 2.124; 95% CI = 1.086 – 4.154, P = 0.028) and COVID-19 (COR = 2.178; 95% CI = 1.243 - 3.818, P = 0.007; AOR= 2.786; 95% CI = 1.454 – 5.340, P = 0.002). Smoking cigarettes, drinking alcohol and sex has not shown association with bronchiectasis in our study.

Pulmonary Tuberculosis

A multicenter, prospective, observational cohort study of bronchiectasis in India (11) and a cohort study in Taiwan (21) have shown that pulmonary tuberculosis is a risk factor for bronchiectasis.

A retrospective cohort research in Egypt (7) and a retrospective cohort study in Malawi (23) also show that pulmonary tuberculosis is a risk factor for bronchiectasis.

A hospital-based cross-sectional study in patients with Chest CT confirmed bronchiectasis followed in the Chest Unit of Tikur Anbessa Specialized Hospital between September 2018 and August 2019 (8), and another cross-sectional study of 22 patients who underwent surgery for bronchiectasis in Tikur Anbessa Specialized Hospital during the period 2012–2017 (24) identified prior respiratory infection (76.4%) of which most were due to pulmonary tuberculosis (92%) as the most common risk factor. Our study also identified pulmonary tuberculosis as the strongest factor associated with bronchiectasis.

Pulmonary tuberculosis may cause bronchiectasis by multiple mechanisms. The primary mechanism is tuberculous bronchitis (34).

Other mechanisms include, but not limited to (35).

- Endobronchial involvement leading to localized bronchial obstruction and fibrosis
- Extrinsic bronchial compression by tuberculous lymphadenopathy
- Decrease pulmonary compliance caused by parenchymal lung destruction

COVID-19

CT interpretations of a retrospective analysis of 120 patients from Wuhan city (26), a retrospective study of 81 patients with COVID-19 (27), and a systematic review and meta-analysis of 13 studies published between December 2019 and February 2020 to provide a summary of evidence on detection of COVID-19 by chest CT and the expected CT imaging manifestations have all shown that COVID-19 is an emerging risk factor for bronchiectasis (28). Our finding is also consistent with these studies as it identified significant association of COVID-19 with bronchiectasis.

Pulmonary changes in COVID-19 include inflammation, consolidation and air bronchogram (28). Fibrosis and post-covid traction bronchiectasis contribute to mechanisms by which COVID-19 causes bronchiectasis (36).

Bronchial Asthma and COPD

A multicenter, prospective observational cohort study of bronchiectasis in India (11), a cohort study in Taiwan (21), a systematic review in China (22), and a retrospective cohort research in Egypt (7) have shown that asthma and COPD are risk factors for bronchiectasis. Our research has shown that both bronchial asthma and COPD are associated with bronchiectasis and consistent with most of the studies.

Bronchial asthma is a state of chronic inflammation. This chronic inflammation may, in long term, involve and damage the bronchi and cause irreversible damage (37). Air trapping and mucus plugging also contribute.

In patients with COPD, there is unopposed neutrophil elastase activity which will cause progressive airway damage (38). There is also chronic air trapping and mucus plug which will cause airway dilatation and progressive damage. Another possible mechanism is repeated chest infections and colonization by *pseudomonas aeruginosa* (39).

In general, our research has identified pulmonary tuberculosis, COVID-19 infection, COPD and bronchial asthma as factors associated with the development of bronchiectasis while smoking, drink alcohol and sex has no significant association with bronchiectasis.

7. STRENGTH AND LIMITATION

7.1. Strength of the study

This study is the first case-control study that assessed determinants of bronchiectasis in Ethiopia.

7.2. Limitation of the study

One of the limitations of this study is inability to include other factors that can potentially have association with bronchiectasis.

This is a hospital based, single center study and generalizability is difficult.

In our set up most patients with COVID-19 and bronchiectasis had their first ever HRCT. Therefore, it is difficult to determine whether they developed bronchiectasis after COVID-19 or they already had bronchiectasis and acquired COVID-19 because they were at increased at risk of acquiring COVID-19.

8. CONCLUSION AND RECOMMENDATION

8.1. Conclusion

From this study, it was found that bronchial asthma, COPD, Previous TB, and Covid-19 are associated with the development of bronchiectasis, while smoking cigarette, drinking alcohol and sex of the individual are not associated with bronchiectasis.

8.2. Recommendation

Based on the findings of this study, the following recommendations are forwarded.

To health professionals

Assess and consider early referral to pulmonologist for patients with undiagnosed clinical presentations compatible with bronchiectasis and risk factors.

More effort needs to be exerted to address undiagnosed bronchiectasis through improving practice of doing HRCT.

To local health policy makers

Training programs and sensitization should be instituted on bronchiectasis and important emphasis should be given to risk factors for bronchiectasis.

To researchers

We recommend further studies done in different settings in the country to further characterize factors associated with bronchiectasis.

We also recommend that factors that affect the development of bronchiectasis on patients with tuberculosis, COPD, bronchial asthma and/or history of COVID-19 infection be studied in larger sample size.

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ANNEXES

Annex I: Information Sheet

RESEARCH TITLE: DETERMINANTS OF BRONCHIECTASIS AMONG PATIENTS ATTENDING CHEST CLINIC AT ST. PAUL'S HOSPITAL MILLENNIUM MEDICAL COLLEGE, ADDIS ABABA, ETHIOPIA

Principal Investigator (PI): Belay Shewaye (MD, Internal Medicine Resident)

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Sponsor: St. Paul's Hospital Millennium Medical College

Annex II: Informed Consent Form

Consent Form

Title: DETERMINANTS OF BRONCHIECTASIS AMONG PATIENTS ATTENDING CHEST CLINIC OF ST. PAUL'S HOSPITAL MILLENNIUM MEDICAL COLLEGE, ADDIS ABABA, ETHIOPIA

Investigator: Belay Shewaye, M.D, Internal medicine department, SPHMMC

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Introduction:

Greetings, you are being asked to participate in a study of determinants of bronchiectasis among patients on follow up at chest clinic of SPMMC. You were selected because you are on follow-up on the selected time frame of the study and you have received a required diagnosis.

Please listen carefully and feel free to ask any questions you may have to the investigator.

Purpose of the study: to determinate factors associated with bronchiectasis among patients on follow up at chest clinic of SPMMC.

Procedure: If you agree to this study you will be asked questions including basic things about you and there will be additional blood test and imaging for the comorbidities under study.

Risks: there is no anticipated risk of participation and acceptance or refusal will not affect any further care.

Benefits: It will help us to know the burden of comorbidities and associated risk factors and will guide us to treat accordingly.

Confidentiality: The study will be anonymous, findings will be strictly confidential, and your identification will not be mentioned. All information will be kept in a password protected computer.

Payment: You will not receive any payment for your participation except gratitude.

Right to refuse or withdraw: You may refuse any time to participate in the study and can withdraw your consent for the data gathered to be used.

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Annex III: Questionnaire

Instruction: This questionnaire is designed to assess determinants of bronchiectasis among patients on follow up at chest clinic of Saint Paul's Hospital Millennium Medical College.

How are you, I am _____ I am working in the research team of Saint Paul's Hospital Millennium Medical College.

The research will be helpful to understand the factors associated with bronchiectasis among patients on follow up at chest clinic of Saint Paul's Hospital Millennium Medical College. The information that you give will help understand associated factors of bronchiectasis and will help in developing better health care in the future. Your participation is voluntary. You don't have to answer any questions that make you feel uncomfortable. If you felt discomfort with the interview, please feel free to drop it any time you want.

This interview will take 30 minutes. Could I have your permission to continue?

1. If yes, signature _____ Continue the interview
2. If no, go to the next participant by writing reasons for his/her refusal

Part One: Sociodemographic Characteristics

Instruction: PUT '√' MARK AGAINST THE ANSWER THAT THE PATIENT THINK CORRECT FOR HIM/HERSELF

Code	Questions	Answer
01	Age in year	_____
02	Sex:	1. Male _____ 2. Female _____
03	Religion	1. Orthodox _____ 2. Protestant _____ 3. Muslim _____ 4. Catholic _____ 5. Others _____
04	Educational status	1. Illiterate _____ 2. Read and write _____ 3. Grade 1-8 _____ 4. Grade 9-12 _____ 5. Technique and vocation _____ 6. College/ University _____
05	Marital status	1. Single _____ 2. Married _____ 3. Widowed _____ 4. Divorced _____
06		1. Government employee _____ 2. Merchant _____ 3. Private _____ 4. Housewife _____ 5. Student _____ 6. Other (specify) _____
07	Monthly income in birr	1. <500 _____ 2. 500-1000 _____ 3. 1001-2000 _____ 4. >2000 _____

08	Social support from friends and others	1. Yes _____ 2. NO _____
09	If yes for question	Specify _____

Part Two: Behavioral Factors

Code	Questions	Answer
010	Have you ever smoked cigarette?	1. Yes _____ 2. No _____
011	If yes, for how long?	1. Less than 1 year _____ 2. 1 to 5 year _____ 3. More than 5 years _____
012	If yes to question 10, how many cigarettes per day?	1. Less than 1 pack per day _____ 2. Average 1 pack per day _____ 3. More than 1 pack per day _____
013	If you smoke, have you quit it now?	1. Yes _____ 2. No _____
014	If you quit, for how long?	1. More than 10 years _____ 2. 5-10 years _____ 3. 1-5 years _____ 4. Less than a year _____
015	Have you ever drunk alcohol?	1. Yes _____ 2. No _____
016	If yes, how long?	1. More than 10 years _____ 2. 5-10 years _____ 3. 1-5 years _____ 4. Less than a year _____
017	If yes, to question to 015, how much do you drink per day?	1. Once in a while _____ 2. Sometimes _____ 3. Usually _____ 4. All the time _____

Part Three: Environmental Factors

Code	Question	Answer
018	Is there someone who smoke in your office or household?	1. Yes_____ 2. No_____
019	If yes, for how long?	1. < 1year_____ 2. 1-5 year_____ 3. >5 years_____
020	Are you exposed to smoke or dust at your working area?	1. Yes_____ 2. No_____
021	If yes, how long?	1. < 1 year_____ 2. 1-5 year_____ 3. >5 year_____
022	Do you use any personal protective equipment at work?	1. Yes_____ 2. No_____
023	How frequently?	1. Always_____ 2. Sometimes_____ 3. Infrequently_____ 4. Never_____

Part Four: History of Previous Illnesses

Code	Questions	Answer
024	Have you ever been treated for tuberculosis?	1. Yes _____ 2. No _____
025	If yes, how long has it been?	1. Less than 1 year _____ 2. 1 to 5 year _____ 3. More than 5 years _____
026	If yes to question 24, how many times were you treated?	1. Once _____ 2. Twice 3. Three times 4. More than three times
027	If you were treated multiple times, when was the last time?	1. Less than a year _____ 2. 1-5 year _____ 3. 5-10 year 4. More than 10 years _____
028	What part of your body was affected?	1. Only lungs _____ 2. Lungs and other _____ 3. Other (specify) _____
029	Have you ever been diagnosed with asthma?	1. Yes _____ 2. No _____
030	If yes, how long?	1. More than 10 years _____ 2. 5-10 years _____ 3. 1-5 years _____ 4. Less than a year _____
031	If you yes to question 029, what medications do you use? (Ask them to show the medications)	1. Salbutamol as needed _____ 2. Salbutamol plus ICS _____ 3. Symbicort _____ 4. Other (Specify) _____ 5. All the time

032	How often do you visit emergency room with asthma exacerbations?	1. Less than once a year____ 2. Average once a year_____ 3. Average twice a year_____ 4. Average three times a year_____ 5. More than three times a year____
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Part Four: History of Previous Illnesses.....Continued

Code	Questions	Answer
033	Do you have any other chronic lung disease?	1. Yes_____ No _____
034	If yes, how long has it been?	1. Less than 1 year_____ 2. 1 to 5 year_____ More than 5 years_____
035	If yes to question 24, how many times were you treated?	1. Once _____ 2. Twice_____ 3. Three times_____ 4. More than three times____
036	Have you ever been treated for Covid-19?	1. Yes_____ No_____
037	If yes, how many times?	1. Just once_____ 2. Two times_____ Three or more times____
038	If yes to question 036, how were you treated?	1. At home_____ — 2. At health institute but not ICU_____ 3. At ICU but not intubated_____ At ICU but not on mechanical ventilation_____

039	How long were you ill?	1. Less than a week_____ 2. 1-2 weeks_____ 3. More than two weeks_____
040	How long were you positive for PCR (explain what this means to the patient)	1. Less than a week_____ 2. 1-2 weeks_____ 3. More than two weeks_____

Part Five: The Bronchiectasis Health Questionnaire

Code	Questions	Answer
041	In the last 2 weeks, I have been tired	1. All of the time _____ 2. Most of the time_____ 3. A good bit of the time_____ 4. Some of the time_____ 5. A little of the time_____ 6. Hardly any of the time_____ 7. None of the time_____
042	In the last 2 weeks, I have been much slower at doing things than other people of my age.	1. All of the time _____ 2. Most of the time_____ 3. A good bit of the time_____ 4. Some of the time_____ 5. A little of the time_____ 6. Hardly any of the time_____ 7. None of the time_____
043	In the last 2 weeks, I have felt anxious	1. All of the time _____ 2. Most of the time_____ 3. A good bit of the time_____ 4. Some of the time_____ 5. A little of the time_____ 6. Hardly any of the time_____ 7. None of the time_____
044	In the last 2 weeks, my chest has felt clear.	1. All of the time _____ 2. Most of the time_____ 3. A good bit of the time_____ 4. Some of the time_____ 5. A little of the time_____

		6. Hardly any of the time____ 7. None of the time_____
045	In the last 2 weeks, I have been embarrassed because of my phlegm (sputum)	1. All of the time _____ 2. Most of the time_____ 3. A good bit of the time_____ 4. Some of the time_____ 5. A little of the time_____ 6. Hardly any of the time_____ 7. None of the time_____

Part Five: The Bronchiectasis Health Questionnaire.....Continued

Code	Question	Answer
046	In the last 2 weeks, I have felt short of breath.	1. All of the time _____ 2. Most of the time_____ 3. A good bit of the time_____ 4. Some of the time_____ 5. A little of the time_____ 6. Hardly any of the time_____ 7. None of the time_____
047	In the last 2 weeks, my sleep has been disrupted because of my bronchiectasis.	1. Every night_____ 2. Most nights_____ 3. Several nights_____ 4. Some nights_____ 5. Occasionally_____ 6. Rarely_____ 7. Never_____
048	In the last 2 weeks, I have had coughing bouts.	1. Every day_____ 2. Most days_____ 3. Several days_____ 4. Some days_____ 5. Occasionally_____ 6. Rarely_____ 7. Never_____
049	In the last 2 weeks, my phlegm (sputum) contained blood.	1. Every time_____ 2. Most times_____ 3. Several times_____ 4. Some times_____ 5. Occasionally_____ 6. Rarely_____ 7. Never_____
		1. More than five times_____

050	In the last one year, I have taken courses of antibiotics for a chest infection.	2. Five times_____ 3. Four times_____ 4. Three times_____ 5. Twice_____ 6. Once_____ 7. None_____ —
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Part five is adopted from: BHQ. King's College Hospital NHS Trust 2014. Dr SS Birring (40).

ANNEX IV: DATA COLLECTION CHECKLIST

Medical Record Number		
Age		
Sex		
Occupation		
Area of Residence		
Indication for HRCT	1. Chronic cough 2. Shortness of breath 3. Hemoptysis 4. Chest pain 5. Desaturation 6. Post-covid 19 7. Lung mass on X-ray 8. COPD 9. Tuberculosis 10. Chronic PTE	11. Follow up 12. Others (Specify).....
HRCT Findings		

1. Normal
2. Dilated bronchi
3. Fibrosis
4. Signet ring
5. Lack of tapering
6. Other (specify)_____

ANNEX V: DECLARATION

I the undersigned resident declare that this thesis is my original work in partial fulfillment of the requirement for certificate of specialty in internal medicine. I also declare that it has never been presented in this or any other higher institution and all the resources and materials used in the research work have been duly acknowledged.

Name of the Resident: _____

Signature: _____

Date: _____

Approval of Advisors

This research work has been submitted for examination with my approval.

Name of Public Health Advisor: _____

Signature: _____

Date: _____

Name of Clinical Advisor: _____

Signature: _____

Date: _____