



SOCIO-ECONOMIC INEQUALITY IN PREVALENCE AND TREATMENT OF CHRONIC LUNG DISEASES AMONG OLDER ADULTS OF INDIA

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ABSTRACT

The chronic lung diseases (CLDs) include chronic obstructive pulmonary lung diseases (COPD), asthma and bronchitis. Among these three, the COPD is the largest contributor of mortality and morbidity. This aims to examine the socioeconomic inequality and predictors of untreated chronic lung diseases (UCLDs) among older adults in India. We have used a sample of 73,396 individuals successfully interviewed in LASI. This study was restricted to 65,768 individuals from all states, who had aged above 45 years and responded to all the variables of interest for this study. The univariate and bivariate analysis was performed for age-sex adjusted estimates of UCLDs. Further, logistic regression was used to identify the potential predictors and Erreygers Concentration Index (ECI) to understand the inequality of CLDs and UCLDs across the socioeconomic characteristics. The overall prevalence of CLD was estimated as 6.7% (95% CI: 6.0% - 7.4%), asthma was 4.8% (95% CI: 4.4% - 5.2%), COPD was 1.4% (95% CI: 1.0% - 1.8%), and bronchitis was 1.2% (95% CI: 0.8% - 1.6%). Individuals in the richest MPCE quintile and those with health insurance are less likely to have UCLD, but those who were currently married and those in the age group 75+ years were more likely to have untreated lung disease. ECI for prevalence of chronic lung disease and COPD were statistically significant at 0.012 and 0.007, respectively, indicating a higher concentration in the prevalence of both the disease among the wealthy. Similarly, ECI value for the prevalence of UCLD was -0.054, indicates to higher concentration among poorer older adults.

KEYWORDS : Chronic lung disease; treatment; older adults; India

INTRODUCTION

Chronic lung diseases (CLDs) are an umbrella term that includes asthma, COPD, and bronchitis, and is the third leading cause of death worldwide¹⁻⁵. CLDs are conditions characterized by respiratory symptoms and airflow limitations that necessitate medical screening and treatments. The CLDs are one of the five most affected non-communicable diseases (NCDs). The elderly population is vulnerable to CLDs, which account for higher mortality and morbidity globally⁶. In 2019, the CLDs accounting for 454.6 million cases with 4 million of deaths, 62% of total DALYs and 69.6% of all deaths was attributable to all risk factors globally⁷. Among these, the second-largest risk factor that contributes to the national and worldwide burden of mortality and morbidity is COPD. It is also growing and remains a challenge for clinicians globally. In 2019, the GBD estimates suggest that COPD is the third leading cause of death with 212.3 million cases and 16.2 million new cases, and it accounts for 3.3 million deaths with 8.3% of total DALYs worldwide⁷, and 80% of deaths occur in low, and middle-income countries⁸. The incidence of COPD was estimated as 2638 per 100000 individuals, which signifies a health burden⁹. In 2019, Asthma accounts 262.4 million cases accounting for 21.6 million of DALYs globally⁷.

Elderly aged 60 and above and those with low BMI currently smoking had a higher risk of developing COPD¹⁰. The odds of having COPD were lower among individuals with secondary education and higher monthly household income, and the risk of COPD was greater among lower socioeconomic status groups¹¹. Socio-economic conditions such as gender, age, smoking history, BMI, basic educational level, and underweight were the risk factors for developing COPD¹². Low household income and educational level were the significant predictors of the higher prevalence of COPD in both urban and rural areas¹³. Studies found that age, gender, place of residence, outdoor and indoor air pollution, body weight status, and cigarette smoking are also risk factors for COPD in men¹⁴.

A study covering Europe, the USA, Australia, and New Zealand surveying patients using the European Community Respiratory Health Survey (ECRHS) determined that the prevalence and incidence of asthma and chronic bronchitis were associated with lower education levels of individuals. Lower socioeconomic groups likely to have high prevalence and incidence of asthma, particularly higher mean asthma scores¹⁵.

India accounts for 15.7% of chronic respiratory diseases and 30.3% of all global deaths. The GBD estimated that there was an increase in COPD cases from 28.1 million to 55.3 million, with a rise in prevalence from 3.3% in 1990 to 4.2% by 2016 in India¹⁶. Lower socioeconomic status is associated with higher prevalence of CLDs,

attributed to limited access to healthcare, education, and resources for disease prevention and management. The burden of CLDs among older adults and elderly in India are growing which underscores the need of public health interventions. Thus, this paper presents the socio-economic inequality in chronic lung diseases among older adults.

METHODOLOGY

Data Source

It is a cross-sectional study. We used data from the baseline survey of Longitudinal Ageing Study in India (LASI) conducted in 2017-18. LASI is a nationally representative prospective cohort of all Indian adults and older men and women aged 45 and above and their spouses who reside in the same household, irrespective of age. LASI Wave 1 collected data from 73,396 respondents. LASI used stratified, multistage cluster sampling to select households, within which all individuals aged 45 years and older, and their spouses, were interviewed face-to-face. The analytical sample was 65,768 from all states, who have aged above 45 years and responded to all the variables of interest for this study. A detailed sample selection was given using a flow chart, as shown in figure 5.1.

Samples selection for the study, LASI wave-1 (2017-18)

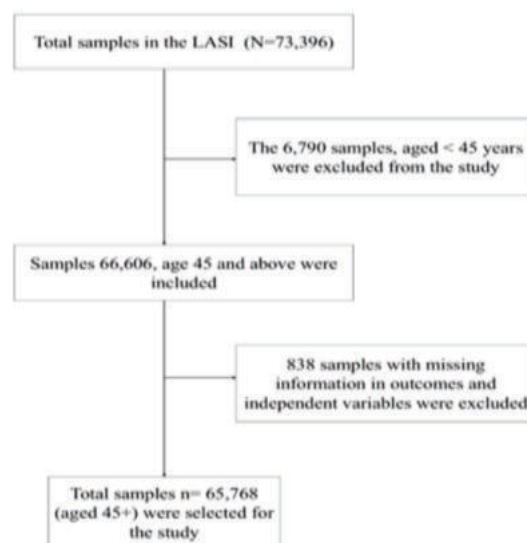


Figure 1: Study sample from LASI wave-1, 2017-18

Outcome Variables

The analyses have been carried out on self-reported chronic lung diseases. All the respondents were asked, “Has any health professional ever diagnosed you with a Chronic lung disease such as asthma, chronic obstructive pulmonary disease/Chronic bronchitis, or other chronic lung problems?”. Affirmative responses were used to classify individuals as having chronic lung disease.

Respondents diagnosed with chronic lung disease were further asked, “Are you receiving physical or respiratory therapy, or any other treatment for your lung disease?”. Those who responded negatively were categorized as having untreated chronic lung disease.

Respondents with a positive diagnosis of CLDs were further asked to specify the type of condition, with options including (a) Chronic Obstructive Pulmonary Disease (COPD), (b) Chronic Bronchitis, (c) Asthma, and (d) Other. Multiple selections were allowed, and affirmative responses were used to classify the type of chronic lung condition accordingly.

Explanatory Variables

Monthly Per Capita Consumption Expenditure (MPCE) quintiles

It is a measure of the average monthly consumption expenditure per person in a household. MPCE was derived by dividing the total consumption expenditure of a household by the number of household members. The consumption expenditure was computed from household food and non-food expenditure and computed monthly. An MPCE quintile was computed that classified the population into five groups: poorest, poorer, middle, richer, and richest, and used in the analyses.

Covariates

Potential socio-demographic confounders are considered in the analysis. Demographic characteristics included age groups (“45-59”, “60-74”, and “75 and above”), sex (“male” and “female”), residence (“rural” and “urban”), an education level (“no schooling”, “less than 5 years”, “5-9 years” and “10 and more years of schooling”), marital status (“currently married”, “Widowed”, “Others”). Social attributes are indicated by caste (“Scheduled Tribe,” “Scheduled Caste,” “Other Backward Classes (OBC),” and “Others.”), religious affiliations (“Hindu,” “Muslim,” “Christian,” and “Others.”), MPCE quintile (“poorest”, “poorer”, “middle”, “richer” and “richest”), work status (“currently working”, “ever worked but not currently working”, and “never worked”) and health insurance coverage (“yes” and “no”).

Statistical Methods

Age-sex Adjusted Prevalence:

We computed the outcome variables age-sex adjusted prevalence, stratified by sociodemographic attributes and across states. Age and sex adjustments were performed to standardize the prevalence estimates, enabling meaningful comparisons between groups while controlling for the effects of these confounders. The detailed adjustment method is explained elsewhere¹⁷.

Inequality Measurement:

To quantify inequality in the prevalence of the outcome variables by economic status, we calculated the Age-sex standardized Erreygers Concentration Index (ECI). This index measured inequality across MPCE quintiles, providing an adjusted and standardized prevalence distribution by economic quintile.

Erreygers' Concentration Index (ECI)

Furthermore, the concentration index (CCI) with Erreygers' correction was used to examine the inequality, which is a quasi-absolute measure appropriate for binary health outcomes¹⁸⁻¹⁹, can be written as,

$$ECI = \frac{4\mu}{(b-a)} \cdot C \text{----- (1)}$$

Logistic Regression Analysis:

We employed fully adjusted logistic regression models to estimate the marginal effects of covariates on the dependent variables. These models included state-level fixed effects for unobserved heterogeneity and regional variation.

The marginal effect in a logistic regression model is the partial derivative of the predicted probability with respect to a predictor variable. For a logistic regression model, the marginal effect of the j^{th}

predictor x_j can be written as:

$$\frac{\partial P(Y = 1|X)}{\partial x_j} = \beta_j \cdot P(Y = 1|X) \cdot (1 - P(Y = 1|X)) \text{----- (2)}$$

Covariates in the models comprised socio-demographic factors such as age, sex, education, residence, caste, religion, marital status, work status, and health insurance coverage.

All estimates, including prevalence rates, Erreygers Concentration Index values, and logistic regression marginal effects, are presented with 95% confidence intervals (Cis). STATA 17.1 and R packages were used to perform the statistical analysis and visualize the maps.

RESULTS

Table 1 presents descriptive statistics for two samples of older adults in India, one diagnosed with CLD and the other with UCLD. The samples were divided into socio-demographic categories such as MPCE quintile, years of education, age, sex, residence, caste, religion, currently married, work status, and health insurance. The results show that the poorest quintile had the highest proportion of individuals with diagnosed CLD (20.9%). The richest quintile has the highest proportion of individuals with UCLD (24.6%). Most individuals in CLD and UCLD had no schooling (50.8% and 49.9%, respectively) and were male (45.8% and 49.9%, respectively). The majority of individuals reside in rural areas (68.8% and 67.5%, respectively), Hindu (82.2% and 82.2%, respectively), currently married (73.3% and 68%, respectively), not currently working (26.1% and 25.8%, respectively), do not have health insurance (79.8% and 80.2%, respectively). These findings highlight the significant disparities in the prevalence of CLD among different socio-demographic groups in India.

Socio-demographic characteristics	Chronic lung Disease (CLD) (n=65,768)		Untreated lung disease (UCLD) (n=3704)	
	N	%	N	%
MPCE quintile				
Poorest	13,010	20.9	632	17.2
Poorer	13,246	21.3	737	19.7
Middle	13,216	20.4	757	19.6
Richer	13,249	19.5	760	18.9
Richest	13,047	17.9	818	24.6
Years of Education				
No schooling	31,020	50.8	1,808	49.9
< 5 years	7,493	10.9	505	12.5
5-9 years	14,908	20.4	881	20.6
≥ 10 years	12,347	17.8	510	17
Age				
45-54	24,217	35	869	19.7
55-64	20,183	29.9	1,058	31
65-74	14,575	23.9	1,112	31.5
75+	6,793	11.3	665	17.8
Sex				
Male	30,610	45.8	1,882	49.9
Female	35,158	54.2	1,822	50.1
Residence				
Rural	42,804	68.8	2,446	67.5
Urban	22,964	31.2	1,258	32.5
Caste				
Schedule Tribe	11,612	8.6	418	6
Schedule Caste	10,926	19.3	696	20.4
OBC	24,918	45.4	1,547	48.6
Others	18,312	26.7	1,043	25
Religion				
Hindu	48,116	82.2	2,780	82.2
Muslim	7,698	11.3	534	11.8
Christian	6,567	3	244	2.6
Others	3,387	3.5	146	3.4
Currently Married				
No	16,830	26.7	1,121	32
Yes	48,938	73.3	2,583	68
Work Status				
Currently Working	30,080	46.2	1,200	33.8
Ever worked but not currently working	17,315	27.6	1,538	40.4

Never Worked	18373	26.1	966	25.8
Health Insurance				
No	50,866	79.8	2,878	80.2
Yes	14902	20.2	826	19.8

Table 2 presents age-sex-adjusted estimates of the prevalence and untreated fraction of CLD among older adults in India, stratified by various socioeconomic and demographic characteristics. The overall prevalence of CLD was estimated at 6.7% (95% CI: 6.0% - 7.4%). The prevalence of CLD was highest among the richest MPCE quintile at 9.2% (95% CI: 5.8% - 12.6%) and lowest among the poorest quintile at 5.4% (95% CI: 4.8% - 6.1%). Older adults with less than 5 years of education had the highest prevalence of CLD at 7.3% (95% CI: 6.3% - 8.4%), while those with 10 or more years of education had a prevalence of CLD at 6.8% (95% CI: 3.0% - 10.5%). The prevalence of CLD increased with age, from 3.8% (95% CI: 3.3% - 4.2%) among those aged 45-54 years to 10.5% (95% CI: 9.2% - 11.8%) among those aged 75 years and above. Males had a higher prevalence of CLD than females (7.2% vs. 6.2%). The prevalence of CLD was higher in urban areas (7.1%, 95% CI: 5.3% - 8.9%) compared to rural areas (6.5%, 95% CI: 6.1% - 6.9%). The untreated fraction of CLD was highest among the poorest MPCE quintiles at 37.7% (95% CI: 30.9% - 44.4%) and lowest among the richest quintiles at 22.6% (95% CI: 15.6% - 29.6%). The untreated CLD decreased with increasing education, from 34.4% (95% CI: 30.5% - 38.3%) among those without schooling to 18.0% (95% CI: 9.6% - 26.4%) among those with 10 or more years of education. It was higher among those aged 45-54 years (38.7%, 95% CI: 34.1% - 43.4%) than older age groups. There was no difference in the untreated fraction of CLD between males and females. The untreated fraction of CLD was higher in rural areas (32.7%, 95% CI: 29.2% - 36.2%) compared to urban areas (22.0%, 95% CI: 15.9% - 28.2%).

Table 2: Age-sex adjusted estimates of prevalence and untreated fraction of chronic lung disease by socioeconomic and demographic characteristics among older adults in India, 2017-18

Socio-demographic characteristics	Chronic lung disease (CLD) (n=65,768)	Untreated lung disease (UCLD) (n=3704)
	N (95%CI)	N (95%CI)
Overall	6.7 (6.0 - 7.4)	
MPCE quintile		
Poorest	5.4 (4.8 - 6.1)	37.7 (30.9 - 44.4)
Poorer	6.1 (5.4 - 6.9)	34.9 (29.2 - 40.6)
Middle	6.4 (5.6 - 7.2)	25.3 (20.5 - 30.1)
Richer	6.6 (5.7 - 7.4)	28.6 (23.3 - 33.9)
Richest	9.2 (5.8 - 12.6)	22.6 (15.6 - 29.6)
Years of Education		
No schooling	6.4 (5.9 - 6.9)	34.4 (30.5 - 38.3)
< 5 years	7.3 (6.3 - 8.4)	30.4 (24.3 - 36.5)
5-9 years	7.1 (6.2 - 7.9)	25.4 (20.6 - 30.3)
≥ 10 years	6.8 (3.0 - 10.5)	18.0 (9.6 - 26.4)
Age		
45-54	3.8 (3.3 - 4.2)	38.7 (34.1 - 43.4)
55-64	6.9 (5.5 - 8.3)	26.8 (19.7 - 33.8)
65-74	8.8 (7.2 - 10.4)	25.1 (19.3 - 31.0)
75+	10.5 (9.2 - 11.8)	31.3 (25.7 - 36.9)
Sex		
Male	7.2 (6.3 - 8.1)	29.4 (24.9 - 33.9)
Female	6.2 (5.5 - 6.9)	29.4 (24.7 - 34.2)
Residence		
Rural	6.5 (6.1 - 6.9)	32.7 (29.2 - 36.2)
Urban	7.1 (5.3 - 8.9)	22.0 (15.9 - 28.2)
Caste		
Schedule Tribe	4.8 (3.8 - 5.8)	34.7 (25.5 - 44.0)
Schedule Caste	7.2 (6.3 - 8.0)	31.6 (25.8 - 37.3)
OBC	7.1 (5.8 - 8.4)	30.5 (24.5 - 36.4)
Others	6.2 (5.6 - 6.8)	24.5 (20.0 - 29.0)
Religion		
Hindu	6.6 (5.9 - 7.4)	29.3 (24.9 - 33.8)
Muslim	7.1 (6.0 - 8.3)	31.4 (24.9 - 37.9)
Christian	6.0 (4.5 - 7.5)	24.7 (14.8 - 34.5)
Others	6.5 (4.8 - 8.2)	27.7 (15.6 - 39.7)
Currently Married		
No	7.0 (5.7 - 8.2)	27.0 (20.8 - 33.3)
Yes	6.5 (6.0 - 7.1)	30.5 (26.3 - 34.8)

Work Status		
Currently Working	5.1 (4.3 - 5.9)	32.9 (27.2 - 38.5)
Ever worked but not currently working	8.4 (7.6 - 9.2)	28.6 (24.2 - 32.9)
Never Worked	7.2 (5.6 - 8.7)	26.4 (19.5 - 33.4)
Health Insurance		
No	6.6 (5.8 - 7.5)	30.1 (25.5 - 34.7)
Yes	6.8 (5.9 - 7.6)	26.8 (22.1 - 31.4)
notes: prevalence for age is adjusted for only sex and for sex is adjusted for age only.		

Table 3 presents age-sex-adjusted estimates of the prevalence of major CLDs, including asthma, COPD, and bronchitis, among older adults in India. The overall prevalence of asthma was 4.8% (95% CI: 4.4% - 5.2%), COPD was 1.4% (95% CI: 1.0% - 1.8%), and bronchitis was 1.2% (95% CI: 0.8% - 1.6%). The prevalence of asthma was highest among the richest MPCE quintile at 6.1% (95% CI: 4.5% - 7.6%) and lowest among the poorest quintile at 4.3% (95% CI: 3.7% - 4.9%). The prevalence of COPD was also highest among the richest quintile at 2.5% (95% CI: 0.6% - 4.5%) and lowest among the poorest quintile at 0.6% (95% CI: 0.4% - 0.8%). The prevalence of bronchitis was highest among the richest quintile at 2.3% (95% CI: 0.3% - 4.3%) and lowest among the poorest quintile at 0.7% (95% CI: 0.5% - 0.9%). The prevalence of asthma and bronchitis increases with age, from 2.6% (95% CI: 2.2% - 2.9%) among those aged 45-54 years to 8.2% (95% CI: 7.1% - 9.2%) among those aged 75 years and above. The prevalence of COPD also increased with age, from 0.7% (95% CI: 0.5% - 0.9%) among those aged 45-54 years to 2.1% (95% CI: 1.4% - 2.8%) among those aged 75 years and above. The prevalence of asthma and bronchitis was higher among females than males, while the prevalence of COPD was slightly higher among males. The prevalence of all three CLDs was higher in urban areas than in rural areas. The prevalence of asthma was higher among the SC categories, COPD and bronchitis were among the OBC categories, while all the types of CLD were lower among the ST categories. A similar pattern of prevalence of all types of CLD was observed across all the religious groups. The prevalence of all types of CLDs was twice as high among older adults who had ever worked but were not currently working compared to those who were currently working.

Table 3: Age-sex adjusted prevalence of major chronic lung disease by socioeconomic and demographic characteristics among older adults in India, 2017-18

Socio-demographic characteristics	Asthma (%)	COPD (%)	Bronchitis (%)
	(95%CI)	(95%CI)	(95%CI)
Overall	4.8 (4.4 - 5.2)	1.4 (1.0 - 1.8)	1.2 (0.8 - 1.6)
MPCE quintile			
Poorest	4.3 (3.7 - 4.9)	0.6 (0.4 - 0.8)	0.7 (0.5 - 0.9)
Poorer	4.6 (3.9 - 5.3)	1.1 (0.8 - 1.3)	1.1 (0.8 - 1.4)
Middle	4.5 (3.8 - 5.2)	1.2 (0.8 - 1.6)	1.3 (0.8 - 1.9)
Richer	4.6 (3.9 - 5.4)	1.7 (1.1 - 2.4)	0.9 (0.7 - 1.2)
Richest	6.1 (4.5 - 7.6)	2.5 (0.6 - 4.5)	2.3 (0.3 - 4.3)
Years of Education			
No schooling	4.9 (4.4 - 5.4)	1.2 (0.8 - 1.5)	0.8 (0.6 - 1.0)
< 5 years	5.4 (4.4 - 6.4)	1.4 (1.0 - 1.7)	1.3 (0.8 - 1.7)
5-9 years	4.9 (4.2 - 5.6)	1.4 (0.9 - 1.9)	1.6 (0.9 - 2.3)
≥ 10 years	3.8 (2.3 - 5.4)	2.2 (-0.5 - 4.9)	2.4 (-0.4 - 5.2)
Age			
45-54	2.6 (2.2 - 2.9)	0.7 (0.5 - 0.9)	0.7 (0.5 - 0.8)
55-64	5.2 (3.8 - 6.6)	1.2 (0.9 - 1.6)	1.2 (0.8 - 1.5)
65-74	5.9 (5.3 - 6.6)	2.3 (0.6 - 3.9)	2.0 (0.4 - 3.7)
75+	8.2 (7.1 - 9.2)	2.1 (1.4 - 2.8)	1.4 (0.9 - 1.8)
Sex			
Male	5.2 (4.4 - 6.1)	1.3 (1.1 - 1.5)	1.1 (0.9 - 1.3)
Female	4.4 (3.9 - 4.9)	1.4 (0.7 - 2.2)	1.3 (0.6 - 2.1)
Residence			
Rural	4.7 (4.4 - 5.1)	1.2 (1.0 - 1.4)	1.0 (0.9 - 1.2)
Urban	4.9 (4.0 - 5.8)	1.8 (0.7 - 2.9)	1.6 (0.6 - 2.7)
Caste			
Schedule Tribe	3.9 (2.9 - 4.8)	0.9 (0.5 - 1.3)	0.5 (0.2 - 0.7)
Schedule Caste	5.4 (4.5 - 6.2)	1.3 (1.0 - 1.7)	1.2 (0.6 - 1.8)
OBC	5.0 (4.4 - 5.6)	1.5 (0.8 - 2.3)	1.5 (0.8 - 2.3)

Others	4.3 (3.9 - 4.8)	1.3 (1.0 - 1.6)	1.0 (0.8 - 1.2)
Religion			
Hindu	4.8 (4.4 - 5.3)	1.3 (0.9 - 1.8)	1.3 (0.8 - 1.7)
Muslim	4.9 (4.0 - 5.7)	1.5 (0.9 - 2.1)	1.2 (0.8 - 1.5)
Christian	4.1 (2.6 - 5.6)	1.0 (0.5 - 1.6)	0.9 (0.3 - 1.5)
Others	3.7 (2.2 - 5.1)	2.4 (1.6 - 3.2)	1.0 (0.3 - 1.6)
Currently Married			
No	4.8 (4.1 - 5.5)	1.6 (0.8 - 2.4)	1.6 (0.8 - 2.5)
Yes	4.8 (4.3 - 5.2)	1.3 (1.0 - 1.5)	1.0 (0.8 - 1.2)
Work Status			
Currently Working	3.9 (3.2 - 4.6)	0.9 (0.6 - 1.3)	0.8 (0.6 - 1.0)
Ever worked but not currently working	6.3 (5.6 - 7.0)	1.4 (1.1 - 1.7)	1.4 (1.0 - 1.9)
Never Worked	4.4 (3.7 - 5.0)	2.1 (0.7 - 3.5)	1.7 (0.4 - 3.0)
Health Insurance			
No	4.7 (4.2 - 5.2)	1.4 (0.9 - 1.8)	1.2 (0.8 - 1.7)
Yes	5.2 (4.3 - 6.0)	1.4 (0.9 - 1.9)	1.3 (0.7 - 1.8)

notes: prevalence for age is adjusted for sex and for sex is adjusted for age only.

Table 4 shows the results of ECI of prevalence of CLD among older adults in India. ECI for prevalence of CLD and COPD were statistically significant at 5% level of significance. ECI values suggest that there was higher concentration in the prevalence of the CLDs among the wealthy. Similarly, ECI value for the prevalence of untreated CLDs was -0.054, indicates to higher concentration among poorer older adults.

Table 4: Erreygers Concentration Index for chronic lung conditions among older adults of India, 2017-18				
Variables	N	ECI Index	95% CI	p- value
Chronic Lung Condition	65768	0.0121	0.001 - 0.023	0.0269
COPD	65768	0.0071	0.001 - 0.013	0.016
Bronchitis	65768	0.0031	-0.002 - 0.011	0.1536
Asthma	65768	0.0054	0.000 - 0.011	0.0659
Untreated	3704	-0.0544	-	-

Table 5 provides insights into the adjusted prevalence of medication for

Table 5: Adjusted Prevalence Of Medication Of Chronic Lung Diseases, COPD, Bronchitis And Asthma Across The Socio-demographic Characteristics Among Middle-aged Adults And Elderly In India, 2017-18

Socio-demographic characteristics	Any chronic Lung disease (CLD) (N=3362)	COPD Medication (N=653)	Bronchitis Medication (N=555)	Asthma Medication (N=2308)
Age				
45-54	60.54 (55.62-65.47)	64.89 (55.42-74.36)	50.68 (39.97-61.39)	64.60 (58.76-70.44)
55-64	72.52 (65.12-79.92)	74.39 (63.81-84.97)	65.82 (55.93-75.72)	75.81 (66.96-84.67)
65-74	75.28 (69.00-81.55)	81.83 (66.12-97.54)	79.61 (61.99-97.23)	76.01 (71.84-80.19)
75+	68.29 (62.19-74.40)	72.93 (60.42-85.45)	76.59 (62.54-90.63)	68.08 (60.92-75.25)
Sex				
Male	69.45 (65.03-73.86)	77.56 (69.15-85.96)	64.34 (50.00-78.69)	71.73 (66.87-76.60)
Female	70.77 (65.17-76.38)	72.42 (60.01-84.83)	73.24 (60.88-85.60)	72.50 (68.16-76.84)
Place of Residence				
Rural	66.96 (63.10-70.82)	68.86 (58.65-79.06)	65.90 (52.14-79.65)	70.20 (66.17-74.23)
Urban	77.61 (71.05-84.17)	86.32 (78.11-94.53)	77.09 (65.00-89.18)	77.55 (71.99-83.12)
MPCE Quintile				
Poorest	65.06 (58.70-71.42)	73.21 (59.31-87.11)	70.96 (55.95-85.97)	66.31 (59.37-73.24)
Poorer	66.44 (60.21-72.67)	66.01 (50.10-81.92)	65.72 (49.64-81.80)	69.17 (62.47-75.88)
Middle	70.07 (64.24-75.91)	83.36 (73.52-93.20)	74.70 (61.27-88.14)	70.83 (64.67-77.00)
Richer	71.47 (64.92-78.03)	67.46 (53.56-81.36)	70.54 (55.37-85.71)	75.55 (68.90-82.20)
Richest	76.14 (69.30-82.99)	79.64 (67.89-91.39)	66.06 (49.89-82.23)	78.44 (72.93-83.95)
Caste				
SC	68.82 (62.74-74.90)	76.88 (65.17-88.59)	63.44 (46.64-80.25)	69.49 (62.71-76.27)
ST	62.43 (53.16-71.69)	59.99 (37.94-82.04)	73.19 (53.61-92.77)	66.06 (56.95-75.17)
OBC	69.39 (63.06-75.72)	73.24 (61.81-84.67)	68.21 (54.49-81.94)	71.56 (66.38-76.74)
Others	74.75 (69.72-79.79)	80.48 (71.38-89.58)	74.90 (62.67-87.12)	77.59 (72.22-82.95)
Religion				
Hindu	70.28 (65.44-75.12)	73.54 (63.46-83.62)	69.67 (57.30-82.04)	72.67 (68.68-76.67)
Muslim	68.48 (61.69-75.28)	86.41 (76.89-95.93)	62.47 (44.14-80.79)	68.89 (61.29-76.49)
Christian	75.64 (65.30-85.97)	64.16 (40.37-87.96)	83.72 (64.35-103.08)	75.80 (62.46-89.13)
Others	71.31 (59.08-83.54)	76.77 (61.86-91.67)	75.84 (54.92-96.75)	72.73 (56.57-88.89)
Level of Education				
Illiterate	65.37 (61.19-69.55)	71.40 (61.17-81.63)	64.87 (50.44-79.30)	67.30 (62.51-72.10)
Less than 5 Years	67.02 (60.37-73.66)	73.41 (58.75-88.07)	63.57 (46.17-80.96)	72.79 (66.20-79.38)
5-9 Years Completed	74.28 (69.01-79.56)	76.25 (65.33-87.16)	76.57 (65.20-87.93)	77.68 (72.13-83.24)

CLD among older adults in India in 2017-18, categorized by socio-demographic characteristics. The data reveals that medication usage generally increases with age, peaking in the 65-74 age group for COPD (81.83%) before slightly declining in the 75+ age group (72.93%). Females exhibit higher medication rates for bronchitis (73.24%) compared to males (64.34%), although both sexes show similar prevalence for any CLD medication (around 70%). Urban residents have a higher prevalence of medication usage across all categories than their rural counterparts, with a notable disparity in COPD medication (86.32% urban vs. 68.86% rural). Economic status significantly impacts medication prevalence, with the richest quintile showing the highest rates for any CLD (76.14%) and COPD (79.64%). Caste and religion also influence medication use, with 'Others' caste group and Christians showing higher prevalence rates for any CLD and asthma medication, respectively. Higher education levels correlate with increased medication prevalence, and widowed individuals show higher rates for COPD medication compared to currently married individuals. Those living with spouse and children have lower prevalence rates than other living arrangements. Employment status and health insurance also play roles, with those who never worked and those with insurance showing higher medication prevalence. Obese individuals exhibit the highest rates for COPD medication (86.19%), and non-smokers and non-drinkers generally show higher medication rates. Finally, individuals with diabetes have higher prevalence rates for COPD medication (81.19%), highlighting the significant impact of comorbid conditions on medication usage.

Table 6 presents marginal effects of socio-demographic attributes on CLD and their treatment among older adults in India. The marginal effects were calculated for CLD, COPD, bronchitis, and UCLD. The results show that the marginal effects of the MPCE quintile on CLD, COPD, and bronchitis were positive and significant, indicating that individuals from higher MPCE quintiles were more likely to have CLD, COPD, and bronchitis. The marginal effect of MPCE quintile on UCLD was negative and significant, indicating that individuals from higher MPCE quintiles were less likely to have UCLD. The significant findings indicate that higher education, and older age were associated with a higher prevalence of CLD, COPD, and bronchitis. Individuals from Schedule Caste, Hindu individuals, and those who were currently working were more likely to have CLD, COPD, and bronchitis.

10 years and more	82.22 (73.75-90.69)	85.27 (72.39-98.15)	73.46 (57.08-89.84)	84.24 (77.65-90.84)
<i>Marital Status</i>				
Currently Married	69.11 (64.44-73.77)	71.44 (61.12-81.75)	67.02 (53.49-80.55)	72.15 (67.82-76.47)
Widowed	72.75 (65.49-80.00)	82.12 (71.85-92.38)	73.05 (59.16-86.94)	72.70 (65.87-79.53)
Others	73.56 (62.14-84.97)	73.19 (46.64-99.75)	89.96 (77.39-102.54)	72.41 (58.92-85.90)
<i>Living arrangement</i>				
Living Alone	64.44 (48.35-80.52)	70.56 (44.23-96.89)	73.14 (39.28-107.00)	64.70 (47.99-81.40)
Living with Spouse/Others	74.76 (68.41-81.11)	70.12 (53.92-86.32)	64.45 (46.11-82.78)	77.93 (72.16-83.70)
Living with spouse and children	66.89 (62.18-71.60)	71.54 (61.08-82.00)	66.74 (52.80-80.69)	69.80 (65.08-74.52)
living with children and /or others	74.45 (67.94-80.97)	82.83 (72.70-92.96)	76.14 (63.53-88.75)	74.50 (68.75-80.25)
<i>Working Status</i>				
Currently Working	66.80 (60.74-72.86)	69.96 (55.53-84.40)	61.01 (43.59-78.43)	69.61 (63.85-75.36)
Ever Worked	70.69 (65.93-75.45)	81.11 (72.23-89.99)	70.34 (56.82-83.86)	72.00 (66.71-77.30)
Never worked	74.04 (66.78-81.29)	73.62 (59.50-87.74)	77.51 (64.43-90.60)	76.66 (70.01-83.32)
<i>Health insurance</i>				
No	69.31 (64.22-74.39)	75.46 (66.16-84.76)	67.08 (53.72-80.45)	71.27 (67.06-75.48)
Yes	74.07 (69.21-78.93)	74.78 (63.03-86.53)	79.09 (67.89-90.28)	76.00 (70.92-81.07)
<i>Body Mass Index</i>				
Underweight	68.05 (63.07-73.03)	75.54 (65.00-86.07)	66.96 (51.92-82.00)	69.33 (63.53-75.14)
Normal	69.10 (64.40-73.80)	69.84 (58.98-80.70)	67.25 (53.94-80.56)	72.30 (67.65-76.95)
Overweight	72.61 (66.98-78.24)	77.22 (66.55-87.89)	71.38 (56.48-86.27)	75.38 (69.14-81.62)
Obese	78.06 (66.03-90.09)	86.19 (66.05-106.33)	78.83 (61.01-96.65)	77.77 (67.34-88.20)
<i>Smoking</i>				
Yes	68.37 (63.75-72.99)	69.66 (57.29-82.04)	63.73 (48.31-79.15)	72.12 (67.54-76.71)
No	71.56 (66.01-77.11)	79.36 (70.38-88.33)	72.94 (60.88-85.01)	72.44 (67.59-77.29)
<i>Drinking</i>				
Yes	70.35 (64.40-76.31)	75.47 (61.85-89.09)	63.44 (44.52-82.37)	73.48 (67.52-79.43)
No	70.22 (65.35-75.10)	75.32 (65.90-84.74)	70.36 (58.18-82.55)	72.07 (67.93-76.21)
<i>Angina</i>				
No	70.46 (65.61-75.30)	76.80 (67.92-85.69)	69.97 (57.66-82.27)	72.06 (68.03-76.09)
Yes	69.06 (62.85-75.27)	67.60 (53.13-82.06)	65.62 (48.46-82.77)	73.69 (66.53-80.85)
<i>Diabetes</i>				
No	69.95 (65.87-74.04)	73.87 (64.65-83.09)	68.91 (56.48-81.34)	72.46 (68.56-76.35)
Yes	71.88 (62.18-81.57)	81.19 (67.00-95.39)	71.55 (53.49-89.62)	71.35 (63.17-79.53)
India	70.15 (65.55-74.76)	74.55 (64.91-84.19)	69.16 (56.52-81.81)	72.17 (68.33-76.01)

Table 6: Marginal effects of socio-demographic attributes on chronic lung diseases and its treatment among older adults in India, 2017-18

Socio-demographic characteristics	N=65,768		N=3,704	
	Chronic Lung Disease (CLD)	COPD	Bronchitis	Untreated Chronic lung disease (UCLD)
	Marginal effect (95% CI)	Marginal effect (95% CI)	Marginal effect (95% CI)	Marginal effect (95% CI)
MPCE quintile				
Poorest	ref.	ref.	ref.	ref.
Poorer	0.007 (-0.002 - 0.017)	0.005** (0.002 - 0.008)	0.004** (0.000 - 0.008)	-0.040 (-0.119 - 0.040)
Middle	0.011** (0.002 - 0.019)	0.007** (0.002 - 0.011)	0.006* (0.000 - 0.012)	-0.12** (-0.196 - 0.052)
Richer	0.012 (0.000 - 0.024)	0.011** (0.004 - 0.018)	0.002 (-0.002 - 0.005)	-0.091** (-0.167 - 0.015)
Richest	0.042** (0.004 - 0.079)	0.019** (0.003 - 0.034)	0.014* (0.000 - 0.027)	-0.138** (-0.224 - 0.052)
<i>Years of Education</i>				
No schooling	ref.	ref.	ref.	ref.
< 5 years	0.009 (-0.004 - 0.022)	0.001 (-0.004 - 0.006)	0.004* (0.000 - 0.009)	-0.011 (-0.083 - 0.061)
5-9 years	0.004 (-0.008 - 0.015)	-0.001 (-0.006 - 0.005)	0.006* (-0.001 - 0.013)	-0.050 (-0.115 - 0.014)
≥ 10 years	-0.004 (-0.036 - 0.028)	0.004 (-0.016 - 0.024)	0.012 (-0.008 - 0.033)	-0.110** (-0.207 - -0.013)
<i>Age</i>				
45-54	ref.	ref.	ref.	ref.
55-64	0.030** (0.011 - 0.049)	0.005** (0.001 - 0.010)	0.005** (0.001 - 0.009)	-0.099** (-0.160 - 0.038)
65-74	0.040*** (0.019 - 0.062)	0.013 (-0.001 - 0.028)	0.011 (-0.003 - 0.024)	-0.125*** (-0.188 - 0.063)
75+	0.048*** (0.031 - 0.066)	0.010** (0.003 - 0.017)	0.004 (-0.001 - 0.008)	-0.086** (-0.165 - -0.008)
<i>Sex</i>				
Male	ref.	ref.	ref.	ref.
Female	-0.016** (-0.027 - -0.005)	-0.004 (-0.010 - 0.001)	0.000 (-0.005 - 0.005)	0.006 (-0.054 - 0.066)
<i>Residence</i>				
Rural	ref.	ref.	ref.	ref.
Urban	0.005 (-0.009 - 0.019)	0.003 (-0.002 - 0.009)	0.002 (-0.002 - 0.005)	-0.100*** (-0.154 - 0.046)
<i>Caste</i>				
Schedule Tribe	ref.	ref.	ref.	ref.
Schedule Caste	0.021** (0.007 - 0.036)	0.003 (-0.004 - 0.010)	0.008* (-0.001 - 0.017)	0.001 (-0.105 - 0.107)
OBC	0.017** (0.002 - 0.031)	0.003 (-0.004 - 0.010)	0.009** (0.003 - 0.014)	0.010 (-0.086 - 0.105)
Others	0.004 (-0.014 - 0.022)	-0.002 (-0.011 - 0.007)	0.001 (-0.005 - 0.008)	-0.031 (-0.134 - 0.072)
<i>Religion</i>				
Hindu	ref.	ref.	ref.	ref.
Muslim	0.005 (-0.008 - 0.019)	0.002 (-0.005 - 0.010)	0.001 (-0.004 - 0.005)	0.017 (-0.046 - 0.081)
Christian	-0.005 (-0.025 - 0.015)	-0.004 (-0.013 - 0.005)	-0.004 (-0.013 - 0.005)	-0.017 (-0.129 - 0.095)

Others	-0.008 (-0.027 - 0.011)	0.007 (-0.003 - 0.017)	-0.004 (-0.011 - 0.004)	-0.019 (-0.148 - 0.110)
Currently Married				
No	ref.	ref.	ref.	ref.
Yes	-0.006 (-0.020 - 0.007)	-0.006 (-0.017 - 0.005)	-0.009 (-0.020 - 0.002)	0.012 (-0.046 - 0.070)
Work Status				
Currently Working	ref.	ref.	ref.	ref.
Ever worked but not currently working	0.030*** (0.014 - 0.046)	0.004 (-0.001 - 0.009)	0.005** (0.000 - 0.011)	-0.024 (-0.085 - 0.037)
Never Worked	0.019*** (0.008 - 0.029)	0.011* (-0.001 - 0.022)	0.007* (-0.001 - 0.016)	-0.019 (-0.092 - 0.055)
Health Insurance				
No	ref.	ref.	ref.	ref.
Yes	0.002 (-0.013 - 0.016)	0.001 (-0.005 - 0.008)	0.001 (-0.006 - 0.007)	-0.043* (-0.094 - 0.008)

Figure 2 shows the prevalence of CLD among older adults across Indian states. The prevalence of CLD was 5.9% in India. The highest prevalence of CLD was observed in the state of Puducherry (11.4%), which was twice higher than the national average. It was followed by the states of Karnataka (10.6%), Rajasthan (10.4%), Kerala (9.5%), West Bengal (8.6%), and Tripura and Delhi each 7.9%. On the other hand, the prevalence of CLD was much lower in the state of Nagaland (0.7%) compared to the prevalence of CLDs on the national average. The lowest prevalence was followed by Meghalaya (1.3%), Sikkim (1.5%), Goa (2.5%) and Chhattisgarh (3.0%).

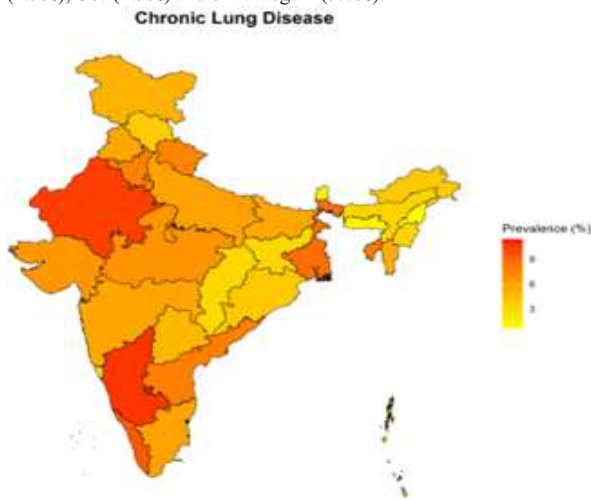


Figure 2: State prevalence of chronic lung diseases among older adults in India, 2017-18

Figure 3 shows the prevalence of UCLD among older adults across Indian states. The prevalence of UCLD was 33.9% in India. The highest prevalence of UCLD was estimated in the state of Mizoram (78.9%), which was more than twice the national average. It was followed by the state of Arunachal Pradesh (74.1%), Meghalaya (67.0%), Nagaland (61.8%), Manipur (58.7%) and Sikkim (52.9%). Similarly, the prevalence of UCLD was much lower in Delhi (9.7%) compared to the national average. The lowest prevalence was followed by Karnataka (12.5%), Goa (19.7%), Lakshadweep (19.9%) and Andaman and Nicobar (22.5%).

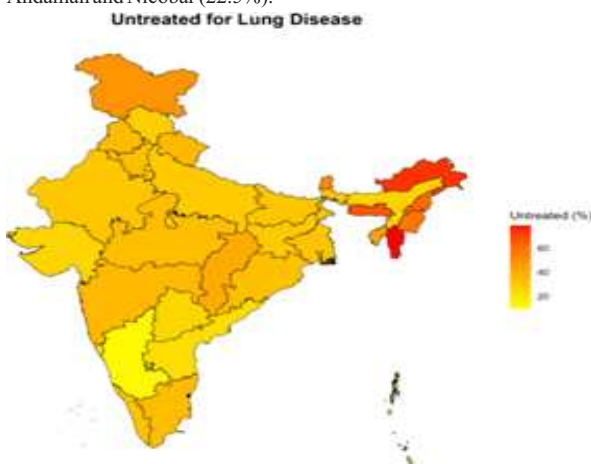


Figure 3: State prevalence of untreated chronic lung diseases among older adults in India, 2017-18

Figure 4 shows the state prevalence of asthma among older adults in India, 2017-18. The prevalence of asthma was 4.0% in India. The highest prevalence of asthma was observed in the state of Rajasthan (8.7%), followed by the state of Tripura (6.2%), Delhi (6.1%), Dadra and Nagar Haveli and West Bengal each 6.0% and Gujarat (5.8%). The lowest prevalence was observed in the state of Nagaland (0.8%), much lower than the national average, followed by Meghalaya (1.0%), Chandigarh, and Sikkim each (1.5%), and Arunachal Pradesh (1.7%).

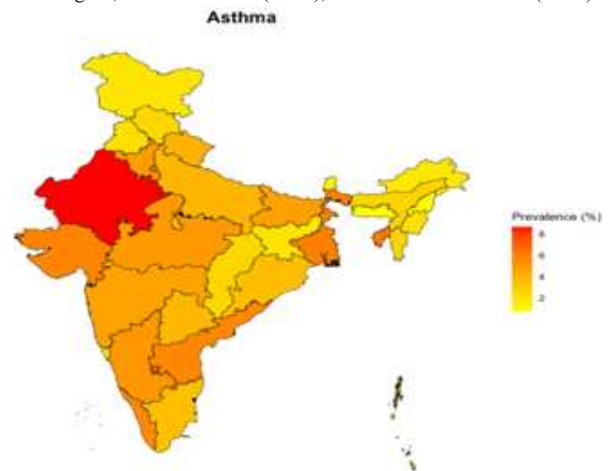


Figure 4: State Prevalence Of Asthma Among Older Adults In India, 2017-18

Figure 5 shows the prevalence of bronchitis among older adults across Indian states. The overall prevalence of bronchitis was only 1.0% in India. The highest prevalence of bronchitis was observed in Kerala (4.1%), four times higher than the national average. It was followed by the states of Maharashtra (3.7%), Lakshadweep (2.4%), Uttarakhand (1.8%), Jammu and Kashmir, and Goa 1.4%. The prevalence of bronchitis was much lower in the states of Sikkim, Madhya Pradesh, Nagaland, Daman and Diu and West Bengal, which was less than national average.

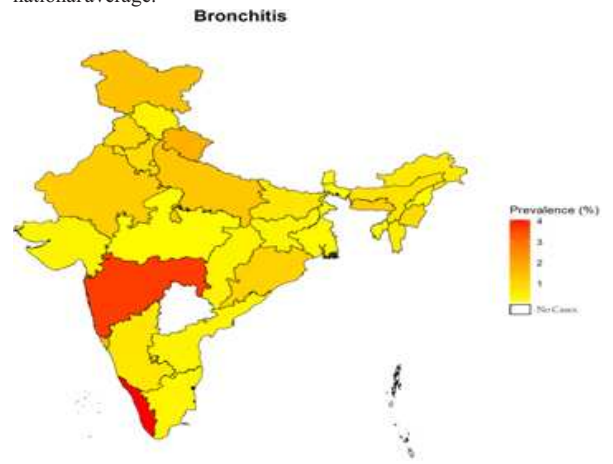


Figure 5: State Prevalence Of Bronchitis Among Older Adults In India, 2017-18

Figure 6 shows the prevalence of COPD among older adults in India, 2017-18. The overall prevalence of COPD was 1.2% in India. The highest prevalence of COPD was observed in the state of Maharashtra

(3.5%), which was three times the national average. It was followed by the state of Kerala (2.6%), Punjab (2.5%), Meghalaya (2.4%), Dadra and Nagar Haveli and Uttarakhand each (2.1%) and Nagaland (1.9%). The prevalence of COPD was much lower in Andhra Pradesh, Jharkhand, Tripura, West Bengal, and Assam, which was less than the national average.

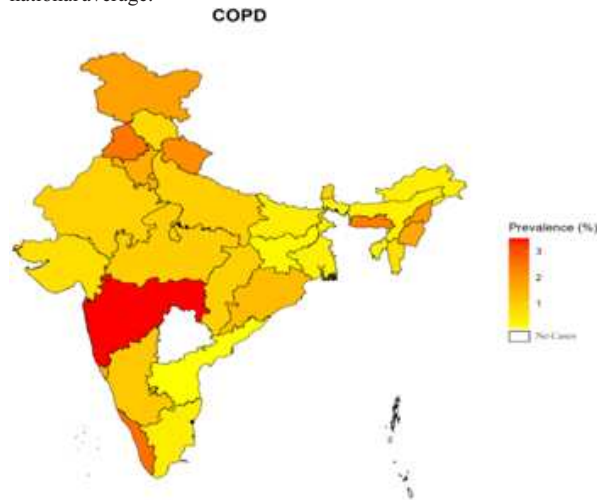


Figure 6: State Prevalence Of COPD Among Older Adults In India, 2017-18

Figure 7 shows the concentration index curve for the prevalence of CLD among older adults in India. The CI curve for CLD was below the line of equality, indicating that there was a pro-rich concentration of CLD prevalence. This inequality suggests that the older adults had a relatively higher burden of CLD among higher-income groups than the lower-income groups.

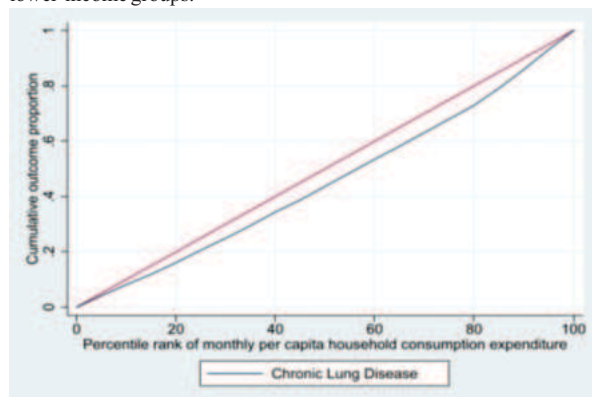


Figure 7: Concentration Index Curve (CI) For Chronic Lung Disease Among Older Adults In India, 2017-18

Figure 8 shows the concentration index curve for the prevalence of UCLD among older adults in India. The CI curve for UCLD was above the line of equality, indicating that there was a pro-poor concentration of prevalence of UCLD. This inequality suggests that older adults had a relatively higher burden of UCLD among lower-income groups than the higher-income groups.

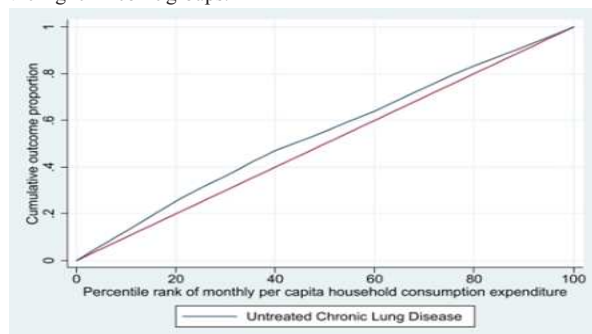


Figure 8: Concentration Index Curve (CI) For Untreated Chronic Lung Disease Among Older Adults In India, 2017-18

Figure 9 shows the concentration index curve for prevalence of asthma among older adults in India. The CI curve for asthma was relatively below the line of equality suggesting that there was a pro-rich concentration of prevalence of asthma. This inequality suggesting that the older adults had relatively higher burden of asthma among higher-income quintiles than the lower income quintiles.

Figure 10 shows the concentration index curve for prevalence of COPD among older adults in India. The CI curve for COPD was much below the line of equality suggesting that there was a pro-rich concentration of prevalence of COPD. This inequality suggesting that the older adults had relatively higher burden of COPD among higher-income quintiles than the lower income quintiles.

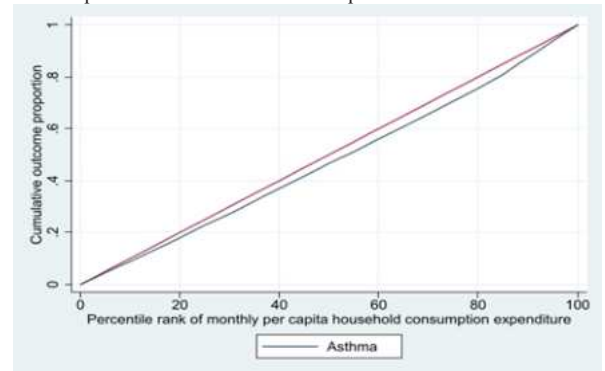


Figure 9: Concentration Index Curve (CI) For Asthma Among Older Adults In India, 2017-18

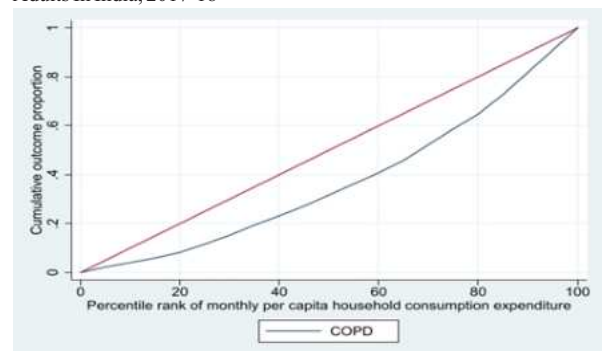


Figure 10: Concentration Index Curve (CI) For COPD Among Older Adults In India, 2017-18

Figure 11 shows the concentration index curve for the prevalence of bronchitis among older adults in India. The CI curve for bronchitis was below the line of equality, suggesting that there was a pro-rich concentration of prevalence of bronchitis. This inequality suggests that the older adults had a relatively higher burden of bronchitis among higher-income quintiles than the lower-income quintiles.

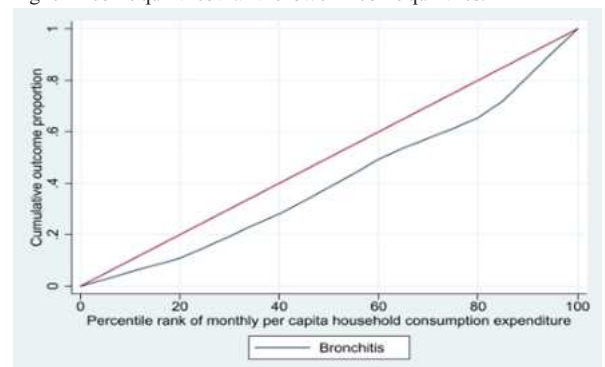


Figure 11: Concentration Index curve (CI) for bronchitis among older adults in India, 2017-18

Figure 12 shows that higher education levels (5-9 years and 10+ years) are associated with a reduced probability of CLD. Additionally, older age groups (65-74 years and 75+ years) show a higher likelihood of CLD compared to the reference group (45-54 years). For UCLD, individuals in the richest MPCE quintile and those with health

insurance are less likely to have UCLD, suggesting better access to healthcare. Conversely, those who are currently married and those in the age group 75+ years are more likely to have UCLD. These findings highlight the critical influence of socioeconomic status, education, age, and marital status on the prevalence and treatment of lung diseases among older adults in India.

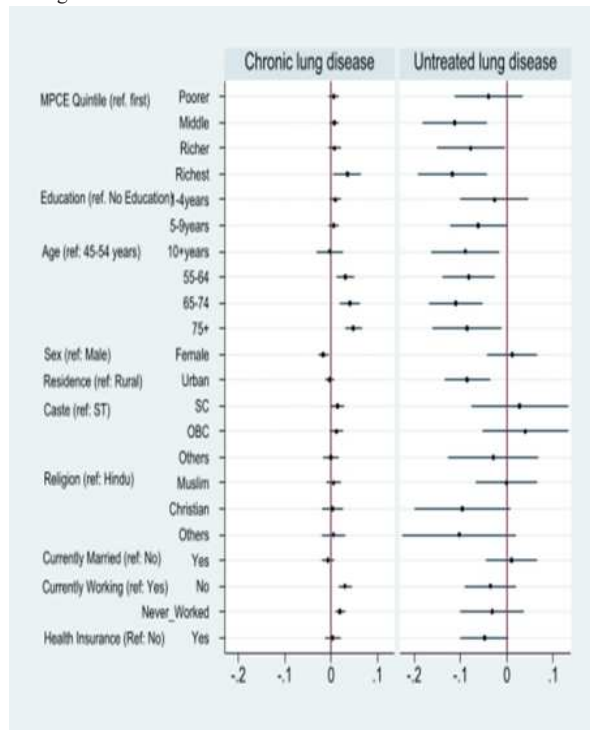


Figure 12: Averaged marginal effects on the probability of chronic lung disease and untreated lung disease across socio-economic characteristics among older adults in India, 2017-18

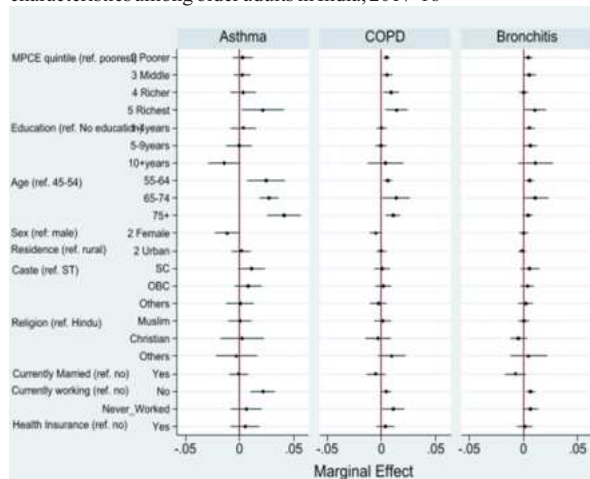


Figure 13: Averaged marginal effects on probability of asthma, COPD and bronchitis across socio-economic characteristics among older adults in India, 2017-18

Figure 13 presents the averaged marginal effects on the probability of asthma, COPD, and bronchitis among older adults in India for the period 2017-18. For asthma, the age group 75+ shows a significant positive marginal effect, suggesting that older adults in this age group have a higher probability of developing asthma compared to the reference group (age 45-54). For COPD, the age groups 65-74 and 75+ also show significant positive marginal effects, indicating an increased likelihood of COPD in these age groups. Additionally, individuals from richest wealth quintile had a significant positive marginal effect for COPD, implying a higher probability of developing COPD. For bronchitis, the age group 75+ again shows a significant positive marginal effect, highlighting an increased risk of bronchitis in this age group. Furthermore, individuals who are currently married exhibit a significant negative marginal effect for bronchitis, suggesting a lower

probability of developing bronchitis compared to those who are not currently married. These findings underscore the importance of age and socio-economic factors in the prevalence of respiratory conditions among older adults in India.

DISCUSSION

In this study, we analysed the prevalence, variations, and socio-economic inequality in three self-reported CLDs: asthma, bronchitis, and COPD. A composite variable, of any CLD, were also computed and analyzed. Along with prevalence, we examined the variations in CLDs across socio-economic characteristics of older adults in India. The following are the salient findings.

First, the prevalence of any CLDs was estimated at 6.7%. It increases with age and higher among females. We found that the prevalence of CLDs is higher among the richest and higher among the better-educated. Second, though the prevalence of self-reported CLDs was higher among the socially and economically advantaged population, the treatment of CLDs was least among the poor and less educated. Third, we found no geographical pattern of CLDs in the country. While the prevalence of asthma was highest in the state Rajasthan, bronchitis was in Kerala and COPD was in the state Maharashtra. Fourth, the socioeconomic inequality in the prevalence of CLDs was pro-rich, while that of medication was pro-poor. Poor and less educated, even though diagnosed, are not treated. Fifth, our multivariate analyses suggest that higher education levels (5-9 years and 10+ years) are associated with a reduced probability of chronic lung disease. Older age groups (65-74 years and 75+ years) show a higher likelihood of CLD than the reference group (45-54 years). For UCLD, individuals in the richest MPCE quintile and those with health insurance are less likely to have UCLD, suggesting better access to healthcare.

Our findings of higher prevalence of CLDs among socially and economically advantaged populations may be attributed to a diagnosis of the disease. The analyses are based on the self-reporting of the diseases, and they remain undiagnosed among a large proportion of poor and marginalized. Even though a small fraction of the poor and less educated are diagnosed with the diseases, the treatment among them remains low.

We have the following limitations. The analyses are based on self-reported CLDs. Though LASI has measured lung function, the data has not been publicly available. Second, we have not conducted detailed state-wise analyses due to sample size constraints. Despite these limitations, it documents the socio-economic pattern in the prevalence and treatment of CLDs among older adults in India.

CONCLUSION

This study highlights significant socio-economic disparities in the prevalence and treatment of CLDs among older adults in India. While CLDs are more frequently reported among socially and economically advantaged groups, likely due to better diagnostic access, treatment remains disproportionately low among the poor and less educated. These findings underscore the need for targeted policies to improve healthcare access for marginalized populations, enhance diagnostic outreach, and address barriers to treatment. Equitable healthcare interventions are crucial to bridging these gaps and ensuring better management of CLDs across all socio-economic strata.

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Conflict of Interest

The authors declare that there are no competing interests or conflicts of interest associated with this manuscript.

Author Contributions

Conceptualization: UKS and SKM;

Formal analysis and interpretation: UKS and AKG;

Drafting the manuscript: UKS, AKG, and SKM;

Critical revision of the manuscript for important intellectual content: SKM, UKS, and AKG.

All authors have read and approved the final version of the manuscript for submission.

Ethics Approval

Not applicable, as this study is based entirely on secondary data sources that are publicly available and do not require ethics committee approval.

Data Availability:

The dataset used for analysis of the current study is available for public use by a data request to the International Institute for Population Sciences, Mumbai, India. The data request form is available at the following link, https://iipsindia.ac.in/sites/default/files/LASI_DataRequestForm_0.pdf

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