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The Burden of Chronic Obstructive Pulmonary Disease and Its Attributable Risk Factors in the Sub-Saharan Africa, 1990-2021: A Systematic Analysis for the Global Burden of Disease Study 2021

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Abstract

Background: *Chronic Obstructive Pulmonary Disease (COPD) is a significant public health challenge in Sub-Saharan Africa (SSA), driven by diverse risk factors such as household air pollution, occupational expo- sures, and smoking. This study provides a comprehensive analysis of COPD burden, including prevalence, mortality, disability, and attributable risk factors across SSA from 1990 to 2021, using data from the Global Burden of Disease (GBD) 2021 study.*

Methods: *The study utilized GBD 2021 data, which integrates multiple sources and employs advanced modeling techniques to estimate COPD metrics. Key outcomes included age-standardized prevalence, years lived with disability (YLDs), mortality, years of life lost (YLLs), and disability-adjusted life years (DALYs). Risk factor attributions were analyzed to identify regional variations.*

Results: *In 2021, SSA had an estimated 9.7 million COPD cases, with an age-standardized prevalence of 1787 per 100,000, marking a 7% increase since 1990. COPD-related disability (YLDs) reached 925,053, while mortality declined by 22% compared to 1990, with 105,000 deaths in 2021. COPD prevalence increased significantly from age 45 onwards, with notable gender disparities emerging after age 70. Household air pollution and occupational exposures were the leading risk factors, though smoking dominated in Southern SSA. Regional disparities were evident, with Southern SSA showing the highest prevalence but stable trends, while Central, Eastern, and Western SSA experienced rising rates.*

Conclusion: *Despite decreasing mortality, COPD prevalence and disability burden in SSA continue to rise, underscoring the need for targeted interventions. Addressing household air pollution, occupational hazards, and improving healthcare access are critical to mitigating COPD's impact. Policymakers should prioritize region-specific strategies to reduce risk factors and enhance COPD management across SSA.*

Keywords: Burden, COPD, Sub-Saharan Africa, Chronic Respiratory Diseases, DALYs, YLDs, Global Burden of Disease, Risk Factors.

List of Abbreviations

COPD - Chronic Obstructive Pulmonary Disease FEV1 - Forced Expiratory Volume in 1 second FVC - Forced Vital Capacity GOLD - Global Initiative for Chronic Obstructive Lung Disease ICD-10 - International Classification of Diseases, 10th Revision ICD-9 - International Classification of Diseases, 9th Revision

LLN - Lower Limit of Normal
ERS - European Respiratory Society
DW - Disability Weight
BMI - Body Mass Index
GBD - Global Burden of Disease (Study)
SSA - Sub-Saharan Africa
YLDs - Years Lived with Disability DALYs - Disability-Adjusted Life Years YLLs - Years of Life Lost
UI - Uncertainty Interval ASR - Age-Standardized Rate PC - Percentage Change
HAP - Household Air Pollution
NCD - Noncommunicable Disease
LMIC - Low- and Middle-Income Countries HAQ - Healthcare Access and Quality (Index) SEV - Standardized Exposure Variable
LDI - Lag-Distributed Income
DisMod-MR - Disease Modeling Meta-Regression (GBD's modeling tool)
MR-BRT - Meta-Regression – Bayesian, Regularized, Trimmed
BOLD - Burden of Obstructive Lung Disease (Study)
MEPS - Medical Expenditure Panel Survey
GET omics - Gene-Environment-Time interactions
LPG - Liquefied Petroleum Gas
TB - Tuberculosis

Introduction

Chronic obstructive pulmonary disease (COPD) is defined by Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2023 as a heterogeneous lung condition characterized by chronic respiratory symptoms (dyspnea, cough, expectoration and/or exacerbations) due to abnormalities of the airways (bronchitis, bron- chiolitis) and/or alveoli (emphysema) that cause persistent, often progressive, airflow obstruction. COPD results from dynamic, cumulative and repeated gene (G)–environment (E) interactions over the lifetime (T) that damage the lungs and/or alter their normal development/aging processes (GET omics) [1].

The WHO highlights COPD as a leading noncommunicable disease (NCD) in low-resource settings, exacer- bated by household air pollution (HAP) and limited diagnostic capacity [2]. The Global Burden of Disease (GBD) studies estimate that COPD is the third-leading cause of global mortality, with SSA experiencing rising prevalence due to aging populations and persistent risk factors like biomass fuel use.

The causes of COPD are multi-factorial: Cigarette smoking COPD (COPD-C) caused by abnormal inflam- matory response to the inhaled products of cigarette combustion, but not all develop air flow limitation. Biomass and pollution exposure COPD (COPD-P) important cause of COPD particularly for women. These patients have less emphysema and more airways involvement, as well as slower lung function decline, than patients with cigarette-induced COPD. COPD due to infections (COPD-I) related with respiratory syncytial virus, other viruses and a history of Tuberculosis treatment. COPD and Asthma (COPD-A), patients with severe and uncontrolled asthma can develop chronic airflow limitation. COPD of unknown causes (COPD-U) may be the result of the interaction of several factors. Genetics (COPD-G) and abnormal lung development (COPD-D) are also considered as COPD causes.

Two main phenotypes exist: The airway type, which is the predominant type and is characterized by chronic obstructive bronchitis with persistent cough and sputum expectoration for at least 12 months. And the emphysema type, with rarefaction of peripheral pulmonary vessels, decreasing gas exchange area and exercise capacity, and cough and/or sputum expectoration [3].

Chronic obstructive pulmonary disease (COPD) is the third leading cause of death worldwide, causing 3.23 million deaths in 2019. Nearly 90% of COPD deaths in those under 70 years of age occur in low- andmiddle-income countries (LMIC). COPD is the seventh leading cause of poor health worldwide (measured by disability-adjusted life years). Tobacco smoking accounts for over 70% of COPD cases in high-income countries. In LMIC tobacco smoking accounts for 30–40% of COPD cases, and household air pollution is a major risk factor [4].

In sub-Saharan (SSA) countries population based studies a review and meta-analysis was conducted and it showed the prevalence of COPD ranged from 1.7% to 24.8% (pooled prevalence: 8%, 95% CI 6–11) [5]. Different studies in SSA even in Africa shows different prevalence range [5, 6, 8, 25]. Mehrotra et al. (2009) reported a wide range of COPD prevalence between different SSA countries and the lack of spirometers and quality spirometry services in much of the subcontinent [6]. Van Gemert et al. (2011) focused on the risk factors for asthma and COPD: current or ever smoking, prior TB, occupational exposures, indoor and outdoor air pollution, biomass fuel use [7]. The systematic reviews by Adeloye et al. (2012) and Finney et al. (2013) revealed the shortage of spirometry and lack of a noncommunicable disease healthcare strategy in most African countries as barriers to diagnosis [8, 9]. A systemic review conducted in East Africa estimate the overall pooled prevalence of COPD to be 13.3% and approximately one of every seven individuals in East Africa has COPD, indicating a notably high prevalence of the disease [10].

Regional disparities are evident, with Southern SSA having the highest prevalence, while Central, Eastern, and Western SSA show increasing trends [11, 12]. Country-specific studies reveal further variations: Uganda: A cross-sectional study found a 16.2% COPD prevalence, linked to biomass smoke exposure [13]. Ethiopia: A community-based study reported 12.4% prevalence, with smoking and biomass fuel as key contributors [14]. Tanzania: The BOLD study estimated 8.1% prevalence, with underdiagnosis due to limited spirometry access [15, 16].

Underdiagnosis remains a critical challenge, with over 80% of COPD cases undetected in some regions due to lack of spirometry and healthcare infrastructure [17, 18].

The burden of chronic obstructive pulmonary disease (COPD) in Sub-Saharan Africa is driven by multiple interconnected risk factors that reflect the region's unique environmental and socioeconomic conditions. Understanding these risk factors is crucial for developing targeted interventions to reduce disease burden. The GBD 2021 study identifies HAP from solid fuels and occupational particulate matter as the leading risk factors for COPD in SSA, accounting for a significant proportion of disability-adjusted life years (DALYs). This aligns with extensive evidence linking biomass fuel exposure to chronic respiratory

disease, particularly among women in rural communities [19, 20]. Occupational hazards, including dust and chemical fumes in mining, agriculture, and manufacturing, further contribute to disease burden, especially in countries with extractive industries [21, 22].

Notably, the role of smoking in SSA differs from global patterns. While tobacco use drives over 70% of COPD cases in high-income nations, it contributes to only 30–40% of cases in SSA, with regional variations. Southern SSA, including South Africa and Lesotho, exhibits higher smoking-attributable COPD due to urbanization and tobacco industry influence [23, 24]. In contrast, other regions face compounded risks from HAP and infectious sequelae (e.g., post-tuberculosis lung damage) [25, 26]. Emerging evidence also implicates ambient air pollution as a growing threat in urban centers, though data remain sparse [27, 28].

The Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) provides detailed, comprehensive, and timely reporting on population health by underlying causes of disability and premature death, complex patterns of disease and injury burden over time and across age groups, sexes, and locations. A global network of collaborators contributed to the production of GBD 2021 by providing, reviewing, and analysing all available data. GBD estimates are updated routinely with additional data and refined analytical methods [29].

In a previous study (2019) of systemic analysis of global burden of disease study (GBD) in SSA reported that the prevalence cases of COPD in SSA were estimated to involve 10.3 million people (95% UI 9.7 million to 10.9 million), showing an increase of 117% compared with the number of all-age COPD cases in 1990. A steady increase over the past three decades is noticed and has progressively become a major public health burden across the region [30]. Lack of generalizability, limited sample size, high non-participation rate, challenges to identify causal risk factors, over- and under-diagnosis and self-reported age have been described as some of the major limitations to understand the distribution and risk factors for COPD in Africa. Our goal is to provide updated information based on the GBD 2021 report currently available.

In SSA, analyses of the burden and attributable risk factors of COPD are limited, and we couldn't find up to dated studies. Therefore, the primary objective of this study is to address this evidence gap and to provide estimation of prevalence, mortality, risk factors, disability association with COPD in SSA countries. Additional we will try to show the trends and variations on the national levels observed in a period of between 1990 to 2021.

Method Overview

Clinical Definition

Chronic inflammatory lung disease that causes obstructed airflow and breathing problems. It includes emphysema and chronic bronchitis.

Case Definition

COPD is defined as in the Global Initiative for Chronic Obstructive Lung Disease (GOLD) classification: a measurement of <0.7 FEV1/FVC (one second of forceful exhalation/total forced expiration) on spirometry after bronchodilation. The severity grading of COPD follows this GOLD class definition: Mild(l), Moderate (II), and Severe (IV) with FEV1 score >=80% of normal, 50-79% of normal, and include J41, J42, J43, J44, and J47. The corresponding ICD-9 codes are 491-492, and 496. J40 & 490 (Bronchitis, not specified as acute or chronic) and J47 & 494 (Bronchiectasis) were removed from COPD mapping in GBD 2017.

Alternative case definitions that differ from the GOLD post-bronchodilation definition are as follows: GOLD pre-bronchodilation, lower limit of normal (LLN) post-bronchodilation, LLN pre-bronchodilation, and Eu- ropean Respiratory Society (ERS) guidelines. These are all different methods of evaluating whether an individual has COPD.

Data Input Sources

GBD 2021 synthesises a large and growing number of data input sources including surveys, censuses, vital statistics, and other health-related data sources. Prevalence, incidence, and remission data relating to COPD are extracted from literature provided by collaborators or found with a systematic review. All data include spirometry-based measures. Other data come from hospital claims data for non-fatal estimation and vital registrations for cause of death.

While no systematic review of the literature was completed for GBD 2021, additional data were included from key relevant survey series, GBD collaborators and an opportunistic search using previous system- atic review search string in PubMed was conducted. New data added this round include the English Longitudinal Study of Aging (ELSA), Korea National Health and Nutrition Examination Survey, BOLD related publications, and several sources from scientific literature. Citations for specific GBD compo- nents, causes and risks, and locations can be found through the Data Input Sources Tool in GHDx: http://ghdx.healthdata.org/gbd/2020/data-input-sources.

Disease Modelling Strategy

There are two different steps in the estimation of COPD burden. First, a DisMod-MR 2.1 model is used to estimate prevalence and incidence. Since people with COPD never fully recover, remission is set to 0 in this step. Only the symptoms are treated. The ceiling on incidence is set at 0.0002 for ages under 15 and 0.0005 for ages under 30 to prevent estimates from increasing in age ranges where primary data is scarce or nonexistent. A set of nation-level covariates that characterize spatiotemporal patterns are included in each model. COPD standardized exposure variables (SEV) aggregates multiple risk factors into a single variable. Healthcare Access and Quality (HAQ) Index on EMR to capture country-level variation of EMR, assuming a negative coefficient (ie, lower mortality with rising GDP and HAQ). The priors of HAQ Index came from the EMR MR-BRT prediction. The proportion of elevation over 1500m was included as a country-level covariate on EMR because of its significance in COPD cause of death models [31].

The GOLD class classifications in DisMod-MR 2.1 are used to estimate the proportion of COPD severities in the second stage. After presenting the numbers as a percentage of all COPD cases, the GOLD class models make use of data from surveys that indicated prevalence by GOLD class. To aid in estimating, the

log of lag-distributed income (LDI) per capita and fixed effects was used from the SEV scalar for GBD 2016. These factors did not yield significant coefficients; thus they had eliminated them for GBD 2017 and did not utilize them for GBD 2019 or GBD 2021. Additionally, random effects were limited to +/-0.5 to account for improbable geographic variance. Following these two stages, the prevalence and incidence of COPD are divided for each severity level by age, sex, and geography [32].

Data processing Age and Sex Split

In some cases, data are reported by only age or only sex, but not both. For example, a study may have included the prevalence of males and females with COPD and then separately reported the prevalence for both sexes in smaller age bins (eg, age 40–45, 46–50, etc.) that have COPD. In these cases, we perform an age-sex split by utilizing proportions within the study to disaggregate the data [33].

When data are not disaggregated into male and female categories for a given data source, we instead perform a sex-split on the data by applying sex proportions from other studies that do have male- and female-specific data. When data are aggregated into age categories larger than 25 years, we split into smaller age bins based on super-regional age patterns in the 2017 COPD model [34].

Severity Splits

The three GOLD class groupings show a grading system that uses physiological measurements instead of direct assessments of the severity of the disease. US Medical Expenditure Panel Survey (MEPS) data used from 2001–2011 to map the epidemiological findings by GOLD class into the three COPD health states for which had disability weights (DW). In particular, the midpoint of the MEPS years of analysis translated, or the 2005 GOLD class designations calculated for the USA, into the GBD classifications of asymptomatic, mild, moderate, and severe COPD [35].

The three COPD health states, along with the related disability weights and lay descriptions, are displayed in the table 1. The table displays the average proportion for each GOLD class for all ages in the USA in 2005 (after scaling to 100%). Additionally, the percentage of MEPS participants reported interacting with health services for COPD within the previous year and had a DW value attributable to the disease of 0. These categories are classified as mild, moderate, and severe, with mild range being between DW values for mild and moderate and moderate and severe, and severe range being between DW values for moderate and severe or higher. The relationship between GOLD class and GBD COPD health states in the United States applies everywhere.

Table 1: Description of health states

Health state	Lay description	DW (95% CI)
Mild COPD	This person has cough and shortness of breath after heavy physical activity but is able to walk long distances and climb stairs.	0.019 (0.011–0.033)
Moderate COPD	This person has cough, wheezing, and shortness of breath, even after light physical activity. The person feels tired and can walk only short distances or climb only a few stairs.	0.225 (0.153–0.31)
Severe COPD	This person has cough, wheezing, and shortness of breath all the time. The person has great difficulty walking even short distances or climbing any stairs, feels tired when at rest, and is anxious.	0.408 (0.273–0.556)

Risk Factors

Different risk factors has been identified such as: male sex, smoking (current, past, or ever), advanced age (per 10-year increase, 50–59 years, >60 years), BMI of less than 18·5 kg/m2, ambient ozone pollution, childhood hospital admission for severe respiratory disease, family history of obstructive lung disease, history of tuberculosis, biomass exposure, and occupational exposure to dust or smoke [36, 37].

Result

Prevalence of COPD in SSA

In 2021, all-age prevalent cases of COPD in SSA were estimated to involve 9.7 million people (95% UI 8.7 million to 10.8 million), with an age-standardized point prevalence of 1787 per 100,000 (95% UI: 1579.4, 1991.3 per 100,000) which was 7% (95% UI: 5%, 10%) higher than 1990 (Table 2). Lesotho, and Cabo Verde had respectively the highest and lowest age-standardized COPD prevalence for both sexes [Fig. 1, 2].

Table 2: Age standardized rate and percentage change of all age COPD prevalence and COPD attributable YLDs in 2021 by Sub-Saharan Africa country

	ASRs in both sex prevalnet cases, 2021 (95% UI)	PC in ASRs prevalnet cases, 1990-
Sub-Saharan Africa	1,787 (1991-1579)	7%
Angola	1672 (1899 -1444)	-5%
Benin	1705 (1930-1496)	5%
Botswana	2017 (2287-1774)	2%
Burkina Faso	1608 (1829-1426)	8%
Burundi	1878 (2111-1651)	10%

Cabo Verde	1001 (1138-873)	2%
Cameroon	1574 (1800-1383)	4%
Central African Republic	2145 (2436-1878)	10%
Chad	1858 (2113-1625)	9%
Comoros	1492 (1696-1300)	-1%
Congo	1717 (1955-1502)	5%
C^ote d'Ivoire	1692 (1935-1490)	9%
Democratic Republic of the Congo	2030 (2309-1800)	16%
Djibouti	1412 (1603-1230)	7%
Equatorial Guinea	1732 (1979-1523)	-6%
Eritrea	1544 (1765-1344)	1%
Eswatini	1922 (2174-1708)	-1%
Ethiopia	1715 (1918-1509)	-6%
Gabon	1531 (1768-1331)	10%
Gambia	1778 (2005-1574)	9%
Ghana	1672 (1876-1471)	16%
Guinea	1842 (2068-1626)	14%
Guinea-Bissau	1758 (2001-1541)	5%
Kenya	1529 (1716-1330)	8%
Lesotho	2335 (2647-2077)	8%
Liberia	1718 (1947-1498)	20%
Madagascar	1858 (2121-1648)	15%
Malawi	1531 (1729-1352)	18%
Mali	1846 (2078-1627)	11%
Mauritania	1501 (1725-1317)	10%
Mozambique	1571 (1772-1376)	11%
Namibia	2047 (2328-1801)	3%
Niger	1946 (2210-1710)	17%
Rwanda	1830 (2058-1622)	7%
Sao Tome and Principe	2084 (2340-1858)	18%
Senegal	1680 (1901-1480)	9%
Sierra Leone	1770 (1987-1551)	10%
Somalia	2117 (2404-1859)	16%
South Africa	2171 (2437-1917)	0%
South Sudan	1601 (1818-1405)	9%
Togo	1726 (1960-1505)	9%
Uganda	1663 (1880-1467)	1%
United Republic of Tanzania	1538 (1744-1356)	11%
Zambia	1548 (1774-1346)	10%
Zimbabwe	1799 (2076-1574)	7%

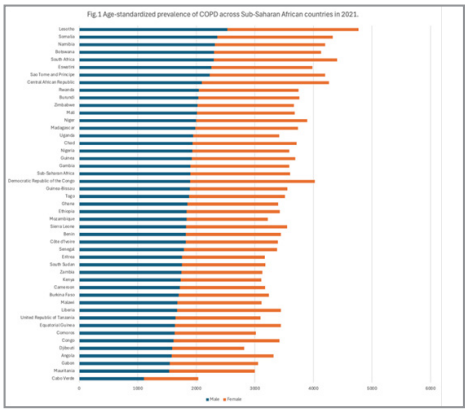


Figure 1: Age-standardized Prevalence of COPD Across Sub-Saharan African Countries in 2021

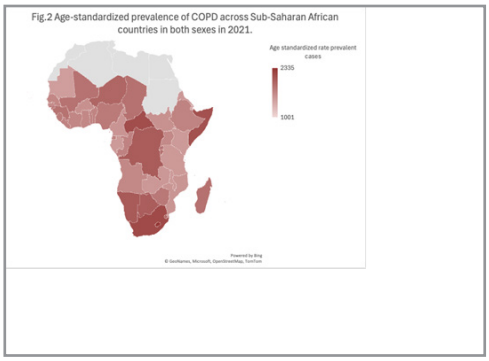


Figure 2: Age-standardized Prevalence of COPD Across Sub-Saharan African Countries in Both Sexes in 2021

The age-specific prevalence of COPD started to increase at age 45 years for both sexes. Important percentage differences in COPD prevalence were observed between males and females from age 70 years ranging from 10% to 45% and reaching the peak at age 95+ years [Fig. 3].

From 1990 to 2021 the prevalence rate of COPD showed an increased trend in Central, Eastern and Western Sub-Saharan Africa, whereas in Southern Sub-Saharan African countries showed stable trend though it is the highest region in age-standardized COPD prevalence [Fig. 3.1]. In all the regiones there is no significant difference between both sexes.

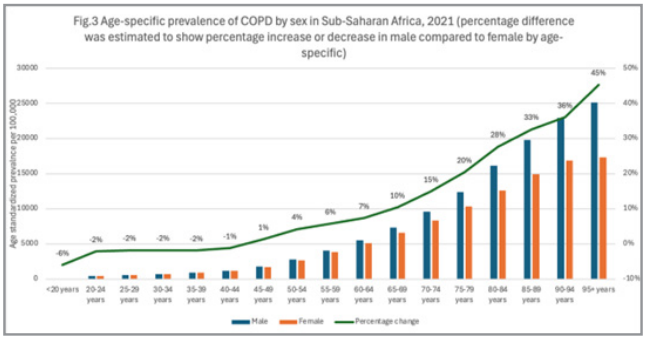
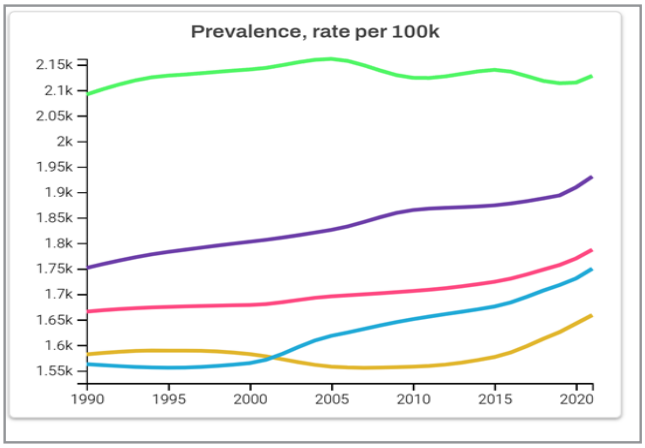


Figure 3: Trend in age-standardized prevalence rate of COPD by region in Sub-Saharan Africa, 1990–2021.



Years Lived with Disabilities due to COPD

In 2021, Sub-Saharan Africa counted 925,053 (95% UI 742,280 to 1.09 million) years lived with disabilities (YLDs) due to COPD. Nigeria, followed by South Africa and Ethiopia, had the highest YLDs due to COPD in 2021. From 1990 to 2021, Sub-Saharan African countries presented an increased percentage change in all-age YLDs due to COPD ranging from 39% in Lesotho to 339% in Djibouti (Table 2).

According to GBD comparative risk assessment framework seven risk factors were considered which are ambient particulate matter pollution, Household air pollution from solid fuels, occupational particulate matter, gases, and fumes, secondhand smoke, smoking, ambient ozone pollution and low temperature. In 2021, household air pollution from solid fuel followed by occupational particulate matters, gases, and fumes were the major contributors to the age standardized YLDs rate per 100,000 in Sub-Saharan Africa. Smoking followed by ambient particulate matter pollution accounted for the major fraction of COPD attributable YLDs in southern Sub-Saharan Africa whereas in western SSA household air pollution from solid fuel is followed by ambient particulate matter pollution [Fig 4]. In male and females.

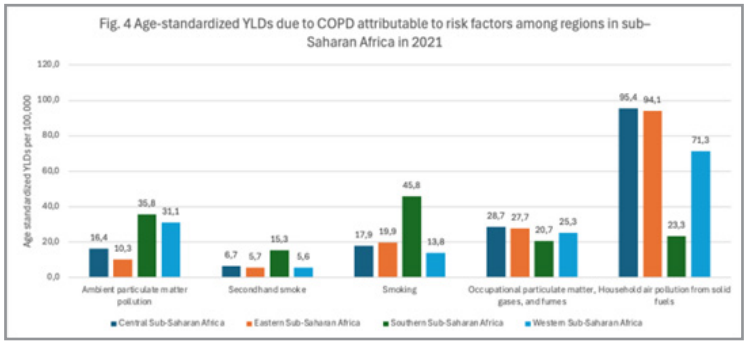


Figure 4: Age-Standardized YLDs Due to COPD Attributable to Risk Factors Among Regions in Sub-Saharan Africa in 2021

Mortality and Year Life Lost (YLL) Due to COPD

In 2021, about 105 thousand people (95% UI 91 thousand to 121 thousand) died due to COPD in Sub-Saharan Africa, with a 22% decrease in age-standardized death rate compared to 1990. The highest reduction of COPD age-standardized death rate was reported in Cabo Verde (56.7%) for both sexes followed by Equatorial Guinea (55.4%) and Rwanda (46.5%) in 2021 compared to the age standardized death rate in 1990. On other hand, only in Lesotho, Zimbabwe and Kenya COPD age standardized death rate increased by 22%, 14% and 7% respectively in the same period (Table 3).

All the regions of SSA showed decreased trend of age-standardized death rate from 1990 to 2021 except the southern SSA has a rapid increase in rate of deaths due to COPD and then a decrease since 1999 [Fig. 5].

Table 3: COPD attributable deaths and YLLs in 2021 and percentage change from 1990 to 2021 across Sub-Saharan Africa country.

	Death	YLL	ASR Death	ASR YLL	PC ASR death	PC ASR YLL
Sub-Saharan Africa	104660	2367134	29	533	-22%	-24%
Angola	2333	55383	29	538	-41%	-45%
Benin	981	21957	24	444	-34%	-36%
Botswana	388	8335	35	641	-46%	-47%
Burkina Faso	1341	29741	19	340	-19%	-21%
Burundi	1343	31224	38	704	-36%	-39%
Cabo Verde	66	1229	16	287	-57%	-59%
Cameroon	2385	57546	25	473	-36%	-35%
Central African Republic	845	22250	56	1106	-17%	-17%
Chad	1389	33141	31	590	-9%	-8%
Comoros	103	2152	26	477	-38%	-41%

Congo	674	15978	36	668	-39%	-42%
C^ote d'Ivoire	2004	48671	24	459	-34%	-34%
Democratic Republic of the Congo	12257	287452	48	886	-8%	-8%
Djibouti	88	2081	20	377	-35%	-35%
Equatorial Guinea	91	2056	25	455	-55%	-60%
Eritrea	707	17785	37	702	-29%	-34%
Eswatini	237	5838	52	1075	-24%	-18%
Ethiopia	8817	186640	25	463	-43%	-50%
Gabon	204	4479	26	477	-42%	-43%
Gambia	244	5513	31	578	-14%	-16%
Ghana	1782	42052	14	262	-7%	-7%
Guinea	1336	29552	29	540	-18%	-17%
Guinea-Bissau	195	5218	36	722	-30%	-32%
Kenya	5824	128943	35	627	6%	7%
Lesotho	618	14482	68	1384	13%	22%
Liberia	421	10042	27	494	-24%	-23%
Madagascar	3941	96519	54	975	-11%	-12%

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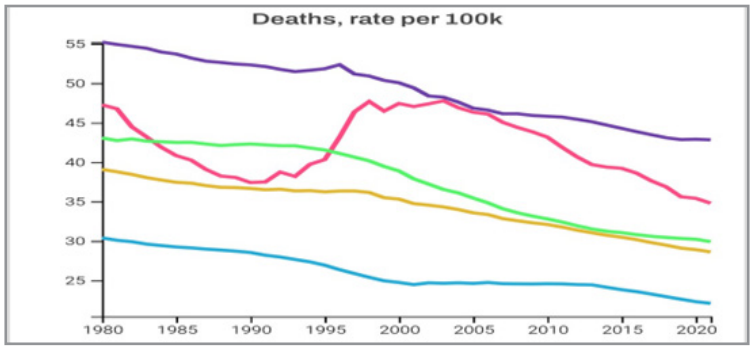

Figure 5: Trend in age-standardized death rate of COPD by region in Sub-Saharan Africa, 1990–2021

In 2021, household air pollution followed by occupational particulate matters and smoking was responsible for the largest fraction of the age-standardized death and YLLs rate due to COPD in sub–Saharan Africa. Smoking followed by ambient particulate matter pollution, low temperature and secondhand smoke accounted for the major fraction of COPD attributable Death and YLLs in southern Sub-Saharan Africa whereas in Central SSA household air pollution from solid fuel followed by occupational particulate matters and ambient ozone pollution plays the largest role.

Disability Adjusted Life Years Due to COPD

In 2021, COPD was responsible for 700 [850 in males, 577 in females] DALYs rate per 100,000 in Sub-Saharan Africa. Lesotho had the highest rate of DALYs attributable to COPD both for males [2329 per 100,000] and females [1213 per 100,000] whereas Cabo Verde [388 per 100,000] in both sex and Ghana [412 per 100,000] had the lowest rate of both sexes DALYs but in terms of sex composition Mauritania showed the lowest rate in male sex [523 per 100,000] [Fig. 6]. All Sub-Saharan countries except Lesotho, Zimbabwe, Kenya, and Mozambique showed a percent change reduction, Ghana showed neither reduction nor increment in COPD related DALYs rate whereas Equatorial Guinea and South Africa showed the highest (53%) and lowest (4%) percentage reduction, respectively.

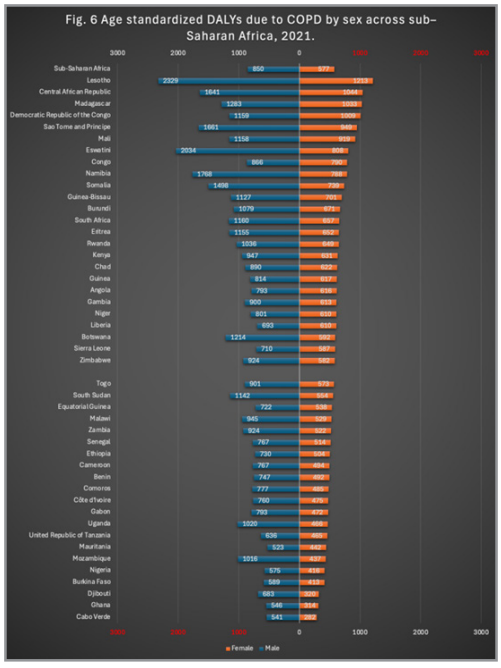

Figure 6: Age Standardized DALYs Due to COPD by Sex Across Sub-Saharan Africa, 2021

COPD related to household air pollution risk contributed to the highest rate of DALYs per 100,000 in Sub-Saharan Africa followed by Occupational particulate matter, gases, and fumes and smoking. In 2019, smoking and ambient particulate matter were ranked 1st and 2nd contributors for DALYs rate attributable to COPD across Southern Sub-Saharan Africa whereas in the rest of the regions Household air pollution from solid fuels followed by Occupational particulate matter, gases, and fumes are the highest [Fig. 7]. The reduction of percentage contribution of household air pollution exhibited similar trend to the reduction of age-standardized DALY rate due to COPD in Sub-Saharan Africa (Fig. 10). In Somalia, household air pollution from solid fuel was responsible for 80–85% of age-standardized DALYs rate due to COPD.

[CHART]

Discussion

The findings from the Global Burden of Disease (GBD) 2021 study on Chronic Obstructive Pulmonary Disease (COPD) in Sub-Saharan Africa (SSA) reveal important trends and patterns that both align with

and differ from previous research in the region.

Prevalence and Trends

The GBD 2021 data estimates 9.7 million people living with COPD in SSA, with an age-standardized prevalence of 1787 per 100,000 population. This represents a 7% increase from 1990, indicating a growing public health concern. These findings are consistent with earlier studies, such as the 2019 GBD analysis which reported 10.3 million COPD cases in SSA, showing a 117% increase from 1990. In contrast, the Global Burden of

Disease (GBD) 2019 study indicates a broader global increase in COPD prevalence, attributed to demographic shifts and exposure to risk factors such as smoking and air pollution (GBD Diseases and Injuries Collaborators, 2020). However, the rate of increase in SSA seems slower compared to regions with higher smoking rates, underscoring the unique regional factors contributing to COPD in SSA. This aligns with the systematic review by Adeloye et al. (2015), which estimated COPD prevalence in Africa at 4.9% with wide regional variation. Both findings emphasize the significant and growing public health burden of COPD in SSA.

Regional Variations

The study reveals significant variations across SSA regions, with Southern SSA showing the highest preva- lence despite a stable trend, while other regions experienced increasing trends. This heterogeneity aligns with previous observations by Mehrotra et al. (2009), who reported wide ranges of COPD prevalence between different SSA countries.

Age and Gender Disparities

The GBD 2021 data shows that COPD prevalence begins to rise significantly at age 45 for both sexes, with notable gender differences emerging from age 70 onwards. This age-related increase is consistent with global patterns of COPD and supports the findings of Van Gemert et al. (2011), who identified age as a key risk factor.

Risk Factors

The major contributors to COPD-attributable YLDs in SSA were household air pollution from solid fuels and occupational exposure to particulate matter, gases, and fumes. This aligns with the World Health Organization's recognition of household air pollution as a major risk factor in low- and middle-income countries (4). Studies by Sana et al. (2020)16 and Mortimer et al. (2022)17 corroborate that biomass fuel use is a predominant risk factor for COPD in SSA, particularly among women. The reliance on traditional cooking methods disproportionately affects rural populations, contributing to high COPD rates in these areas.

However, it's important to note that in Southern SSA, smoking and ambient particulate matter pollution were the primary risk factors, highlighting regional differences in exposure patterns.

Smoking remains a significant risk factor. Van Gemert et al. (2015)18 and GBD Risk Factors Collaborators (2020)11 note that while smoking prevalence in SSA is relatively low compared to high-income countries, it remains a major contributor to COPD in urban areas. Occupational exposure to dust and fumes is another key contributor identified in both this analysis and studies such as Zoller et al. (2018)19, which examined chronic airflow obstruction in Tanzania.

Our analysis does not extensively discuss ambient air pollution as a significant risk factor, while other studies, including Hystad et al. (2019)20 and Rylance et al. (2020)21, highlight its growing role in urban areas due to rapid industrialization and vehicular emissions.

Mortality Trends

Despite the increasing prevalence, there has been a 22% decrease in the age-standardized death rate due to COPD in SSA from 1990 to 2021. This improvement in mortality rates, despite rising prevalence, suggests advancements in COPD management and treatment across the region. However, the trend is not uniform, with countries like Lesotho, Zimbabwe, and Kenya showing increases in COPD-related mortality [38]. This is consistent with global trends observed in the GBD 2017 study (22), which attributes declining mortality rates to advancements in healthcare and better management of respiratory diseases (Li et al., 2020)23.

Disparities persist across SSA. Countries like Nigeria and Ethiopia bear a disproportionate burden of COPD- related disability-adjusted life years (DALYs), as noted in both our analysis and the GBD study (2019)11. Meanwhile, countries with stronger health systems, such as South Africa, report relatively lower DALYs and mortality rates, highlighting the importance of healthcare infrastructure.

Conclusion

The GBD 2021 findings provide a more nuanced picture compared to earlier meta-analyses. For instance, a systematic review in East Africa estimated the overall pooled prevalence of COPD to be 13.3%12, which is higher than the SSA-wide prevalence reported in the GBD 2021 study. This difference could be due to regional variations within SSA or methodological differences between studies.

The GBD 2021 study also addresses some of the limitations noted in previous research, such as the lack of spirometry data and quality spirometry services highlighted by Adeloye et al. (2012)8 and Finney et al. (2013)9.

By incorporating a wide range of data sources and using standardized methodologies, the GBD 2021 study provides a more comprehensive and comparable assessment of COPD burden across SSA countries.

In conclusion, while the GBD 2021 study confirms many findings from previous research, it also provides updated and more detailed insights into the COPD burden in SSA. The study highlights the complex interplay of increasing prevalence, decreasing mortality, and varying risk factors across the region, emphasizing the need for tailored, country-specific approaches to COPD prevention and management in Sub-Saharan Africa.

Implications and Recommendations

The GBD 2021 study reinforces COPD as a major but underprioritized public health issue in SSA, with distinct epidemiological patterns shaped by environmental, occupational, and healthcare access factors. To mitigate this burden, a multi-sectoral approach is essential:

Household Energy Interventions: Scaling up clean cooking technologies (e.g., LPG, electric stoves) to reduce HAP exposure, particularly for women and rural populations.

Tobacco Control: Implementing stricter regulations on tobacco sales and advertising, especially in high- prevalence regions.

Healthcare Strengthening: Expanding spirometry access, training primary care providers, and integrating COPD management into existing NCD and TB programs.

Surveillance and Research: Investing in longitudinal studies to track disease progression and evaluate inter- vention cost-effectiveness. Public health strategies should also focus on addressing gender and age-specific needs, given the disparities highlighted

in this study. In conclusion, while the burden of COPD in SSA continues to grow, declining mortality rates offer a glimmer of hope. Targeted, evidence-based interventions can further mitigate the impact of COPD and improve the quality of life for millions in the region.

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