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Estimating the prevalence of COPD in an African country: evidence from southern Nigeria

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Abstract

 # Background—Though several environmental and demographic factors would suggest a high burden of chronic obstructive pulmonary disease (COPD) in most African countries, there is insufficient country-level synthesis to guide public health policy.

 # Methods—A systematic search of MEDLINE, EMBASE, Global Health and African Journals Online identified studies reporting the prevalence of COPD in Nigeria. We provided a detailed synthesis of study characteristics, and overall median and interquartile range (IQR) of COPD prevalence in Nigeria by case definitions (spirometry or non-spirometry).

 # Results—Of 187 potential studies, eight studies (6 spirometry and 2 non-spirometry) including 4,234 Nigerians met the criteria. From spirometry assessment, which is relatively internally consistent, the median prevalence of COPD in Nigeria was 9.2% (interquartile range, IQR: 7.6–10.0), compared to a lower prevalence (5.1%, IQR: 2.2–15.4) from studies based on British

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Medical Research Council (BMRC) criteria or doctor's diagnosis. The median prevalence of COPD was almost the same among rural (9.5%, IQR: 7.6–10.3) and urban dwellers (9.0%, IQR: 5.3–9.3) from spirometry studies.

 # Conclusions—A limited number of studies on COPD introduces imprecision in prevalence estimates and presents concerns on the level of response available across different parts of Nigeria, and indeed across many countries in sub-Saharan Africa.

Keywords

epidemiology; prevalence; COPD; chronic respiratory disease; Nigeria

Chronic obstructive pulmonary disease (COPD) is a progressive, potentially life-threatening lung disease that affects over 380 million adults worldwide with an estimated global economic cost of over $2 trillion.[1–3] In 2015, COPD accounted for 3.2 million deaths, representing 5% of all global deaths, with more than 90% occurring in low- and middle-income countries (LMICs).[1,4]

In Nigeria and across many countries in sub-Saharan Africa, COPD is a major public health problem.[5–7] The prevalence of tobacco smoking, a major risk for COPD, is increasing in many settings, particularly among the younger population groups.[8] Outdoor air pollution continues to worsen, particularly in growing urban settings, contributing further to increased risk.[4] Further, second-hand smoke and indoor smoke from the use of unclean cooking and heating fuels are major risks among women and children in many rural settings.[9] Low income, poor nutrition, childhood respiratory infections, tuberculosis, and HIV infection, are additional COPD risks that have been reported in many African settings, including Nigeria.[10] Yet, facilities and strategies for prevention, early diagnosis, treatment and overall management of COPD have been relatively limited and are currently suboptimal.[1112] Additionally, the awareness of COPD is poor, hence government and policymakers don't consider COPD a health priority.[5,11,13,14] Consequently, diagnosis is often missed and treatments are not guideline-based.[5,11,14,15]

Priority setting and policy making rely on perceived disease burden, and evidence of COPD burden in many parts of Africa is largely lacking.[10,12] A relative lack of standard diagnostic facilities and the required expertise to perform spirometry are among the key factors.[3,6,16] In Nigeria, available data on COPD burden have been based on varying survey protocols and case definitions.[13] Consequently, there is not yet a comprehensive epidemiologic description of the COPD burden in the country. To fill this knowledge gap, we systematically searched for available evidence on COPD in Nigeria and provided a detailed synthesis of COPD prevalence in the country to further raise awareness of the burden.

METHODS

The study was conducted and reported according to the PRISMA guidelines.[17]

Search strategy

Epidemiologic studies of COPD in Nigeria were identified in MEDLINE, EMBASE, Global Health (CABI), and Africa Journals Online (AJOL) using a combination of search terms (Table 1). Searches were first conducted on 01 December 2021 with this updated on 04 July 2022 and limited to studies published after 1 January 1990. Unpublished documents were sourced from Google Scholar and Google searches. Titles and abstracts of studies were reviewed, and full texts of relevant studies were accessed. The reference lists of accessed full texts were further hand-searched for additional studies. When necessary, we contacted the authors of selected papers for any missing information.

Selection criteria

We sought population-based studies reporting on the prevalence of COPD in a Nigerian setting. As there were very few population-based studies from our initial searches, we also searched for hospital-based studies on the prevalence of COPD and only selected such studies if they were conducted among out-patients and provided enough data on the catchment population of the hospital on which the prevalence estimate was based. We excluded other hospital-based or clinical reports, studies on Nigerians in the diaspora, reviews, viewpoints, and commentaries.

Case definitions

There are existing limitations in the case definition and diagnosis of COPD across Africa and many LMICs.[1,4] Hence, to have a broad view of current research efforts, we included all studies based on COPD irrespective of the case definitions employed and presented results based on individual case definitions. First, we included studies that were based on spirometry, as these are largely consistent with the diagnosis of COPD worldwide.[18,19] We employed the Global Initiative on Obstructive Lung Disease (GOLD) recommended a fixed ratio of forced expiratory volume in one second (FEV_1) to forced vital capacity (FVC) that is less than 0.7 ($FEV_1/FVC<0.7$).[18] We also considered studies with the ratio (FEV_1/FVC) less than the lower limit of normal (LLN), which is calculated by subtracting the standard deviation (multiplied by 1.64) from the mean.[18] This is because respiratory physicians have argued that using a fixed ratio may potentially result in underdiagnoses in younger patients and more frequent diagnoses in the elderly, as lung elasticity decreases with age.[2,4] Second, we included studies based on the British Medical Research Council (BMRC) questionnaire for chronic bronchitis in which there is an affirmative response to the definition “daily productive cough for at least three consecutive months for more than two successive years”.[20] Third, we considered any studies based on a previous COPD diagnosis by a physician. We sorted our data and analysis based on these criteria – spirometry and non-spirometry (BMRC and doctor’s diagnosis).

Data extraction

Eligible studies were independently assessed by two reviewers (BMA and YL). An eligibility guideline was applied to ensure consistency in selection. The disagreement was resolved in another meeting with the DA. From selected studies, data on the location, study period, study design, study setting (urban, rural, or mixed), sample size, diagnostic criteria

and mean age of the population were extracted, and matched with corresponding data on COPD cases, sample population, the prevalence of COPD in the study.

Quality assessment

From each full text, study design and methodology, case definitions, and the generalizability of the reported estimates to a larger population within the Nigerian geo-political zone were further checked, by adapting a previously used quality guideline for studies on the burden of chronic diseases.[21–24] We checked for sampling approach (was it representative of a target subnational population?), statistical methods (was it appropriate for the study outcome?), and case ascertainment (was it based on spirometry, BMRC criteria, informal interviews, or not reported?). Studies were graded as *high (4–5), moderate (2–3), or low quality* (*0–1*) (see Tables 2 and 3, and online supplementary document for details of all full-text manuscripts accessed and quality grading).

Data analysis

We provided a narrative synthesis of study characteristics and individual estimates of COPD prevalence from each study. Due to limited data and observed high heterogeneity in a preliminary analysis, we found pooling by meta-analysis inappropriate for this study (see online supplementary document for details). Rather, we estimated each study's median and interquartile range (IQR) separately by case definitions (spirometry or non-spirometry). We have applied this approach in a previous study on COPD prevalence in Africa[12]. All statistical analyses were conducted on Stata (Stata Corp V.14, Texas, USA).

RESULTS

Search results

The search of the databases returned 184 studies (MEDLINE 66, EMBASE 102, Global Health 12, and AJOL 4) and 3 additional studies were identified through Google Scholar and hand-searching reference lists of relevant studies. After removing duplicates, applying the aforementioned selection criteria, and full-text examinations, a total of 8 studies[25–32] were included (Figure 1).

Study characteristics

The 8 studies yielded 17 data points. There were 15 data points from the South-west and 2 from the South-south of Nigeria. There were no studies from the northern region. Rural dwellers had 13 data points, while urban had four (Table 3). Six studies were based on a spirometry-defined epidemiologic assessment and two on non-spirometry definitions (BMRC criteria or doctor's diagnosis). Only one of the spirometry-based studies was based on LLN.[26] Two studies were based on a review of out-patient cases matched to an estimated catchment population[25,28]. The study period ranged from 1992 to 2016, with most studies conducted within one year. The total sample population from all studies was 4,234, with a mean age ranging from 35.8 to 55.0 years (Table 3). Four studies were rated high quality and four moderate (Table 3, Online supplementary document).

Prevalence of COPD in Nigeria

The lowest COPD prevalence was reported in a study of soldiers in Ibadan, Oyo State, South-west Nigeria, with an estimated prevalence of 2.2% using the BMRC criteria[29]. The highest prevalence of COPD was reported among factory workers in the oil-producing city of Port Harcourt, Rivers State, South-south Nigeria at 9.0%. Another high prevalence was estimated in the peri-rural setting of Ile-Ife, Osun State, South-west Nigeria at 7.7%[26]. The distribution of the crude prevalence rates from individual studies appears to be rising with increasing age and study years. For example, the Ibadan study[29] was conducted in 1992 with a mean age of 35.8 years, while the Port Harcourt study[31] had a mean age of 52 years and was conducted in 2016.

From studies based on spirometry, the median prevalence of COPD in Nigeria was 9.2% (interquartile range, IQR=7.6–10.0) (Table 4). As observed in Figure 2, the median prevalence was lower with wide IQR from studies based on BMRC criteria or doctor's diagnosis (5.1%, IQR=2.2–15.4). The wide IQR may further underpin the uncertainties from studies based on BMRC criteria or doctor's diagnosis, with higher heterogeneity (I^2=74.3%, P=0.001) observed in a preliminary analysis, compared to a lower heterogeneity from spirometry studies (I^2=45.6%, P=0.065).

Sex-specific estimates from spirometry assessment revealed a higher median prevalence among men at 8.6% (IQR=7.6–10.5) compared to women at 6.3% (IQR=3.8–6.7) (Table 4). Only one study[27] reported sex-specific estimates for non-spirometry studies, at 6.7% among men and 5.1% in women.

In terms of residence, the median prevalence of COPD was slightly higher in rural settings (9.5%, IQR=7.6–10.3) compared to urban settings (9.0%, IQR=5.3–9.3) from spirometry studies (Table 4). Although generally lower in non-spirometry studies, the median prevalence was also higher in rural settings at 5.4% (IQR=4.0–15.4), compared to 2.2% reported in the only non-spirometry study conducted among urban dwellers[29].

From all studies, the prevalence of COPD increased with the rising mean age of the sample population (Figure 3).

COPD prevalence in the WHO African region

To compare estimates from other African settings with Nigeria, we ran additional literature searches for studies in the World Health Organization (WHO) African region. The highest spirometry-based prevalence of COPD at 23.8% was estimated in Cape Town, South Africa, in 2005[19]. The lowest prevalence (2.3%) was reported in the Mbarara district, Uganda, in 2018[33] (Table 5).

DISCUSSION

Herein, we provide the first national estimates of the prevalence of COPD in Nigeria. With Nigeria being the most populous country in Africa, our findings are also relevant on the continent, and useful for relevant international comparisons.

Our review revealed that there is an absence of a nationally representative study on COPD prevalence across Nigeria, similar to observations in many African countries.[6,10,12] There is a strong likelihood that our estimates are under-estimations due to the lack of data, varying case definitions, and underdiagnoses across several settings.[10,34] However, based on available data, we noted higher and internally consistent estimates from studies based on spirometry (compared to non-spirometry), but still with very low levels of certainties in terms of national and sub-national representativeness. The prevalence of COPD we have estimated in Nigeria in this review is lower than reported in some other African settings. For example, a 2015 spirometry-based survey that followed standard survey protocols in Uganda revealed a higher estimate of COPD prevalence at 16.2%,[35] which is similar to our previous estimate of 13.4% in Africa.[12] The highest spirometry-based prevalence of COPD in Africa at 23.8% was estimated in Cape Town, South Africa, in 2005.[19] Asides from the lack of data from many settings, there is no clear explanation for the lower comparative COPD prevalence in Nigeria, thus suggesting a need for a nationally representative study on prevalence, risk factors, economic burden and outcome.

As observed in this study, higher COPD prevalence among men is common in the literature.[19,26,34] However, women are generally more susceptible to COPD exposures compared to men, presenting with a faster annual decline in FEV_1 and a higher risk of hospital admissions and death from respiratory failure and related comorbidities.[36,37] Women may also be more affected in rural settings where data and surveillance may be weaker or variable in population coverage completeness. In Nigeria and many African settings, rural dwellers are regularly exposed to smoke from firewood and other biomass fuels, as this is the main source of energy for cooking.[5,12] In this study, the relatively similar prevalence of COPD among rural and urban dwellers (9.5% vs 9.0% from spirometry assessment) further underpins a rising burden in rural settings. Smoke from biomass fuel, in contrast to tobacco smoking, is an important and highly prevalent risk for COPD among women in rural Africa where over 90% of the population employ this for domestic cooking, and are exposed at an average of 3–5 hours daily in poorly ventilated kitchens.[35]

Existing programs for the prevention, care and management of COPD in Nigeria are mostly poorly developed,[5,38] reflective of Africa more broadly. In a survey of 106 physicians in 34 countries, Mehrotra and colleagues[39] reported that only 23 physicians satisfactorily used spirometry to diagnose COPD, and effective treatment is largely unavailable or unaffordable for diagnosed cases. There is a strong need for strategies to improve population-wide awareness and provision of facilities for the diagnosis and treatment of COPD.[6,8] These programs are likely to be most effective if adequate capacity is developed at the primary care levels of health delivery which is likely the first point of contact for most patients in urban and rural settings.[3]

The main limitation of this study is the narrow national representation of the available data. For example, there were no studies from the northern regions, and we also extracted data from some hospital-based studies for better insight into the burden of COPD at facility levels. We also had challenges from varying prevalence rates, a wide range of populations, inconsistent diagnostic criteria, and inconsistent study designs and quality.[6,39]

CONCLUSIONS

Studies on the prevalence of COPD in Nigeria are still mainly from the southern parts of the country, and many of these are not based on spirometry. This presents huge uncertainties on the current level of evidence. Furthermore, it presents concerns on the level of response available across different parts of the country, and indeed across many countries in Africa, for a disease currently rated the third leading cause of death globally. This study has provided some insights on the burden of COPD in Nigeria, relevant for policies, programming, and future research in the country and Africa.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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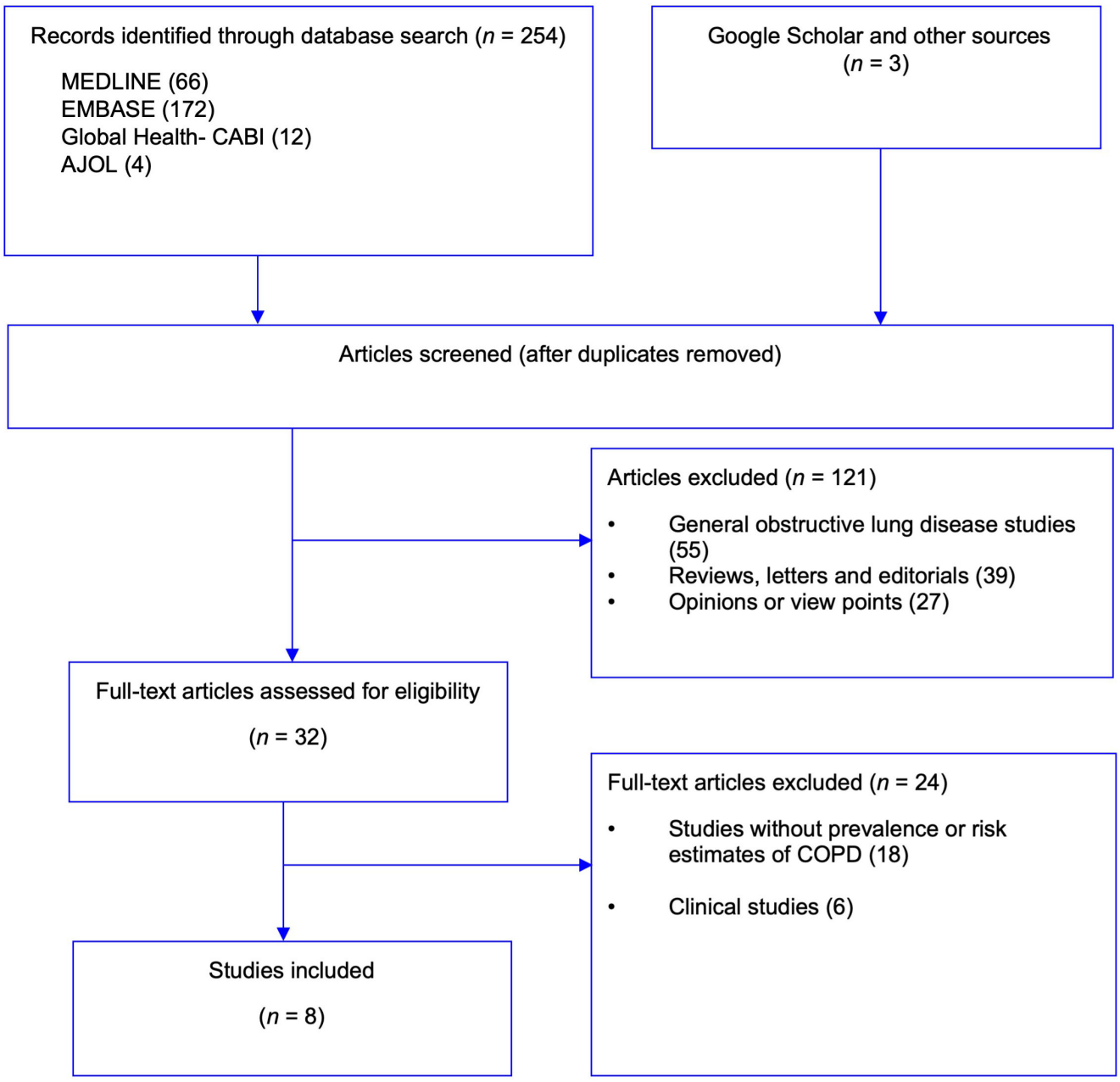

FIGURE 1.
Flow chart of selection of studies on chronic obstructive pulmonary disease (COPD) in Nigeria.

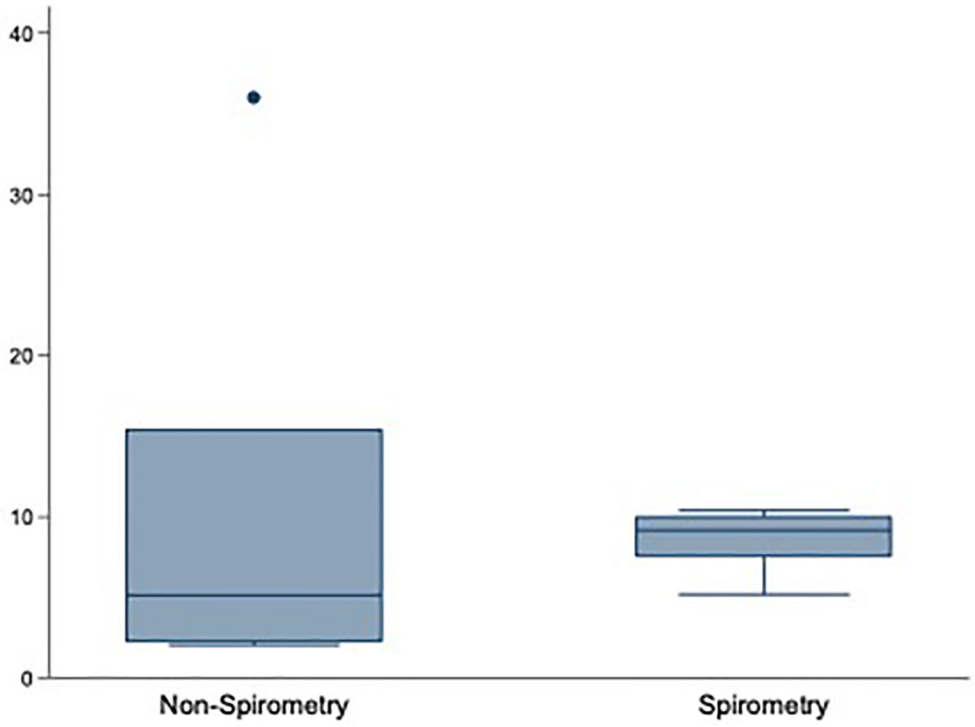

FIGURE 2.
Distribution of chronic obstructive pulmonary disease (COPD) prevalence in Nigeria by case definition.

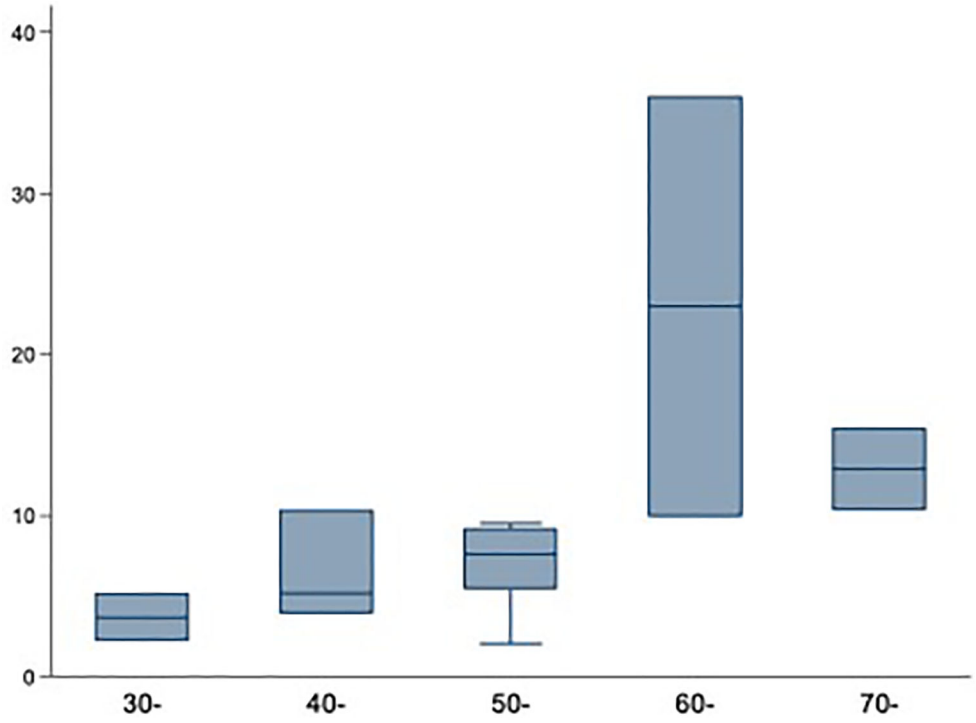

FIGURE 3.

The prevalence of chronic obstructive pulmonary disease (COPD) in Nigeria by age (in years).

TABLE 1.

Search terms on chronic obstructive pulmonary disease (COPD) in Nigeria.

#	**Searches**
1	exp Nigeria/
2	exp vital statistics/
3	(incidence* or prevalence* or morbidity or mortality).tw.
4	(disease adj3 burden).tw.
5	exp “cost of illness”/
6	case fatality rate.tw
7	hospital admissions.tw
8	Disability adjusted life years.mp.
9	(initial adj2 burden).tw.
10	exp risk factors/
11	2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10
12	exp chronic obstructive lung disease / or copd / or chronic obstructive airway disease / or chronic bronchitis /or emphysema
13	1 and 11 and 12
14	Limit 13 to “1990-current”

TABLE 2.

Quality assessment of selected studies.

Quality criteria	Assessment	Score	Maximum score
Sampling method (was it representative of a target subnational population?)	Yes	1	1
	No	0	
Appropriateness of statistical analysis	Yes	1	1
	No	0	
Case ascertainment (was it based on spirometry, BMRC criteria, informal interviews, or not reported?)	Spirometry	3	3
	BMRC or doctor's diagnosis	2	
	Informal interviews	1	
	Not-reported	0	
Total (*high (4–5), moderate (2–3), or low quality* (*0–1*))			5

TABLE 3.

Characteristics of studies on prevalence of chronic obstructive pulmonary disease (COPD) in Nigeria.

Author	Study period	Location	Geopolitical zone	Study design	Case definition	Study Setting	Age range (mean)	Sample	Overall prevalence, CI (%)	Quality
Adeniyi et al.[25]	2012	Owo, Ondo State	South-west	Hospital based retrospective study	FEV1/FVC < 0.7	Semi-urban/ Rural	25+ (50.0)	914	7.6	Moderate
Obaseki et al.[26]	2012	Ile-Ife, Osun State	South-west	Population-based cross-sectional study	FEV1/FVC < LLN	Semi-urban/ Rural	40+ (53.3)	875	7.7	High
Desalu et al.[27]	2009	Ido-Ekiti, Ekiti State	South-west	Population-based cross-sectional study	BMRC criteria or doctor's diagnosis	Semi-urban/ Rural	35+ (55.5)	391	5.6	Moderate
Desalu et al.[28]	2004–2010	Ido-Ekiti, Ekiti State	South-west	Hospital based retrospective study	FEV1/FVC < 0.7	Semi-urban/ Rural	18+ (49.9)	368	10.3	Moderate
Harris-Eze[29]	1992	Ibadan, Oyo State	South-west	Population-based cross-sectional study	BMRC criteria or doctor's diagnosis	Urban	18+ (35.8)	804	2.2	Moderate
Douglas & Katchy[31]	2016	Port-Harcourt, Rivers State	South-south	Population-based cross-sectional study	FEV1/FVC < 0.7	Urban	40+ (52.0)	200	9.0	High
Ozoh et al.[30]	2012	Idi-Araba, Lagos	South-west	Population-based cross-sectional study	FEV1/FVC < 0.7	Urban	40+ (53.7)	412	5.3	High
Gathuru et al.[32]	1999	Benin, Edo State	South-south	Population-based cross-sectional study	FEV1/FVC<0.7	Urban	30–69 (47.0)	270	9.3	High

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Table 4.

Crude estimates of prevalence of COPD in Nigeria.

			Both sexes		Men		Women	
			Prevalence (IQR) %	***Data points***	***Prevalence (IQR) %***	***Data points***	***Prevalence (IQR) %***	***Data points***
Diagnostic criteria	***Spirometry***		9.2 (7.6–10.0)	10	8.6 (7.6–10.5)	3	6.3 (3.8–6.7)	3
	BMRC or doctor's diagnosis		5.1 (2.2–15.4)	7	6.7	1	5.1	1
Settings	***Spirometry***	*Rural*	9.5 (7.6–10.3)	7	-	-	-	-
		Urban	9.0 (5.3–9.3)	3	-	-	-	-
	BMRC or doctor's diagnosis	*Rural*	5.4 (4.0–15.4)	6	-	-	-	-
		Urban	2.2	1	-	-	-	-

Table 5.

Prevalence of spirometry-confirmed COPD in the WHO African region

First Author	Study period	Country	Location	Setting	Protocol	Screening	Age	Sample	Cases	Prevalence (%)
Buist[19]	2005	South Africa	Cape Town	Urban	BOLD	FEV1/ FVC<0.7	40+	847	202	23.8
Fullerton[40]	2001	Malawi	Southern Malawi	Mixed	ATS/ERS	FEV1/ FVC<0.7	30+	332	45	13.6
Khelafi[41]	2011	Algeria	Algiers	Mixed	ATS/ERS	FEV1/ FVC<0.7	21+	1800	87	4.9
Magitta[42]	2018	Tanzania	Simuyu	Rural	BOLD	FEV1/ FVC<0.7	35+	496	87	17.5
Musafiri[43]	2008–2009	Rwanda	Huye & Kigali	Mixed	Standard questionnaire	FEV1/ FVC<LLN	15+	1824	82	4.5
Musafiri[43]	2008–2009	Rwanda	Huye & Kigali	Mixed	Standard questionnaire	FEV1/ FVC<0.7	15+	1824	212	11.6
North[33]	2015	Uganda	Mbarara	Rural	Standard questionnaire	FEV1/ FVC<0.7	18–93	565	13	2.3
Pefura-Yone[44]	2013–2014	Cameroon	Yaounde	Rural	ATS/ERS	FEV1/ FVC<LLN	19+	1276	31	2.4
Van Gemert[35]	2012	Uganda	Masindi	Rural	Standard questionnaire	FEV1/ FVC<0.7	30+	588	95	16.2