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Prevalence and Risk Factors of COPD in Nepal: A Systematic Review and Meta-Analysis

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ABSTRACT

Background: Chronic Obstructive Pulmonary Disease is a common, preventable, and treatable disease. Here, we conducted a systematic review of Chronic Obstructive Pulmonary Disease and its risk factors in Nepal for the last two decades.

Methods: We systematically searched databases to find all relevant Chronic Obstructive Pulmonary Disease research papers from 2000 to 2020. Two reviewers screened the literature using Covidence based on the study protocol. Data extraction was done using Microsoft Excel from selected studies. Final data analysis was done using CMA v.3. Our review protocol is available in PROSPERO (CRD42020215486) on 20 November 2020.

Results: The database search revealed 1416 studies of which 13 were included in quantitative analysis. The prevalence of Chronic Obstructive Pulmonary Disease in the adult population was 22·7% (CI, 12·5-37·7) of whom 54·9% were female (CI, 51·9-57·9). Nearly three-fourth of the participants (73·1%) of Chronic Obstructive Pulmonary Disease patients had informal education (CI, 58·6-84·0). The commonest primary occupation was agriculture and farming in 39·4% (CI, 31·3-48·2), followed by homemaker (36·8%). It was observed that 28·5% of the Chronic Obstructive Pulmonary Disease patients were former smokers, 25·8% non-smokers, and 59·4% were current smokers. More than two-third (76·2%) of Chronic Obstructive Pulmonary Disease patients relied upon traditional firewood cooking, whereas only 14.6% was adopted fireless cooking.

Conclusions: The pooled prevalence of Chronic Obstructive Pulmonary Disease in Nepal was significantly high with more cases in females compared to males. Smoking and traditional firewood cooking were major risk factors among Chronic Obstructive Pulmonary Disease cases in Nepal.

Keywords: Chronic obstructive pulmonary disease; cooking; tobacco smoking.

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a common respiratory condition resulting from airflow limitation, which includes emphysema and chronic bronchitis.[1,2] The global prevalence of COPD was 13·1%, and in Asia, it was estimated to be 13·5% in 2019.[3] The age-standardized prevalence of COPD in Nepal is comparable over the past two decades (4,899·1/100,000 to 4,810·3/100,000 from 1990-2016), predominantly affecting males.[4] Risk factors for COPD include tobacco smoking, indoor air pollution with the use of biomass fuel for cooking, second-hand smoke exposure, aging, and genetic factors.[5,6] According to a nationwide survey in 2016, 27% of males were smokers, 66% of households used solid fuels for cooking, and 31% of households were exposed to second-hand smoke.[7] COPD attributes about 90% of deaths in low- and middle-income countries and exposure to risk factors of COPD is high in Nepal.[8,9] No prior meta-analyses have pooled the prevalence and risk factors of COPD in Nepal. Thus, we conducted this meta-analysis by pooling data from studies published from 2000-2020.

METHODS

We used the MOOSE guideline for reporting this systematic review.[10] After the preliminary search and literature review on our research questions, we prepared our protocol. We then published our protocol in PROSPERO (CRD42020215486) on 20 November 2020.[11]

This systematic review included published cross-sectional studies and observational studies reporting the prevalence of COPD in Nepal from 1 January 2000 to 31 December 2020, including adult patients diagnosed

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with COPD, and/or studies with details of COPD such as risk factors, outcome, and outcome predictors. Only the peer-reviewed articles published in English were included in the study.

However, editorials, commentary, viewpoints, and studies lacking adequate data of interest, and studies conducted outside Nepal were excluded.

The study included all patients diagnosed with COPD who were more than 18 years of age.

We systematically searched databases (PubMed, PubMed Central, Embase, Scopus, and Google Scholar) to find all relevant papers from 2000 till 2020 related to COPD in Nepal using appropriate keywords like "Chronic Obstructive Pulmonary Disease", "COPD", "Emphysema", "Chronic Bronchitis" and "Nepal". The team also manually searched the bibliographies of initially selected articles (snowballing) to identify more relevant studies. Two reviewers screened the title and abstracts of included studies using Covidence based on the study protocol and any conflict was resolved with the third reviewer's opinion.[12]

We have included our detailed electronic search strategy in Supplementary file 1.

DATA COLLECTION AND ANALYSIS

A data extraction form was created in Microsoft Excel. This form included (a) title of the study, (b) name of the authors, (c) study year, (d) study design, (e) sample size, (f) prevalence, (g) study area, (h) demographic details like age, sex, marital status, occupation, ethnicity [upper caste (Brahmin and Chhetry), lower caste, and other ethnic groups], eco-developmental region, and (i) various risk factors like smoking history, cooking method, second-hand smoking, physical activity, occupational exposure to dust/dirt, other concomitant diseases, and outcomes like left ventricular ejection fraction (LVEF). Three researchers independently extracted data using the data extraction form. Then, three researchers individually cross-checked and critically reviewed the data extracted by the other two researchers. Any form of dispute that arose during the data extraction process was resolved by group consensus.

Assessment of risk of bias in included studies

Two researchers independently determined the risk of bias of included studies using the Joanna Briggs Institute (JBI) tool (Table 1).[13] This study used a quality assessment checklist to assess the quality of included studies. All discrepancies that arose during the quality assessment process were solved by group consensus.

Table 1. JBI critical appraisal of included studies.

Study	Was the sample frame appropriate to address the target population?	Were study participants sampled appropriately?	Was the sample size adequate?	Were the study subjects and the setting described in detail?	Was the data analysis conducted with sufficient coverage of the identified sample?	Were valid methods used for the identification of the condition?	Was the condition measured in a standard, reliable way for all participants?	Was there appropriate statistical analysis?	Was the response rate adequate, and if not, was the low response rate managed appropriately?
Adhikari TB et al.[14]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bhandari R et al.[15]	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bhandari GP et al.[16]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dhakal N et al.[17]	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dhimal M et al.[18]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Neopane A et al. [19]	Yes	NA	Yes	Yes	Yes	Yes	Yes	Unclear	Yes
Paudel B et al.[20]	Yes	NA	No	Yes	Yes	Yes	Yes	Yes	Yes
Prajapati BK et al.[21]	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Shrestha IL et al.[22]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Shrestha B et al.[23]	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Shrestha R (a) et al.[24]	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Shrestha R (b) et al.[25]	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Thapa N et al.[26]	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes

NA: Not Applicable

Assessment of heterogeneity

We assessed heterogeneity using the I-squared (I^2) test from the Cochrane Handbook for Systematic Reviews of Interventions for interpretation of I^2 tests. As per the standard assumption I^2 more than 50% is considered as significant and random effect model was used while in lower heterogeneities fixed effect model was adopted.

Data synthesis

We used CMA v.3 for data synthesis.[27] Proportion was used to pool the data with a 95% confidence interval, where appropriate.

SENSITIVITY ANALYSIS

Analysis pooling the proportion, sensitivity analyses were run excluding individual studies to depict the significant impact of that study on the overall result.

RESULTS

A total of 1416 studies were identified after database searching and we removed 176 duplicates. After screening the title and abstracts of 1240 studies, we excluded 1183 studies. We assessed the full text of 57 studies and 44 studies were excluded for definite reasons (Figure 1). We included 13 studies in our final quantitative and qualitative analysis (Table 2).

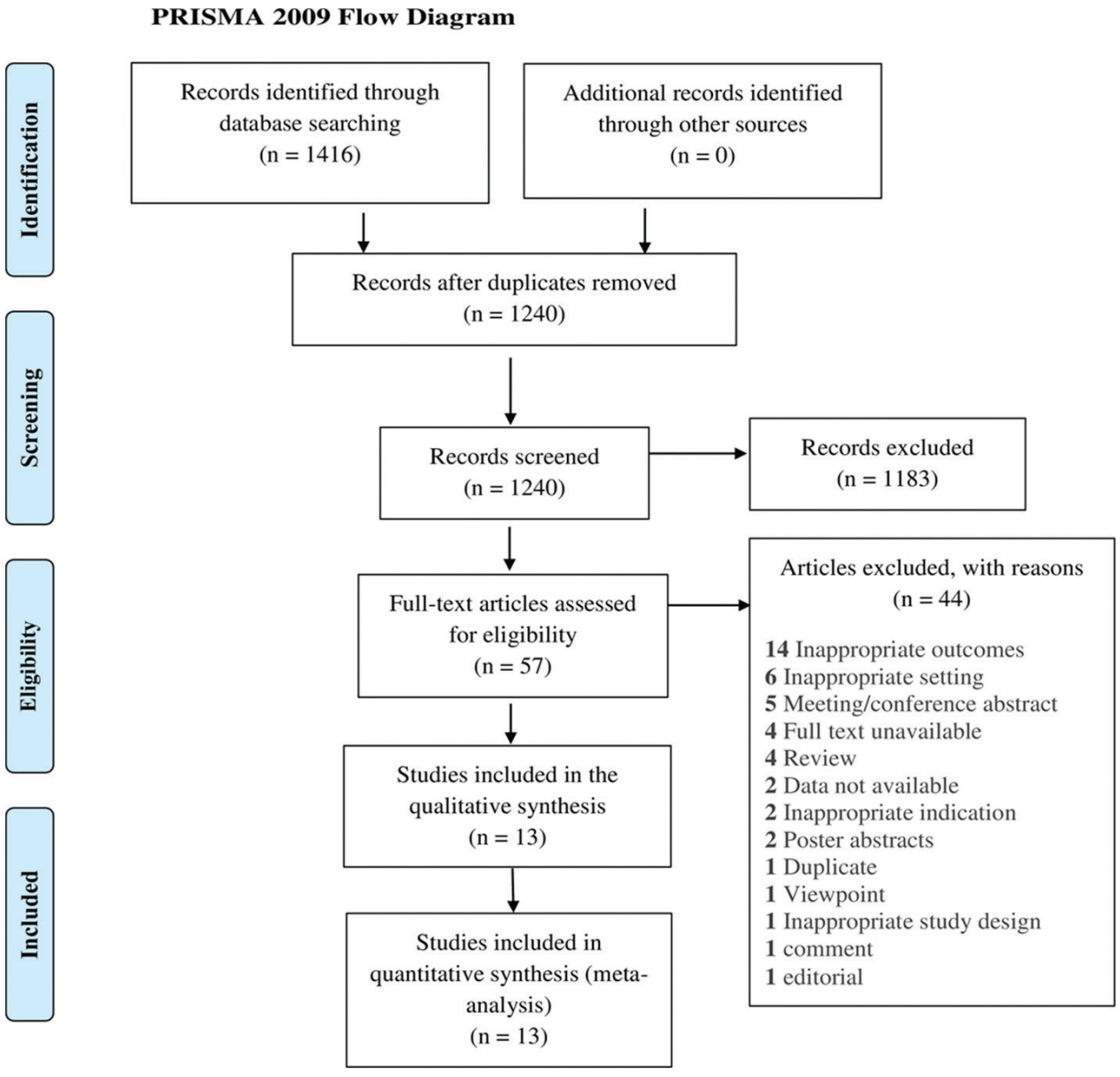

Figure 1. PRISMA Flow Diagram.

Table 2. Basic study details of included studies

Study	Study year	Study design	Sample	Study Location	Diagnostic method	Prevalence	Other reported outcomes
Adhikari TB et al.[14]	2019	Cross-sectional study	1438	Pokhara	Spirometry	122/1438	Risk factors like occupation, smoking history, and cooking methods
Bhandari R et al.[15]	2006-2009	Cross-sectional study	313	Mid-Western Regional Hospital	Clinical	-	Sociodemographic factors like sex, ethnicity, and education of COPD patients
Bhandari GP et al.[16]	2009-2010	Cross-sectional study	11,901	Nepal	As per International Classification of disease	-	Prevalence of other non-communicable diseases like diabetes and cancer
Dhakal N et al.[17]	2010-2011	Cross-sectional study	200	Nepal	Clinical	100/200	Risk factors like occupation and smoking history
Dhimal M et al.[18]	2016-2018	Cross-sectional study	8945	Nepal	Spirometry	1047/8945	Socio-demographic factors like sex, education, and socio-developmental region of patients
Neopane A et al.[19]	2005-2006	Cross-sectional study	228	Kathmandu	Spirometry	93/228	Risk factor like smoking in COPD patients
Paudel B et al.[20]	2006-2007	Prospective study	60	Pokhara	Clinical and spirometry	-	Left ventricular ejection fraction in COPD patients
Prajapati BK et al.[21]	2014-2015	Cross-sectional study	755	Dhulikhel Hospital	Spirometry	237/755	Risk factors like smoking history and occupation of COPD patients.
Shrestha IL et al.[22]	2003-2004	Cross-sectional study	168	Nepal	British Medical research questionnaire	-	Risk factors like smoking history and cooking methods of COPD patients
Shrestha B et al.[23]	2007-2008	Cross-sectional study	507	Kathmandu	Not mentioned	24/168	Left ventricular ejection fraction in COPD patients
Shrestha R (a) et al.[24]	2015	Cross-sectional study	100	Dhulikhel	Clinical	-	Socio-demographic factors like sex and education of COPD patients
Shrestha R (b) et al.[25]	2014-2015	Cross-sectional study	150	Tertiary Care hospital, Dhulikhel	Not mentioned	-	Risk factors occupation, like smoking history and cooking methods
Thapa N et al.[26]	2015-2016	Analytical Cohort study	198	Tansen, Okhaldhunga	Spirometry	-	Socio-demographic factors like sex, education, marital status

QUANTITATIVE ANALYSIS

COPD prevalence

In total, six studies have reported the prevalence of COPD in the adult population. Pooling of the data using random-effects model showed 22·7% (Proportion, 0·227; CI, 0·125-0·377, I^2=99) study participants with COPD (Figure 2). Sensitivity analysis by excluding individual studies did not result in significant changes (Supplementary file 2, Figure 1).

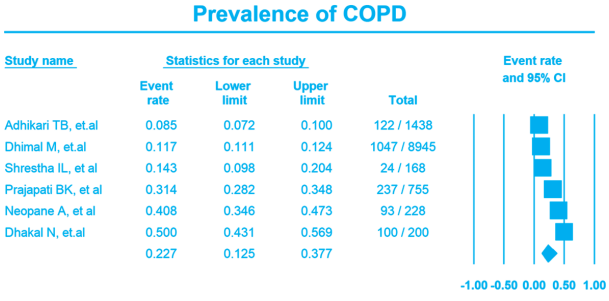

Figure 2. Forest plot showing the prevalence of COPD using random-effects model among studies reporting prevalence outcome.

Gender distribution of COPD

A total of 11 studies reported the gender-wise distribution of COPD cases. The pooling of the data showed 54·9% of COPD patients were female (Proportion, 0·549; CI, 0·519-0·579; I^2=64) (Supplementary file 2, Figure 2).

The literacy rate among COPD patients

Five studies reported educational status among COPD patients. The pooling of the data showed 73·1% of COPD patients had no formal education (Proportion, 0·731; CI, 0·586-0·840; I^2, 94) (Supplementary file 2, Figure 3).

Occupations among COPD patients

Among the COPD patients, the most common (39·4%) primary occupation was agriculture and farming (Proportion, 0·394; CI, 0·313-0·482; I^2, 89) followed by 36·8% housewife (Proportion, 0·368; CI, 0·270-0·478; I^2, 92), and 6·4% in white collar job (Proportion, 0·064; CI, 0·034-0·116; I^2, 85) (Figure 3).

Smoking status

There were three studies which reported 28·5% of the COPD patients were former-smoker (Proportion, 0·285; CI, 0·119-0·542, I^2, 93). Similarly, 59·4% of the participants were current smokers (Proportion, 0·594; CI, 0·334-0·810; I^2, 97) and remaining were non-smokers who had never smoked (Proportion, 0·258; CI, 0·110-0·495; I^2, 96) (Figure 4).

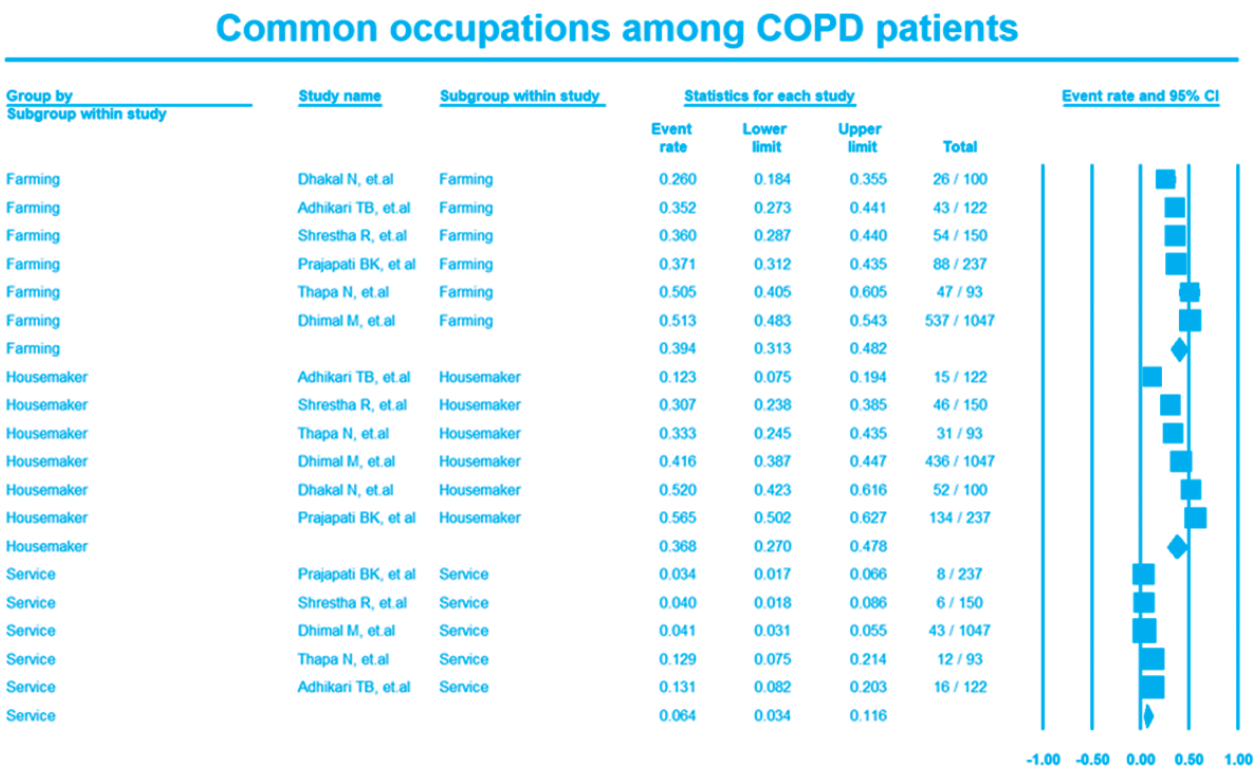

Figure 3. Forest plot showing common occupations among COPD patients using a random-effects model.

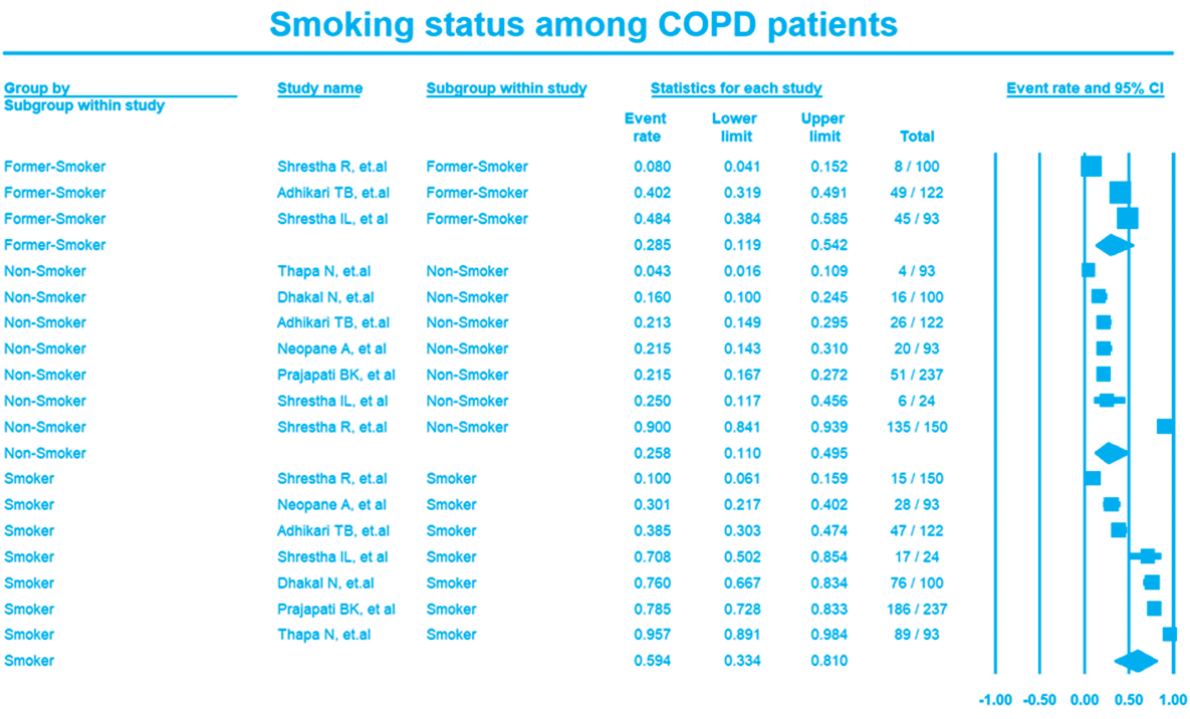

Figure 4. Forest plot showing smoking status among COPD patients using a random-effects model.

Primary cooking methods

Fireless cooking was reported to be used by 14·6% of COPD patients (Proportion, 0·146; CI, 0·099- 0·213) and reported only in one study. LPG use was reported in two studies and was used by only 5·1% (Proportion, 0·051; CI, 0·008-0·265; I^2, 80). A majority (76·2%) of COPD patients in three studies gave a history of traditional firewood cooking (Proportion, 0·762; CI, 0·488-0·914; I^2, 93) (Supplementary file 2, Figure 4).

Ethnicity, marital status, and area of residence

It is observed that 52·8% of COPD patients belonged to the upper caste (Brahmin and Chhetry) (Proportion, 0·528; CI, 0·472-0·585), 13·3% of the COPD patients were from lower caste (Proportion, 0·133; CI, 0·076-0·223), while 36·9% were from other ethnic groups (0·369; CI, 0·278-0·470). Two studies reported the marital status of the COPD patients, of whom 75·8% were married (Proportion, 0·758; CI, 0·687-0·817). Two studies reported eco-developmental setting of the COPD patients, where 80·7% (Proportion, 0·807; CI, 0·173-0·988) of patients were from rural settings (Supplementary file 2, figure 5).

GOLD stage and LVEF status

Two studies reported the Global Initiative for Chronic Obstructive Lung Disease (GOLD) stage of COPD patients. Pooling data of those two studies showed GOLD-II was the most common (43·7%) stage (Proportion, 0·437; CI, 0·387-0·489), next being GOLD-I (27·9%) stage (Proportion, 0·279; CI, 0·169-0·426), followed by GOLD-III (Proportion, 0·200; CI, 0·089-0·390) and GOLD-IV (Proportion, 0·068; CI, 0·046-0·100). Similarly, two studies reported LVEF status among COPD patients where 77·5% (Proportion, 0·775; CI, 0·712-0·828) had good LVEF while rest 22.5% (Proportion, 0·225; CI, 0·172-0·288) had poor LVEF (Supplementary file 2, figure 6).

Publication bias

The publication bias of included studies was assessed using Egger's funnel plot . For most of the outcomes assessed, there was asymmetry in the funnel plot but gender distribution of COPD showed a symmetrical plot (Supplementary file 2, figure 7).

DISCUSSION

The pooled prevalence of COPD in Nepal was 22·7% (95% CI, 12·5% - 37·7%). The previous study on the burden of COPD in Nepal estimated the prevalence of COPD at 4,810 per 100,000 in 2016.[4] The prevalence of COPD is likely to increase as the Nepalese population is aging because 7% of the current population were above 60 years contrary to 6% in 2011.[28] The most common stage was GOLD- II (43·7%) followed by GOLD- I (27·9%), GOLD-

III (20%) and GOLD- IV (6·8%).

The majority of patients with COPD were females (54·9%) compared to males (45·1%). We observed 59·4 % of patients with COPD were current smokers while 28·5% were former smokers with smoking accounting for 87·9% of COPD cases. The history of traditional firewood cooking was seen in 76·2% of patients. Our study highlighted the risk factors for COPD which were consistent with the findings of Nepal Demographic Health Survey 2016 which showed that 27% of males were smokers in comparison to 6% females, 66% households used solid biomass fuels such as firewood and animal dung for cooking, and 31% households were exposed to second-hand smoke.[7] Electricity is used for cooking by less than 1% and clean fuel by 29.3% of Nepalese population.[7] Smoking and traditional firewood cooking are the major risk factors for COPD in Nepal. The Nepalese Government has taken an initiative to promote renewable energy in geographically remote areas.[29] The higher prevalence of COPD among females may be because they are more involved in cooking. The use of firewood in poorly ventilated households by the female is common in Nepal.[7] COPD is a major health problem in Nepal which places Nepal second in the South East Asian Region (SEAR) countries and one of the leading countries in the world for COPD-related mortalities and Disability Adjusted Life Years (DALY).[30] The findings of our study show the importance of health promotion to prevent smoking and the use of firewood for cooking. We found a majority of COPD patients had a low level of education leading to inadequate knowledge about the hazards of smoking and the use of traditional firewood for cooking. The government of Nepal has a multisectoral action plan for the prevention and control of non-communicable diseases focusing on a reduction in premature mortality from non-communicable diseases by 25% till 2025.[31] As per our findings, the major challenges for policymakers are to improve the education and awareness about risk factors like smoking and traditional firewood to an illiterate population living in various remote areas of the country with limited access to health services and education. The use of fireless cooking should be promoted throughout the country decreasing the reliance on traditional firewood for cooking.

Our study is the first meta-analysis to evaluate the risk factors in COPD patients at a national level pooling the data from various parts of the country. Our study had several limitations. Firstly, there was a lack of an adequate number of studies focusing on the prevalence of COPD in Nepal. Additionally, included studies were mostly taking some clusters of population based on the geopolitical area or hospital settings so the generalizability of the study findings is another limitation. The heterogeneities could be explained by the variations in the patient population and their features. We could not evaluate DALYs and mortality due to a lack of relevant data in our search.

CONCLUSIONS

The pooled prevalence of COPD in Nepal was significant with increased cases in females compared to males. Smoking and traditional firewood cooking were major risk factors for COPD in Nepal so guideline to change these risk factors to decrease the burden of the COPD from policy-making level is warranted.

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