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Factors Associated with Chronic Obstructive Pulmonary Diseases in Nepal: Evidence from a Nationally Representative Population-Based Study

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Background: The Global Burden of Diseases Study 2017 predicted that chronic obstructive pulmonary disease (COPD) is the second leading cause of death, the fourth leading cause of premature death, and the third cause for DALYs lost in Nepal. However, data on the population-based prevalence of COPD in Nepal are very limited. This study aims to assess the prevalence of COPD and factors associated with the occurrence of COPD in Nepal.

Methods: From a nationally representative, population-based cross-sectional study on chronic non-communicable diseases, the prevalence of COPD and its associated factors was determined. Of 12,557 participants aged over 20 years, 8945 participants completed a questionnaire and spirometry. Eligible participants were also asked to answer a COPD diagnostic questionnaire for screening COPD cases, and if needed underwent pre-bronchodilator and post-bronchodilator spirometry. COPD was defined as a post-bronchodilator FEV1/FVC (forced expiratory volume in 1 s/forced vital capacity) ratio of <0.70. Multivariate logistic regression was performed to identify factors associated with COPD. Sampling weights were used for all data analyses.

Results: The prevalence of COPD in Nepal was 11.7% (95% CI: 10.5% to 12.9 %), which increased with age, and higher in those with a low educational level, those who had smoked ≥50 pack-years, persons having a low body mass index (BMI), and residents of Karnali province. Multivariate analysis revealed that being aged 60 years and above, having a low BMI, low educational status, having smoked more than 50 pack-years, provincial distribution, and ethnicity were independent predictors of COPD.

Conclusion: COPD is a growing and serious public health issue in Nepal. Factor such as old age, cigarette smoking, low educational attainment, low BMI, ethnicity, and locality of residence (province-level variation) plays a vital role in the occurrence of COPD. Strategies aimed at targeting these risk factors through health promotion and education interventions are needed to decrease the burden of COPD.

Keywords: COPD, prevalence, non-communicable diseases, Nepal

Background

Chronic obstructive pulmonary disease (COPD) is a major public health problem and one of the major causes of chronic morbidity and mortality worldwide.[1] According to the Global Burden of Disease (GBD) study, the prevalence of COPD was 3919 per 100,000 population globally and it was the third leading cause of global mortality in 2017.[2,3] More importantly, COPD is a major killer in low- and middle-income countries (LMICs) where more than 90% of COPD deaths occur.[4] Furthermore, COPD-associated mortality is predicted to increase by 160%

in the Southeast Asian region in the coming decades.[5] The economic impact of COPD among LMICs is also expected to increase to £1.7 trillion by 2030.[6] As per the GBD 2017 prediction, COPD is the second leading cause of death in Nepal, the fourth leading cause of premature death, and the third cause for disability-adjusted life years (DALYs) in Nepal.[1] In Nepal, some subnational, largely hospital-based studies have yielded a prevalence of COPD ranging from 23% to 43%.[7–9] A systematic analysis of the GBD Study by Soriano et al identified Nepal as one of the four countries with the highest age-standardized DALYs due to COPD in 2015.[10] A hospital-based study conducted among non-specialist institutions in Nepal showed COPD as the most (43%) common condition among outpatients followed by cardiovascular disease.[7] Taken together, this evidence suggests that the anticipated increase in the prevalence of COPD may further strain the health care systems of Nepal.

Being a multi-etiological disease condition, COPD is associated with several causal risk factors.[11] In Nepal, the prevalence and risk factors for COPD are expected to be high due to growing exposure, for example, to a high smoking rate and relatively high levels of air pollution.[12–15]

It has been shown that the reported prevalence of COPD varies around the globe mainly due to the use of different sampling methods, diagnostic criteria, and measurement modalities.[16] Amidst a dearth of evidence, the objective of this study is to determine the prevalence and associated risk factors of COPD in adults living in Nepal. It is the first national population-based prevalence study aimed at determining both the prevalence of COPD, through objective measurement using spirometry, and the associated determinants of this disease. The findings of this study will be important for informing health policy makers and health care providers aimed at improving the prevention and management of NCDs in Nepal in line with the global 25*25 target adopted by the World Health Organization and the health-related Sustainable Development Goal 3.[17]

Methods
Study Design and Subjects
This study has used data from the prevalence study of selected chronic non-communicable diseases in Nepal. This is a population-based, nationwide cross-sectional survey conducted from 2016 to 2018 in all seven provinces of Nepal. Data were collected through a multistage cluster sampling with a mix of probability proportionate to size (PPS) and systematic random sampling. The detailed methodology has been presented elsewhere.[18] Males and females aged ⩾20 years and residents in the study area for at least the last 6 months were eligible for participation in the study. One participant out of the eligible candidates in each selected household was selected to take part in the survey using the Kish method.[19] Research participants who had reported any eye, thoracic or abdominal surgery in the last two months, history of recent documented coronary artery disease (CAD), cough, hemoptysis, or pregnancy, were not included for spirometry. Of 13,200 participants who were approached for an interview, 12,557 accepted. Among 12,557 participants, only 8945 participants (67.8%) performed the spirometry test at an acceptable level. Figure 1 shows the flow diagram of the study conducted. The study was carried out following the principles of the Declaration of Helsinki. The ethical principles of respect, beneficence and justice were maintained throughout the data collection process. Ethical approval was received from the Ethical Review Board of Nepal Health Research Council (NHRC). Written informed consent from participants was ensured after informing the study participants about the objectives of the study and their rights to decline or withdraw from the study. The confidentiality and anonymity of the participants were maintained by assigning unique identification codes.

Data Collection Procedures
All recruited participants were invited to participate in the study at a convenient and accessible site or at home. The trained interviewers conducted face-to-face interviews using a standardized questionnaire to collect information about participants' socio-demographic and past medical history. For assessing COPD, trained interviewers administered the standardized COPD Diagnostic Questionnaire to screen participants for spirometry.[20,21] After an eligibility evaluation for spirometry, the interviewers took the participants through spirometry examination. Participants with airflow limitation (FEV1/FVC<0.70) were further examined with post-bronchodilator spirometry.

Spirometry and Diagnostic Criteria
Spirometry was performed using Spirolab III® model color LCD (MIR, Rome, Italy) to measure pulmonary functions. Three best spirometry readings, out of which the best two were within 200 mL of each other, were taken from each
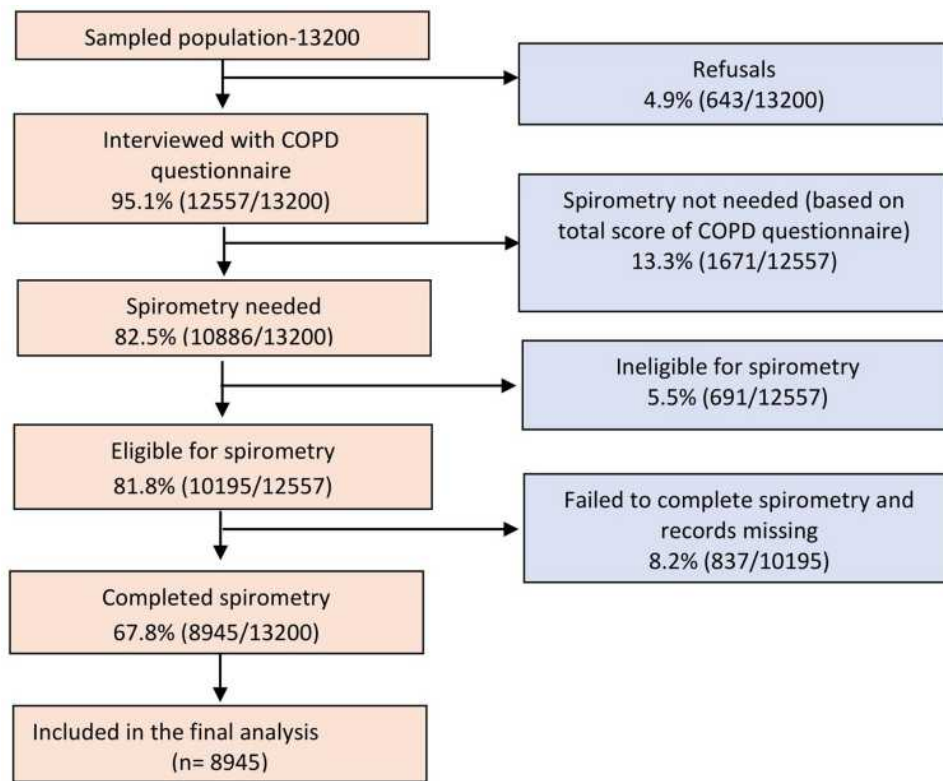
Figure 1 Flow diagram of the study.

participant with a maximum of eight attempts. Participants who had obstructive lung diseases (FEV1/FVC<0.7) were given Asthalin® Salbutamol (400 microns, Cipla) through a metered-dose inhaler, and post-bronchodilator spirometry readings were taken maintaining the American Thoracic Society and European Respiratory Society (ATS/ERS) standards.[22] Participants who could not perform spirometry despite eight attempts were documented as "could not perform" (CNP). The definition of COPD proposed by the Global Initiative for Chronic Obstructive Lung Diseases (GOLD), 'a post-bronchodilator FEV1/ FVC (forced expiratory volume in 1s/forced vital capacity) ratio below 0.70′ was taken for this study.[23] The severity of COPD was determined by the GOLD criteria. The obstruction was diagnosed by assessing airflow limitation. The severity of COPD was also determined by the GOLD criteria post-bronchodilator FEV_1 (Mild FEV_1 ≥80% of predicted, Moderate FEV_1 ≥50 to ≤80% of predicted, Severe FEV_1 ≥30 to ≤50% of predicted and Very Severe FEV_1 ≤30% of predicted). Furthermore, COPD diagnosis was confirmed based on spirometry readings by a respiratory physician (pulmonologist). Although the prime focus of this study was on COPD, restrictive defect

is common while conducting spirometry and defined as an FEV1/FVC≥70 and an FVC<80% predicted.[24] We have also recorded a substantial proportion of restrictive defect in this study.

Explanatory Variables

The explanatory variables of interest for this study included health, lifestyle and sociodemographic data. Health and lifestyle indicators included smoking status (smoker, non-smoker), number of cigarette packs consumed per year (0–14, 15–24, 25–49, 50+), and BMI (underweight, normal weight, overweight and obese). Sociodemographic characteristics of the participants included ethnicity (upper caste group, disadvantaged Janajatis, relatively advantaged Janajatis, disadvantaged non-Dalit Terai caste, Dalit and religious minorities), sex (male, female), age (20–39 years old, 40–59 years old, and 60 years or older), education (illiterate/no formal schooling, below secondary school level [<10 years of formal education], secondary school and above [≥10 years of formal education]) and provinces of residence (Province 1, Province 2, Bagmati Province, Province 5, Gandaki Province, Karnali Province, Sudurpashchim Province).

Data Management and Analysis

We used android mobile phones inbuilt with data collection software (Research and Monitoring – REMO software) to collect data digitally, including that of the face-to-face interviews and spirometry readings. Spirometry readings from the field were sent to a respiratory physician for confirmation of COPD. Different categories were assigned to the readings, from 0 for normal to 8 for very severe conditions of obstruction and restriction. Data from the readings were entered in separate EpiData files with unique participant IDs and later merged with the main data set from the field. Data cleaning including the correction of inconsistencies was performed in SPSS version 16.0. Data were then exported to Stata version 13 for analysis. To adjust for unequal distribution of selection and to adjust for non-response, all the estimation was done based on sampling weight. We presented our results as percentages and odds ratio (including both unadjusted and adjusted odds ratio) with 95% confidence intervals (CI). We conducted a bivariate analysis to analyze the association between each explanatory variable and COPD prevalence. To be included in multivariable modeling, we considered $P \leq 0.25$ as statistically significant for each variable. We further assessed multicollinearity (variance inflation factor with a value >1) for all independent variables found to be statistically significant from the bivariate analysis and then conducted multivariable logistic regression with COPD prevalence as a dependent variable using the independent variables identified as statistically significant in the bivariate analysis.

Results

The sociodemographic characteristics of the study population by age, sex, ethnicity, education, province, and place of residence are presented in Table 1. More than two-fifth (42.8%) of the participants belonged to the age-group of 40–59 years. More females than males participated in the study (57.4% versus 42.6%). The majority (54.5%) of participants were illiterate and had no formal schooling. More people belonged to the upper caste group (34.1%) which was followed by disadvantaged Janajatis (21.0%). About one-fourth of the participants were from Bagmati Province (24.7%) followed by Province 5 (17.4%), Province 1 (16.8%), Province 2 (16.5%), Gandaki Province (10.3%), Sudurpashchim Province (9.1%), and Karnali Province (5.2%). More than half (51.5%) of the participants lived in rural areas.

Table 1 Socio-Demographic Characteristics of the Study Population (N=8945)

Characteristics	N	%
Age		
20–39	3080	34.4
40–59	3824	42.8
60 years and above	2041	22.8
Sex		
Male	3807	42.6
Female	5138	57.4
Ethnicity		
Upper caste group	3049	34.1
Disadvantaged Janajati	1878	21.0
Relatively advantaged Janajati	1504	16.8
Disadvantaged non-Dalit Terai caste	1355	15.1
Dalit	905	10.1
Religious minorities	254	2.8
Education		
Illiterate/No formal schooling	4876	54.5
Below secondary (<10 years)	2064	23.1
Secondary and above (≥10 years)	2005	22.4
Province		
Province 1	1504	16.8
Province 2	1473	16.5
Bagmati Province	2211	24.7
Gandaki Province	921	10.3
Province 5	1559	17.4
Karnali Province	462	5.2
Sudurpaschim Province	815	9.1
Place of residence		
Rural	4611	51.5
Urban	4334	48.5

The classification of COPD based on GOLD criteria is presented in Table 2. According to these criteria, 3.9% were classified as having mild obstruction (GOLD I), 5.4% moderate obstruction (GOLD II), 1.7% severe obstruction (GOLD III) and 0.6% as very severe obstruction (GOLD IV).

The overall prevalence and descriptive statistics of COPD in our study population are summarized in Table 3. The overall prevalence of COPD in Nepal was 11.7% (95% CI:10.5-12.9). We found a higher prevalence of COPD (16.8% [95% CI: 14.9–18.8]) among current smokers compared to non-smokers (9.1% [95% CI: 7.9–10.5]), and the prevalence increased with higher reported numbers of cigarette packs per year of smoking. Similarly, those individuals classified as underweight

Table 2 Classification of COPD Based on GOLD Criteria

Categories	Number	Percentage	95% CI
Normal	6973	77.2	75.5–78.8
Restrictive defects	970	11.2	9.8–12.8
GOLD I: Mild obstruction	330	3.9	3.4–4.6
GOLD II: Moderate obstruction	473	5.4	4.7–6.2
GOLD III: Severe obstruction	143	1.7	1.4–2.1
GOLD IV: Very severe obstruction	56	0.6	0.4–0.9

Table 3 Descriptive Characteristics of Participants with COPD (N=8945)

Characteristics	Total	COPD		95% CI
Socio-Demographic Characteristics	N	n	%	
Age				
20–39	3080	197	6.2	4.9–7.7
40–59	3824	386	10.5	9.1–12.1
60 years and above	2041	426	21.6	19.3–24.1
Sex				
Male	3807	478	12.5	11.1–14.1
Female	5138	531	11.0	9.6–12.4
Ethnicity				
Upper caste group	3049	335	11.6	9.9–13.5
Disadvantaged Janjati	1878	177	9.3	7.7–11.1
Relatively advantaged Janjati	1504	151	10.2	8.3–12.5
Disadvantaged non-Dalit Terai caste	1355	200	15.2	11.9–19.2
Dalit	905	114	13.4	10.4–17.2
Religious minorities	254	32	12.4	8.0–18.6
Education				
Illiterate/No formal schooling	4876	722	15.7	14.1–17.6
Below secondary (<10 years)	2064	186	9.0	7.6–10.6
Secondary and above (≥10 years)	2005	101	5.2	4.2–6.5
Province				
Province 1	1504	92	6.2	4.8–8.0
Province 2	1473	240	16.4	13.2–20.3
Bagmati Province	2211	253	11.7	9.7–14.1
Gandaki Province	921	56	6.0	4.0–8.9
Province 5	1559	145	9.5	7.5–11.8
Karnali Province	462	109	25.1	18.1–33.8
Sudurpaschim Province	815	114	14.3	11.8–17.3
Place of residence				
Rural	4611	523	11.7	10.0–13.6
Urban	4334	486	11.7	10.1–13.4
Lifestyle characteristics **Smoking status**				
Smokers	2990	482	16.8	14.9–18.8
Non-smokers	5955	527	9.1	7.9–10.5
Packs per year				
0–14	8210	847	10.7	9.5–11.9
15–24	280	58	22.1	16.9–28.2
25–49	234	52	21.3	15.7–28.2
50+	221	52	25.5	19.6–32.5
BMI				
Underweight	1108	247	21.7	18.5–25.4
Normal	5619	600	11.3	10.0–12.7
Overweight	2218	162	7.7	6.4–9.3

had a higher prevalence of COPD, ie, 21.7% (95% CI: 18.5–25.4) whereas those who were overweight had only 7.7% (95% CI: 6.4–9.3). The prevalence of COPD by sex was similar with 12.5% (95% CI: 11.1–14.1) among males and 11.0% (95% CI: 9.6–12.4) among females. In terms of age, individuals aged 60 years and above had the highest prevalence of 21.6% (95% CI: 19.3–24.1) among the age groups. By ethnicity, the prevalence ranged from 9.3% (95% CI: 7.7–11.1) among disadvantaged Janajatis to 15.2% (95% CI: 11.9–19.2) among disadvantaged non-Dalit Terai caste groups. The prevalence of COPD among participants who were illiterate and/or had no formal schooling was 15.7% (95% CI: 14.1–17.6). Among participants with secondary education and above, COPD prevalence was 5.2% (95% CI: 4.2–6.5). The prevalence of COPD varied considerably also by province, ranging from 6.0% (95% CI: 4.0–8.9) in Gandaki Province to 25.1% (95% CI: 18.1–33.8) in Karnali Province. In terms of residence, the prevalence of COPD was almost identical with 11.7% (95% CI: 10.0–13.6) among those residing in rural and 11.7% (95% CI: 10.1–13.4) among those residing in urban areas of Nepal. The distribution of COPD prevalence for provinces stratified by sex and area of residence is shown in Figure 2.

Factors Associated with COPD

A summary of bivariate and multivariable analyses is presented in Table 4. Initially, a bivariate analysis was conducted with COPD prevalence as the dependent variable and individual background characteristics and risk factors as independent variables. The odds of having COPD were estimated for nine factors: age, sex, ethnicity, education, province, BMI, smoking, packs per year, and area of residence (Table 4). Out of these variables, all
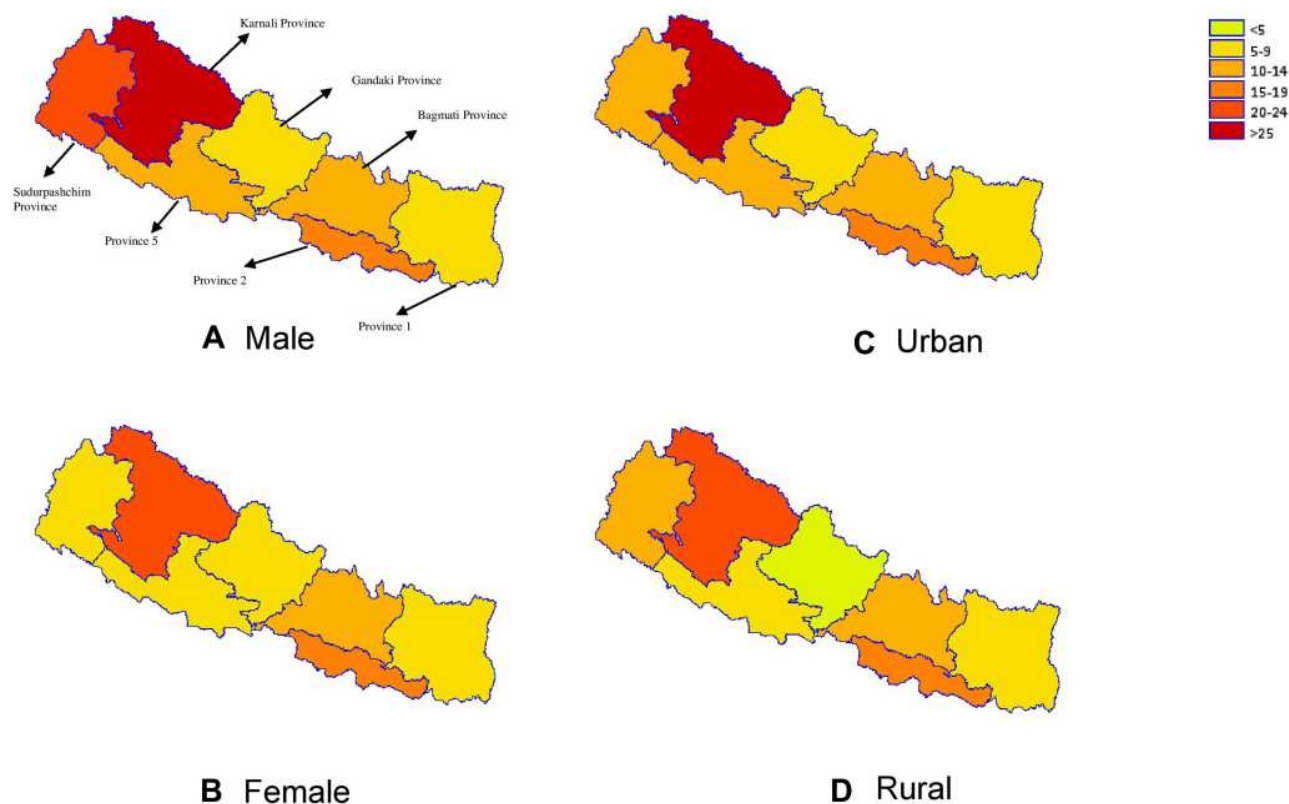
Figure 2 Geographical distribution of COPD prevalence by sex and residence in Nepal. The map is created using GMAP procedure in SAS 9.4.

except the area of residence had p value <0.25 in bivariate analysis, which were then taken to the multivariable analysis.

A summary of the multivariable logistic regression analysis of COPD prevalence shows that smoking, low education level, belonging to a disadvantaged non-Dalit Terai caste, higher age, a high number of cigarette packs consumed per year, being a resident of Karnali Province, and having a lower BMI, are associated with COPD. The results of our study show that participants aged 60 years or above had 3.1 times (95% CI: 2.3–4.1) higher odds of having COPD compared to 20–39 years old individuals. Members of a disadvantaged non-Dalit Terai caste group had 1.5 times (95% CI: 1.0–2.6) higher odds of having COPD compared to disadvantaged Janajatis, participants with residence in Karnali Province had 4.8 times (95% CI: 2.6–8.9) higher odds of having COPD compared to those of Gandaki province, and those who were illiterate and/or without formal schooling had higher odds (OR = 2.0; 95% CI: 1.5–2.7) of having COPD compared to participants with secondary or higher education (≥10 years). Current smokers had higher odds (OR: 1.3; 95% CI: 1.1–1.7) of having COPD compared to non-smokers; participants who

were classified as underweight by BMI had higher odds (OR = 1.7; 95% CI: 1.4-2.1) of having COPD and those with overweight had lower odds (OR = 0.7; 95% CI: 0.5–0.9) of having COPD compared to participants with a normal BMI. Likewise, persons who consumed 50 or more packs of cigarettes per year had 1.7 (95% CI: 1.1–2.4) times higher odds of having COPD compared to those who reported 0–14 packs per year of smoking.

Discussion

The findings presented here are the results of the first nationwide population-based prevalence study on COPD and associated factors in Nepal. They show that the COPD prevalence of adults aged 20 years and above in Nepal is 11.7%, with nearly four-fold higher prevalence in Karnali Province (25.1%) compared to Gandaki Province (6.0%). A higher rate of COPD can be attributed mainly to the use of biomass fuels in poorly ventilated houses, a relatively higher rate of smoking and indoor air pollution,[25] and lower availability of COPD services in Karnali Province which is the least developed province of Nepal in terms of Human Development Index.

Table 4 Socio-Demographic and Lifestyle Factors Affecting Chronic Obstructive Pulmonary Diseases (COPD) in Nepal (n=8945)

Variables	N	COPD			p value
		n (%)	OR (95% CI)	AOR 95% CI	
Sociodemographic characteristics					
Age (ref: 20–39 years)					
20–39	3080	197 (6.2)			
40–59	3824	386 (10.5)	1.8 (1.4–2.3)	1.5 (1.2–1.9)	0.002
60 years and above	2041	426 (21.6)	4.2 (3.3–5.4)	3.1 (2.3–4.1)	0.000
Sex (ref: female)	5138	531 (11.0)			
Male	3807	478 (12.5)	1.2 (1.1–1.4)	1.0 (0.8–1.2)	0.841
Ethnicity (ref: disadvantaged Janajati)	1878	177 (9.3)			
Upper caste group	3049	335 (11.7)	1.3 (0.1–1.7)	1.3 (1.0–1.7)	0.047
Relatively advantaged Janajati	1504	151(10.2)	1.1 (0.8–1.5)	1.2 (0.9–1.6)	0.281
Disadvantaged non-Dalit Terai caste	1355	200 (15.2)	1.8 (1.2–2.5)	1.5 (1.0–2.6)	0.029
Dalit	905	114 (13.4)	1.5 (1.1–2.1)	1.2 (0.9–1.7)	0.196
Religious minorities	254	32 (12.4)	1.4 (0.8–2.3)	1.2 (0.7–2.1)	0.441
Education (ref: secondary and above)	2005	101 (5.2)			
Illiterate/no formal schooling	4876	722 (15.7)	3.4 (2.7–4.4)	2.0 (1.5–2.7)	0.000
Below secondary (<10 years)	2064	186 (9.0)	1.8 (1.4–2.4)	1.5 (1.1–2.1)	0.005
Province (ref: Gandaki Province)	921	56 (6.0)			
Province 1	1504	92 (6.2)	1.0 (0.6–1.7)	1.0 (0.6–1.8)	0.937
Province 2	1473	240 (16.4)	3.1 (1.9–5.1)	2.6 (1.5–4.5)	0.001
Bagmati Province	2211	253 (11.7)	2.1(1.2–3.3)	2.2 (1.4–3.7)	0.002
Province 5	1559	145 (9.5)	1.6 (1.0–2.7)	1.6 (0.9–2.7)	0.091
Karnali Province	462	109 (25.1)	5.3 (2.9–9.7)	4.8 (2.6–8.9)	0.000
Sudurpaschim Province	815	114 (14.3)	2.6 (1.6–4.2)	2.4 (1.4–3.9)	0.001
Lifestyle characteristics					
Smoking status (ref: non-smokers)	5955	527 (9.1)			
Smokers	2990	482 (16.8)	2.0 (1.7–2.4)	1.3 (1.1–1.7)	0.006
Packs per year (ref: 0–14)	8210	847 (10.7)			
15–24	280	58 (22.1)	2.4 (1.7–3.3)	1.3 (0.9–1.9)	0.102
25–49	234	52 (21.3)	2.3 (1.6–3.3)	1.3 (0.9–1.9)	0.198
50+	221	52 (25.5)	2.9 (2.0–4.1)	1.7 (1.1–2.4)	0.009
BMI (ref: normal)	5619	600 (11.3)			
Underweight	1108	247 (21.7)	2.2 (1.8–2.7)	1.7 (1.4–2.1)	0.000
Overweight	2218	162 (7.7)	0.7 (0.5–0.8)	0.7 (0.5–0.9)	0.002

The COPD prevalence in Nepal, 11.7% based on the post-bronchodilator FEV1/FVC <70% criterion, is within the range found in other studies conducted in Japan, Morocco, Portugal, and Italy,[26–29] but higher than the prevalence of 8.2% in China,[30] lower than the prevalence of 17.2% observed in Korea[31] and 17.5% in Tanzania,[32] and similar to 13.5% in Bangladesh.[33] A population-based study using the Burden of Obstructive Lung Disease criteria which employed spirometry measurements to estimate the prevalence of COPD in 12 countries[34] reported similar COPD estimates (globally 10.1%; participating Asian countries 11.4–13.9%) in line with the results of our study. This study showed that males had a slightly higher COPD prevalence than females (12.5% in males and 11.0% in females) and the finding is similar with other studies in Bangladesh and China that males had a higher prevalence than females.[30,33]

Our study reveals that the prevalence of COPD in Nepal is higher among persons of older age and among current smokers. These results are consistent with those of population-based studies conducted in China[30] and Bangladesh,[33] and in line with the international epidemiology of COPD[35] the prevalence of COPD was higher among participants who were illiterate and/or had no formal schooling compared to those with secondary and higher education (≥10 years) which is similar to the results reported by Kanervisto et al.[36] Interestingly, our study documents great variation in the prevalence of COPD between the different provinces of Nepal. Overall, COPD prevalence was the highest in Karnali Province, with 25% among the seven provinces in Nepal and the national average was11.7%. This higher prevalence of COPD may be due to more widespread or heavier cigarette smoking and the use of solid biomass fuels in poorly ventilated rooms as the main source for cooking.[37] The findings from our study indicated a higher prevalence of COPD among disadvantaged non-Dalit Terai caste group and upper caste compared to disadvantaged Janajatis. Similar to this finding, a study conducted in the mid-western region of Nepal reported a higher proportion of COPD among the socially disadvantaged group (Dalit) against Janajatis.[9] The higher prevalence among this group may be attributed to factors, such as low educational level, low level of awareness and their economic status, which may affect their health service utilization. Our data also show a negative association between BMI and COPD prevalence in Nepal which is consistent with the literature.[38]

As found and supported in other studies[29,30,39] there was also a positive trend with the increase of cigarette packs per year, confirming smoking as a significant risk factor for the development of COPD. In fact, above 50 pack-years COPD prevalence almost tripled if compared to 0–14 packs per year (10.4% versus 25.5%), highlighting the dramatic burden of cigarette smoke-related health care resource utilization and costs in Nepal.

Various risk factors have been associated with COPD. It is well known that smoking is the major known risk factor for developing COPD.[40–42] As expected, this study also found that participants with higher smoking rates had a higher prevalence of COPD in Nepal. Age is another well-established risk factor for COPD, and our study also depicts the same. We observed a nearly three times higher prevalence of COPD among individuals aged 60 years or above compared to individuals aged 20 to 39 years. This is in line with the results reported in previous studies.[35,43]

The present study has several strengths: First of all, as a large-scale and population-based study with a high overall response rate, it used home visits to estimate the prevalence of COPD in Nepal and ensure that the study results are representative at the sub-national level. While many other studies on COPD included adults over 40 years of age only,[44] this study included adults aged 20 years and above to avoid missing any people with airflow obstruction.

Secondly, epidemiological studies that rely on physician diagnosis or patient-reported physician diagnosis, without lung function assessment (ie, use of spirometry), usually underestimate the prevalence of COPD.[45] To overcome this, COPD diagnostic questionnaires were used for screening COPD cases in this study together with high-quality control of the performance of spirometry which resulted in a good reproducibility of spirometry.

However, this study also has some limitations: firstly, we used the fixed FEV1/FEV ratio to diagnose COPD which may lead to over and under-diagnosis in older and younger adults, respectively.[46] Similarly, post-bronchodilator spirometry was not performed for all study participants. We also lack information about environmental exposure, such as solid biomass fuel use, which could be used to quantify the effects of these factors on COPD. Finally, the cross-sectional nature of the study did not allow us to establish a causal relationship between COPD and associated factors.

Conclusion

This first nationwide, population-based study using spirometry revealed that COPD remains a huge hidden burden of high-prevalence disease in Nepal. Cigarette smoking, older age, lower BMI, low educational attainment, having smoked more than 50 pack-years, province of residence, and ethnicity, are major risk factors for COPD in Nepal. The prevention and early detection of COPD using spirometry and relevant public health interventions based on risk factors should become a public health priority in Nepal to reduce the high COPD-related morbidity and mortality in the country.

Disclosure

The authors report no conflicts of interest in this work.

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