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ORIGINAL RESEARCH

Prevalence and Risk Factors of Chronic Obstructive Pulmonary Disease Among Agriculturists in a Rural Community, Central Thailand

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Purpose: The present study aimed to determine the prevalence and risk factors of chronic obstructive pulmonary disease (COPD) among agriculturists in a remote rural community in central Thailand.

Methods: A cross-sectional study was conducted in January 2020. Face-to-face interviews were conducted using standardized questionnaires to determine demographic characteristics and risk behaviors. COPD was defined by the spirometric criterion for airflow limitation constituting a postbronchodilator fixed ratio of FEV1/FVC <0.70 following the Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines 2019. Multivariable logistic regression analysis was used to determine the risk factors for COPD, and the magnitude of association was presented as adjusted odds ratio (AOR) with 95% confidence interval (95% CI).

Results: A total of 546 agriculturists were enrolled in the study. The overall prevalence of COPD was 5.5% (95% CI: 3.6–7.4). The prevalence of COPD among males was 8.0% (95% CI: 4.7–11.3), and 3.2% (95% CI: 1.1–5.2) among females. The risk factors of COPD included age ≥60 years old (AOR 2.7, 95% CI: 1.1–7.0), higher intensity of smoking (AOR 1.1, 95% CI: 1.0–1.1), swine farm worker (AOR 4.1, 95% CI: 1.7–10.3), cattle farm worker (AOR 3.3, 95% CI: 1.4–8.2) and home cooking (AOR 2.7, 95% CI: 0.8–9.7).

Conclusion: Our data emphasized that COPD was one of the significant health problems among agriculturists in a rural community. Agricultural jobs such as animal farmers and behavioral factors such as smoking were associated with COPD. Effective public health interventions, especially, modifying risk behaviors, should be promoted in remote rural areas to prevent the disease and reduce its morbidity and mortality.

Keywords: COPD, farmers, swine, cattle, smoking, Thailand

Introduction

Chronic obstructive pulmonary disease (COPD) is an under-recognized health problem and the leading cause of morbidity and mortality worldwide.[1] Projections of global COPD mortality in 2030 involved approximately 7.4% of total deaths making it the fourth leading cause of death.[2] A recent review demonstrated that the estimated prevalence of COPD was 12.2% overall, 15.7% among males and 9.9% among females.[3] In Thailand, the national prevalence of COPD was 2.1% in 1999 and is projected to total 7.0% in 2010.[4]

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COPD is a principle condition leading to several serious complications, ie, cor pulmonale, recurrent pneumonia, pneumothorax and respiratory failure.[5–8] Although the pathogenic mechanisms of COPD remain unclear, various risk factors such as genetic constitution, bronchial hyper-responsiveness, perinatal factors, childhood asthma, air pollution and cigarette smoking were identified to cause the disease.[6–8] In addition, COPD is considered a common occupational disease in particular populations including tunnel workers,[9] coal miners[10] and agricultural workers.[11,12] Related studies have reported the prevalence of COPD among agricultural workers including cattle, swine and poultry breeders was relatively high compared with that among nonfarming workers.[12] Agricultural workers can be exposed to biochemical, organic and inorganic substances which may contribute to COPD, for instance, dust, biomass smoke, ammonia, silica and endotoxins.[8,11–18]

Approximately one half of the Thai population live in rural areas where the characteristics of healthcare infrastructure and providers differ from those of urban settings especially in remote rural areas.[19] According to Thai national health policies, some noncommunicable diseases including type 2 diabetes and hypertension, but not COPD have been actively surveyed at the community level. Thus, the current situation of COPD in rural communities remains limited. Most of the Thai population in rural communities works as agriculturists. However, the information of factors potentially responsible for COPD among agriculturists remains limited, which is essential to focus on preventing the disease. Attenuating the risk factors of COPD will also help to slow disease progression and reduce associated complications. The present study aimed to determine the prevalence and risk factors of COPD among agriculturists in a remote rural community in Chachoengsao Province, central Thailand.

Materials and Methods

Study Designs and Subjects

The study was conducted in a remote rural community in Thakradan Subdistrict, Sanam Chai Khet District, Chachoengsao Province located 160 km east of the Bangkok Metropolitan Area, Thailand. Thakradan rural community consists of five villages including Na-Yao, Na-Ngam, Na-Isan, Thungso-Hongsa and Thung-Hiang. These remote villages house approximately 4000 people, most of whom were agriculturists or herdsmen. This community might represent a typical Thai agriculture community. A longitudinal survey had been conducted in this community since Phramongkutklao College of Medicine established a teaching community. Recently, noncommunicable diseases including diabetes and hypertension have raised concerns in this community, leading to some intervention programs. However, the true situation for COPD including its actual magnitude and associated factors remains unknown. To date, no recent study could represent the real situation of COPD in a Thai rural community. This single-site study provided preliminary information regarding the COPD situation in such a population. A cross-sectional study was conducted in January 2020. The minimal calculated sample size of 351 was determined using Slovin's[20] according to a 95% confidence interval (CI) with a margin error of 0.05. The investigators expected that 20% of available individuals would be unable to participate; thus, we enrolled approximately 422 individuals to our study. Information on population was retrieved from the Ministry of Interior (Thailand), the National Population Registry to determine the sampling frame. The registered populations were selected from five villages using stratified sampling by village and then a random sample was drawn from each stratum.[21] The subjects residing in the target areas at the period of study were included. Inclusion criteria comprised agriculturists or herders aged at least 18 years old. Agriculturists and herders were defined as those working as agriculturists or herders more than ten years. Subjects were excluded from the study, if they presented contraindications for spirometry including acute myocardial infarction within one week, no decompensated heart failure, cardiac arrhythmia, history of syncope related to forced expiration/cough, eye surgery within one week, brain surgery within four weeks, sinus surgery or middle ear surgery or infection within one week, presence of pneumothorax, thoracic surgery within four weeks, abdominal surgery within four weeks, late-term pregnancy and active or suspected transmissible respiratory or systemic infections such as tuberculosis.[22]

This study was reviewed and approved by the Royal Thai Army Medical Department Institutional Review Board. Written informed consent was obtained from the participants following the WMA Declaration of Helsinki–Ethics principles for medical research involving human subjects (Reference number: R156q/62).

Data Collection

The investigators provided the information sheets and informed subjects of the objectives and methods of the study. Informed consent was obtained before conducting the research. If participants could not read the information sheet, the investigators would read the information to them and then participants could use their fingerprint to confirm their agreement on the consent form. Participants did not receive any incentive for joining the study. Among the 648 enrolled individuals, 546 participants were included in the study. During the study, face-to-face interviews were conducted using standardized questionnaires to obtain essential information from participants within 30 minutes. The interviews were conducted by well-trained interviewers.

The Thai version of the standardized questionnaires was adapted by following the Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines 2019 and European Community Respiratory Health Survey II.[23,24] The standardized questionnaire of the study was reviewed and approved by a pulmonologist, epidemiologist, and the institutional review board before using in an interview. The questionnaires covered information on demographic characteristics, occupational history and factors related to COPD within the previous 12 months. Data regarding agricultural history comprised two main specific groups including (1) plant cultivation (rice, cassava, rubber tree and corn) and (2) livestock (poultry, cattle and swine). To be classified in each group, subjects must have been employed in any type of cultivation or livestock breeding for more than ten years. Smoking status was categorized as never, ex-smoker and current smoker. Never smoked characterized participants who had never smoked, or who had smoked less than 100 cigarettes in his or her lifetime.[25] Ex-smoker was defined as smoke-free for 12 months. Additionally, smokers were asked the age at which they started to smoke. Smoking history included the number of packaged or hand-rolled cigarettes daily and the number of smoking years. The number of pack-years was calculated using the number of packs of cigarettes smoked daily multiplied the number of years the patient had smoked (1 pack = 20 cigarettes).[26] Home cooking history was defined by participants having a cooking process conducted in their home during the last 12 months. Exercise was defined by regular aerobic exercise for 30 minutes daily and at least 3 days/week. Bodyweight and height were measured using standardized balance scales (DETECTO, St. Webb City, MO, USA) (to the nearest 0.1 kg) and stadiometer (DETECTO) (to the nearest 0.1 cm), respectively. Body mass index (BMI) was calculated as body weight in kilograms divided by height in meters squared (kg)/height (m^2). BMI level was classified according to the Asia-Pacific BMI classifications in five groups, ie, <18.5 kg/m^2, 18.5 to 22.9 kg/m^2, 23.0 to 24.9 kg/m^2, 25.0 to 29.9 kg/m^2 and ≥30 kg/m^2.[27]

Spirometry Testing

Spirometry testing was performed using a pneumotachograph (Minispir™ Spirometer with SpO2, MIR, Rome, Italy) between 08.00 and 12:00 AM. The spirometer is used by medical technologists who have been trained in a specific program of a pulmonary function test. Standardization of spirometry testing was conducted following the official American Thoracic Society and European Respiratory Society technical statements (ATS/ERS).[22] The participants were advised to avoid smoking within one hour before testing, performing vigorous exercise within one hour before testing, and wearing clothing that substantially restricted full chest and abdominal expansion. The medical technologists instructed and demonstrated the test before performing spirometry testing. The participants attached the nose clip, inserted the mouthpiece in the mouth, and closed their lips around the mouthpiece. The participants breathed normally; then inhaled completely and rapidly with a pause of ≤2 seconds at total lung capacity (TCL). Next, the participants exhaled with maximal effort until no more air could be expelled. After that, the participants inhaled with maximal effort until completely full. A minimum of three acceptable forced expiratory volumes in one second (FEV_1) and three acceptable forced vital capacity (FVC) measurements were reported. The largest FEV_1 and the largest FVC were calculated for FEV_1/FVC. Bronchodilator responsiveness testing was performed when the FEV_1/FVC ratio was <0.7. Bronchodilator responsiveness testing was performed by administering 400 μg of the short-acting β_2-agonist salbutamol (Ventolin™) delivered as 2 Metered-Dose Inhaler (MDI) actuations of 200 μg. The participants gently and incompletely exhaled and actuated the salbutamol MDI at the beginning of a slow inhalation to TLC from the holding chamber. After that, the participants held their breath for five to ten seconds before exhaling. Two separate MDI actuations were delivered at 30-second intervals. Then, the post-bronchodilator maneuver was performed 15 minutes after administering the final MDI actuation. COPD was defined by the spirometric criterion for airflow limitation constituting a post-bronchodilator fixed ratio of FEV_1/FVC < 0.70.[23]

Classification of airflow limitation severity in COPD (based on post-bronchodilator FEV1) in among subjects with FEV1/FVC < 0.70 were divided into 4 four levels including mild, moderate, severe, and very severe. GOLD 1 (mild) was defined by FEV1 ≥ 80% predicted. GOLD 2 (moderate) was defined by 50% ≤FEV1 ≤ 80% predicted. GOLD 3 (severe) was defined by 30% ≤FEV1 ≤ 50% predicted, and GOLD4 (very severe) was defined by FEV1<30%.[23]

The participants presenting COPD would receive standard care under their healthcare coverage scheme. The list of participants with COPD was registered in the health database at the Health Promoting Hospital Baan Na-Yao, the primary care unit in the rural area. Additionally, participants with COPD received long-term medical treatment such as bronchodilators, inhaled corticosteroids, and recommendations of life-style modification to alleviate COPD progression including smoking cessation.

Statistical Analysis

Data were analyzed using StataCorp, 2015, Stata Statistical Software: Release 14 (College Station, TX, USA: StataCorp LP). Demographic characteristics were determined using descriptive statistics. Categorical data were presented as number and percentage while continuous data were presented as mean and standard deviation (SD). Prevalence of COPD was determined using descriptive statistics and reported as a percentage with 95% confidence interval (95% CI). Binary logistic regression analysis was used to determine the risk factors for COPD, and the magnitude of association was presented as crude odds ratio (OR) with 95% CI. The multicollinearity was tested. The variables significant in univariate analysis and in established relationship with the outcome were included in the final model. Multivariable analysis was performed to adjust confounders using logistic regression. Adjusted odds ratio (AOR) from multivariable analysis was presented with corresponding 95% CI. A *p*-value less than 0.05 was considered statistically significant.

Results

Characteristics of the Study Participants

Among the 648 enrolled individuals, a total of 546 participants met the acceptability criteria by spirometry and were included in the analysis. The average age of participants was 57.1±13.6 years. In all, 262 (48%) agriculturists were male. Most participants obtained their highest education level from primary school accounting for 74.5%. The agriculturists' characteristics including cultivation, livestock and both accounted for 16.7%, 31.3% and 52.0%, respectively. Descriptive characteristics of the study participants are shown in Table 1.

Prevalence of COPD Among Agriculturists in a Rural Community

Of the total 546, 46 participants showed FEV_1/FVC (prebronchodilator) <0.7. After bronchodilator responsiveness testing, 30 subjects remained FEV_1/FVC (postbronchodilator) <0.7. Thus, the overall prevalence of COPD was 5.5% (95% CI: 3.6–7.4). Of the 30 subjects with COPD, 22 (73.3%) were classified in GOLD 1 (mild symptom), and 8 (6.7%) subjects were classified in GOLD 2 (moderate symptom). The prevalence of COPD among males was 8.0% (95% CI: 4.7–11.3) while the prevalence was 3.2% (95% CI: 1.1–5.2) among females. The prevalence of COPD among agriculturists aged ≥60 years old was 9.2% (95% CI: 5.6–12.9). In agricultural jobs, the prevalence of COPD in crop cultivation was 5.3% (95% CI: 3.2–7.3), while in livestock rising was 7.8% (95% CI: 5.0–10.5).

Risk Factors for COPD Among Agriculturists in a Rural Community

Table 2 presents the univariate logistic regression analysis for the risk factors of COPD among agriculturists. After adjusting for potential confounders, the risk factors for COPD included age, smoking intensity, cattle farming, swine farming, and home cooking; multivariate logistic regression analysis showed that agriculturists, aged ≥60 years old, tended to be at high risk of COPD compared with those aged <60 years old (AOR 2.7, 95% CI: 1.1–7.0). A dose–response relationship between smoking intensity and COPD was identified (AOR 1.1, 95% CI: 1.0–1.1). We found that cattle raising was associated with COPD (AOR 3.3, 95% CI: 1.4–8.2). In addition, the prevalence of COPD among the agriculturists with swine farming was higher than those without swine farming (AOR 4.1, 95% CI: 1.7–10.3). Those having a history of home cooking tended to be at higher risk for COPD; however, without association (AOR 2.7, 95% CI: 0.8–9.7).

Discussion

The present study determined the prevalence and risk factors of COPD among agriculturists in a rural community in Thailand using the GOLD guideline 2019.[23] The prevalence of COPD in this rural community was 5.5% which was relatively low compared with the previous population-

Table 1 Demographic Characteristics of Agriculturists in a Rural Community, Central Thailand (n=546)

Characteristics	n (%)
Gender	
Male	262 (48.0)
Female	284 (52.0)
Age (years)	
18–39	48 (8.8)
40–49	101 (18.5)
50–59	148 (27.1)
60–69	142 (26.0)
70–79	84 (15.4)
≥80	23 (4.2)
Mean±S.D.	57.1±13.6
Min-Max	18–94
Religions	
Buddhism	536 (98.2)
Christian	10 (1.8)
Marital status	
Single	39 (7.1)
Married	457 (83.7)
Widowed	30 (5.5)
Separated/divorced	20 (3.7)
Level of education	
No formal education	44 (8.1)
Grade 1–6	407 (74.5)
Grade 7–9	44 (8.1)
Grade 10–12 or vocational level	37 (6.8)
Bachelor's degree or higher	14 (2.6)
Agriculture	
Livestock	91 (16.7)
Crop	171 (31.3)
Both	284 (52.0)
BMI (kg/m^2)	
<18.5	50 (9.2)
18.5–22.9	261 (47.8)
23.0–24.9	107 (19.6)
25.0–29.9	110 (20.1)
≥30	18 (3.3)
Mean±S.D.	22.8±3.4
Min-Max	14.3–35.9
Agricultural duration (years)	
<30	216 (39.6)
30–39	104 (19.0)
40–49	114 (20.9)
≥50	112 (20.5)
Mean±S.D.	31.3±15.2

(*Continued*)

Table 1 (Continued).

Characteristics	n (%)
Home cooking	459 (84.1)
Charcoal used as fuel for cooking	342 (62.6)
Firewood used as fuel for cooking	123 (26.8)
Gas used as fuel for cooking	370 (80.6)

Abbreviations: BMI, body mass index; S.D., standard deviation.

based study conducted in northern Thailand in 2010.[28] This previous study was conducted among people aged at least 40 years, while the villagers aged at least 18 years were included in our study. However, when the same age groups were analyzed, the prevalence of COPD was comparable. The prevalence of COPD among males was significantly higher than that found in the female group. This finding was compatible with other related studies.[27–29] Compared with the prevalence of COPD among crop cultivation workers, the prevalence of that among livestock raising workers was relatively high, similar to the recent studies conducted in France[12] and Norway.[29]

We found that agriculturists aged ≥60 years were more likely to present COPD compared with those aged <60 years old. Similarly, recent studies in Sweden, Denmark and the United Arab Emirates reported that people with older age especially more than 60 years old were positively associated with COPD.[30–32] This phenomenon could be explained by the fact that lung function progressively declines with rising age as a consequence of structural and physiological changes to the lungs including reduced elastic recoil and compliance of the chest wall. Additionally, FEV_1 and FVC decreases with increasing age among both males and females.[33–35] Other evidence has illustrated via the possible roles regarding aging hallmarks including genomic instability, deregulated nutrient sensing, cellular senescence and stem cell exhaustion that disturb the repair and remodeling structural cells and lung tissues, resulting in COPD.[35–38]

In concordance with related reports,[39–41] we found that COPD was linked to cigarette smoking intensity with a significant dose–response relationship. The finding was consistent with the related study of Forey et al (2011) reporting that the amount smoked and packs-years was attributable to increased risk of COPD, and affirming the causal relationship between COPD and cigarette

Table 2 Risk Factors for COPD Among Agriculturists in a Rural Community, Central Thailand, 2020 (n=546)

Factors	Non-COPD	COPD	Univariate Analysis			Multivariate Analysis		
	n (%)	n (%)	OR	95% CI	*p*-value	AOR	95% CI	*p*-value
Gender								
Female	275 (96.8)	9 (3.2)	1.00			1.00		
Male	241 (92.0)	21 (8.0)	2.66	1.20–5.92	0.016	1.05	0.38–2.95	0.921
Age (years)								
18–59	290 (97.6)	7 (2.4)	1.00			1.00		
≥60	226 (90.8)	23 (9.2)	4.22	1.78–10.00	0.001	2.67	1.02–6.99	0.046
BMI (kg/m^2)								
18.5–22.9	247 (94.6)	14 (5.4)	1.00					
<18.5	43 (86.0)	7 (14.0)	2.87	1.10–7.53	0.032			
23.0–24.9	104 (97.2)	3 (2.8)	0.51	0.14–1.81	0.296			
≥25.0	122 (95.3)	6 (4.7)	0.87	0.33–2.31	0.777			
Mean±S.D.	22.9±3.4	21.4±3.6	0.86	0.76–0.98	0.020	0.88	0.77–1.02	0.102
Rice cultivation								
No	184 (96.3)	7 (3.7)	1.00					
Yes	332 (93.5)	23 (6.5)	1.82	0.77–4.33	0.174			
Cassava cultivation								
No	272 (94.8)	15 (5.2)	1.00					
Yes	244 (94.2)	15 (5.8)	1.12	0.53–2.33	0.772			
Rubber tree								
No	472 (94.4)	28 (5.6)	1.00					
Yes	44 (95.7)	2 (4.3)	0.77	0.18–3.32	0.722			
Corn cultivation								
No	460 (94.1)	29 (5.9)	1.00					
Yes	56 (98.2)	1 (1.8)	0.28	0.04–2.12	0.219			
Poultry raising								
No	241 (95.6)	11 (4.4)	1.00					
Yes	275 (93.5)	19 (6.5)	1.51	0.71–3.23	0.287			
Cattle raising								
No	390 (96.5)	14 (3.5)	1.00			1.00		
Yes	126 (88.7)	16 (11.3)	3.54	1.68–7.45	0.001	3.33	1.36–8.18	0.009
Swine raising								
No	451 (96.0)	19 (4.0)	1.00			1.00		
Yes	65 (85.5)	11 (14.5)	4.02	1.83–8.82	0.001	4.13	1.65–10.32	0.002
Agricultural duration (years)								
<30	212 (98.1)	4 (1.9)	1.00					
30–39	98 (94.2)	6 (5.8)	3.25	0.90–11.76	0.073			
40–49	107 (93.9)	7 (6.1)	3.47	0.99–12.11	0.051			
≥50	99 (88.4)	13 (11.6)	6.96	2.21–21.89	0.001			
Mean±S.D.	30.8±15.2	40.6±12.1	1.05	1.02–1.07	0.001			
Smoking status								
Never	363 (98.6)	5 (1.4)	1.00					
Current smoker	89 (89.9)	10 (10.1)	8.16	2.72–24.46	<0.001			
Ex-smoker	64 (81.0)	15 (19.0)	17.02	5.97–46.45	<0.001			

(*Continued*)

Table 2 (Continued).

Factors	Non-COPD	COPD	Univariate Analysis			Multivariate Analysis		
	n (%)	n (%)	OR	95% CI	*p*-value	AOR	95% CI	*p*-value
Smoking intensity (pack-year)								
Never	363 (98.6)	5 (1.4)	1.00					
<5	33 (91.7)	3 (8.3)	6.83	1.56–29.87	0.011			
5–9	26 (86.7)	4 (13.3)	11.20	2.84–44.24	0.001			
≥10	94 (83.9)	18 (16.1)	13.94	5.05–38.52	<0.001			
Mean±S.D.	4.7±10.8	28.7±34.8	1.06	1.04–1.08	<0.001	1.06	1.03–1.08	<0.001
Home-cooking								
No	80 (95.2)	4 (4.8)	1.00					
Yes	433 (94.3)	26 (5.7)	1.20	0.41–3.53	0.740	2.70	0.76–9.65	0.125
Exercise								
No	358 (94.2)	22 (5.8)	1.00					
Yes	158 (95.2)	8 (4.8)	0.82	0.36–1.89	0.648			

Notes: Multivariable logistic regression (Enter); adjusted for gender, age, BMI, cattle raising, swine raising, smoking intensity and home-cooking
Abbreviations: BMI, body mass index; S.D., standard deviation.

smoking.[42] Cigarette smoke contains a high concentration of reactive oxidant substances inducing chronic inflammatory changes in the central and peripheral airways, and lung parenchyma.[43,44] The inflammatory process leads to infiltrated mucosa, submucosa and glandular tissue resulting in increased mucus contents, epithelial-cell hyperplasia and wall thickening in the small conducting airways.[45] Additionally, structural remodeling and loss of elastic recoil by emphysematous destruction of the parenchyma lead to ongoing decline of FEV_1.[45–47] In the rural community, cigarette smoking rates among high school students were approximately 15%,[48] moreover, one-third of the agriculturists especially among males had ever smoked both packed cigarettes and hand-rolled tobacco cigarettes; thus, smoking cessation should be suggested to smokers. Furthermore, smoking cessation was associated with reduced non-communicable diseases including cardiovascular disorders and cancers, and it was associated with an increased quality of life.[46,49,50]

Swine raising was identified as a risk factor of COPD in a few studies.[51,52] Swine farmworkers are often exposed to various types of inhalable dust, eg, wood dust, litter, fecal material and a complex mixture of organic materials derived from feed.[41,53] The related report suggested that chronic exposure to these organic materials leads to increased adaptive immune mechanisms. Then, an increase in pro-inflammatory agents would affect the inflammatory responses leading to chronic respiratory disorders.[54–56] Additionally, cattle farmworkers were associated with COPD which was similar to the related studies conducted in France[12] and Norway.[29] A 12-year longitudinal study reported that dairy farmers presented a more progressive decline in FEV_1/FVC than controls.[57] The related studies have reported that a high concentration of gases due to byproducts of animal waste including hydrogen sulfide and ammonia was linked to reduced FEV_1 and associated with COPD.[58,59] The recent study of Marescaux et al (2016) found that the prevalence of COPD in a traditional farm was relatively high compared with those found among dairy farmers in a modernity farm.[60] Most swine and cattle farms in remote rural communities in Thailand are traditional farms; thus, this situation may impact COPD among agriculturists in rural settings.

The present study showed that agriculturists in a remote rural area with a history of home cooking tended to be at higher risk for COPD; however, without association. A study conducted in South China also showed similar findings suggesting that indoor pollutants from biomass fuel cooking may be an important risk factor for COPD.[61] Almost all populations in the Thai countryside used a traditional stove with biofuel including charcoal and firewood for their home cooking. The combustion of biofuel is very incomplete in traditional stoves resulting in substantial emissions and contributing high levels of household air pollution.[62] Pollutants from biomass combustion comprised a mixture of droplets, small solid particles and gasses such as carbon monoxide, nitrogen dioxide and others penetrating deep in the lungs.[63]

Furthermore, evidence has suggested that replacing biomass with biogas for cooking and improving kitchen ventilation leads to a decreased risk of COPD.[64,65]

This study employed a cross-sectional design, making it difficult to establish a cause–effect relationship between the associated factors and COPD. Another limitation was the small sample size in the study. Further study is needed to identify either environmental or biological agents that cause COPD to develop in each subgroup of farmers in Thailand. However, the study used spirometry testing as a diagnostic test for COPD which is the gold standard according to GOLD 2019 and ATS/ERS statement. Moreover, the association between factors and outcomes was able to be presented. In the study, bronchodilator responsiveness testing was performed when the FEV1/FVC ratio was <0.7; however, the case of FVC may have been underestimated, and participants with COPD may have been missed. On the other hand, COPD was defined by a postbronchodilator fixed ratio of FEV1/FVC <0.70. The prevalence of COPD among the elderly may have been overestimated while the prevalence of COPD among young adults may have been underestimated.[66,67] Although social desirability bias might also have existed in the study due to conducting face-to-face interviews, a standardized questionnaire of the study was reviewed and approved by a pulmonologist, epidemiologist and the institutional review board. Additionally, the interviews were conducted by well-trained interviewers.

The present study identified a few modifiable risk factors for COPD which would be useful for prevention and control strategies at the community level. Agriculturists especially those residing in rural communities should be targeted for more educational interventions in raising awareness about COPD, its associated complications and adjusting their behaviors especially smoking cessation. The authorities in the rural communities such as healthcare workers at primary care units should provide screening for COPD and suggestions, advice and support for the agriculturists using various measures. For instance, personal protective equipment such as hygienic masks for animal farmworkers should be provided, as well as improving kitchen ventilation for home cooking and promoting smoking cessation. Our study may not be generalized to the whole country but may reflect challenges of agriculturists residing in rural communities in Thailand.

Conclusion

Our data emphasized that COPD is a significant health problem among agriculturists in a rural community in Thailand. Animal farmers and behavioral factors such as smoking were associated with COPD. Effective public health interventions, especially modifying risk factors, should be provided in remote rural areas to alleviate the progression of COPD and its associated serious complications.

Abbreviations

COPD, chronic obstructive pulmonary disease; GOLD, the Global Initiative for Chronic Obstructive Lung Disease; ATS/ERS, an official American Thoracic Society and European Respiratory Society technical statement; TLC, total lung capacity; FEV_1, forced expiratory volume in 1 second; FVC, forced vital capacity; MDI, metered dose inhaler; OR, odds ratio; AOR, adjusted odds ratio; 95% CI, 95% confidence interval; BMI, body mass index.

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Disclosure

The authors report no potential conflicts of interest in this work.

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