Chronic obstructive pulmonary disease among women using biomass fuels in some rural areas of Fayoum governorate

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Context Chronic obstructive pulmonary disease (COPD) is an important health problem; it represents an important health challenge in terms of both prevention and treatment. Although smoking is recognized as the most important risk factor for COPD, rural women in developing countries have a greater risk not as a result of smoking, as smoking is uncommon there, but due to smoke from domestic biomass fuel combustion, which is another potential risk factor.

Aims The aim of this study was to investigate exposure to biomass fuel as a potential risk factor for COPD among women in the rural areas of Fayoum governorate in whom cigarette smoking was not the risk factor.

Materials and methods This study included 100 nonsmoker women who used biomass fuels and 100 women who had not used biomass throughout their life who served as controls. All groups in the study were subjected to questionnaire on respiratory symptoms, clinical examination, and were investigated using spirometer.

Statistical analysis Data were analyzed using SPSS, version 11. Quantitative data were analyzed using the χ^2-test, whereas the *t*-test was used for comparison between groups as regards quantitative data.

Results Biomass fuel is an important risk factor for development of COPD among rural nonsmoker women who use biomass. The decline in forced expiratory volume in first second and forced expiratory flow 25–75% is significantly related to the duration of exposure to biomass fuels.

Conclusion It was detected that biomass fuel is an important risk factor for development of COPD. Biomass fuels affect pulmonary functions and this is strongly related to the duration of biomass use. *Egypt J Broncho* 2015 9:227–230

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Introduction

Chronic obstructive pulmonary disease (COPD) is an important public health problem; it represents an important health challenge in terms of both prevention and treatment [1,2].

COPD is a major cause of chronic morbidity and mortality as many people suffer from this disease, with the prevalence ranging from 3 to 17% in developed countries; however, in developing countries the prevalence rates are higher, ranging from 13 to 27% (with a few exceptions) [3].

Although smoking is recognized as the most important risk factor for COPD, rural women in developing countries are at a greater risk not as a result of smoking, as smoking is uncommon among women in rural areas, but due to smoke from domestic biomass fuel combustion, which is another potential risk factor for the development of COPD [2].

About half the world's population, mostly in developing countries, use solid fuels (biomass and coal) as their main energy source, resulting in potentially harmful exposures [4]. Most of these people live in the rural areas of developing countries, where about 80% of households rely on biomass fuels as their major or the only source of domestic energy for cooking and sometimes space heating [5].

The aim of this study was to investigate exposure to biomass fuel as a potential risk factor for COPD among women in some rural areas in Fayoum governorate in whom cigarette smoking is not the risk factor.

Materials and methods

Study design

This study included 100 nonsmoker women who used biomass and 100 women who did not use biomass selected from the surgical and the gynecology outpatient clinics as controls. This group was matched with cases as regards age, occupation, level of education, and social standard.

All patients and controls were subjected to the following:

(1) History taking.
(2) Thorough clinical examination.
(3) Routine laboratory investigations.
(4) Chest radiographiy (posteroanterior and lateral views).
(5) Simple spirometric study before and after bronchodilator (the apparatus used was Winspiro PRO spirometry [MIR Spirodoc Oxi Diagnostic Spirometer/Winspiro PC software. Intermedics supply, Inc, Miami, USA]).
(6) Arterial blood gas analysis at room air if SpO_2 is less than 92%.

Inclusion criteria

(1) Age 40–60 years.
(2) Female sex.
(3) History of nonsmoking.
(4) History of biomass exposure.

Exclusion criteria

(1) Age less than 40 and more than 60 years.
(2) Male sex.
(3) Absent history of biomass exposure.
(4) Individuals with medical history of bronchial asthma, chronic heart diseases, chronic liver diseases, chronic renal diseases, or occupational lung diseases.

Statistical analysis

Data were computed and analyzed using SPSS, version 11 (Statistical Package for Social Sciences (SPSS)/IBM company/SAGE UK, London). Quantitative data were analyzed using the χ^2-test, whereas the *t*-test was used for comparison between groups as regards quantitative data. A multivariate analysis was used to identify the most relevant factors affecting COPD.

Ethical consideration

This study was reviewed by the Faculty of Medicine Research Ethical Committee. The participants were informed about the objectives of the study, the examination, and the investigation that would be carried out. Confidentiality of their information was assured and the participants had the right to refuse to participate in the study. All patients gave their formal consent. The protocol was approved the Ethical Committee of the Fayoum University.

Results

The study was carried on 200 women attending our chest clinic in Fayoum University Hospital. The age of the women enrolled in this study ranged between 40 years as a minimum age and 60 years as a maximum age, with a mean age of 50.64 ± 6.34 years.

The control group had normal forced expiratory volume in first second/forced volume capacity (FEV_1/FVC) ratio, whereas the case group was classified as follows: 23 women had normal ratio, 13 had obstructive abnormality, and 64 had restrictive abnormality, with statistically significant difference between the case and control groups ($P = 0.000$) (Table 1).

The case group was classified as follows: 22 cases had normal FEV_1, 49 cases had mild affection, 24 cases had moderate affection, and five cases had severe affection, with statistically significant difference between the case and control groups ($P = 0.000$) (Table 2).

The case group was classified as follows: 29% of cases had normal forced expiratory flow (FEF), 23% had mild affection, and 20% had moderate affection (Table 3). However, 11% of cases had severe affection and 17% of them had very severe affection of FEF, with a statistically significant difference between the case and control groups ($P = 0.000$).

Among cases with the duration of biomass usage of 10–20 years, seven were considered normal, one as obstructive, and 13 as restrictive (Table 4). Among cases with the duration

Table 1 Relation between FEV_1/FVC ratios and the case and control groups

FEV_1/FVC ratio	Cases = 100 [*N.* (%)]	Control = 100 [*N.* (%)]	Total = 200 [*N.* (%)]	*P* value
Normal	23 (23.0)	100 (100)	123 (61.5)	0.000*
Obstructive	13 (13.0)	0 (0)	13 (6.5)	
Restrictive	64 (64.0)	0 (0)	64 (32.0)	

FEV_1, forced expiratory volume in first second; FVC, forced volume capacity; *Significant.

Table 2 Classification of the studied group on the basis of the value of FEV_1

FEV_1	Cases = 100 [*N.* (%)]	Control = 100 [*N.* (%)]	Total = 200 [*N.* (%)]	*P* value
+80	22 (22.0)	100 (100)	122 (61.0)	0.000*
+50–80	49 (49.0)	0 (0)	49 (24.5)	
+30–50	24 (24.0)	0 (0)	24 (12.0)	
<30	5 (5.0)	0 (0)	5 (2.5)	
Total	100 (100)	100 (100)	200 (100)	

FEV_1, forced expiratory volume in first second; *Significant.

Table 3 Relation between FEF25–75% and the case and control groups

FEF25–75%	Cases = 100 [*N.* (%)]	Control = 100 [*N.* (%)]	Total = 200 [*N.* (%)]	*P* value
Normal	29 (29.0)	100 (100)	129 (64.5)	0.000*
Mild	23 (23.0)	0 (0)	23 (11.5)	
Moderate	20 (20.0)	0 (0)	20 (10.0)	
Severe	11 (11.0)	0 (0)	11 (5.5)	
Very severe	17 (17.0)	0 (0)	17 (8.5)	

FEF25–75%, forced expiratory flow rate at 25–75% of flow-volume curve; *Significant.

Table 4 Relation between duration of biomass use and FEV_1/FVC ratios

FEV_1/FVC ratio	No uses [*N.* (%)]	10–20 [*N.* (%)]	+20–30 [*N.* (%)]	+30 [*N.* (%)]	Total [*N.* (%)]	*P* value
Normal	100 (50)	7 (3.5)	16 (8.0)	0 (0)	123 (61.5)	0.000*
Obstructive	0 (0)	1 (0.5)	6 (3)	6 (3)	13 (6.5)	
Restrictive	0 (0)	13 (6.5)	41 (20.5)	10 (5.0)	64 (32.0)	
Total	100 (50)	21 (10.5)	63 (31.5)	16 (8.0)	200 (100)	

FEV_1, forced expiratory volume in first second; FVC, forced volume capacity; *Significant.

of biomass usage for more than 20–30 years, there were 16 normal, six obstructive, and 41 restrictive cases. Cases using biomass for more than 30 years had no normal ratio, had six obstructive abnormality, and 10 restrictive abnormality, with statistically significant difference between the case and control groups ($P = 0.000$).

Discussion

COPD is a leading cause of morbidity and mortality worldwide and results in an economic and social burden that is both substantial and increasing [1]. Although smoking remains the predominant risk factor for COPD [6], it needs to be emphasized that the prevalence of COPD in nonsmokers suggests the existence of other risk factors such as passive smoking, occupational exposure, and indoor air pollution [7]. In recent times, exposure to biomass smoke resulting from household combustion of solid fuels has been identified as an important risk factor for COPD, with rural women in developing countries being more exposed to disease [8]. In addition to respirable particulate matter, biomass combustion results in high levels of pollutants such as carbon monoxide, oxides of nitrogen and sulfur, formaldehyde, and benzene that are a major source of respiratory irritants in the etiopathogenesis of COPD [9].

In our study, 200 women were recruited from the rural areas of Fayoum governorate. Women aged between 40 and 60 years, with the mean age 50.64 ± 6.34 years, were included in the study. Our study showed a strong relationship between biomass fuel use and prevalence of COPD in rural nonsmoker women, as well as presence of a significant percentage of restrictive patterns, denoting association of biomass with other restrictive lung diseases. The decline in FEV_1 and FEF25–75% is significantly related to duration of exposure to biomass fuels.

Similar to our study were those performed by, Shengming *et al.* [10], Kurmi *et al.* [11], Priscilla *et al.* [12], Justino *et al.* [13], Kiraz *et al.* [14], Liu *et al.* [15], Mejza *et al.* [16] and Ekicia *et al.* [17] were performed. Shengming *et al.* [10] reported a higher prevalence of COPD in the whole population and subpopulation of nonsmoking women in rural areas compared with urban areas of south China (12 vs. 7.4%) despite a higher incidence of smoking in urban women compared with rural women (7.2 vs. 2.5%). This suggests that other important factors might have contributed to COPD. In contrast to our study, in this study, the relation between biomass duration and FEV_1 and FVC and FEF25–75% was not ascertained. Kurmi *et al.* [11] showed that the prevalence of airflow obstruction was higher in individuals exposed to biomass smoke in rural Nepal compared with nonexposed participants (8.1 vs. 3.6%). However, in this study, postbronchodilator lung function was not measured. The study showed significant reduction in FEV_1 and FEF25–75% in populations using biomass across all age groups, but there was no significant association between FVC and biomass use. Despite significant decline in FEF25–75%, they stated that FEF25–75% is not recommended in clinical practice for the diagnosis of small airway obstruction, although its deficit provides additional evidence for the presence of airflow obstruction. These results are similar to those reported in our study on significant reduction in FEV_1 and FEF25–75% in relation to biomass use. Kiraz *et al.* [14] showed higher prevalence of COPD in rural than in urban women from Turkey (12.4 vs. 3.9%). The study showed that values of FEV_1 were relatively low in rural than in urban women. This was in agreement with our results in which values of FEV_1 were low in women who used biomass fuel compared with those who did not use biomass fuel. Liu *et al.* [15] showed that the total prevalence of COPD in the studied population was 19.4%, with higher prevalence in rural than in urban areas of Guangdong Province in China (12 vs. 7.4%). Priscilla *et al.* [12], in contrast to our study, reported no statistically significant results in the detection of COPD in rural women of Tamil Nadu, but they showed that higher COPD was detected in biomass fuel users than in clean fuel users. Justino *et al.* [13] showed that 13% of nonsmoking women had FEV_1/FVC less than 70%, with a slight increase in women using biomass fuel compared with those using gas stoves (82.8 vs. 79.9%) in rural Mexico. The study revealed that most of the cases using biomass had moderate decline in FEV_1 similar to that reported in our study, in which 47% of cases had moderate decline in FEV_1 (50–80%). There was a small significant difference in FEV_1 and FVC between women using biomass and those using gas stoves. Ekicia *et al.* [17] suggested that biomass smoke was an important contributing factor to the development

of COPD in nonsmoking women living in rural areas. Mejza *et al.* [16] showed an independent relationship of farming, in addition to biomass use, with lower FEV_1/FVC values, as well as increased COPD risk, in a random population sample of Malopolska inhabitants. The study showed significant reduction in lung function in individuals using biomass. Filip *et al.* [18] showed significantly low FEV_1/FVC ratio in individuals exposed to biomass combustion and occupational exposures among Malopolska inhabitants, with 26.6% having a ratio less than 70%. The study showed significant decrease in lung function in individuals using biomass with stage 2 or higher COPD (FEV_1 50–80%).

Acknowledgements

Conflicts of interest

None declared.

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