Prevalence of Chronic Bronchitis-Asthma Symptoms in Biomass Fuel Exposed Females

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Abstract

Objectives: We investigated whether exposure to biomass fuel is a potential risk factor for chronic bronchitis and asthma among females in rural area in Van (east Turkey).

Methods: The effect of indoor pollution producing various respiratory symptoms was studied in 177 females. Of these, 90 were those who used biomass fuel and 87 were nonusers of biomass fuel. A part of the European Community Respiratory Health Survey questionnaire and British Medical Research Council questionnaire were used.

Results: Asthma related symptoms (AS) (wheezing, and combination of wheezing without a cold and wheezing with breathlessness) were reported in 63.3% of those who used biomass fuel, and in 12.9% of nonusers ($p < 0.0001$). The use of asthma medication was reported as 3.3% of biomass fuel users, and in 2.7% of nonuser ($p > 0.05$). Long term cough and/or morning cough together with sputum (chronic bronchitis symptoms (BS) was reported as 58.9% in the user group, and 29.4% in the nonuser group ($p < 0.0001$). Significant differences in AS and BS were found between biomass fuel user and nonuser groups in the rural area.

Conclusions: The results of this study showed a significant association between symptoms of chronic bronchitis-asthma and biomass fuel usage in females living in a rural area.

Key words: biomass fuel, asthma, chronic bronchitis (CB), questionnaire

Introduction

Air pollution from smoky cooking fuels has been identified as a serious health hazard in developing countries, especially for females and children (1, 2). Elevated indoor pollutant concentrations continue to be a fact of life for people who live in impoverished areas and cook over open fires fueled by charcoal, wood, dung, kerosene, or oil (3). However, people in developing countries spend around 90% of their time indoors. It is estimated that approximately 50% of households worldwide cook with some type of biomass fuel. A number of epidemiologic studies have shown that indoor pollution is associated with chronic pulmonary diseases (4). However, there is evidence that environmental influences are also relevant either in the initial development of asthma or in the augmentation of its prevalence, which cannot be explained by changes in reporting or diagnosis

(5). Apart from smoking habits and industrial pollution, particularly in rural areas, the major cause of obstructive pulmonary diseases in developing countries may be the use of biomass fuels for cooking and heating purposes (6). Padmavati and Joshi were the first to show the high prevalence of chronic bronchitis and chronic cor pulmonale in females in rural North India due to the use of firewood and cow-dung cakes as fuel for domestic cooking (7). In Turkey, especially in rural areas, wood and other biomass forms are used as the primary cooking fuel in special rooms with traditional stoves which are inefficient and emit large quantities of smoke indoors. Concentrations of airborne particulate matter in kitchens with traditional stoves burning biomass fuel are on the order of milligrams per cubic meter (8). In this study, we used the European Community Respiratory Health Survey and British Medical Research Council questionnaire. The European Community Respiratory Health Survey is a multinational survey with the aim of estimating the prevalence of asthma-like symptoms, atopy and bronchial lability, and also the variation in exposure to suspected risk factors (9,10).

The purpose of this study was to evaluate the chronic effects of biomass on respiratory symptoms, i.e. to estimate the prevalence of chronic bronchitis and asthma related symptoms in females who cook on biomass fuel stoves.

Received Aug. 5 2002/Accepted Oct. 17 2002

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Materials and Methods

Subjects

This study was an epidemiological cross-sectional investigation of risk factors for the development of COPD and asthma in biomass fuel exposed females in Van city (east Turkey). Five villages were chosen around Van, Turkey according to systematic sampling technique. These villages were free of any industrial or general atmospheric pollution. The villagers lived in mud-walled-type of houses. Houses contained traditional stoves placed in a special room. In addition, LPG stoves were also used. The females cooked on stoves with biomass fuels daily or a minimum of four times per week. In this study, the population consisted of 177 females. The population samples were divided into two groups according to biomass fuel use: Group A—those who cook on biomass fuel (n: 90, 18–75 years), Group B—never cooked on biomass fuel (n: 87, 17–67 years). The subjects were also separated as smokers and nonsmokers. Subjects were classified as smokers if they were smoking daily. Non-smokers were defined as subjects who had never smoked daily. The biomass fuel user group was divided into two groups according to the duration of biomass exposure (1–20 and >20 years).

The questionnaire

The European Community Respiratory Health Survey (ECRHS) questionnaire was used which contains seven questions commonly related to the diagnosis of asthma. In addition, four questions on bronchitis-related symptoms and smoking, based on the British Medical Research Council (BMRC) were also included. All questions translated into Turkish are shown in Appendix 1. In this study, the questionnaire was applied directly to females in their homes by a physician.

Classifications

Symptomatic individuals were divided into three groups

according to the following definitions: those reporting use of asthma medication or having had an attack of asthma during the previous year (Q5 or Q6) were classified as having an asthma-related disorder (AD). Also positive answers to questions 1, 1a and 1b, i.e. individuals who reported wheezing occurring in the absence of colds, were classified as having asthmatic symptoms (AS). Those reporting problems with phlegm and also long-term cough and/or morning cough (Q8 and/or Q9, and Q10) were classified as having bronchitis symptoms (BS) (11).

Statistical analysis

Chi-square and t tests were used to analyze the differences between the groups. P values less than 0.05 were considered significant.

Results

All 177 subjects responded to the questionnaire. Table 1 shows the responses to the written questionnaire. Table 2 shows the characteristics of the subjects. The mean age of females who used biomass fuel was 41 ± 12 years and the mean time of exposure was 17.3 ± 10 years. Thirty-three percent of the study population were smokers. The mean age of females without biomass fuel usage was 33 ± 13 years ($p < 0.01$) and twenty-nine percent of this group were smokers. The prevalence of smokers was not significantly different among the groups. The history of wheezing was more common in group A ($p < 0.0001$). The prevalence of asthmatic symptoms (AS) was 63.3% in those who used biomass fuel, 12.9% in those who never used biomass fuel. The prevalence of AS and BS were higher in group A than the other group ($p < 0.0001$, $p < 0.0001$). Biomass fuel users reported more cough symptoms (Q8, Q9, and Q4) than the other subjects. The symptoms of chronic bronchitis (BS) in the biomass fuel used group were significantly higher ($p < 0.0001$). The asthma-related disorders (AD) were similar in the two groups (n.s.) (Table 4).

Table 1 Positive answers on airway symptoms, medication and smoking as % of subjects in each group

	Biomass fuel user	Never used biomass fuel	p value
1. Wheezing	68.8	17.3	0.0001
1a. Breathless while wheezing	68.8	14.7	0.0001
1b. Wheezing without cold	52.2	5.3	0.0001
2. Woken by chest tightness	51.1	29.3	0.01
3. Woken by attacks of breathlessness	51.1	24	0.001
4. Woken by attacks of cough	53.3	33.3	0.01
5. Asthma attack	3.3	2.7	0.8
6. Current asthma medication	3.3	2.7	0.8
7. Hay fever/allergic rhinitis	65.5	56	0.2
8. Long term cough	61.1	28	0.0001
9. Morning cough	58.8	26.7	0.0001
10. Productive cough	56.6	22.7	0.0001
11. Current smokers	33.3	29.3	0.582

Table 2 Characteristics of study groups

	n	Age (years)	Duration of exposure to biomass fuel (year $\pm$ SEM)	Current smokers %
Biomass usage	90	41 ± 12	17.3 ± 10	33
No biomass fuel usage	87	33 ± 13	—	29.3
p value	>0.05	<0.01		>0.05

Table 3 Positive answers on airway symptoms and medication as % of subjects in smoking and nonsmoking females who cook using biomass fuel

	Smokers	Nonsmokers	p value
Q1. Wheezing	83.3	61.6	n.s.
Q2. Woken by chest tightness	46.6	53.3	n.s.
Q3. Woken by attacks of breathlessness	53.3	50	n.s.
Q4. Woken by attacks of cough	60	50	n.s.
Q5. Asthma attack	6.6	1.6	n.s.
Q6. Current asthma medication	3.3	3.3	n.s.
Q8. Long term cough	60	61.6	n.s.
Q9. Morning cough	40	51.6	n.s.
Q10. Productive cough	46.6	61.6	n.s.

There was no significant difference in positive answers between smokers and nonsmokers in biomass fuel users (Table 3).

According to duration of biomass fuel exposure, in group A, AS was higher in over 20 years duration of biomass fuel usage than 1–20 years usage ($p<0.001$). Although BS increased in females who used biomass fuel, there was no significant difference for BS between 1–20 years and greater than 20 years duration of biomass fuel usage ($p>0.05$) (Table 5).

Discussion

Indoor pollution from biomass fuels such as wood, dry dung, crop residues for cooking is still a problem in developing countries. The persons most frequently affected are females who do the cooking for households in rural villages. They suffer from impaired health due to prolonged and repeated contact with these harmful pollutants (12). Mortality and morbidity from obstructive lung disease has increased among these individuals (13). The role of indoor exposure to biomass fuels in the development of the disease has been examined in various studies.

Pandey (2) investigated 1,375 subjects in rural region of Nepal to determine whether there was any relation between domestic smoke pollution and chronic bronchitis. He found that the prevalence of chronic bronchitis in females increased with the duration of time per day spent near the fireplace. In the present study, the increasing trend of chronic bronchitis in females was similar among smokers, nonsmokers and ex-smokers. However, their study showed a high prevalence of chronic bronchitis (12.57%) among nonsmoking females. Padilla et al. (14) investigated older females (>40 years) with chronic bronchitis and chronic airway obstruction (CAO). They reported a causal role of domestic wood smoke exposure for chronic bronchitis and CAO. In the present study, the incidence of BS and AS increased in biomass fuel using subjects. However the incidence of BS and asthma symptoms were similar among smoking and nonsmoking females. The present study showed that the prevalence of chronic bronchitis symptoms was 58.9% (Table 4). This finding showed that indoor pollution due to biomass fuel was an important factor for CB and AS in females with biomass fuel usage. The significantly higher mean age of the biomass fuel user group may be considered a confounding factor for this result. Padilla et al. showed that both years of exposure and hours of exposure per day had independent and

Table 4 Positive answers on respiratory symptoms in the biomass fuel user and nonuser groups as asthma related symptoms, asthma disorder, and bronchitis symptoms

	Biomass fuel user	Nonuser	p value
AS	63.3	12.9	0.0001
AD	3.3	2.7	n.s.
BS	58.9	29.4	0.0001

Table 5 Positive answers according to duration of biomass fuel usage (1–20 years and >20 years)

	1–20 %	20–30 [↑] %	p value
AS	56.5	78.6	0.0005
AD	5.6	—	0.07
BS	57.5	60.7	0.623

significant contributions to CB and CAO. We showed that CB tended to be more frequent in the >20 years biomass fuel exposed group compared with the 1–20 years exposed group, but there was no significant difference ($p>0.05$). In one study, risk factors of COPD were investigated in Saudia Arabia. They reported that exposure to indoor open fires in poorly ventilated homes was a risk factor for COPD (15). Dennis et al. (16) showed that tobacco use, wood smoke for cooking, passive smoking, and gasoline use for cooking were associated with obstructive airway disease. In that study, wood-smoke exposure was associated with the development of obstructive airways disease among females in Bogota.

In Ellegard's study (17), it was reported that wood users had more cough symptoms than users of other fuels, but there was no significant difference in cough symptoms between charcoal users and users of modern fuels. In his study, other respiratory symptoms such as dyspnea, wheezing, inhalation and exhalation difficulties were not associated with wood use. Their results suggested that wood use should be restricted due to its effect on respiratory health. In the present study, the prevalence of asthma and chronic bronchitis symptoms were higher in biomass fuel users than nonuser females though all nonuser subjects in our study used LPG.

Behara and Jindal (18) reported that CB in chulla (dried dung, crop residues, and agricultural wastes) users was higher than kerosene and LPG users. They found that smoking females exposed to cooking fuels experienced respiratory symptoms more often than nonsmokers. In that study, respiratory symptoms were observed in 13 percent of nonsmoking females who used four different types of cooking fuels: biomass fuel, LPG, kerosene, and mixed fuels. Mixed fuel users experienced more respiratory symptoms (16.7%) followed by biomass fuel users (12.6%). The symptomatic females had higher ages except for LPG users. Similarly, the symptomatic females had higher exposure times in all fuel groups, and mixed fuels such as a combination of two or more except the LPG users. CB in biomass fuel users was significantly higher than other fuels. In that study, the incidence of CB and asthma were 2.9% and 0.5% in biomass fuel users, respectively. The prevalence of respiratory symptoms was greater with increased exposure index (duration of cooking) in all four groups. In addition, smoking females

who are also exposed to cooking fuels experienced respiratory symptoms more often than nonsmokers. The present study showed 58.9 percent prevalence of CB symptoms. The symptoms of CB were higher in biomass fuel used subjects than the never used group. According to the duration of biomass fuel usage, AS was significantly higher for biomass fuel usage of >20 years than for 1–20 years usage. Although BS increased in females with usage for >20 years, there was no significant difference between these groups. In addition, the present findings showed that there was no significant difference between smoking and nonsmoking females in terms of AS and BS.

Bronchial asthma, as mentioned in some cases, is unlikely to be due to cooking fuels alone. However, if such patients are exposed to domestic fuel producing smoke, the symptoms will be aggravated. In another study of Behara (19), bronchial asthma was observed in 3.2% of female subjects (Chandigarh-Indian) and dyspnea was reported in 4.9% of nonsmoking females in an urban population. The present study, the incidence of bronchial asthma was 3.3% in biomass fuel using females and 2.7% in never used biomass fuel subjects in a rural population.

Menezes et al. (20) investigated the prevalence of chronic bronchitis in Pelotas in a southern Brazil city, in addition to some risk factors for the diseases. They reported that the prevalence of CB was 12.7%. In that study, a significant increase in the prevalence of CB was shown with high levels of indoor air pollution (16% vs 9.3%). The odds ratios of CB was 1.86 with high indoor pollution, 1.64 for medium indoor pollution, and 1 for minimum indoor pollution. Bakke et al. (21) reported that

the estimated prevalence of asthma and chronic obstructive lung disease was 1.7% and 6.4% in an urban population, and 3.7% and 3.3 in a rural population. In that study, both COLD and spirometric airflow limitation were more prevalent in urban than rural areas, but this difference disappeared after adjusting for age. They found that the prevalence of obstructive lung disease (asthma or COLD) was not significantly different between the genders. Xu et al. (22) reported that the crude prevalence rates for bronchitis (OR: 2.4) and asthma (OR: 0.9) in Beijing-China were 13% and 5%, respectively, in this random sample of adult never smokers. An increased odds ratio of bronchitis was significantly associated with high indoor and outdoor pollution. However, no association between asthma and air pollution was observed in that study. They demonstrated a significant relation between indoor coal combustion and reported chronic respiratory symptoms and bronchitis in never smoking adults. In that study, the time of exposure did not correlate with the severity of the pulmonary involvement. In addition, they reported that the effects of outdoor air pollution would be underestimated if indoor air pollution was not accounted for.

In conclusion, the results of the present study suggest a significant association between symptoms of chronic bronchitis-asthma and biomass fuel usage in females living in a rural area. Biomass fuel usage as an important contributing factor in chronic bronchitis and asthma symptoms is still a common form of indoor pollution in Turkey. Use of smokeless devices and adequate ventilation might be helpful in preventing some of these effects.

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Appendix 1

Questions of European Community Respiratory Health Survey (Q1–Q7) and British Medical Research Council (Q8–Q11) questionnaires

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- Q1. Have you had wheezing or whistling in your chest at any time in the last 12 months?
- Q1a. Have you been at all breathless when the wheezing was present?
- Q1b. Have you had this wheezing or whistling when you did not have a cold?
- Q2. Have you woken up with a feeling of tightness in your chest at any time in the previous 12 months?
- Q3. Have you been woken by an attack of shortness of breath at any time in the previous 12 months?
- Q4. Have you been woken by an attack of coughing at any time in the previous 12 months?
- Q5. Have you had an attack of a sthma in the previous 12 months?
- Q6. Are you currently taking any medicine (including inhalers, aerosols or tablets) for asthma?
- Q7. Do you have any nasal allergies including “hay fever”
- Q8. Have you had troubles with long term cough in recent years?
- Q9. Do you usually cough in the morning?
- Q10. Do you usually cough up phlegm?
- Q11. Do you smoke? (answer yes even if you only smoke a few cigarettes or pipe tobacco per week, or if you have quit smoking for less than one year).
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