

# Indoor Air Pollution as a Risk Factor for Lung Cancer in Women

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## Abstract

**Objectives:** Tobacco smoking is the most common risk factor for lung cancer. But a significant proportion of lung cancer occurs in non-smokers. Indoor pollution due to domestic fuels has been recently implicated as a causative agent in lung cancer especially in women. We conducted a case control study to find out the role of indoor air pollution due to domestic cooking fuels in Indian women.

**Methods:** In a case control study 67 women with proven lung cancer were recruited. Forty-six females having a non-malignant respiratory disease constituted the control group. The patients and controls were asked about the exposure in various cooking fuels using a questionnaire.

**Result:** There were 50(74.6%) non-smokers and 17(25.4%) smokers among the female cancer cases ( $p=0.016$ ). Adenocarcinoma was the commonest histological type of malignancy ( $n=26$ , 38.8%) in the whole group and was the predominant form in the nonsmoking females. Tobacco smoking was the most important risk factor for lung cancer with OR of 4.87 (95% CI 1.34-17.76). Among non-smokers out of all the cooking fuels the risk of development of lung cancer was highest for biomass fuel exposure with an odds ratio of 5.33 (95% CI 1.7-16.7). Use of mixed fuels was associated with a lesser risk (OR= 3.04, 95% CI 1.1-8.38). In multivariate logistic regression analysis biomass fuel exposure was still significant with OR of 3.59 (95% CI 1.07-11.97) even after adjusting for smoking and passive smoking.

**Conclusion:** This study indicated that biomass fuel exposure is an important risk factor in the causation of lung cancer among women in addition of exposure to tobacco smoke. ©

## INTRODUCTION

Domestic cooking is an important duty of an average Indian housewife. On an average, an Indian woman spends about four to six hours daily for cooking. Mainly four different types of cooking fuels are used in this country: biomass fuel (Wood, Cow-dung cake, agricultural waste, coal etc.); liquefied petroleum gas (LPG); kerosene and a mixture of these. About 95% of the rural population in India still relies primarily on biomass fuels (dung, crop residues, and wood).<sup>1</sup>

Use of these fuels causes a number of respiratory problems, which include acute respiratory infections in children, chronic obstructive lung disease in non-smokers.<sup>2-6</sup> It has also been implicated as a risk factor for lung cancer in women.<sup>7-9</sup> Use of unprocessed solid fuel causes indoor air pollution with high concentration of PM<sub>10</sub> particles<sup>1</sup> Biomass smoke, however, contains a wide-range of chemicals that are known or suspected human carcinogens.<sup>7,8</sup> Thus, they may be important risk

factors for development of lung cancer. Studies from China have shown that coal burning at home is a significant risk factor for development of lung cancer in non-smoking females.<sup>9</sup> Coal smoke contains many potential carcinogens like SO<sub>2</sub>, CO, TSP, B(a)P, radon, thoron.<sup>7</sup> Use of kerosene for cooking has also been seen associated with development of lung cancer as reported in some studies.<sup>10</sup> In the present study we have tried to find out the role of domestic cooking as a risk factor in the development of lung cancer in non-smoking Indian women.

## MATERIALS AND METHODS

This is a case control study in which 67 women with proven lung cancer attending the Lung Cancer Clinic at the Department of Pulmonary Medicine, Postgraduate Institute of Medical Education and Research, Chandigarh. Patients were recruited between January 1999 and December 2002. Only those in whom the diagnosis of lung cancer was confirmed on cytological or histological examination of the material obtained from the primary site or a metastatic lymph node/pleural fluid with obvious primary lesion in the lungs detected radiologically, were included. Forty-six females having

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a non-malignant respiratory disease constituted the control group.

The questionnaire, which was used, required information on demographic factors, life time exposure to smoking, detailed occupational history, residence and exposure to indoor air pollution due to burning of organic fuels. Effects of individual variables were assessed using unconditional logistic regression models. The odds ratios (OR) and 95 per cent confidence intervals (CI) were calculated. Analysis was done using statistical program SPSS.

## RESULTS

The age in the cases varied from 30-80 years ( $52.5 \pm 11.1$ ) and in the controls the age ranged from 31-70 years ( $43.5 \pm 15.5$ ) ( $P > 0.05$ ). There were 50(74.6%) non-smokers and 17(25.4%) smokers among the female cancer cases ( $p=0.016$ ). Adenocarcinoma was the commonest histological type of malignancy ( $n=26$ , 38.8%) (Table 1) in the whole group and was the predominant form in the nonsmoking females ( $n=25$ , 50%). In smoking females squamous and small cell carcinoma were the common cause. In the control group there were 43 non-smokers and three smokers. Tobacco smoking was the most important risk factor for lung cancer with OR of 4.87 (95% CI 1.34-17.76). Thirty six (53.7%) of the lung cancer patients had history of exposure to environmental tobacco smoke (passive smoking) compared to only 13(28.3%) among controls ( $p=0.007$ ). For passive smoking the odds ratio was 2.95 ( $p=0.008$ , 95% CI 1.322-6.571).

Among non-smokers out of all the cooking fuels the risk of development of lung cancer was highest for biomass fuel exposure with an odds ratio of 5.33 (95% CI 1.7-16.7) (Table 2). Use of mixed fuels was associated with a lesser risk (OR= 3.04, 95% CI 1.1-8.38). Exposure index (calculated by multiplying the average duration of cooking daily with the number of years cooked by the subject) in case of lung cancer cases was  $148.5 \pm 83.9$  vs.  $83.1 \pm 59.73$  in controls ( $p < 0.001$ ). In multivariate logistic regression analysis biomass fuel exposure was still significant with OR of 3.59 (95% CI 1.07-11.97) even after adjusting for smoking and passive smoking. Passive smoking was not an important contributory factor for development of lung cancer in non-smoking females ( $p > 0.05$ ).

## DISCUSSION

Lung cancer is one of the commoner malignant neoplasms in India. Complex circumstances like genetic predisposition, environmental exposures, lifestyle habits combine over a lifetime to initiate and promote tumor growth in the lung. This study has confirmed that tobacco smoking is an important risk factor for development of lung cancer even in women. As compared to men, women from Asia are shown to experience a weaker risk of lung

**Table 1 : Histological types of lung cancer in women**

Histology	Frequency	Percent
Squamous	11	16.4
Adeno	26	38.8
Small cell	11	16.4
Others	19	28.4
Total	67	100.0

**Table 2 : Risk factors for lung cancer in women**

	Univariate		Multivariate	
	Odds ratio	95% CI	Odds ratio	95% CI
Smoking	4.871	1.337-17.753	2.611	.639-10.670
Passive smoking	2.948	1.322-6.571	2.014	.825-4.917
<b>Cooking fuel</b>				
LPG*	1		1	
Kerosene	2683.463	.000-infinity	1827.535	.000-infinity
Biomass	5.333	1.700-16.731	3.594	1.079-11.966
Mixed	3.048	1.108-8.381	2.816	.997-7.950

\*Reference category

cancer following smoking.<sup>11</sup> A report had shown a prevalence of ever smoking of 12 per cent among women and 89 per cent among men.<sup>12</sup>

Environmental tobacco smoke (ETS) is an important indoor air pollutant that may be a contributing risk factor. A meta-analysis of 41 studies showed that environmental tobacco exposure carries a Relative Risk of developing lung cancer of 1.48 (1.13-1.92) in males and 1.2 (1.12-1.29) in females.<sup>13</sup> In a study on non-smoking lung cancer patients environmental tobacco exposure during childhood carries an OR of 3.9 (95% CI 1.9-8.2).<sup>14</sup> There is increasing risk with increase in number of smokers in the house and duration of exposure. Women had high OR of 5.1.

Our study showed a significant contribution of biomass fuel exposure in the development of lung cancer. This association is present even after adjusting for smoking. In India majority of houses use unprocessed solid fuel for cooking.<sup>15</sup> The effect of coal fumes from heating or cooking in poorly ventilated houses on lung cancer risk has drawn attention. A study from China showed a good correlation between indoor air pollution as measured by benzo(a)pyrene concentration and high lung cancer mortality rates.<sup>9</sup> Polycyclic aromatic hydrocarbons well-known human carcinogens were found in the indoor air from combustion of coal.<sup>16</sup> Domestic coal combustion also has caused arsenic, selenium poisoning and possibly mercury poisoning which can be carcinogenic.<sup>16</sup> Another suspected risk factor for lung cancer is the volatile substance generated from cooking oils heated at high temperatures.<sup>17,18</sup> In a retrospective analysis by Gupta D *et al* on risk factors of lung cancer cumulative exposure of > 45 yr in women to indoor air pollution from use of coal or wood for cooking

or heating showed an OR of 1.43 (CI 0.33-6.30).<sup>19</sup>

In conclusion, this study has confirmed that biomass fuel exposure is a principal risk factor in the causation of lung cancer among women in addition of exposure to tobacco smoke. Better-ventilated kitchens and use of smokeless chimneys should be emphasized as a measure to lessen the risk of lung cancer to Indian women.

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### Announcement

#### **Diabetes and Pregnancy Study Group - India**

At the recently held International Colloquium on Diabetes and Pregnancy, it was decided to form "Diabetes and Pregnancy Study Group - India", to have a nationwide perspective on Gestational Diabetes Mellitus (GDM). Those who are interested in joining this group are invited to contact:

The Secretariat : Diabetes and Pregnancy Study Group - India. **Dr. V Seshiah** Diabetes Care and Research Institute, 31A, Ormes Road, Kilpauk, Chennai 600 010. India.  
Tel. : 91 44 2641 2296, 2661 5757; E-mail : vseshiah@gmail.com

### Announcement

#### **ITP Study Group**

At the recently held First National Conference on Idiopathic Thrombocytopenic Purpura, it was decided to form ITP Study Group with a view to study the natural history of the disease in India and also to see the commonly prevailing practice in treating this disease. Based on the information collected in such study, recommendations can be made about the management of ITP in India including a possible role of alternative forms of therapy.

Those who are interested in joining the study group should contact : **Dr B C Mehta** at (labmed@ghrc-bk.org). It is necessary that those who wish to join the group have easy access to internet. All communications of the study group will be through e-mail and web. Members will have access to the data/information on web.