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Smoke and lung disease

Where there's smoke there's lung disease

Youcheng Liu

Exposure to biofuels in China

Although global energy consumption from biomass fuels or biofuels is only a small part of the total (12%), the use is much more prevalent in developing countries than in developed countries (33% vs 3%).[1] It is estimated that almost 3 billion people or 50% of households worldwide use biomass and coal as their main source of energy for cooking, heating and other household needs.[2 3] Biofuels have higher emission factors for particulate matter and other pollutants, especially during incomplete combustion at lower temperatures,[4] which generates indoor airborne particles at levels much higher than those for cleaner fuels[5] or outdoors,[3] and well above levels in most polluted cities.[6] Such particles also have small aerodynamic diameters (ranging from 0.05 to 1 μm for wood smoke, for example)[1] and can penetrate deep into the alveolar region to induce adverse pulmonary effects. Some of the earliest work concerned with respiratory health and the burning of biofuels in developing countries started with investigations into wood smoke exposure in the 1960s in Papua New Guinea.[1 7 8] More studies on domestic smoke pollution and chronic bronchitis were conducted in rural Nepal.[9 10] In the past two decades a number of epidemiological studies have been conducted specifically to evaluate the burning of solid biofuels as a risk factor for chronic obstructive pulmonary disease (COPD). These studies, performed in various regions of the developing world such as Saudi Arabia,[11] Columbia,[12] Mexico,[13] Turkey[14] and Nepal,[5] have shown a link between biofuel cooking and COPD in women. In addition, a link has also been found in developed countries.[15] Little has been reported, however, on health impacts in general[16]—and the risk of COPD in particular[17]—of biofuel indoor air pollution in rural China. A recent large study from rural China showed a significant decrease in reported history of COPD and other respiratory ailments in biofuel and improved stove users compared with coal and traditional stove types.[18]

In this issue of *Thorax* Liu *et al*[19] report a large-scale COPD prevalence study conducted in rural south China and provide further evidence to support the hypothesis that burning of biofuels is a risk factor for COPD in women in rural communities (***see page 889***). The authors show that the prevalence of COPD was significantly higher in the rural community as a whole—and in non-smoking women in particular—than in the urban community. This was true even after controlling for other risk factors such as smoking status, history of family respiratory diseases and childhood cough, sex, age group, body mass index (BMI) and social economic status (defined by family income). Biofuels, including agricultural crop residuals and firewood, were the main fuel type used in this community and cooking was done in a poorly ventilated kitchen area with inefficient traditional stoves. Environmental measurements showed significantly higher concentrations of sulfur dioxide (SO_2), carbon monoxide (CO), particulate matter with aerodynamic diameter <10 μm (PM_{10}) and nitrogen dioxide in rural kitchen areas using biofuels than in urban kitchens using liquid petroleum gas (LPG).

This study improves our understanding of the risk of COPD in the context of a whole array of other possible COPD risk factors and in comparison with earlier studies which had smaller sample sizes from the community[5 14] or were based on hospital patient data.[11–13] The study by Liu *et al* has a much larger sample size and is based on random cluster sampling from large populations which provides a more representative sample. Exposure assessments in earlier studies were based on questionnaires with no[11–14] or limited number of pollutants measured (mostly PM_{10} and CO).[5] In addition, some of these studies were of a case-control design where exposure assessments using questionnaires may be subject to recall bias and possible exposure misclassifications. Liu *et al*[19] monitored in real time multiple

air pollutants emitted from the combustion of biofuels as well as from coal and LPG, and specifically analysed their contributions to the prevalence of COPD in non-smoking women after adjustment for other possible risk factors. They identified SO_2 as contributing significantly to the risk of COPD in non-smoking women. In addition, both the urban and rural communities in the study had low outdoor air pollution levels which reduced the possibility of community air pollution exposure as a significant risk factor.

Perhaps one of the greatest strengths of the study by Liu *et al* is the range of variables in personal characteristics they collected using a standard questionnaire that allowed a systematic analysis of their independent contributions to the prevalence of COPD and the identification and control of confounding factors when the effect of biofuels was analysed. Their data did in fact show that, in addition to the predominant use of biofuels in this community, the population had a higher percentage of younger people (40–49 years), much less education, lower social economic status, a higher prevalence of family respiratory disease history and early childhood cough, and more exposures to environmental tobacco smoke and occupational dust than the urban community. These variables were found to be independently associated with the prevalence of COPD. When controlled for other factors, age, BMI, smoking status and a family history of respiratory diseases and early childhood cough remain significantly associated with the prevalence of COPD. This indicates that multiple risk factors are involved in the aetiology of COPD in this rural population.

It is generally accepted that COPD results from an interaction between individual risk factors (such as α_1-antitrypsin deficiency) and environmental exposures to toxic agents such as cigarette smoking, occupational dusts, indoor and outdoor air pollution and lower respiratory infections in early childhood.[20] Tobacco smoke (including environmental tobacco smoke) is well established as the most important risk factor for COPD and is responsible for 90% of the causes of COPD.[21] The prevalence of COPD in different countries is, in general, related to rates of smoking and time of introduction of cigarette smoking.[22] The study by Liu *et al*[19] and previous investigations of biofuel together confirm smoking as the number one risk factor for COPD and also suggest that cooking and heating with biofuels in rural communities has a significant impact on the risk of COPD in non-smoking women in developing countries. It is possible that other factors may also be involved in the interplay, such as genetic differences in the imbalance of proteinases and antiprotenases in the lung and oxidative stress or immune dysregulation,[23] reduced pulmonary function resulting from long-term exposure to organic dust,[24] hygienic conditions and poor access to health care. However, these factors in general are less well studied and understood.

Although the study by Liu *et al* was performed in Guangdong Province, this may be extrapolated to many other parts of China where cooking patterns are similar and fuel use is strikingly different between urban and rural communities. The study also stresses the public health impact of their findings and suggests that a strategic plan that includes public health campaign, healthcare improvement, early medical diagnosis and treatment and feasible alternatives to cleaner fuels is needed in reducing the risk of COPD in rural China. Although more studies are needed to characterise exposures at personal levels and better establish the link between biofuel air pollution and the risk of COPD, current evidence warrants further preventive interventions. In reality, smoking and exposure to environmental tobacco smoke will remain the bigger public health challenge than biofuel air pollution in China, since it has about 30% of the world's smokers and more than 50% of non-smokers exposed to environmental tobacco smoke, including women, infants and children. While household energy use in China has been upgraded rapidly in recent years along the energy ladder with more households in urban areas using LPG,[25] biofuels and coal remain the significant energy source for rural families[18] and it may take a long time to change because of economic constraints. Intervention studies are needed to find acceptable, feasible and effective measures for reducing the emissions of biofuels and modifying lifestyle and cultural practice in traditional cooking. Such measures might include installing chimneys on stoves, changing to more efficient stove types or increasing the ventilation in kitchens by windows or local exhaust fans. In addition, behavioural changes and mitigation methods may be offered at a personal level to reduce the risk of COPD.

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