

Traditional biomass stoves shown to cause lung inflammation

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Traditional cookstoves that use biomass materials shown to cause lung inflammation like COPD. Credit: ATS

Traditional stoves that burn biomass materials and are not properly ventilated, which are widely used in developing nations where cooking is done indoors, have been shown to significantly increase indoor levels of harmful PM2.5 (minuscule atmospheric particulates) and carbon monoxide (CO) and to stimulate biological processes that cause lung inflammation and may lead to chronic obstructive pulmonary disease (COPD), according to new research published online in the *Annals of the American Thoracic Society*.

In "Pro-Inflammatory Effects in *Ex Vivo* Human Lung Tissue of Respirable Smoke Extracts from Indoor Cooking in Nepal," Professor Ian P. Hall of the University of Nottingham, UK led a study of the pulmonary effects of traditional [cook](#) stoves (TCS), in comparison with improved, ventilated stoves (ICS) and liquid petroleum gas (LPG) stoves. Field research was led by Siva Praveen Puppala, Ph.D., of Nepal's International Centre for Integrated Mountain Development.

Why conduct the study in Nepal? "I have had links with Dhulikhel Hospital in Kathmandu for seven years," Prof. Hall explained. "When on hospital rounds, I noticed a lot of admissions for COPD, both men and women. Nepalese men smoke, but women generally don't, while they are also traditionally the family cooks. I was interested in why women were getting COPD, and the most obvious question to explore was whether it was due to indoor biomass smoke, so we decided to study these exposures."

The researchers measured personal exposures to PM2.5 and CO during cooking on a range of stoves in 103 households in four different Nepalese villages, each village at a different elevation (from 200 to 4,000 meters above sea level), and took measurements outdoors as well as indoors when cooking was not being done. They also exposed surgically removed [lung tissue](#) to soluble smoke samples collected during cooking, and then applied the samples to the tissue and tested it for 17 different inflammatory substances. There would not be any CO in these extracts, so the researchers only looked at other components of the extracts.

Increased levels of 7 of 17 inflammatory substances occurred in the lung tissue following TCS biomass smoke exposure. Cooking with the improved cook [stove](#) still caused an inflammatory response related to six of these substances. LPG cooking activated two inflammatory substances. Study authors believe these elevated levels during ICS and LPG cooking may be due to inflammation-causing substances not tested for.

"Little was previously known about the mechanisms underlying the lung's response to biomass smoke," said Dr. Hall. "Now, we have shown, for the first time, that biomass smoke samples collected in a real-life environment from rural Nepal have pro-inflammatory effects on human lung tissue. These exposures, which induce [lung inflammation](#), may partially explain the increased risk of COPD in

these communities."

Lung inflammation is a major cause of COPD. More than 90 percent of deaths from COPD are in low and [middle-income countries](#), and COPD has a high incidence rate in the regions of Nepal studied.

The researchers found that the overall average PM2.5 exposure was reduced by 51 percent in homes that used ICS and by 80 percent in households using LPG stoves, in comparison with traditional stoves. Exposures to particulates in different locations while cooking with traditional stoves were 5-29 fold higher than 24-hour World Health Organization (WHO) exposure standards. Even the reduced exposures to PM2.5 using either ICS or LPG were higher than WHO recommended levels. Higher particulate levels were also found in higher elevations.

The indoor CO concentration was reduced by 72 percent and 86 percent, respectively, in households using ICS and LPG. All cooks who used TCS exhaled higher levels of CO while they were cooking than when they were not.

The traditional biomass stoves, which are used by 80 percent of the Nepalese population and widely used in low and middle-income nations throughout the developing world, burn wood, crop residues or dried dung. Cooking is done on open fires in rooms without a chimney or proper ventilation. Improved biomass stoves, which have improved compression systems and/or vent fumes through a chimney, have been tried in some villages. Twenty-one percent of Nepalese homes use liquefied petroleum gas stoves, which burn a mixture of propane, butane and isobutane.

"These data support the need to reduce exposures in order to improve respiratory health in this setting," stated Dr. Hall. "Additional methods other than those being tried may be needed to reduce exposures to levels that will prevent lung inflammation and reduce the risk of developing COPD."

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