SMOKING AND SECONDHAND SMOKE

Study Finds No Level of SHS Exposure Free of Effects

How much exposure to tobacco smoke can the lungs endure before damage ensues? The answer appears to be none, based on gene activity measured by researchers at Cornell University. "No level of smoking or exposure to secondhand smoke [SHS] is safe. Even at the lowest detectable levels of exposure, we could detect changes in gene expression within the cells lining the airways," says coauthor Ronald Crystal, head of pulmonary and critical care medicine at New York-Presbyterian/Weill Cornell Medical Center.

Crystal and coworkers at Cornell analyzed gene activity in small airway epithelial cells collected from 121 healthy volunteers. The type of cells tested are where early damage first occurs that leads to chronic obstructive pulmonary disease (COPD) and bronchogenic cancer, according to Crystal.

The volunteers, all of whom had normal lung function, were categorized by tobacco smoke exposure status as determined by their urine levels of nicotine and cotinine. Nonsmokers had nondetectable urine nicotine or cotinine levels, low-exposure individuals had urine nicotine and/or cotinine levels up to 1,000 ng/mL, and active smokers had urine nicotine and/or cotinine levels greater than 1,000 ng/mL. The low-exposure group included occasional smokers and people exposed to SHS.

The researchers first compared the smokers and nonsmokers. Microarrays detected significant changes between these two groups in the activity of 372 genes. Among the low-exposure group, about a third of these 372 genes were up- or downregulated compared with nonsmokers, and 11% of the genes differed compared with active smokers.1

Even subjects with the lowest levels of nicotine and cotinine had enhanced activity of biological pathways involved in the metabolism of xenobiotics by cytochrome P450 and arachidonic acid. The same two pathways also were highly activated in smokers, suggesting exposure to low levels of SHS caused changes in the airways similar to those from active smoking, representing the earliest biologic abnormalities that can lead to disease.2 The authors believe this may be the first study to document biological changes in the lung cells of people exposed to low levels of tobacco smoke.

The results support epidemiologic studies that link early respiratory damage to low levels of SHS exposure or occasional smoking.3,4 However, the tobacco smoke–induced gene changes “do not tell us which ones [genes] are dangerous and which are protective,” Crystal notes.

Moreover, the cross-sectional nature of the study precluded determining whether the genetic changes predicted disease. Followup studies lasting 20 years or more are needed to sort out the genes that play a role in the development of lung diseases, and Crystal plans to follow some of the people in this study.

People often wonder what level of exposure to SHS is harmful—is it a problem, for instance, to hang out with smoking friends once or twice a week? Crystal’s study “employs sophisticated molecular genetic techniques to address this very important public health question of whether a threshold exists,” says Norman Edelman, a professor of preventive medicine at Stony Brook University Medical Center and chief medical officer at the American Lung Association.

The finding that no level of tobacco smoke exposure appeared safe “is important for informing both individual behavior and public health policy,” Edelman says.

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RESPIRATORY HEALTH

Measuring the Health Effects of Crop Burning

What to do with crop residue left in fields at the end of a growing season is, literally, a burning issue. Some farmers prefer the inexpensive approach of setting the stubble ablaze, but repeated burning is not good for the soil, and the resulting smoke is a health hazard. Although many studies have measured the particles released into the air by crop burning, fewer have isolated the effect of the smoke on lung function. New research now shows the smoke produced by crop burning could have a lasting effect on children’s lung function.2

Ravinder Agarwal, head of the University Science Instrumentation Centre at Thapar University in Patiala, India, and colleagues used portable spirometers to regularly test the lung function of children aged 10–13 and adults aged 20–35 over the course of a year. The 40 participants were healthy nonsmokers living in a village surrounded by farmland, with little traffic and no industry within 10 km.8

Children’s force vital capacity (FVC)4 dropped from a mean 98% in August to 92% in July 2009. Mean FVC dipped as low as 88% in October and November, when farmers burned their rice crop residue, and in April and May, when they burned wheat stubble. The children’s mean lung function remained significantly lower throughout the test period. The mean lung function of the adult study participants declined during the burn seasons as well, but largely returned to original levels by the end of the study.3

Decreases in lung function correlated with increases in the concentration of particulate matter, which exceeded India’s national air quality standards during the burn season.3 Small particles (PM10 and PM2.5)—which make up the majority of the smoke produced by crop burning—were more closely associated with decreases in lung function than suspended particulate matter (SPM), which can contain particles 100 µm or larger.5

The findings linking seasonal burning with health issues “coincide with the anecdotal evidence that we have been seeing in the Canadian prairies,” notes Kate Letkemann, environmental issues coordinator of The Lung Association, Manitoba, and a member of the provincial Crop Residue Burning Advisory Committee. On top of regulations regarding what time of day and where crop residue can be burned,2 Manitoba uses incentives to encourage farmers to adopt alternative residue management practices, says Andrew Nadler, coordinator of the governmental Manitoba Crop Residue Burning Program. In the United States, crop burning is regulated at the state level.7

Argawal’s work “builds a relationship between pulmonary function tests and the concentration of SPM, PM10, and PM2.5,” notes Shijian Yang of the School of Environmental Science and Engineering at China’s Shanghai Jiao Tong University. But he would like to see further research that looks closely at the dose–effect relationship between lung function and crop residue burning. Yang’s work has shown that the peak concentration of PM10 and its duration may be more important than average concentrations for estimating the health effects of burning crops.3

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4. FVC is the amount of air a person can exhale in the first second of breathing out, expressed as the percentage of the predicted values for the person’s age, height, ethnicity, and sex.