

## Study confirms the risk of exposure to secondhand tobacco smoke outdoors

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Tens of thousands of Americans die each year from secondhand tobacco smoke, according to a 2006 report by the U.S. Surgeon General. While the health risks associated with indoor secondhand smoke are well documented, little research has been done on exposure to toxic tobacco fumes outdoors.

Now, Stanford University researchers have conducted the first in-depth study on how smoking affects air quality at sidewalk cafés, park benches and other outdoor locations. Writing in the May issue of the *Journal of the Air and Waste Management Association* (JAWMA), the Stanford team concluded that a non-smoker sitting a few feet downwind from a smoldering cigarette is likely to be exposed to substantial levels of contaminated air for brief periods of time.

"Some folks have expressed the opinion that exposure to outdoor tobacco smoke is insignificant, because it dissipates quickly into the air," said Neil Klepeis, assistant professor (consulting) of civil and environmental engineering at Stanford and lead author of the study. "But our findings show that a person sitting or standing next to a smoker outdoors can breathe in wisps of smoke that are many times more concentrated than normal background air pollution levels."

Klepeis pointed to the 2006 Surgeon General's report, which found that even brief exposures to secondhand smoke may have adverse effects on the heart and respiratory systems and increase the severity of asthma attacks, especially in children.

"We were surprised to discover that being within a few feet of a smoker outdoors may expose you to air pollution levels that are comparable, on average, to indoor levels that we measured in previous studies of homes and taverns," said Wayne Ott, professor (consulting) of civil and environmental engineering at Stanford and co-author of the JAWMA study. "For example, if you're at a sidewalk café, and you sit within 18 inches of a person who smokes two cigarettes over the course of an hour, your exposure to secondhand smoke could be the same as if you sat one hour inside a tavern with smokers. Based on our findings, a child in close proximity to adult smokers at a backyard party also could receive substantial exposure to secondhand smoke."

Unlike indoor tobacco smoke, which can persist for hours, the researchers found that outdoor smoke disappears rapidly when a cigarette is extinguished. "Our data also show that if you move about six feet away from an outdoor smoker, your exposure levels are much lower," Klepeis added.

The public has become increasingly concerned about the effects of outdoor smoking, Ott noted. More than 700 state and local governments have passed laws restricting outdoor smoking at playgrounds, building entrances and other public areas, according to the American Nonsmokers' Rights Foundation. Some of the strictest ordinances are in California. The city of Santa Monica, for example, recently banned smoking at parks, beaches, ATM machines, theater lines, open-air restaurants and other outdoor locations.

"Throughout the country, cities and counties are looking at various laws against outdoor smoking, and some of the proposals are pretty drastic," Ott said. "The problem is that until now, there have been virtually no scientific data to justify such restrictions. In fact, our paper is the first study on outdoor smoking to be published in a peer-reviewed scientific journal."

## Particulate matter

In the study, the researchers used portable electronic monitors to make precise measurements of toxic airborne particles emitted from cigarettes at 10 sites near the Stanford campus. "We wanted to quantify the potential level of exposure to outdoor tobacco smoke that could occur in everyday settings," Klepeis said. "To do this, we used five different, state-of-the-art instruments to measure secondhand smoke at parks, open-air cafes, sidewalks and outdoor pubs where smokers were present."

Each instrument was calibrated to measure an airborne pollutant known as particulate matter-2.5 (PM2.5), which consists of thousands of microscopic particles that are less than 2.5 micrometers in width--about 30 times narrower than a human hair.

"PM2.5 is a toxic pollutant produced by cigarettes, wood-burning stoves, diesel engines and other forms of combustion," Ott explained. "It contains benzo(a)pyrene, a carcinogen, and many other toxic chemicals that can penetrate deep inside the lungs."

According to the Environmental Protection Agency, exposure to PM2.5 can lead to serious health problems, including asthma attacks, chronic bronchitis, irregular heartbeat, nonfatal heart attacks and even premature death in people with heart or lung disease. The current EPA ambient air standard for PM2.5 is 35 micrograms per cubic meter of air averaged over 24 hours. Levels that exceed 35 micrograms are considered unhealthy "However, since tobacco smoke contains many toxic components, including carcinogens, it may be even less healthy than typical ambient air pollution," Klepeis noted.

## Test results

To measure PM2.5 levels in secondhand smoke, the researchers placed the instruments near actual smokers in different open-air environments. "We also performed controlled experiments with burning cigarettes, which allowed us to make precise measurements of PM2.5 levels at different distances," Klepeis said.

The results were clear: The closer you are to an outdoor smoker, the higher your risk of exposure.

"A typical cigarette lasts about 10 minutes," Klepeis said. "We found that if you're within two feet downwind of a smoker, you may be exposed to pollutant concentrations that exceed 500 micrograms of PM2.5 over that 10-minute period. If you're exposed multiple times to multiple cigarettes over several hours in an outdoor pub, it would be possible to get a daily average of 35 micrograms or more, which exceeds the current EPA outdoor standard."

Outdoor tobacco smoke consists of brief plumes that sometimes exceed 1,000 micrograms, Klepeis added. "On the other hand, clean air typically contains less than 20 micrograms of PM2.5," he said. "Therefore, a person near an outdoor smoker might inhale a breath with 50 times more toxic material than in the surrounding unpolluted air."

However, the researchers found that air quality improved as they moved away from the smoker. "These results show what common sense would suggest--when you're within a few feet downwind of a smoker, you get exposed," Ott explained. "But likewise, when you go a little distance or stay upwind, the exposure goes way down. If there's just one smoker, and you can sit six feet away, you would have little problem. At the same time, if there are a lot of smokers nearby, you may be exposed to very high levels of secondhand smoke. So this thing that critics have been dismissing as trivial is not."

Added Klepeis: "If people realize that being near outdoor smokers can result in potentially large exposures to toxic air pollution, they may decide they do not wish to be exposed in a variety of outdoor settings. This realization may lead to an increased number of smoking bans in public locations."

Source: Stanford University

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