Thirdhand Smoke: Studies Multiply, Catchy Name Raises Awareness

By Rabiya S. Tuma

Health agencies have warned of the danger of secondhand smoke for decades. Now a small but growing number of scientists are testing the possible health effects associated with the residue that cigarette smoke deposits on furniture, clothing, and other surfaces, a substance some are calling “thirdhand smoke.”

The magnitude of the problem, the amount of attention and resources it warrants, and even the definition of the term itself remain a matter of debate, however. Some tobacco control experts think any effect from thirdhand smoke will be relatively limited and that the new term has driven recent interest more than scientific discoveries have. Despite that skepticism, at least one tobacco research agency has decided that thirdhand smoke and its potential effect on public health warrants greater scrutiny and announced a new funding initiative to support basic research on the potential hazards.

Last year, Jonathan Winickoff, M.D., associate professor of pediatrics at Massachusetts General Hospital in Boston, and colleagues made headlines when they published a report on public attitudes about smoke residue, calling it “thirdhand smoke.” On the basis of a nationwide telephone survey, Winickoff’s team reported that individuals who thought thirdhand smoke was dangerous were more likely to ban smoking entirely from their homes than were individuals who did not perceive a health risk from smoke residue. The study attracted widespread media attention. Many of the news stories, though, focused not on the survey results but on the phrase “thirdhand smoke,” reporting that this was a new health hazard associated with cigarettes.

Defining the Term

Winickoff and colleagues define thirdhand smoke as anything left after a cigarette is put out, including invisible smoke left in the air and the residue left on surfaces. “It is the tobacco smoke residue that remains after a cigarette is extinguished,” Winickoff said in an interview. “That definition is based on something that people see happen: They see the cigarette go out, the smoke clears out a little, and now we are talking about thirdhand smoke.”

He contends that a new term was needed because much of the public thought that any hazard associated with smoking was gone when the smoke cleared. “In focus groups, we found parents who would try to protect their children by turning on a fan and rendering the smoke invisible,” he said. “Their perception of secondhand smoke was visible tobacco smoke. That is why this concept of thirdhand smoke is so important: It takes something from an annoyance and bad smell to something that could be harmful.”

Not everyone agrees with his definition, though. “As far as I’m aware, almost everyone includes the smoke that has curled off the tip of the cigarette and is sitting in the air after the cigarette is put out as secondhand smoke,” said David Burns, M.D., professor emeritus of medicine at the University of California, San Diego, School of Medicine in La Jolla, who has studied the role of behavior and media on smoking cessation. “The particulates that settle on surfaces and reappear in the atmosphere are thirdhand smoke by some people’s definition.”

Lara Gundel, Ph.D., a staff scientist at Lawrence Berkeley National Laboratory in California, who studies chemical reactions in smoke residue, also thinks that a more specific definition would be valuable but acknowledges that the nascent field is still in flux. “The very small community we know who are actively considering what is a good definition of thirdhand smoke are still thrashing out how we are going to make it a very clear concept,” she said. “As an environmental chemist and as someone...
knowledgeable about how air moves around in buildings and such, my opinion about the differentiation between secondhand and thirdhand smoke is that after someone has stopped smoking it is going to take about three air exchanges to get rid of 99% of the secondhand smoke that is in the air. Anything that is left in the environment after that is going to be thirdhand smoke.”

**New Carcinogens**

What researchers appear to agree on at this point is that the residue left on surfaces is not innocuous. Gundel’s group demonstrated that the nicotine deposited on surfaces can react with other indoor pollutants, including ozone, which seeps in from outdoors, and nitrous acid, which is common in houses with gas-burning appliances. In their experiments, the team taped filter paper either to the interior of an experiment chamber or to the glove compartment in a smoker’s truck. They then exposed the filter paper with its smoking residues to gaseous nitrous acid at concentrations found in homes and vehicles, and discovered that tobacco-specific nitrosamines formed rapidly. The newly formed nitrosamines included compounds regularly seen in tobacco smoke, as well as a compound called NNA [(1-(N-methyl-N-nitrosamino)-1-(3-pyridinyl)-4-butanal)], which is not present in fresh tobacco smoke.

“Nitrosamines are themselves compounds that are able to induce cancer in some animal models,” Gundel said. “The concern about these particular nitrosamines is that some of them are very potent. We saw that these compounds can be formed really easily in a realistic environment and that thirdhand smoke can get more toxic with time.” Work from Lawrence Berkeley National Laboratory over the last 10–15 years by Gundel and others shows that nicotine is easily deposited on surfaces, such as walls and furniture, and that it gradually outgases, releasing potentially toxic compounds into the air of the room.

“We also found out that we could not actually measure a limit to the uptake of nicotine in a room that had painted wallboard,” Gundel said. Even with a smoking machine smoking 30 cigarettes a day, month after month, more nicotine just kept adsorbing to the wallboard. That suggests that anyone who enters that room later will be exposed to nicotine—and the tobacco-specific nitrosamines that form when it reacts with other pollutants. Winickoff and others are particularly concerned about small children who spend time on the floor and put either their dirty fingers or objects in their mouth and thus may be exposed to the residue.

In fact, Georg Matt, Ph.D., professor of psychology at San Diego State University, who was a coauthor on Winickoff’s article last year, reported in 2004 that household dust and surfaces in the homes of smokers contained nicotine. Infants living in those houses had substantially higher levels of cotinine, a nicotine metabolite, in their urine than infants living in nonsmoking homes. Moreover, parents who smoked only outdoors reduced, but did not eliminate, their children’s exposure. Those children had cotinine in their urine at a level between the levels found in children of indoor smokers and nonsmokers.

**Health Implications**

Exactly how toxic thirdhand smoke and its derivatives might be is now under investigation. The University of California Tobacco-Related Disease Research Program, which is funded by a state cigarette tax and which supported the work by Gundel and her collaborators, awarded three new grants in June. One recipient, Bo Hang, M.D., Ph.D., a staff scientist at the Lawrence Berkeley National Laboratory, will test the thirdhand smoke’s effect on DNA. “If it can cause DNA damage, then you have the possibility to form cancer,” Hang said. “We need to look for the evidence experimentally to assess the genotoxicity of thirdhand smoke. At this stage, that is all we can do.”

In June, the agency also announced a $3.75 million initiative to study many aspects of the problem, including identification of chemical toxins, potential physiological routes of exposure, health effects, and magnitude of exposure in different workplace and home environments.

“Think of all the hotels where smoking is allowed,” said Kamlesh Asotra, Ph.D., a program director at the Tobacco-Related Disease Research Program. “The maids who come to clean it up are at risk. It takes only 30 minutes for NNA to form and after 3 hours there is plenty of NNA on the surfaces. Or think of all the homes in the country where someone smokes, and the spouses and children are at risk. There are tremendous policy implications here.”

**All in the Name?**

But for Burns, the term itself seems to generate the attention more than any major health risks. “Everybody likes to use the new terms, but I really don’t think this is something that is going to substantively alter the number of people who are seriously ill or dying from tobacco in our society,” he said. “I think it is a real issue for people who very sensitive and a legitimate area of investigation. But do I think we are going to make major public health strides by eliminating thirdhand smoke exposure? I would be surprised if that were true.”

For Winickoff, though, increasing public awareness of the possible hazards of thirdhand smoke could change attitudes and protect vulnerable populations, especially children. “The bottom-line implication of the thirdhand smoke concept is that there is no way to safely smoke indoors. Even if you smoke when no one is present, you still risk exposing nonsmokers,” he said. If the public’s attitude toward smoking changes—and Winickoff contends that it has since his team published their report last year—then even fewer nonsmokers will be exposed to tobacco smoke, and fewer children will grow up to be smokers.

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