Study raises new alarm over long-term exposure to second-hand smoke

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Chronic exposure to second-hand smoke results in lower body weight and cognitive impairments that more profoundly affects males, according to new research in mice led by Oregon Health & Science University.

The study published today in the journal *Environmental Health Perspectives*.

"The hope is that we can better understand these effects for policymakers and the next generation of smokers," said lead author Jacob Raber, Ph.D., professor of behavioral neuroscience in the OHSU School of Medicine. "Many people still smoke, and these findings suggest that that the long-term health effects can be quite serious for people who are chronically exposed to second-hand smoke."

The research examined daily exposure of 62 mice over a period of 10 months. Researchers used a specially designed "smoking robot" that went through a pack of cigarettes a day in ventilated laboratory space at OHSU. The longest previous study of this kind lasted three months.

"Nobody has done this, ever. This study is unique," Raber said. "It really gives you the ability to look at long-term effects."

"This study more accurately replicates the human experience by daily exposing mice to cigarette smoke," added senior author Glen Kisby, Ph.D., professor of pharmacology at Western University of Health Sciences in Lebanon, Oregon.

Second-hand smoke is already considered a risk factor for dementia in people, but the new study put the theory to the test.

Researchers first divided mice into two groups—one wild-type and one expressing the human tau protein, important in Alzheimer's-like dementia. Starting in April of 2018, they exposed mice to cigarette smoke for 168 minutes a day, then conducted behavioral and cognitive testing. They also examined lung and brain tissue.

Key findings:

- Smoke harms 'healthy' mice. Researchers theorized that second-hand smoke would be especially harmful for mice with the human tau protein. However, "we actually found the opposite," Raber said. In many of the behavioral and cognitive tests—including swimming speeds and migrating through a maze—wild-type mice were more affected than human tau mice after both groups were exposed to second-hand smoke.
- Smoke especially harms males. Researchers discerned a clear sex-related difference in cognition, with clearly discernable changes in the hippocampus region of the brain among males compared to females.
- Loss in body weight. Researchers found lower body weights in wild-type mice following second-hand smoke compared with human tau mice. Further, they also

noticed that males were disproportionately impacted by a loss in body weight compared to females.
- Brain changes: Researchers discovered more profound changes in metabolic pathways, which are linked chemical reactions, in the brains of wild-type males than females. Researchers also found more profound effects in the brains of wild-type than the human tau mice.

Although smoking rates have declined in recent generations in some countries, smoking—and exposure to second-hand smoke—remains widespread in much of the world. The World Health Organization estimates 1.5 to 1.9 billion people worldwide will be smokers in 2025.

"Long-term exposure to second-hand smoke triggers detrimental changes," Raber said. "Based on our study, it seems that males might be more susceptible than females. People should take that into consideration."

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