Thirdhand Smoke Resource Center

What do we know about the health risks of thirdhand smoke?

The Short Answer

Thirdhand smoke is the chemicals left behind when someone smokes tobacco. Thirdhand smoke is unhealthy for people and pets. It can stick around for a long time in homes and cars. It gets into your body if you inhale, swallow, or touch the chemicals. Getting rid of it is really hard and can cost a lot of money.

Thirdhand smoke affects both people and pets, from tiny cells to entire organ systems. It can be found in nearly any indoor environment, including homes, cars, and cafes, and it can harm those who don't smoke. It can be toxic residue on surfaces and in dust as well as chemicals in the air.

We know about the health risks of thirdhand smoke from four major types of research:

- Studies of thirdhand smoke chemistry have shown that it contains more than 25 chemicals known to cause cancer, affect a person's ability to have children, or cause birth defects.
- Laboratory studies of lung, skin, liver, blood, and reproductive cells have shown that thirdhand smoke can impair a cells' ability to function and repair themselves.
- Animal studies have shown many health effects, including slow wound healing, increased "bad" cholesterol, and lung inflammation.
- Studies with healthy human volunteers have shown damage to human cells and increased respiratory illnesses in children, including pulmonary illness, viral/other infectious illness, and bacterial infections.

The Long Answer

Thirdhand smoke is the chemical residue from tobacco smoke. It is also called "tobacco smoke residue" or "stale tobacco smoke." The chemicals in thirdhand smoke are toxic to humans, especially children. It can linger for years in dust and on household surfaces. It can also become embedded in carpets, furniture, clothes, and building materials. It is difficult and expensive to remove.

Thirdhand smoke chemicals can be found in nearly every type of indoor environment, including single-family homes, low-income multiunit housing, high-end condominiums, homes of people with smoking bans, homes of people who previously smoked, homes after people who smoke moved out, nonsmoking rooms in hotels, cafes, other public places, rental cars, and public transportation. Thirdhand smoke can be both toxic residue on surfaces and in dust and dangerous chemicals in the air in these spaces.

Thirdhand smoke impacts the health of people and animals at multiple levels. It can harm genetic material, affect the ways individual cells function, interfere with the body's ability to fend of infections, and impair entire organ systems in the human body. Thirdhand smoke can make pre-existing conditions worse or create new ones.

Scientific evidence about the health effects of thirdhand smoke exposure comes from four major types of studies:

1) Health effects of chemicals found in thirdhand smoke

Thirdhand smoke contains some of the same toxic chemicals as first- and secondhand smoke, including nicotine, tobacco-specific nitrosamines, polycyclic aromatic hydrocarbons, heavy metals, and ultrafine particles. Overwhelming evidence suggests that exposure to this mixture of toxic chemicals and ultrafine particulate matter is harmful to human health. The WHO's International Agency for Research on Cancer lists some of these chemicals because they are known to cause cancer. California law requires more than 25 of the pollutants found in thirdhand smoke to be listed under Proposition 65 because they are known to cause cancer, birth defects, or other reproductive harm. Additional harmful chemicals form when thirdhand smoke on surfaces and in dust comes in contact with other chemicals, such as ozone, in an indoor environment.

2) Health effects of thirdhand smoke exposure on human cells

Studies of human cells show that exposure to thirdhand smoke can directly damage DNA (e.g., DNA strand breaks), the genetic material found in nearly every cell that contains the instructions our cells need to develop, function, grow, and reproduce. Thirdhand smoke causes oxidative stress in human cells, interfering with their normal functioning and repair mechanisms. Thirdhand smoke chemicals impair our cells' ability to regenerate and repair themselves. Thirdhand smoke can harm various cell types in the human body, include lung, skin, liver, blood, and reproductive cells.

3) Health effects of thirdhand smoke exposure on animals

In 1939, Dr. A. H. Roffo published one of the first animal studies on thirdhand smoke. He showed that rabbits developed skin cancer when thirdhand smoke residue was applied to their skin. In 1953, Dr. E. L. Wydner conducted a similar experiment in mice, showing the same outcomes. A more recent study by Dr. Martins-Green showed that mice exposed to thirdhand smoke through their bedding material have the following symptoms:

- slow wound healing
- inflammation in lungs
- elevated levels of fat in the liver
- high blood sugar levels
- increased blood clotting
- hyperactive behavior
- poor weight gain after birth
- elevated LDL ("bad") cholesterol and low HDL ("good") cholesterol levels

4) Health effects of thirdhand smoke on humans

Researchers have found that people living in or visiting places where people have smoked in the past are exposed to toxic components of thirdhand smoke. Researchers determined this by measuring thirdhand smoke biomarkers in people's urine, blood, or saliva. They even found thirdhand smoke toxicants in newborns, infants, children, and nonsmoking adults living in thirdhand smoke-polluted environments.

Researchers at the University of California, San Francisco studied the effects of thirdhand smoke exposure in healthy, non-smoking human volunteers in a laboratory setting. They found that thirdhand smoke damaged the participants' lung cells after only three hours of exposure.

Researchers the from Cincinnati Children's Hospital and San Diego State University found that children exposed to thirdhand smoke were more likely to be diagnosed with pulmonary illness, viral/other infectious illness, and bacterial infection.

Do you have more questions about the toxic legacy of tobacco smoke, how it affects human health, and what we can do about it? Learn more here.

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