

Dirty air now could harm hearts of offspring later

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A parent's exposure to dirty air before conception might spell heart trouble for the next generation, a new animal study suggests.

Wondering about the possible health risks for children of people routinely exposed to highly polluted air, including soldiers and residents of some of the world's largest cities, researchers from The Ohio State

University studied the effects of dirty air on mice.

And they found an abundance of evidence of harm to the [offspring](#) of parents that routinely breathed dirty air prior to mating.

"We found that these offspring had a variety of heart problems during the prime of their lives and the effects were so robust that it was somewhat shocking," said study senior author Loren Wold, director of biomedical research at Ohio State's College of Nursing.

Heart function was impaired. Inflammatory markers linked to increased heart disease risk were high. They had markers of oxidative stress, a condition in which levels of beneficial antioxidants are low. Calcium regulatory proteins, which are critical to the function of the beating heart, were altered. And these mice were young and otherwise healthy—comparable to 20-year-old humans.

The first-of-its-kind study appears online today in the *Journal of the American Heart Association*.

"This suggests that heart problems related to pollution exposure could start even before conception, and if that's true it has implications worldwide," said Wold, a professor of nursing and medicine at Ohio State.

Wold and his team also uncovered evidence of gene-related differences that might explain the cardiovascular changes they saw. They examined epigenetic regulators, which play an important role in the expression of genes—meaning that they have influence over predisposition to health problems, including cardiovascular disease.

"I looked at important epigenetic regulators in the offspring, and some were activated, which could explain the differences we saw. The next

step will be a more-detailed analysis," said study lead author Vineeta Tanwar, a research scientist at Ohio State.

To conduct the study, researchers concentrated air from Columbus, Ohio, until the level of harmful particulate matter—particles suspended in the air—reached a level on par with large cities such as Los Angeles and Beijing. The research focused on the presence of PM2.5, particles that are small enough to pass from the lungs into the bloodstream.

The test mice breathed this air for about 30 hours a week.

"They were, on average, exposed to less particulate matter than what the U.S. Environmental Protection Agency has set for daily air quality standards," Tanwar said.

Then, the mice were kept in normal air during mating and the researchers compared their offspring to the offspring of mice that were not exposed to the polluted air.

"The first thing we did was to do a basic echocardiograph and we could see profound heart dysfunction in the offspring of particulate-matter-exposed mice," Tanwar said. "Then, we began to look at [single cells](#) and at typical markers of heart disease and found a lot more evidence that preconception pollution could harm the offspring."

The study focused only on [male offspring](#) because the research team wanted to narrow its focus on this first experiment. Going forward, they plan to compare male and female offspring, try to determine which parent's exposure might matter more to offspring, evaluate heart health later in the lifespan of the mice and explore potential changes in the eggs and sperm of [mice](#) exposed to dirty air.

"A key question here is how are changes in the sperm and eggs passing

on the information to the offspring to cause this [heart](#) dysfunction?" Wold said.

Though more animal research is needed, this study also opens the door to exploring the role of air pollution on the health of future generations, he said. For instance, it might make sense to begin by working with adults with high levels of exposure to particulate matter, such as residents of New Delhi and Beijing, Wold said.

"We already know that humans have dramatic cardiovascular effects from exposure to dirty air, high blood pressure in particular. And we know that babies can be harmed by pollution both before and after birth," Wold said.

"Understanding whether the damage may begin even before conception is critical."

More information: Vineeta Tanwar et al. Preconception Exposure to Fine Particulate Matter Leads to Cardiac Dysfunction in Adult Male Offspring, *Journal of the American Heart Association* (2018). [DOI: 10.1161/JAHA.118.010797](#)

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