

Q&A: Worm study raises concern about DEET's effect on reproduction

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Researchers have uncovered evidence hinting that the most common bug spray ingredient, DEET, might cause reproductive problems by affecting the formation of egg cells during pregnancy.

The findings come from a study in *C. elegans*—worms that don't look

like they have much in common with humans yet serve as surprisingly useful bellwethers of how toxins in the environment affect [human reproduction](#).

The research, [published](#) Jan. 4 in *iScience*, raises difficult questions. Chief among them is how to balance the possible reproductive harms of DEET-containing products in people—including infertility, miscarriage, or birth defects—with the need to ensure that people remain protected from diseases transmitted through [insect bites](#), such as malaria, Lyme disease, West Nile virus, and Zika virus disease.

Whether and how much DEET use causes reproductive problems in humans will need to be confirmed in future studies. [Such studies](#) have been scarce to date in humans because of the ethical concerns involved.

Harvard Medicine News spoke with study senior author Monica Colaiácovo, professor of genetics in the Blavatnik Institute at Harvard Medical School, about what her team found and what it means.

Why did you conduct this study?

Monica Colaiácovo: The biggest motivator was how high DEET scored in our initial screens of [how various chemicals in our environment affect meiosis](#), using the model organism *C. elegans*. Meiosis is the type of cell division that creates eggs and sperm.

DEET was one of our top hits in terms of chromosomes not separating properly, so eggs end up with abnormal numbers of chromosomes. In humans, this can cause miscarriage, stillbirth, infertility, and genetic conditions such as Down syndrome. We knew we had to look at this carefully.

Research has shown that DEET products can have neurologic effects on

people who use them, but no one had really looked at what DEET is doing in meiosis. We wanted to understand whether it would cause a problem. Only a few human studies have been done, and practically everyone uses DEET, so the possibility that it could affect reproduction felt palpable for people in our lab.

What did you find?

Using our worm model, we showed for the first time that DEET can have effects on meiosis. Then we showed why.

We saw that DEET has a significant impact on [gene expression](#)—the pattern of genes that are active or inactive in a cell. We found that the change resulted in [oxidative stress](#) (an imbalance between free radicals and antioxidants) and abnormal structure of the materials that form chromosomes, which compromised the ability of chromosomes to separate properly as the cell divided. Egg cells and the worm embryos they gave rise to were less healthy.

How applicable are the worm findings to humans?

That is always the big question. Many human genes have equivalents in *C. elegans*, and worms are a powerful model for looking at effects on reproduction. *C. elegans* have been instrumental in uncovering how environmental toxicants such as the plastics chemical BPA can harm reproductive health.

We observed the changes in meiosis when the levels of DEET inside the worms were the same as, and in some cases lower than, what you find in blood or urine samples from the regular human population.

That said, the paradigm for exposure wasn't the same as it is for most

people. The worms were exposed to DEET for 24 hours at a time, which may not apply to anyone, or apply to only certain groups, such as agricultural workers. And there are some metabolic and physiological differences between worms and humans.

A very important thing from our studies is that we're providing reproducible, well-controlled, substantial data. Other groups can take up this work in mice or other animal models and further advance our understanding of what DEET may be doing in human reproductive systems. We can also build on this evidence to flag chemicals of concern for policymakers.

At this stage, how would you frame recommendations for people? How do you balance reproductive health with prevention of diseases from mosquitoes and ticks?

My family is from South America, where Zika and dengue, for example, are common, and I want to make sure people are not scared away from being careful. So-called tropical diseases transmitted by insects are moving into new regions of the world as the climate changes, putting more and more people at risk. The consequences of stopping the use of insect repellents can be very serious.

So, we want prevention. We want repellents. And DEET is a very effective option we have right now. At this moment, I would say we should be aware of the potential reproductive risks of DEET-containing products and be sure to follow the application instructions when using them. Our work suggests this is very important for pregnant women because female meiosis begins in the developing fetus in the womb.

I would love to see research give rise to best practices for applying

DEET products during pregnancy, when there's often so much confusion and anxiety about what to do or not do.

I also hope our work helps drive the development of DEET alternatives that are safe and effective. It would be great to have an effective insect repellent that doesn't make us worry about our health or that of our children.

More information: Altered gene expression linked to germline dysfunction following exposure to DEET, *iScience* (2024). DOI: [10.1016/j.isci.2023.108699](https://doi.org/10.1016/j.isci.2023.108699). [www.cell.com/iscience/fulltext ... 2589-0042\(23\)02776-1](https://www.cell.com/iscience/fulltext/S2589-0042(23)02776-1)

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