Plastic particles themselves, not just chemical additives, can alter sex hormones

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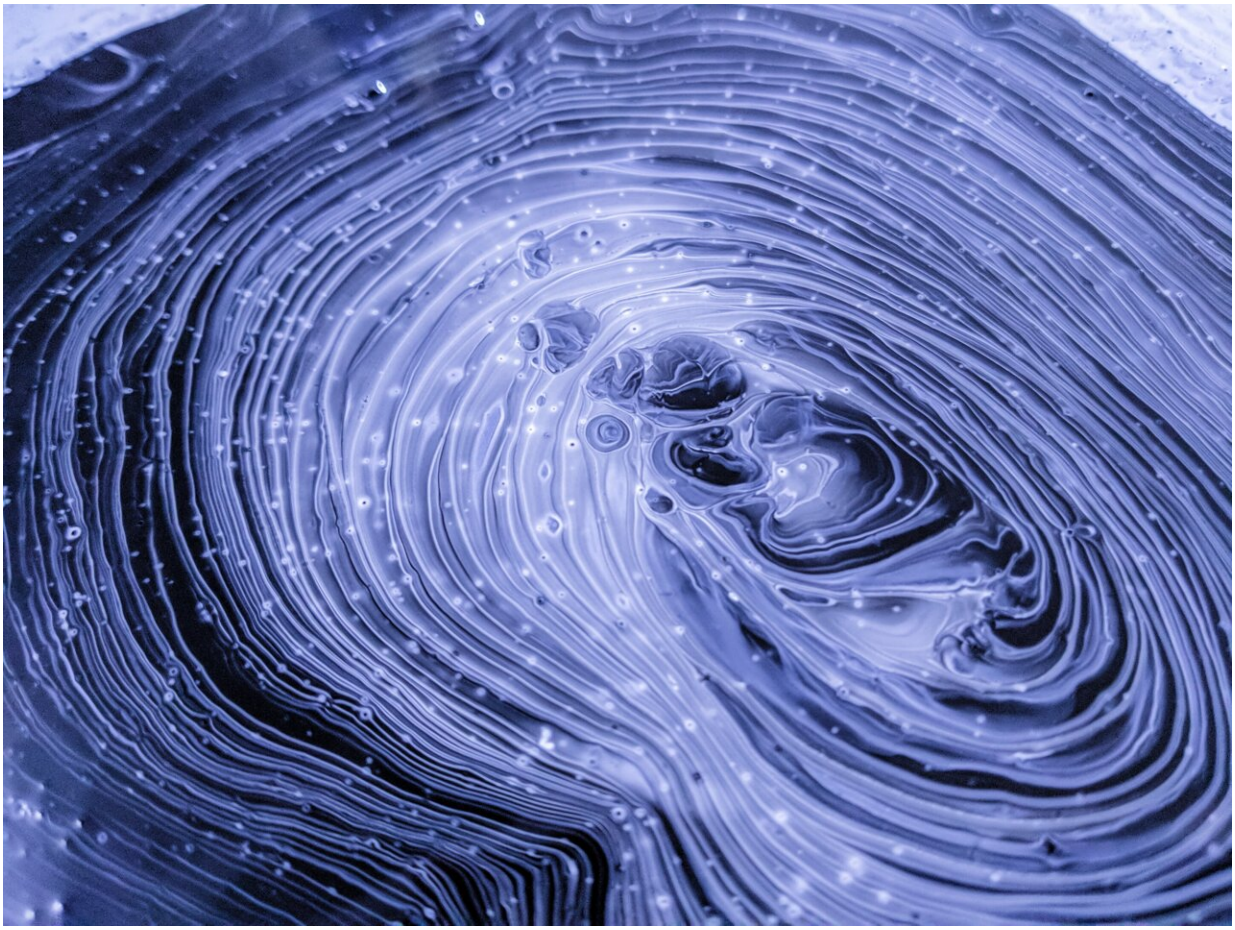

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Amid rising evidence that additives designed to improve plastics also

disrupt sex hormones, a Rutgers laboratory trial shows that plastic itself can do likewise when inhaled at moderate levels.

Previous studies focused on chemicals such as bisphenol-A (BPA) that make plastics stiffer or more flexible. These findings spurred ongoing efforts to find safer plastic additives.

The Rutgers study showed that microscale and nanoscale particles (MNPs) of polyamide, a common plastic better known as nylon, produced endocrine-disrupting effects when inhaled by female lab rats in concentrations experienced by humans.

The disruption of sex hormones delivered by the endocrine system could help explain health issues such as increasing obesity and declining fertility.

"Previous research has focused almost exclusively on chemical additives," said Phoebe Stapleton, assistant professor at the Rutgers Ernest Mario School of Pharmacy and senior author of the new study published in *Particle and Fibre Toxicology*. "This is one of the first studies to show endocrine disrupting effects from a plastic particle itself, not based on exposure to the plasticizing chemical."

"The other innovation was the method of exposure," Stapleton said. "Previous studies have injected animals with the particles being studied or fed them to them. We figured out how to aerosolize the MNP to be inhaled just as we breathe it in real life. We expect many labs to use this method for experiments going forward as it better mimics actual exposure."

Researchers used an extremely fine, commercially available, food-grade nylon powder as their model MNP. They then placed the powder onto a rubber pad and put the pad atop a bass speaker. The bass pulse sent the

smallest nylon particles into the air, and air streams within the system delivered them to the rats.

The study aimed to assess the toxicological consequences of a single 24-hour exposure of MNPs to female rats in heat. After exposure, the researchers estimated the pulmonary deposits of MNPs and measured their impact on pulmonary inflammation, cardiovascular function, systemic inflammation, and endocrine disruption.

Results theorized through pulmonary modeling suggested that inhaled particles deposited in all regions of the rats' lungs without causing significant pulmonary inflammation. However, researchers noted an impairment in vascular function and a decrease in the levels of the reproductive hormone 17 beta-estradiol.

Plastics have been commonly used since shortly after World War II. According to previous Rutgers research, manufacturers have made about 9 billion metric tons of plastic in the past 60 years. About 80% of it is exposed to atmospheric forces that chip off invisibly small particles that float in the air we breathe.

Concern that these microplastics and nano-plastic particles could affect human health by disrupting our hormones is relatively new, Stapleton said. Still, numerous studies have provided evidence that plastic chemical additives can have such an effect.

"Unfortunately, there's very little that people can do to reduce exposure at the moment," Stapleton said. "You can be aware of your flooring, wear natural fibers, and avoid storing food in plastic containers, but invisibly small plastic particles are likely in nearly every breath we take."

More information: Chelsea M Cary et al, Single inhalation exposure

to polyamide micro and nanoplastic particles impairs vascular dilation without generating pulmonary inflammation in virgin female Sprague Dawley rats, *Particle and Fibre Toxicology* (2023). DOI: 10.1186/s12989-023-00525-x