

The reproductive hazards of nitrous oxide

On-the-job exposure to high levels of laughing gas is no laughing matter. A new study suggests that the gas, known more formally as nitrous oxide, may impair a woman's ability to conceive — a troubling finding for thousands of female dental assistants, hygienists, and dentists in the United States alone.

This is not the first time nitrous oxide has been linked to fertility problems. A 1989 study showed the gas prevented conception in female rats (SN: 3/25/89, p.182).

Andrew S. Rowland of the National Institute of Environmental Health Sciences in Research Triangle Park, N.C., and his colleagues decided to take that research a step further, this time by looking at the effect of nitrous oxide on women working as dental assistants.

The researchers began their retrospective investigation by recruiting 459 female dental assistants, ages 18 to 39, who had become pregnant during the four years prior to the study's start. Next, the team collected detailed information about each dental worker's exposure to nitrous oxide, a euphoria-producing anesthetic often used in dental offices.

Those who said they were exposed to the gas were asked how many hours per week they worked in a room where patients received nitrous oxide. The women were also asked whether their dental office used equipment to collect unused or exhaled gas and vent it away from the work area.

The team then calculated how many menstrual cycles each woman had had between the time she stopped using birth control and the time she became pregnant. After controlling for factors known to reduce fertility, such as a history of pelvic inflammatory disease, the researchers discovered that women exposed to high levels of nitrous oxide were "significantly less fertile" than women exposed to lower levels of the gas or not exposed.

Women with five or more hours of exposure to high levels of nitrous oxide per week were only 41 percent as likely as their peers to conceive each month, the researchers report in the Oct. 1 *NEW ENGLAND JOURNAL OF MEDICINE*. The team found no fertility hazard for women exposed to lower levels of the gas, primarily because they worked in rooms where excess gas was vented.

Nobody knows the mechanism by which nitrous oxide interferes with fertility. It is possible that the gas blocks the brain's secretion of gonadotropin-releasing hormone and thus prevents ovulation, Rowland speculates. On the other hand, the gas may disrupt the development of a fertilized egg and thus cause a very early miscarriage, he adds.

In this study, women who reported heavy exposure to laughing gas took

longer to conceive than their peers. However, Rowland and other scientists wonder whether chronic occupational exposure to high levels of nitrous oxide may lead to cases of outright infertility.

Of course, women may not be the only ones with fertility problems. Patricia A. Baird of the University of British Columbia in Vancouver wonders whether male dentists or dental assistants also suffer reproductive hazards because of laughing gas exposure. Baird, who wrote an editorial in the same issue of the journal, notes that nitrous oxide has been shown

Taking the measure of Newton's gravity law

More than 300 years ago, Isaac Newton devised a remarkably simple mathematical relationship to encapsulate how the force of gravity depends on the separation of two objects and their masses. Since then, researchers have sought possible deviations from Newton's gravitational law, but have generally failed to produce any compelling experimental evidence of such discrepancies. Instead, these efforts — especially over the last decade — have substantially increased the precision with which experiment agrees with theory.

Using what they describe as the world's most sensitive "gravity gradiometer," Ho Jung Paik and his co-workers at the University of Maryland in College Park have now improved that precision by a factor of 10. Their experiment sets a new upper limit on any potential deviations from Newtonian gravitation, when measured over a range of a few meters between gravitationally interacting objects.

To obtain this result, Paik and his colleagues used a new instrument designed to detect minute variations in a gravitational field. Each of the instrument's three cylindrical arms contains a pair of motion-detecting accelerometers. Each accelerometer, in turn, consists of a disk of niobium connected to a special spring.

Moving an object closer to the instrument slightly shifts the positions of the niobium masses by different amounts, depending on the distance of each of the masses from the object. The researchers can readily detect differences between the tiny displacements of pairs of accelerometers by using superconducting circuitry and taking advantage of the fact that niobium itself becomes a superconductor at liquid-helium temperatures.

To check Newton's gravitational law, Paik and his colleagues observed how their gravity gradiometer responded to the motion of a nearby, 1,500-kilogram pendulum about 3.3 meters long. Although they applied an ingenious strategy to circumvent the need for precise

to produce abnormalities in sperm and reduced fertility in male rats.

From 35 to 50 percent of U.S. dental offices use nitrous oxide to kill pain and calm their patients, Rowland says. The Chicago-based American Dental Association advises its members to rely on equipment that minimizes exposure to the gas, according to an ADA spokesman. However, not all dentists follow that recommendation, Rowland says.

The new study suggests that dentists should begin to steer clear of nitrous oxide as a standard painkiller, Baird contends. "It makes sense not to expose staff and dentists to an agent that poses a concern in this way," she says. — *K.A. Fackelmann*



The three mutually perpendicular arms of this gravity gradiometer contain sensitive mass-spring motion detectors.

measurements of the instrument-pendulum separation, they still had to find ways to correct for the pendulum-induced shaking, tilting, and twisting of the building in which the pendulum was mounted.

"That small amount of [extraneous] motion bothered us," Paik says. It took nearly two years to work out ways to eliminate these effects from the measurements.

The final result confirmed that Newton's law of gravity holds to within two parts in 10,000 for masses a few meters apart. "We have plans to improve this further," Paik says.

The researchers are also developing new instruments, based on the same technology, for detecting gravitational waves and for observing variations in Earth's gravitational field from an aircraft or an orbiting satellite. — *I. Peterson*