Gender may play role in recovery from pneumonia after ozone exposure

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Does air pollution have a bigger effect on the immune system of females than males? It did among mice exposed to ozone -- a major component in air pollution that is known to negatively affect lung function -- and then infected with pneumonia, as significantly more females died from the infection than males.

It is known that some immune functions differ in males and females, in humans as well as in rodents. Generally, scientists use male animals in their research to avoid the complicating influence of female hormones on study data. Hypotheses based on single-sex results, however, may miss critical pieces of information. The researchers believe this study, for example, suggests that air pollutants, such as ozone, have a significantly higher negative effect on females than on males and that consideration of the role of environmental pollutants on health should take gender into account.

“If we could extrapolate what we found to the human population, it would mean women with lung infections may be at higher risk for negative outcomes if they are exposed to high amounts of air pollution, and in particular, ozone,” said Joanna Floros, Ph.D., Penn State College of Medicine professor of cellular and molecular physiology, pediatrics and obstetrics and gynecology, and the lead investigator on the study.

More than 100 million people in the United States live in areas with ozone levels higher than recommended by the U.S. Environmental Protection Agency’s air quality standards. Though ozone occurs naturally

in the stratosphere and provides a protective layer high above the earth, it is the prime ingredient of smog at ground level. Smog is known to exacerbate respiratory problems.

In the study, mice were exposed for three hours either to filtered air or to air with high levels of ozone. They then were infected with a pneumonia bacteria at a dosage that assured all mice would become sick with the disease. Researchers monitored the mice for two weeks and calculated survival rates.

There were three obvious findings. First, the mice exposed to ozone before infection died more often than did mice that had breathed only filtered air.

Second, ozone was even more damaging to one type of mouse, which was genetically engineered without the gene responsible for producing a "protective" or host defense protein called SP-A and had even higher mortality from pneumonia than did ordinary (wild-type) mice, after both groups were exposed to ozone. SP-A is a molecule that provides first-line defense in the lung against various inhaled irritants, bacteria, viruses, and pollen, and it is a component of a complex substance (called surfactant) that coats the tiny air sacs in the lung and prevents the lungs from collapsing.

Third, ozone exposure significantly decreased the likelihood of surviving pneumonia exposure for the female mice compared to males. In both the wild-type mice and in the genetically altered mice, being female increased the risk of death.

Source: Penn State