Wildfire smoke exposure linked to reduced immune system, lung functions

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In the study, investigators found a link between reduced immune system function and abnormalities in lung function, particularly in female animals. Credit: K.West/CNPRC

(Medical Xpress)—California wildfires in 2008 led to a natural experiment with monkeys living outdoors at the California National Primate Research Center at the University of California, Davis, showing for the first time that exposure to high levels of fine particle pollution affects both development of the immune system and lung function.

"These animals were breathing the same air that we were breathing, so from a health point of view, it's very significant," said Professor Lisa Miller, who carried out the study and leads the center's Respiratory

Diseases Unit. Miller noted that the monkeys, which live in outdoor corrals, would have received a higher dose than human residents of Davis.

In June 2008, widespread wildfires in Northern California caused notable smokiness in the Davis area. Over a period of 10 days levels of small particles classed as PM2.5 (inhalable particles smaller than 2.5 microns) at the UC Davis campus were recorded at 50 to 60 micrograms per cubic meter. Some readings reached nearly 80 micrograms per cubic meter, well over the federal standard of 35 micrograms per cubic meter.

The California National Primate Research Center houses about 5,000 animals, mostly rhesus macaques. Many of the animals are born and live outdoors in large family groups of 100 or more. Infants are born in late spring and early summer.

With funding from the California Air Resources Board, Miller, a professor at the UC Davis School of Veterinary Medicine, tested lung function and took blood samples from monkeys that were born during the 10 days of peak air pollution.

The study took advantage of a rare case of scientific serendipity: as it happens, the high levels of particle pollution coincided with the end of the season when rhesus monkey babies are typically born at the federally funded center. All animals were studied when they were young adults, 3 years old.

The following year, no days came close to exceeding the federal standard, allowing investigators to compare lung function and levels of immune system activation of the 2008 smoke-exposed monkeys to those born in the same months in 2009 when there were no wildfires.

Several parameters of immune system function that help protect the

body from bacterial infection were reduced in the animals exposed as infants to the wildfire PM2.5, compared to animals born the following year. This is the first time fine particle pollution has been shown to influence the branch of the immune system that combats infectious disease.

Unexpectedly, investigators found a link between reduced immune system function and abnormalities in lung function, particularly in female animals.

The results suggest that, as a result of the adverse impact on the immune system, the exposed monkeys are more susceptible to infectious disease. The results also suggest that infancy is a period during which high PM2.5 exposures may adversely influence both development of the innate immune system and development of lung function. Infancy may be associated with increased vulnerability to high levels of air pollution exposure because of the rapid lung and immune system development that occurs during the early months of life.

Researchers intend to continue their research on the two groups of monkeys throughout their lives to see if the adverse immune and lung function impacts persist.

While several studies suggest short-term exposure to wildfire emissions (over a few days) can worsen symptoms of asthma and other lung diseases, no studies to date have investigated whether there are long-term health consequences to such exposures.

Numerous scientific studies have previously linked exposure to PM2.5, which can be deeply inhaled into the airways and lungs, to a variety of problems, including premature death, especially in people with pre-existing heart disease. These particles are also found in smog, along with ozone and other components.

The California Air Resources Board has implemented a number of emissions control regulations that have dramatically reduced PM2.5 levels statewide. While the PM2.5 levels measured in summer 2008 are much higher than levels typically seen today, those levels were common in the past, before California implemented emissions control regulations.

Provided by UC Davis