

Air pollution shown to worsen movement disorder after stroke

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Scientists from Hiroshima University uncovered the relationship between stroke and air pollution. Credit: Yasuhiro Ishihara, Hiroshima University

Air pollution has been shown to have a negative effect on the prognosis of ischemic stroke, or stroke caused by reduced blood flow to the brain, but the exact mechanism is unknown. A team of researchers recently conducted a study to determine whether or not increased inflammation of the brain, also known as neuroinflammation, is the main culprit.

The team published their findings in the February 16, 2023, issue of *Particle and Fibre Toxicology*.

Mice exposed intranasally to urban aerosols from Beijing, China, for one week demonstrated increased neuroinflammation and worsening [movement disorder](#) after [ischemic stroke](#), compared to control mice that were not exposed to [air pollution](#).

Additionally, this effect was not observed in urban-aerosol treated mice lacking a receptor for chemicals released by the burning of fossil fuels, wood, garbage and tobacco, called [polycyclic aromatic hydrocarbons](#) (PAH). This suggests that PAHs are involved in both neuroinflammation and increased movement disorder associated with [air pollution exposure](#) in ischemic stroke.

"We designed this study to determine the effects of air pollution on disorders in the central nervous system," said Yasuhiro Ishihara, senior author of the research paper and professor in the Graduate School of Integrated Sciences for Life at Hiroshima University. "Our narrower focus was to determine whether or not the prognosis of ischemic stroke was affected by air pollution," said Ishihara.

The group went one step further by identifying specific components of air pollution that may directly contribute to lower prognoses in ischemic stroke.

They found evidence that intranasal exposure to air pollution from Beijing, China, increased neuroinflammation after ischemic stroke in mice through activation of microglial cells, which are [immune cells](#) found in the brain. Movement disorder was also negatively impacted in ischemic stroke mice exposed to the same air pollution.

A second set of experiments replacing Beijing air pollution with PM_{2.5}

(tiny, aerosolized particles of air pollution that are 2.5 micrometers in width or less) from Yokohama, Japan, demonstrated similar results, suggesting the PM_{2.5} fraction of urban air pollution contains the chemical responsible for increased neuroinflammation and decreased ischemic stroke prognosis.

In order to identify chemicals in air pollution responsible for decreased ischemic stroke prognosis, the research team used a mouse that lacked the aryl hydrocarbon receptor, a receptor that is activated by the presence of PAHs, to determine whether or not exposure to the Beijing air pollution would have a similar effect on mice without working aryl hydrocarbon receptors.

Mice lacking the aryl hydrocarbon receptor demonstrated lower microglial cell activation and movement disorder compared to normal mice, suggesting that the PAHs present in Beijing air pollution are responsible for at least some of the neuroinflammation and lower prognosis seen in ischemic [stroke](#) mice exposed to air pollution.

Ultimately, the goal of the research team is to better understand the mechanism by which PM_{2.5} causes neuroinflammation, since air pollution is inhaled first into the respiratory tract. "Can [small particles](#) move from the nose to the brain? Does lung or systemic inflammation affect the brain immune system?" asked Ishihara.

More information: Miki Tanaka et al, Polycyclic aromatic hydrocarbons in urban particle matter exacerbate movement disorder after ischemic stroke via potentiation of neuroinflammation, *Particle and Fibre Toxicology* (2023). [DOI: 10.1186/s12989-023-00517-x](https://doi.org/10.1186/s12989-023-00517-x)

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