

News Release

Glomerular Injury Induced by Daily Exposure to the Low-Frequency Component of Environmental Noise via Endothelin Signaling in Mice

Key Points

- We demonstrated in a mouse model that the low-frequency component of environmental noise can impair kidney function.
- We showed that low-frequency noise can induce glomerular injury.
- We identified endothelin, a vasoconstrictor, as a potential mediator of low-frequency noise-induced kidney injury.

Summary

A research group led by Assistant Professor Takumi Kagawa and Professor Masashi Kato (corresponding author) at the Department of Occupational and Environmental Health, Nagoya University Graduate School of Medicine, demonstrated in a mouse model that daily exposure to the low-frequency component (≤ 100 Hz) of environmental noise may impair kidney function. The study also identified endothelin, a potent vasoconstrictor, as a potential mediator of this kidney injury.

Research Background

Environmental noise generated by transportation systems, air-conditioning equipment, and other common sources has become an increasing public health concern. Previous epidemiological studies have reported an association between environmental noise exposure and impaired kidney function. However, it has remained unclear which frequency components of environmental noise are responsible for these adverse effects and the underlying biological mechanisms. Therefore, this study aimed to identify the frequency component associated with kidney dysfunction and investigate its underlying mechanism using a mouse model.

Research Results

Mice were exposed for five days to environmental noise recorded from common residential sources, including outdoor air-conditioning units and heat pump water heaters. Environmental noise exposure significantly increased serum creatinine and blood urea nitrogen (BUN), indicating impaired kidney function.

To identify the responsible frequency component, the recorded environmental

noise was separated into low-frequency (≤ 100 Hz) and non-low-frequency components. Exposure to the low-frequency component alone reproduced the kidney dysfunction induced by the original environmental noise, whereas the non-low-frequency component had no detectable effect. Even when both components were presented at the same sound pressure level (100 dBZ), kidney dysfunction was observed only in mice exposed to the low-frequency component.

Furthermore, low-frequency noise exposure induced glomerular injury and activated endothelin signaling in the kidney. Pharmacological blockade of endothelin receptors attenuated both kidney dysfunction and glomerular injury, suggesting that endothelin signaling plays a key role in mediating low-frequency noise-induced kidney injury.

Research Summary and Future Perspective

This study demonstrates that prolonged exposure to the low-frequency component of environmental noise may impair kidney function and identifies endothelin signaling as a potential mechanism underlying this effect. These findings provide new insights into the health risks associated with the low-frequency component of environmental noise, which has received relatively little attention compared with overall noise exposure. Future studies will further evaluate the safety of low-frequency noise under a wide range of exposure conditions and provide scientific evidence to support evidence-based environmental noise management.

Publication

Kagawa T, Chen D, Ohgami N, Tong K, Gao Y, Iwasaki N, Harusato A, Tsuzuki T, Hayashi T, Shimizu Y, Murohara T, Kato M. Glomerular Injury Induced by Daily Exposure to the Low-Frequency Component of Environmental Noise via Endothelin Signaling in Mice. *Environ Sci Technol*. 2026 Jun 30;60(25):17562-17573. doi: [10.1021/acs.est.5c12555](https://doi.org/10.1021/acs.est.5c12555). Epub 2026 Jun 18. PMID: 42312733; PMCID: PMC13325858.

Japanese ver.

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