The effects of particulate matter (PM) pollution on the brain

Nicolette Boesen[1,2], **Sungsu Lim**[1], **YunKyung Kim**[§*1, 2]

[1]*Convergence Research Center for Diagnosis, Treatment and Care System of Dementia, Brain Science Institute, Korea Institute of Science and Technology (KIST), Seoul, 02792, Republic of Korea*
[2]*Division of Bio-Medical Science & Technology, KIST School, University of Science and Technology (UST), Seoul, 02792, Republic of Korea*

**Presenting Author: Kim YunKyung (yunkyungkim@kist.re.kr)*
§ Corresponding Author: Kim YunKyung (yunkyungkim@kist.re.kr)

Particulate matter (PM) has been recognized as a potential risk factor for various diseases, causing an adverse effect on health. Conventionally, the larger sized particles (PM10) have been shown to negatively influence pulmonary and cardiovascular health, leading to an inflammatory effect and environment. The smaller sized particles, such as PM2.5 and especially PM0.1, can freely pass through to blood vessels and the circulatory system. This may then lead to a direct penetration of particulate matter to the brain. Accumulating clinical investigations indicate an effect of particulate matter on the development of attention-deficit hyperactivity-disorder (ADHD) and the influence of particulate matter on prenatal as well as postnatal development may predispose individuals to a life-long detrimental effect shown in autism spectrum disorder (ASD). Further clinical investigations indicate that there is a relationship between particulate matter exposure and brain diseases, especially for Alzheimer's disease (AD) patients that live in polluted areas. This polluted environment leads to an increase in neurodegeneration and neuroinflammation, which subsequently leads to a decline in cognitive ability and development of AD.

Due to this substantial and negative effect of particulate matter on brain function and neurodegenerative diseases like AD, research elucidating the underlying mechanisms and pathways is required to determine short-term as well as long-term effects and push for preventative measures and awareness. To evaluate the effects of particulate matter on the brain, we utilized a direct inhalant-based exposure mechanism of particulate matter [1] to our Tau-BiFC mice [2]. The Tau-BiFC system is a fluorescence Turn-ON sensor that indicates neuronal degeneration associated with tauopathies that induce AD. Using a newly designed exposure chamber setup, a three-week, 8-hour daily exposure of PM2.5 led the Tau-BiFC mice to develop tau pathology in diverse brain regions, indicating an effect of PM2.5 on the whole brain. Our mRNA sequencing results further indicated that the most affected cell type within the brain were epithelial cells, which are known to form the basis of blood vessels. Secondly, astrocytes were also affected upon particulate matter exposure. These results suggests that PM2.5 penetrates the brain via blood vessels and subsequently activates astrocytes, which in turn may lead to tau pathology activation.

[1] Park, Lee, Lee, et al. Exposure of ultrafine particulate matter causes glutathione redox imbalance in the hippocampus: A neurometabolic susceptibility to Alzheimer's pathology. *Science of the total environment*. 2020; 718: 137267.

OR

[1] Cho, Lee, Lee, et al. Synthesis of primary-particle-size-tuned soot particles by controlled pyrolysis of hydrocarbon fuels. *Energy&fuels*. 2016; 30(8): 6614-6619.

[2] Shin, Kim, Song, et al. Visualization of soluble tau oligomers in TauP301L-BiFC transgenic mice demonstrates the progression of tauopathy. *Progress in neurobiology*. 2020; 187: 101782.