Atmospheric particulate matter (PM), often referred to as aerosols, consists of tiny solid particles and liquid droplets suspended in the air. These particles vary in size, composition, and origin, and they play a significant role in air quality, human health, and climate change. Here are the key aspects of atmospheric particulate matter:

Types of Particulate Matter PM10: Particles with a diameter of 10 micrometers or less. These include dust, pollen, and mold. PM10 particles can be inhaled and may cause health issues, especially in the respiratory system.

PM2.5: Particles with a diameter of 2.5 micrometers or less. These finer particles, which include combustion particles, organic compounds, and metals, can penetrate deeper into the lungs and even enter the bloodstream, posing more severe health risks.

Sources of Particulate Matter Natural Sources:

Volcanic eruptions: Release ash and sulfur dioxide, which can form fine particles. Dust storms: Transport dust over long distances. Wildfires: Emit large quantities of smoke and ash. Sea spray: Releases salt particles into the air. Biological sources: Pollen, mold spores, and plant debris. Anthropogenic Sources:

Combustion processes: Vehicles, industrial facilities, and power plants emit soot and other fine particles. Construction and demolition: Generate dust and other coarse particles. Agricultural activities: Produce dust and particles from soil and crop residues. Residential heating and cooking: Emit particles from burning fuels like wood, coal, and oil. Health Impacts Respiratory Issues: Exposure to PM can lead to conditions such as asthma, bronchitis, and other respiratory infections. Cardiovascular Problems: Fine particles can penetrate the bloodstream, increasing the risk of heart attacks and strokes. Premature Death: Long-term exposure to high levels of PM2.5 is associated with an increased risk of premature death from heart and lung diseases. Other Health Issues: PM exposure has been linked to adverse birth outcomes, cognitive decline, and various cancers. Environmental and Climatic Impacts Visibility Reduction: Particulate matter can cause haze, reducing visibility. Climate Effects: PM can influence climate change in several ways: Direct Effect: Particles can scatter and absorb sunlight, affecting the Earth's radiative balance. Indirect Effect: Aerosols can alter cloud properties, influencing cloud formation, reflectivity, and precipitation patterns. Measurement and Regulation Monitoring: PM levels are monitored using various methods, including air sampling and remote sensing. Regulations: Governments and international bodies have set air quality standards to limit PM concentrations. For example, the U.S. Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQS) for PM10 and PM2.5. Mitigation Strategies Emission Controls: Implementing stricter emission standards for vehicles and industrial sources. Cleaner Technologies: Promoting the use of cleaner fuels and energy sources, such as renewable energy. Public Awareness: Educating the public about the sources and health effects of PM and encouraging behaviors that reduce PM emissions, such as reducing the use of fossil fuels and avoiding open burning. Conclusion Understanding and managing atmospheric particulate matter is crucial for protecting public health and the environment. Continued research and policy efforts are needed to reduce emissions and mitigate the impacts of PM on society and the planet.

Atmospheric particulate matter (PM) exacerbates the risk factor for Alzheimer's and Parkinson's disease risk factors (PD) by promoting the alpha-synuclein (α-syn) pathology in the brain. However, the molecular mechanisms of astrocytes involvement in α-syn pathology underlying the process remain unclear.

Li et al.in a study investigated PM with particle size <200 nm (PM0.2) exposure-induced α-syn pathology in ICR mice and primary astrocytes, then assessed the effects of mammalian target of rapamycin inhibitor (PP242) in vitro studies. We observed the α-syn pathology in the brains of exposed mice. Meanwhile, PM0.2-exposed mice also exhibited the activation of glial cell and the inhibition of autophagy. In vitro study, PM0.2 (3, 10 and 30 μg/mL) induced inflammatory response and the disorders of α-syn degradation in primary astrocytes, and lysosomal-associated membrane protein 2 (LAMP2)-mediated autophagy underlies α-syn pathology. The abnormal function of autophagy-lysosome was specifically manifested as the expression of microtubule-associated protein light chain 3 (LC3II), cathepsin B (CTSB) and lysosomal abundance increased first and then decreased, which might both be a compensatory mechanism to toxic α-syn accumulation induced by PM0.2. Moreover, with the transcription factor EB (TFEB) subcellular localization and the increase in LC3II, LAMP2, CTSB, and cathepsin D proteins were identified, leading to the restoration of the degradation of α-syn after the intervention of PP242. Our results identified that PM0.2 exposure could promote the α-syn pathological dysregulation in astrocytes, providing mechanistic insights into how PM0.2 increases the risk of developing PD and highlighting TFEB/LAMP2 as a promising therapeutic target for antagonizing PM0.2 toxicity [1].

[1]
Li B, Liu T, Shen Y, Qin J, Chang X, Wu M, Guo J, Liu L, Wei C, Lyu Y, Tian F, Yin J, Wang T, Zhang W, Qiu Y. TFEB/LAMP2 contributes to PM0.2-induced autophagy-lysosome dysfunction and alpha-synuclein dysregulation in astrocytes. J Environ Sci (China). 2024 Nov;145:117-127. doi: 10.1016/j.jes.2023.09.036. Epub 2023 Oct 5. PMID: 38844312.