Particulate Matter

PM stands for particulate matter (also called particle pollution): the term for a mixture of solid particles and liquid droplets found in the air. Some particles, such as dust, dirt, soot, or smoke, are large or dark enough to be seen with the naked eye. Others are so small they can only be detected using an electron microscope.

Particle pollution includes:

PM10 : inhalable particles, with diameters that are generally 10 micrometers and smaller; and

PM2.5 : fine inhalable particles, with diameters that are generally 2.5 micrometers and smaller.

How small is 2.5 micrometers? Think about a single hair from your head. The average human hair is about 70 micrometers in diameter – making it 30 times larger than the largest fine particle.

By gene microarray analysis validated by quantitative RT-PCR and immunostaining Ljubimova et al, examined whether rat (n=104) inhalation exposure to air pollution particulate matter (PM) resulted in brain molecular changes similar to those associated with human brain tumors. Global brain gene expression was analyzed after exposure to PM (coarse, 2.5-10µm; fine, <2.5µm; or ultrafine, <0.15µm) and purified air for different times, short (0.5, 1, and 3 months) and chronic (10 months), for 5h per day, four days per week. Expression of select gene products was also studied in human brain (n=7) and in tumors (n=83). Arc/Arg3.1 and Rac1 genes, and their protein products were selected for further examination. Arc was elevated upon two-week to three-month exposure to coarse PM and declined after 10-month exposure. Rac1 was significantly elevated upon 10-month coarse PM exposure. On human brain tumor sections, Arc was expressed in benign meningiomas and low-grade gliomas but was much lower in high-grade tumors. Conversely, Rac1 was elevated in high-grade vs. low-grade gliomas. Arc is thus associated with early brain changes and low-grade tumors, whereas Rac1 is associated with long-term PM exposure and highly aggressive tumors. In summary, exposure to air PM leads to distinct changes in rodent brain gene expression similar to those observed in human brain tumors [1)].

1)
Ljubimova JY, Kleinman MT, Karabalin NM, Inoue S, Konda B, Gangalum P, Markman JL, Ljubimov AV, Black KL. Gene expression changes in rat brain after short and long exposures to particulate matter in Los Angeles basin air: Comparison with human brain tumors. Exp Toxicol Pathol. 2013 Nov;65(7-8):1063-71. doi: 10.1016/j.etp.2013.04.002. Epub 2013 May 18. PubMed PMID: 23688656.