Fact Sheet: Particle Pollution and Health in North Carolina

Particle pollution, the airborne particles resulting from sources like wood burning, highway dust and diesel engines, is deadly. This fact sheet provides information about the sources and composition of particulate matter, the effects on human health, and ways we can reduce particulate matter and protect ourselves from particulate matter exposure.

What is particulate matter?
Particle pollution refers to a mix of very tiny solid and liquid particles that are in the air we breathe. Because of their size you can’t see the individual particles. You can only see the haze that forms when millions of particles blur the spread of sunlight. Although we often think of particles as solids, some are completely liquid and some are solids suspended in liquids. The EPA calls particle pollution a “mixture of mixtures”\(^1\).

Particulate matter is distinguished by size. Coarse particles, between 2.5 and 10 micrometers in diameter, are called PM 10. Fine particles, less than 2.5 micrometers in diameter – 100 times thinner than the human hair -- are called PM 2.5.

Where does particulate matter come from?
Vehicle diesel exhaust contains particulate matter and air toxics. Mechanical processes, like mining, construction and demolition, dust storms, plowing fields, and tire, brake pad and road wear create coarse particles, or PM 10. Burning fossil fuels and wood and agricultural products generate a large part of the raw materials for fine particles, or PM 2.5. The gases these process create can vaporize and then condense to become a particle of the same chemical compound, or they can react with other gases or particles in the atmosphere, like soot, heavy metals, and SO2, to form a particle of a different chemical compound.\(^2\)

How does particulate matter affect human health?
The presence of PM poses more danger to human health than that of ground-level ozone and/or other common air pollutants.\(^3\) The respiratory health effects of PM depend on the size,
composition and oxidative potential of the particles\textsuperscript{4} (Figure 1). When PM is inhaled, the larger particles (PM\textsubscript{10}) cling to the nasal passage, trachea, and bronchi and can usually be eliminated by coughing. The smaller particles (PM\textsubscript{2.5}) reach the alveoli in the lungs and lead to increased inflammation and a variety of cardiopulmonary effects\textsuperscript{5}. The deposition of these particles in the lungs in individuals with poor lung function can increase the risk of adverse health effects.

**Figure 1. Diagram of PM Respiratory Pathways**

**Short-term exposure can be deadly.** Numerous studies have noted an increased level of ER visits of asthma patients due to increased PM\textsubscript{10} and PM\textsubscript{2.5} exposure. Deaths can occur on the very day that particle levels are high, or within one or two months afterward. Children exposed to an excess level of PM\textsubscript{2.5} within 24 hours are under a **significantly high risk of respiratory symptoms**, asthma medication use and **reduced lung function**.\textsuperscript{6} Children’s health is threatened for a variety of reasons. Their lungs and alveoli aren’t fully grown until adulthood. The body’s defenses that help adults fight off infections are still developing in young bodies. Children have more respiratory infections than adults, which also seems to increase their susceptibility to air pollution.\textsuperscript{7}

\textsuperscript{6} Kim, Kabir, Kabir, 2015.
\textsuperscript{7} American Lung Association, 2015.
Chronic exposure to particle pollution can shorten life by one to three years. PM exposure has also been linked to autism, stroke and dementia.8,9

Furthermore, the health impacts of particulate matter vary depending on what chemicals the matter is composed of, the synergistic effects those chemicals may have with other air pollutants that are present, and the characteristics of the population (e.g., age, access to health care, socio-economic status) that is exposed. Therefore, the raw amount of PM is not as significant as the context in which it appears.10,11

**How much particulate matter is there in NC?**
The 27 air quality monitoring stations in North Carolina that collect data that can be compared to the National Ambient Air Quality Standard (NAAQS) have recorded levels of particulate matter that fall within the NAAQS as acceptable, but the scarcity of these monitors and the nature of the way they function make them an imperfect vehicle for understanding the level of particle pollution that exists in an area. The monitors only analyze the air that directly flows over them. Thus, although a monitor may be situated near a source of particle pollution, it will not record the pollution if the prevailing wind directs the particulate matter away from it.12

**How are vehicle idling, PM, and health connected?**
Diesel particulate matter particles is composed of fine and ultra-fine particles and a part of a complex mixture that makes up diesel exhaust13. **Vehicle exhaust has been identified by the American Lung Association as a major source of air pollution that causes adverse health effects such as asthma.** This connection is significant for schools, as 10% of North Carolina's children have asthma, making it the leading cause of school absence14. According to the US Department of Energy, personal-vehicle idling wastes about 3 billion gallons of fuel—

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13 EPA Health Assessment Document For Diesel Engine Exhaust 2002 file:///C:/Users/CAC%20User/Downloads/HEALTH_ASSESSMENT_DIESEL.PDF
generating around 30 million tons of CO₂—anually in the U.S\textsuperscript{15}. To bring that down to the individual scale, consider that ten seconds of idling uses more fuel than restarting the engine.

**How can we prevent exposure to PM?**
Protection from particulate matter requires a three-pronged strategy. First, we should increase the number of air quality monitors, particularly in areas where high levels of particulate matter are likely to occur, such as alongside highways, near industrial sites and in areas where outdoor burning takes place. Second, we should reduce the amount of particulate matter we produce by reducing idling and retrofitting older diesel engines, wood stoves, and other combustion equipment with state-of-the-art filters, and by educating the public about ways to avoid creating particle pollution. Third, we should provide public health education about the importance of avoiding exposure to particulate matter, especially for pregnant women, children, outdoor workers, and people with asthma or other respiratory or cardiac conditions.

**Can this effort be successful?**
A long-term study of six US cities estimated that the US could prevent approximately 34,000 premature deaths a year if the nation could lower annual levels of particle pollution by 1 mg/m\textsuperscript{3}.\textsuperscript{16} Evidence exists that this is possible. In rural California, a rule requiring curtailing emissions from wood burning stoves, establishing a public health education program to reduce wood-burning emissions and curtailing residential wood burning when air quality was forecast to be poor significantly reduced the mean concentrations of PM2.5 and P10 and reduced hospital admissions related to particulate matter exposure.\textsuperscript{17} In Los Angeles, concentrated smog-reduction efforts significantly improved children’s lung function.\textsuperscript{18}

\textsuperscript{15} US Department of Energy \url{http://www.anl.gov/sites/anl.gov/files/Idling-PersonalVehicles050715.pdf}
\textsuperscript{16} American Lung Association, 2015.
\textsuperscript{17} Yap and Garcia, 2015.