Diesel Exhaust & Particulate Matter Health Risk

What is Diesel Exhaust?

Diesel exhaust is a toxic mixture of tiny fine and ultrafine carbon soot particles and gases from the burning of diesel fuel and lubricating oil. These microscopic carbon soot particles absorb metals and toxic gases in the exhaust and deliver them to your lungs. At risk are commuters and people living or working in proximity to truck traffic, construction workers, agricultural and other heavy equipment operators.

Diesel Kills

Particulate diesel soot kills an estimated 21,000 Americans every year. Medical researchers are just beginning to understand how combustion particles can cause fatal diseases such as cancer, stroke, and heart attacks. When inhaled, these tiny, poison-laden particles may, in fact, be capable of directly triggering a response from the cardiovascular system or crossing the blood-barrier from lungs into the bloodstream, delivering them to internal organs.

- Exposure to particles is a well-known cause of premature death as documented in the two largest long-term air pollution studies ever conducted, the Harvard Six Cities Study and the 150-city American Cancer Society study.[1]
- The 90-city National Morbidity and Mortality Air Pollution Study associated daily exposures of particles with premature death.[2]

Heart Disease

The largest fraction of particulate matter-related premature deaths in the U.S. are believed to be from heart disease. Doctors have long known the relationship of inflammation and heart disease and particles may have a fatal inflammatory effect on the heart. Other factors include atherosclerosis (hardening of the arteries) and cardiac arrhythmias that may be precursors to sudden death or stroke. Research also suggests that particles have the ability to directly alter heart rate function and cause myocardio infarction or "MI"-- a potentially fatal blockage of blood supply to the heart.

- A 2007 Harvard study of 54,000 workers in the trucking industry found a higher risk in heart disease in the trucking industry compared to the general U.S. population: a 49 % higher risk in drivers, a 32% higher risk in dock workers, and a 34% higher risk in shop workers. [3]

- A 2004 study of highway patrolmen exposed over a shift, particulate matter was linked to irregular heartbeats and increases in blood inflammatory markers.[4]
- A 2004 study found that heavy equipment operators exposed to diesel exhaust have a 47 percent increased risk of death due to ischemic heart disease (congestive heart failure/heart attacks).[5]
- Researchers documented a 24% increase in risk of women having a cardiovascular event and an overall 76% increase in risk of death from cardiovascular disease for each 10 ug/m3 of PM2.5 in the ambient air. Within-city risks were higher than the risk between cities suggesting the importance of local sources of particles, such as diesel vehicles.[6]
- Ultrafine particles in fresh diesel exhaust (tiny particles under 0.1 micros in size), can lead to systemic acute inflammation and exacerbation of cardiovascular disease and atherosclerosis according to recent studies.[7,8]
- A 2007 study of 700 heart attack survivors shows that they were most likely to have been in heavy traffic the hour before they suffered the heart attack, whether in cars, streetcars or buses. [9] Studies find that traffic-related health risks are better correlated to truck rather than car volume and therefore may be more strongly related to diesel engine exhaust.
- A link between exposure to particles and vascular inflammation/atherosclerosis is suggested by animal studies and could explain how particles are linked to heart attacks.[10]

Cancer

Researchers repeatedly find associations between exposure to diesel exhaust and cancers. Approximately three dozen occupational studies conducted over the past three decades link diesel exhaust exposure to lung cancer, posing an increased cancer mortality risk of 10-40%. In the laboratory, scientists have observed DNA damage and cell mutations that could be an indicator of the ability of particles to trigger cancer.

Based on EPA's 2005 National Air Toxic Assessment released in 2011, CATF estimates that the lung cancer risk from particles is approximately three times the combined risk of the 80 air toxics modeled by EPA.

- Over 30 epidemiological studies link diesel particulate matter to lung cancers.[11,12 ,13, 14,15,16,17]
- Risk of lung cancer death was linked to fine particles in a study that tracked a million people over a decade and a half in 150 U.S. metropolitan areas[18]
- Diesel soot is identified as a carcinogen U.S. EPA, the State of California and the International Agency for Research on Cancer (IARC).[19, 20, 21] Other compounds in diesel exhaust, other than soot are also known carcinogens such as polycyclic aromatic hydrocarbons, and formaldehyde.
- Operators of heavy machines in ground and road construction exposed to diesel exhaust are at risk of death from cancers of the digestive system, intestines, lung, liver, bladder and stomach. [22]

- CATF estimates that, based on EPA's 2005 NATA data released in 2011, the lung cancer risk from exposure to diesel particles is 159 times greater than the EPA's "acceptable" risk of 1 cancer in a million.
- In a study of 55,000 railroad workers over 38 years, Harvard researchers found an overall 40% increased risk of lung cancer for workers in 30 job categories.[23,24]
- The NIOSH Teamsters (truckers) study concluded that the lifetime excess risk for truckers was 10 times higher than the 1/1000 excess risk allowed by OSHA in occupational settings.[25]
- A 2007 Harvard study of 54,000 truckers from 1985-2000 found a 10 % higher risk for lung cancer in drivers and dock workers compared to the general U.S. population.
- Recent studies link particulate matter exposure to DNA damage. [26]

Respiratory Health Impacts

Researchers have long associated diesel exhaust, particulate matter and traffic with reduced lung function and lung growth, asthma attacks, asthma sensitization and in one study, emphysema.

- Multiple studies link asthma and allergic sensitization and particles.[27, 28,29,30,31,32] An East Bronx NY study suggests children exposed to higher levels of heavy duty diesel exhaust have higher incidences of asthma.[33]
- A 2009 field study found that short-term exposure of asthmatics to urban roadside diesel traffic led to consistent and significant reductions in lung function, airway acidification and inflammation.[34] A study from the Netherlands links asthma diagnosed before 1 year of age to traffic.[35] In a California study, asthma and bronchitis was found to be 7 percent higher among children attending school in high-traffic areas, compared with schools along quieter streets.[36]
- Heavy equipment operators exposed to diesel exhaust have a significantly elevated risk of death from emphysema.[37]
- Deficits in lung function growth were found in southern California 18 year olds exposed to PM2.5 and black carbon. [38] The number of children with lung function deficits was 5 times greater in communities with the highest levels of PM2.5 compared to communities with the lowest levels of PM2.5.

Exposure to diesel exhaust, and proximity to traffic poses a risk of other serious disease including stroke, diabetes, slowed fetal growth, infant mortality and possibly autism.

- Diabetes: A 2010 study links particulate matter air pollution to diabetes in the U.S. (http://care.diabetesjournals.org/content/33/10/2196). The study found that counties with higher levels of particulate matter had increased prevalence of diabetes, even where counties were in attainment with the EPA's National Ambient Air Quality Standard for fine particles ($PM_{2.5}$). Elevated circulatory and cardiovascular disease risk was found in another

study based on 24 hour exposures to particles.[39]

- Nervous system impairment. A study of railroad workers exposed to diesel exhaust concluded: "crews may be unable to operate trains safely."[40]
- Stroke. Diesel exhaust particles may raise the risk of blood clots and stroke.[41] Risk more than doubled within 2 hours of exposure to high levels of fine particles in a Japanese study.[42] Formation of blood clots (thromboses), have been documented in laboratory animals exposed to diesel particles.[43]
- Autism A 2010 study correlates prenatal freeway traffic proximity in California and incidence of autism. The risk of autism is nearly double (86% increase) inside 1,000 feet. Diesel exhaust could be a risk factor.[44]
- Slowed fetal growth as a result of maternal exposure during pregnancy[45] and infant mortality.[46, 47]

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