

What Are the Health Harms Associated With Petroleum-Based Fuels and Combustion By-Products?

(For descriptions of pollutants please see fact sheet on Toxic Pollutants)

Research on people exposed at work or via the general environment and on animals exposed in laboratories has shown that petroleum pollutants can cause or aggravate a wide range of serious health problems including cancer, birth defects, asthma, and chronic obstructive pulmonary disease.

Early Death: Population death rates from cardiovascular and respiratory causes rise on the days during and after episodes of bad air pollution (1-4), the short-term concentration of particulate matter (PM) is the most strongly linked pollutant factor in most studies. Long-term exposure to PM is also linked to early death, primarily from cardiovascular and respiratory causes (5-9).

Cancer: Vaporized gasoline and engine exhaust from gasoline and diesel engines are complex chemical mixtures that have been recognized as cancer-causing by state, federal and international agencies (10-12). Many of the individual chemical components of fuels and exhaust are also recognized carcinogens.

- † Studies of workers with high exposure to diesel exhaust report increased risk of lung cancer (13-16).
- † Long term exposure to PM, ozone and sulfur dioxide has been associated with lung cancer in the general population (8-9).
- † Benzene and 1,3-butadiene cause leukemia in humans (17-19).
- † Acetaldehyde, ethylbenzene, formaldehyde, and naphthalene are volatile organic compounds in exhaust that cause various cancers in laboratory animals (20-22).
- † Several polyaromatic hydrocarbons cause cancer in laboratory animals, others induce genetic mutations but have not been tested to see if they cause cancer in animals (23-24).
- † Arsenic, beryllium, cadmium, chromium and nickel are found at low levels in engine exhaust particulate and are known or probable human carcinogens (20).

† Lead, used previously in gasoline, causes kidney cancer when ingested by laboratory rodents and thus may cause cancer in humans (20).

Respiratory Illness: Many petroleum-related air pollutants affect respiratory tissues, producing short term health effects like nose and throat irritation and asthma attacks as well as long term lung damage, chronic bronchitis and other illness.

- † Hospital admissions for pneumonia, asthma and chronic lung disease rise following days with elevated PM pollution (1, 25-27).
- † Long term exposure to traffic-related pollutants, especially ozone, is linked to chronic respiratory illness such as bronchitis, chronic airways obstruction, and lung inflammation which can lead to permanent tissue damage (28-31).
- † Growth of lung function in children is hampered by living in areas of higher air pollution; PM, acid vapor and nitrogen dioxide have been most clearly linked to this effect (32-34).
- † Exposure to diesel exhaust, ozone, ambient PM, nitrogen dioxide, sulfur dioxide or formaldehyde worsens the health of adults and children with asthma (35-41).
- † Children's need for urgent or emergency care for asthma symptoms has been associated with elevations in ozone, PM, traffic density and NO₂ (42-46). During a period of decreased traffic in one urban area, urgent care visits for asthma in children were fewer (47).
- † In addition to aggravating pre-existing asthma, exposure to traffic-related pollutants may cause new cases of asthma in previously unaffected children (48-49) and adults (50).
- † Ozone levels are associated with school absenteeism for respiratory illness (51).
- † Acute exposure to ozone decreases lung function (30, 52).
- † Acetaldehyde, acrolein, formaldehyde, and peroxyacetyl nitrate are potent irritants of the respiratory tract mucous membranes (53-54).

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- † Longer term exposure to acetaldehyde produced nasal and respiratory tract damage in hamsters and rats in laboratory studies (20).
- † Acrolein causes inflammation, abnormal cellular changes, and tissue death in the nasal passages of rats (55).
- † Decreased pulmonary function and nasal lesions have been seen in workers with high exposures to formaldehyde (55). Formaldehyde can cause asthma-like signs and symptoms, especially those who have been sensitized by previous or long-term exposure (42, 55).
- † Naphthalene caused inflammation and cellular changes in the nasal passages of mice (22, 55).

Heart and Blood Problems: Increased hospital admissions for heart disease are associated with elevated particulate matter pollution (3, 26, 56-58). Carbon monoxide aggravates cardiovascular illness and is associated with increased hospitalization for cardiovascular causes (59-61). Carbon monoxide also reduces aerobic capacity during exercise in healthy people (61). Lead can cause anemia and high blood pressure (62). Of the volatile organic compounds, few have been tested for cardiac effects in people.

Effects on Reproduction and Fetal Development:

Many of the pollutants associated with combustion of petroleum fuels have been linked to low birthweight or pre-term birth, including carbon monoxide (63), PM (64-65), 1,3-butadiene (20), benzo(a)pyrene (20), and lead (62).

- † Ozone and carbon monoxide levels during the second month of pregnancy have been associated with fetal heart malformations (66).
- † The level of particulate matter pollution has also been associated with infant mortality (64).
- † In mice, 1, 3-butadiene damages ovaries and testes (20).
- † Benzene causes sperm abnormalities in male mice. Delayed development of fetuses has been observed in laboratory studies of rodents and in limited studies of humans with occupational exposure to benzene (20).
- † Pregnant rodents exposed to toluene in the laboratory

had fewer live births; fetuses showed signs of growth retardation or birth defects (20).

- † Benzo(a)pyrene, a polyaromatic hydrocarbon, causes fetal deaths, low birthweight and birth defects in mice (20).

Nervous System Toxicity: Volatile organic compounds like hexane, toluene, xylene and methyl ethyl ketone found in gasoline and diesel fuels are associated with nervous system damage (20, 68-69). Carbon monoxide causes neurological problems in people who recover from high exposures (61). Even at very low levels, lead poisons the brain and nerves slowing cognitive development in children and affecting neurobehavioral function in children and adults (62, 67). Learning difficulties and lower performance on tests of intelligence are associated with a child's blood lead level. Manganese (only present in a few US gasolines) is associated with Parkinson's-like symptoms and other neurobehavioral effects (70).

Other Health Impacts: While cancer, respiratory and developmental/reproductive effects are some of the most notable hazards of using petroleum derived fuels, other categories of health effects have also been associated with specific compounds. Adverse impacts on the kidney and the immune system are examples. Some of these effects are only associated with compounds that are found at relatively low levels in exhaust, and so the overall importance to public health may not be high. But the cumulative health effects of these toxins have not been adequately studied and could be significant.

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11. The list of agents evaluated for carcinogenicity and resulting classifications by the National Toxicology Program can be found at: <http://ehp.niehs.nih.gov/roc/toc10.html>
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