Diesel Exhaust and Cancer Risk

What is diesel exhaust?

Diesel is a type of fuel derived from crude oil. Diesel fuel is used in most large engines, including those in many trucks, buses, trains, and ships; construction, farm, and mining equipment; generators; and in some cars.

Diesel exhaust is made up of 2 main parts: gases and soot (particles). Each of these, in turn, is made up of many different substances.

- The gas portion of diesel exhaust is mostly carbon dioxide, carbon monoxide, nitric oxide, nitrogen dioxide, sulfur oxides, and hydrocarbons, including polycyclic aromatic hydrocarbons (PAHs).
- The soot (particulate) portion of diesel exhaust is made up of particles such as carbon, organic materials (including PAHs), and traces of metallic compounds.

Both the gases and the soot of diesel exhaust contain PAHs.

Exhaust from diesel engines brings a complex mixture of soot and gases to roadways (and nearby homes), cities, farms, and other places. Health concerns about diesel exhaust relate not only to cancer, but also to other health problems such as lung and heart diseases.

How are people exposed to diesel exhaust?

People can be exposed to diesel exhaust at work, around the home, or while traveling, mainly by breathing in the soot and gases. Diesel exhaust exposure is widespread in the modern world.

The amount of diesel exhaust people are exposed to varies greatly. Measuring these exposures isn't easy because diesel exhaust is chemically complex and many parts of it are also found in a lot of other sources. This is a major challenge when trying to study the health effects of diesel exhaust.

At work

People with some of the highest work exposures include truck drivers, toll booth workers, miners, construction workers, forklift drivers and other heavy machinery operators, railroad and dock workers, firefighters[1], and garage workers and mechanics. Some farm workers also spend a lot of time around diesel exhaust.

Where you live and play

People can also be exposed to diesel exhaust where they live and in other places where they spend a lot of time. Although this is typically at lower levels than in workplace settings, it can still add up over time.

Exposures are highest where diesel traffic is heaviest, such as along major highways and in cities. People living near industrial sites, railroads, or ports might also be exposed to higher levels. This often includes people who live in lower-income neighborhoods.

While traveling in a vehicle

Exposure to diesel exhaust may be higher while traveling in a car or other vehicle, especially when on roads with heavier truck or bus traffic. Commuting for work is a potential source of diesel exhaust exposure for many people.

One particular area of concern is children’s exposures to diesel exhaust and other pollutants while riding in school buses, as the buses themselves typically run on diesel fuel.

Does diesel exhaust cause cancer?

Researchers use 2 main types of studies to try to determine if something might cause cancer:

- **Lab studies** (studies done using lab animals or cells in lab dishes)
- **Studies in people** (epidemiologic studies)

In most cases neither type of study provides enough evidence on its own, so researchers look at both lab-based and human studies when trying to figure out if something causes cancer.

Results of studies in the lab

In studies of cells in lab dishes, diesel exhaust (as soot or chemical extracts) has been found to cause changes in the cells' DNA. These types of changes are usually needed for cancer to develop, although not all substances that cause DNA changes also cause cancer.

Several studies have found that long-term, heavy exposure to diesel exhaust can cause lung cancer in lab animals such as rats.

Results of studies in people

It's not easy to study the possible health effects of diesel exhaust in people. First, it's often hard to correctly define and measure the level of exposure. It can also be hard to account for the other cancer risk factors that people exposed to diesel exhaust might have, such as smoking.

Lung cancer

Lung cancer is the major type of cancer thought to be linked to diesel exhaust. Several studies of workers exposed to diesel exhaust have shown small but significant increases in lung cancer risk. Workers with the heaviest and most prolonged exposures, such as railroad workers, heavy equipment operators, miners, and truck drivers, have been found to have higher lung cancer death rates than unexposed workers. Based on the number of people exposed at work, diesel exhaust may pose a substantial health risk.

The possible link between lung cancer and exposure to diesel exhaust outside the workplace has not been studied as extensively.

Other cancers

Several studies have looked for possible links between diesel exhaust and other cancers, including cancers of the bladder, larynx (voice box), esophagus, stomach, and pancreas. Studies have also looked for links to blood system cancers such as lymphomas and leukemias (including childhood leukemia).

While some studies have found possible links, others have not. More research is needed to show if diesel exhaust exposure is linked to any of these other cancers.

What expert agencies say about diesel exhaust

Several national and international agencies study substances in the environment to determine if they can cause cancer. (A substance that causes cancer or helps cancer grow is called a *carcinogen*.) **The American Cancer Society looks to these organizations to evaluate the risks based on evidence from lab, animal, and human research studies.**

Some of these expert agencies have classified diesel exhaust as to whether it can cause cancer, based largely on the possible link to lung cancer.

The **International Agency for Research on Cancer (IARC)** is part of the World Health Organization (WHO). One of its major goals is to identify causes of cancer. IARC classifies diesel engine exhaust as “carcinogenic to humans,” based on sufficient evidence that it is linked to an increased risk of lung cancer. IARC also notes that there is “some evidence of a positive association” between diesel exhaust and bladder cancer.

IARC also classifies outdoor air pollution, of which diesel exhaust is a part, as being “carcinogenic to humans,” based on sufficient evidence that it causes lung cancer.

The **National Toxicology Program (NTP)** is formed from parts of several US government agencies, including the National Institutes of Health (NIH), the Centers for Disease Control and Prevention (CDC), and the Food and Drug Administration (FDA). The NTP has classified exposure to diesel exhaust particulates as “reasonably anticipated to be a human carcinogen,” based on limited evidence from studies in humans (mainly linking it to lung cancer) and supporting evidence from lab studies.

The US **Environmental Protection Agency (EPA)** maintains the Integrated Risk Information System (IRIS), an electronic database that contains information on human health effects from exposure to various substances in the environment. The EPA classifies diesel exhaust as “likely to be carcinogenic to humans.”

The **National Institute for Occupational Safety and Health (NIOSH)** is part of the CDC that studies exposures in the workplace. NIOSH has determined that diesel exhaust is a “potential occupational carcinogen.”

(For more information on the classification systems used by these agencies, see Determining if Something Is a Carcinogen[2].)

Can I reduce my exposure to diesel exhaust?

Diesel exhaust can cause health problems, including an increased risk of lung cancer (and possibly other cancers).

Since people can be exposed to diesel exhaust anywhere diesel engines are in use, including near highways and other roads, government regulations may be as important as personal choices in limiting exposure to potentially harmful chemicals in diesel exhaust.

For example, as a result of EPA regulations (which have recently been updated to better protect public health), as well as improvements in technology, newer diesel engines give off much lower amounts of certain chemicals than older engines. But many older diesel engines are still in use, so it makes sense to avoid exposure whenever possible.

At work

If you are exposed to diesel exhaust at work, there may be ways you can reduce or prevent exposures. This might also help protect you from other chemical exposures that are likely to happen in the workplace.

If you work in or around vehicles that run on diesel fuel, limiting the time spent near idling engines may help lower your exposure to fumes.

Talk with your employer to be sure that you are protected adequately. Personal protective equipment, such as respirators, may be a key part of a workplace protective program. If needed, workplace changes such as ventilating the exhaust away from where you breathe might also be important.

For more information on preventing or reducing workplace exposures at your job, consult your company’s safety and health manager. If needed, you can get additional assistance from the Occupational Safety & Health Administration (OSHA)[3], the government agency responsible for enforcing workplace safety.

Where you live and spend time

If you are exposed to diesel exhaust fumes in your environment, you can take some of the same precautions. For example, try to avoid or limit spending time near large sources of diesel exhaust, such as near trucks and buses.

Commuting to and from work exposes many people to possible sources of diesel exhaust, whether they are in a car (or other passenger vehicle) or on some type of public transportation. For some people, working from home (telecommuting or teleworking) might be an option to lower their exposure, as well as to save money on commuting expenses.

On a governmental level, laws such as the Clean Air Act and the Diesel Emissions Reduction Act are designed to help reduce diesel emissions from trucks and other large engines, lowering public exposure to diesel exhaust.

Another important program is the EPA's Clean School Bus Program, created as part of the bipartisan Infrastructure Investment and Jobs Act of 2021. Children can be exposed to diesel exhaust during school bus travel or when standing near running school buses outside of school. The Clean School Bus Program provides funding to school districts to replace older buses with zero-emission and low-emission models. These new buses can help make the air cleaner for students, bus drivers, and school staff near bus loading areas, as well as the neighborhoods where the buses go every day.

Hyperlinks

1. www.cancer.org/cancer/risk-prevention/chemicals/firefighting.html
2. www.cancer.org/cancer/risk-prevention/understanding-cancer-risk/determining-if-something-is-a-carcinogen.html
3. www.osha.gov/

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