MILAGRO

Megacity Initiative - Local and Global Research Observations

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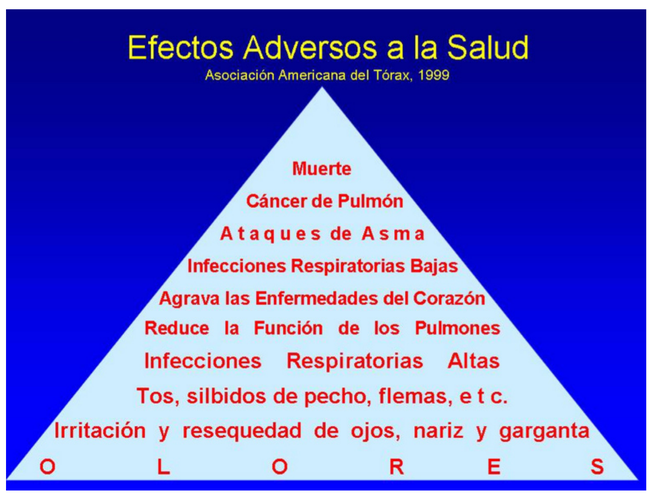
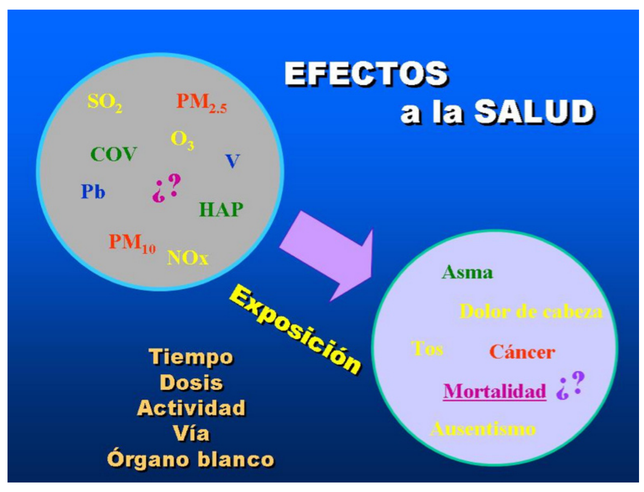
HEALTH STUDIES: IMPACTS OF EXPOSURE TO ATMOSPHERIC POLLUTANTS





Human Health

Air pollution can adversely affect human health by direct inhalation and by other exposures such as contamination of drinking water and food and skin transfer. Information about health effects on humans comes from animal studies and evaluation, human exposure studies, and epidemiology.

Criteria Pollutants

Several pollutants have been found to have adverse effects on humans, plants and certain materials. The so-called "criteria pollutants" are those for which acceptable concentration limits have been set to protect public health and welfare.

There are two time-related categories of health effects: acute and chronic. Acute effects tend to act immediately on a specific target organ or point of entry into the human body; these are typically the eyes and the lung. The chronic effects are those for which there may be a long period between an exposure and the resultant health effect. The direct human effects of air pollution vary according to both the intensity and the duration of exposure and also with the health status of the population exposed. Certain sectors of the population may be at greater risk; these include children and the elderly, and those already suffering from cardiopulmonary and respiratory disease.

In the following sections, the health consequences and ecological impacts for each criteria pollutant are briefly summarized.

Ground-level Ozone (O3) is a secondary pollutant formed by photochemical reactions. It is a strong oxidant that affects the respiratory system and damages lung tissue. Among the acute effects are cough and chest pain, eye irritation, headaches, lung function losses, and asthma attacks.

Sulfur Dioxide (SO2) is produced mainly from the burning of coal, but also of sulfur-rich gasoline and fuel oil. Sulfur dioxide has its own acute health effects, which include irritation and restriction of air passages, accompanied by symptoms that may include wheezing, shortness of breath, and chest tightness during exercise in persons with asthma. The chronic effects of sulfur dioxide exposure include immune system suppression and increased probability of bronchitis.

Nitrogen Oxides (NOx) include nitric oxide (NO) and nitrogen dioxide (NO2), they are emitted from motor vehicles and power generation plants. In addition to being a precursor for ozone formation, they can react with ammonia, moisture, and other compounds to form nitric acid and related particles. Human health concerns include effects on breathing and the respiratory system, damage to lung tissue, and premature death.

Carbon Monoxide (CO) is produced as a product of incomplete combustion, it is emitted mainly by gasoline-fueled motor vehicles. However, catalytic converters and emissions controls have greatly reduced CO emissions. Other sources include forest fires and agricultural burning. Carbon monoxide has a high affinity for hemoglobin and is able to displace oxygen in the blood, which in turn can lead to harmful cardiovascular and neurobehavioral effects. CO is even more dangerous at higher elevations where the partial pressure of oxygen is lower and where many people may already suffer from inadequate oxygen supply.

Particulate Matter (PM) - especially fine particles with diameter of less than 2.5 □m or PM2.5 - contains microscopic solids or liquid droplets that are so small that they can get deep into the lungs and cause serious health problems, including: increased respiratory symptoms, such as irritation of the airways, coughing, or difficulty breathing; decreased lung function; aggravated asthma; development of chronic bronchitis; irregular heartbeat; nonfatal heart attacks; and premature death in people with heart or lung disease. People with heart or lung diseases, children and older adults are the most likely to be affected by particle pollution exposure. PM10 are generated mainly by agriculture, mining, and road traffic, while PM2.5 are primary combustion particles or are formed as secondary pollutants from the condensation of gas phase species.

Lead (Pb) in the atmospheric is mostly generated from antiknock compounds added to gasoline. The use of unleaded gasoline has practically eliminated problems of lead exposure from air pollution. Lead is a very toxic metal. It inhibits hemoglobin synthesis in red blood cells, impairs liver and kidney function and causes neurological damage. Children are particularly sensitive to the chronic effects of lead, with slowed cognitive development, reduced growth and other effects reported.

Hazardous Air Pollutants or Air Toxics

In addition to criteria air pollutants, there is concern about emissions into the atmosphere of other types of compounds which may also have adverse health effects and which are referred to as hazardous air pollutants (HAPs) or air toxics. An example is formaldehyde, an important chemical used widely by industry to manufacture building materials and numerous household products, glues, permanent press fabrics, paper product coatings, fiberboard, and plywood. It is also widely used as an industrial fungicide, germicide, and disinfectant. It is also a by-product of combustion and certain other natural processes. It is a toxic compound that is of particular concern as an indoor air pollutant; it is also emitted from motor vehicles outdoors as well as formed by photochemical reactions of VOCs. Thus, it may be present in substantial concentrations both indoors and outdoors.

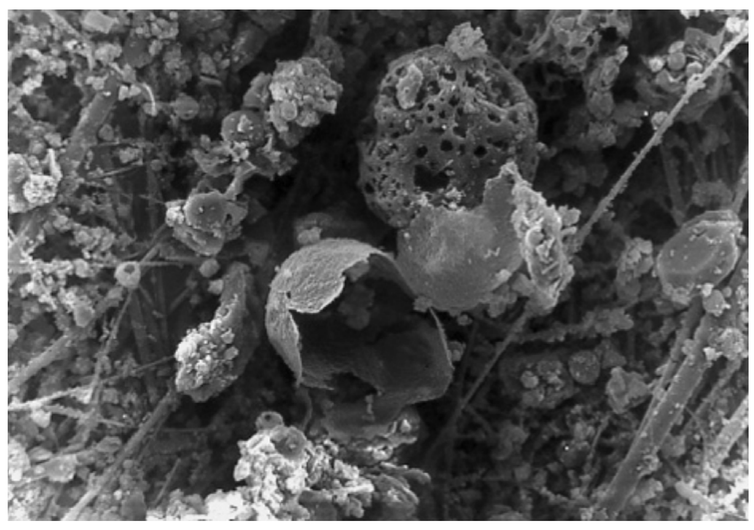
Air toxins may also include carcinogens or mutagens, as is the case with some polycyclic aromatic hydrocarbons (PAHs). In the US, there is an official list of 189 compounds considered to be HAPs that are regulated by the Clean Air Act Amendments of 1990.

Indoor Air Pollutants

The design and construction of most modern homes keeps the level of indoor air pollution very low. However, if ventilation of rooms is poor, or household appliances are faulty, pollution can build up to levels that may be detrimental to human health.

Because there are many possible sources of air pollutants in the home, indoor air quality can vary widely. For example, painting or stripping in enclosed spaces may lead to a temporary increase in indoor pollutants such as VOCs. Another significant source of indoor pollution is the burning of fuels in flueless appliances, such as portable gas heaters, gas stoves, and ovens. In some parts of the world, the radioactive gas radon can seep into the house from the ground, and accumulate indoors if ventilation is poor. In households with smokers, exposure to tobacco smoke is an important factor in indoor air quality assessment.

In many developing countries, the population continues to rely on the use of unprocessed solid fuels for cooking and heating (firewood, household coal, plastic, trash, etc.) that can lead to high indoor concentrations of fluorine and arsenic with consequent health effects.

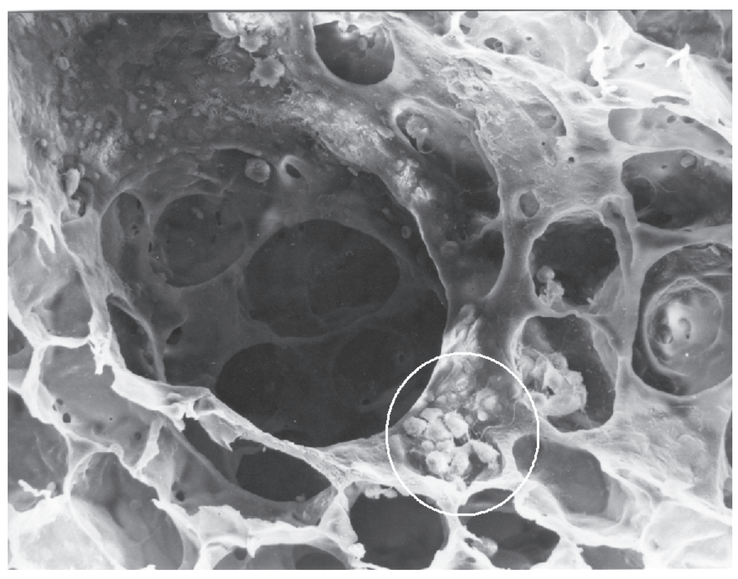


Study of the health effects of particles

Of the criteria pollutants, particles are the ones that best help to predict adverse health effects. Particles are a complex mixture of solid and liquid compounds that penetrate our organism. The following photograph illustrates a variety of shapes and sizes.

Pollutants that are inhaled by breathing usually settle in the lungs. The picture below shows what pulmonary tissue looks like. Particles tend to lodge themselves in specific areas (circle). As a result, our immune system tries to eliminate them, even when they are not always successful.

Some pollutants travel deeper into the pulmonary tissue and penetrate the blood stream through the thousands of capillaries embedded in the thin walls located there. Once inside the blood stream, they will travel freely throughout the entire body. Although it is not yet known exactly how the process works, it is undeniable that once they have penetrated the lungs or the blood stream, pollutants can cause great damage to our body. This is why more studies are required on this subject.



Effects from atmospheric pollution in MCMA on the population and microenvironments

This study aims to determine the level of exposure of children and their parents to suspended particles and volatile organic compounds. It will also determine the concentrations of these pollutants in both indoor and outdoor areas and will attempt to identify possible connections with allergies, asthma, and reductions in visibility and perception.

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