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HEALTH EFFECTS OF AIR POLLUTION

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ABSTRACT
An air pollutant is known as a substance in the air that can cause harm to humans and the environment. Pollutants can be in the form of solid particles, liquid droplets, or gases. In addition, they may be natural or man-made. Pollutants can be classified as either primary or secondary. Air pollution, both indoors and outdoors, is a major environmental health problem affecting everyone in developed and developing countries alike. Air pollution has both acute and chronic effects on human health. Even relatively low concentrations of air pollutants have been related to a range of adverse health effects. Health impact of air pollution depends on the pollutant type, its concentration in the air, length of exposure, other pollutants in the air, and individual susceptibility. Air pollution can affect our health in many ways with both short-term and long-term effects. Different people are affected by air pollution in different ways. Some individuals are much more sensitive to pollutants than are others. Young children and elderly people often suffer more from the effects of air pollution. People with health problems such as asthma, heart and lung disease may also suffer more when the air is polluted. There are various air pollution control technologies and land use planning strategies available to reduce air pollution. The World Health Organization (WHO) Air quality guidelines (AQGs) are designed to offer global guidance on reducing the health impacts of air pollution.
Keywords: air pollutant, air pollution, health effects

1. INTODUCTION

Air pollution means the presence of one or more unwanted substances in air. An air pollutant is known as a substance in the air that can cause harm to humans and the environment. Pollutants can be in the form of solid particles, liquid droplets, or gases [1].

Pollutants can be classified as either primary or secondary. Usually, primary pollutants are substances emitted directly into the atmosphere from a process, such as ash from a volcanic eruption, the carbon monoxide gas from a motor vehicle exhaust, road transport, or sulfur dioxide released from factories, power station and industrial plants.

Secondary pollutants are not emitted directly. Rather, they form in the air when primary pollutants react or interact. An important example of a secondary pollutant is ground level ozone - one of the many secondary pollutants that make up photochemical smog. Ozone is formed in the air as a result of chemical reactions. Whilst ozone does build up within cities on hot summer days, higher levels are usually found in the countryside, because of the special nature of the reactions involving the formation of ozone.

Note that some pollutants may be both primary and secondary: that is, they are both emitted directly and formed from other primary pollutants.
Air pollutants occur both outdoors or indoors, and can be natural or man-made. Outdoor air pollution, sometimes called ambient air pollution, occurs in both urban and rural areas, although a different mix of air pollutants may be found in the countryside to that found in a city. Typical urban air pollutants from man-made activities include nitrogen oxides, carbon monoxide, sulphur dioxide, hydrocarbons and particulate matter. All these pollutants are called primary pollutants because [2-5].
Common indoor air pollutants include carbon monoxide and nitrogen dioxide from faulty gas heaters and cookers, carbon monoxide and benzence from cigarette smoke, and volatile organic compounds (VOCs) from synthetic furnishings, vinyl flooring and paints. In addition, there are biological pollutants such as dust mites and mould. Since most of us spend 80 to 90% of the time indoors, air quality could have a real bearing on our health [6].
Air pollution is caused by both natural and man-made sources. Major man-made sources of ambient air pollution include industries, automobiles, and power generation. In indoor environments, tobacco smoke and combustion of solid fuels for cooking and heating are the most significant sources. In addition, construction material, furniture, carpeting, air conditioning, and home cleaning agents and insecticides can also be significant sources of chemical and biological pollutants indoors.
Air pollution, both indoors and outdoors, is a major environmental health problem affecting everyone in developed and developing countries alike. Air pollutants have a negative impacts on humans, animals and plants, and on air quality [7].
Health impact of air pollution depends on the pollutant type, its concentration in the air, length of exposure, other pollutants in the air, and individual susceptibility. Different people are affected by air pollution in different ways. Poor people, undernourished people, very young and very old, and people with preexisting respiratory disease and other ill health, are more at risk. In cities, for instance, poor tend to live and work in most heavily polluted areas, and in rural areas poor are more likely to cook with dirtier fuels [9,10].
Air pollution has both acute and chronic effects on human health. Health effects range anywhere from minor irritation of eyes and the upper respiratory system to chronic respiratory disease, heart disease, lung cancer, and death. Air pollution has been shown to cause acute respiratory infections in children and chronic bronchitis in adults. It has also been shown to worsen the condition of people with preexisting heart or lung disease. Among asthmatics, air pollution has been shown to aggravate the frequency and severity of attacks. Both short-term and long-term exposures have also been linked with premature mortality and reduced life expectancy [11,12].
Air pollutants can also indirectly affect human health through acid rain, by polluting drinking water and entering the food chain, and through global warming and associated climate change and sea level rise [13].

2. PARTICULATE MATTER

Particulate matter (PM) affects more people than any other pollutant. The major components of Particulate matter are sulfate, nitrates, ammonia, sodium chloride, carbon, mineral dust and water. It consists of a complex mixture of solid and liquid particles of organic and inorganic substances suspended in the air. The particles are identified according to their aerodynamic diameter, as either PM_{10} (particles with an aerodynamic diameter smaller than 10 μm) or $PM_{2.5}$ (aerodynamic diameter smaller than 2.5 μm). The latter are more dangerous since, when inhaled, they may reach the peripheral regions of the bronchioles, and interfere with gas exchange inside the lungs.

2.1. Health effects

The effects of particulate matter on health occur at levels of exposure currently being experienced by most urban and rural populations in both developed and developing countries. Chronic exposure to particles contributes to the risk of developing cardiovascular and respiratory diseases, as well as of lung cancer. In developing countries, exposure to pollutants from indoor combustion of solid fuels on open fires or traditional stoves increases the risk of acute lower respiratory infections and associated mortality among young children; indoor air pollution from solid fuel use is also a major risk factor for chronic obstructive pulmonary disease and lung cancer among adults. The mortality in cities with high levels of pollution exceeds that observed in relatively cleaner cities by 15–20%. Even in the EU,

average life expectancy is 8.6 months lower due to exposure to $PM_{2.5}$ produced by human activities [13-18].

3. OZONE (O_3)

The previously recommended limit, which was fixed at 120 μg/m^3 8-hour mean, has been reduced to 100 μg/m^3 based on recent conclusive associations between daily mortality and ozone levels occurring at ozone concentrations below 120 μg/m^3.

Ozone at ground level – not to be confused with the ozone layer in the upper atmosphere – is one of the major constituents of photochemical smog. It is formed by the reaction with sunlight (photochemical reaction) of pollutants such as nitrogen oxides (NO_x) from vehicle and industry emissions and volatile organic compounds (VOCs) emitted by vehicles, solvents and industry. The highest levels of ozone pollution occur during periods of sunny weather.

3.1. Health effects

Excessive ozone in the air can have a marked effect on human health. It can cause breathing problems, trigger asthma, reduce lung function and cause lung diseases. In Europe it is currently one of the air pollutants of most concern. Several European studies have reported that the daily mortality rises by 0.3% and that for heart diseases by 0.4 %, per 10 μg/m^3 increase in ozone exposure [19].

4. NITROGEN DIOXIDE (NO_2)

The current WHO guideline value of 40 μg/m^3 (annual mean) set to protect the public from the health effects of gaseous NO_2 remains unchanged from the level recommended in the previous AQGs.

As an air pollutant, NO_2 has several correlated activities:

- At short-term concentrations exceeding 200 μg/m^3, it is a toxic gas which causes significant inflammation of the airways.
- NO_2 is the main source of nitrate aerosols, which form an important fraction of $PM_{2.5}$ and, in the presence of ultraviolet light, of ozone.

The major sources of anthropogenic emissions of NO_2 are combustion processes (heating, power generation, and engines in vehicles and ships).

4.1. Health effects

Epidemiological studies have shown that symptoms of bronchitis in asthmatic children increase in association with long-term exposure to NO_2. Reduced lung function growth is also linked to NO_2 at concentrations currently measured (or observed) in cities of Europe and North America [20,21].

5. SULFUR DIOXIDE (SO_2)

A SO_2 concentration of 500 μg/m^3 should not be exceeded over average periods of 10 minutes duration. Studies indicate that a proportion of people with asthma experience changes in pulmonary function and respiratory symptoms after periods of exposure to SO_2 as short as 10 minutes.

The revision of the 24-hour guideline for SO_2 from 125 to 20 μg/m^3 is based on the following considerations:

- Health effects are now known to be associated with much lower levels of SO_2 than previously believed.
- A greater degree of protection is needed.
- Although the causality of the effects of low concentrations of SO_2 is still uncertain, reducing SO_2 concentrations is likely to decrease exposure to co-pollutants.

SO_2 is a colourless gas with a sharp odour. It is produced from the burning of fossil fuels (coal and oil) and the smelting of mineral ores that contain sulfur. The main anthropogenic source of SO_2 is the burning of sulfur-containing fossil fuels for domestic heating, power generation and motor vehicles.

5.1. Health effects

SO_2 can affect the respiratory system and the functions of the lungs, and causes irritation of the eyes. Inflammation of the respiratory tract causes coughing, mucus secretion, aggravation of asthma and chronic bronchitis and makes people more prone to infections of the respiratory tract. Hospital admissions for cardiac disease and mortality increase on days with higher SO_2 levels. When SO_2

combines with water, it forms sulfuric acid; this is the main component of acid rain which is a cause of deforestation [22].

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