Air Pollution(outdoor)

Background

Ambient (outdoor air) pollution presents a significant environmental risk to the health of millions of people around the world. It can cause stroke, heart disease, lung cancer and both chronic and acute respiratory diseases, including asthma. Estimates from 2012 showed that ambient pollution caused the premature death of 3.7 million adults and children in both urban and rural areas. Some 88% of these premature deaths occurred in low-and middle-income countries, with the greatest number occurring in the Western Pacific and South-East Asia regions.

In addition to outdoor air pollution, indoor smoke is a serious health risk for some 3 billion people who cook and heat their homes with biomass fuels and coal.

Key facts

- Environmental health problems caused by ambient pollution affect both the developed and developing world.
- Ambient pollution increases the risk of respiratory and heart disease, particularly in those people with existing health problems. Data published by WHO in 2012 revealed a stronger link than previously thought between both indoor and outdoor air pollution exposure and cardiovascular diseases as well as between air pollution and cancer.
- Studies show that children, the elderly and those living in poverty are at greater risk of health problems caused by outdoor air pollution.
- People’s short- and long-term cardiovascular and respiratory health improve as air pollution levels reduce.
- The World Health Organization mortality data from 2012 estimates that around 80% of outdoor air pollution-related premature deaths were caused by strokes as well as heart disease. Some 22% of deaths were due to chronic obstructive pulmonary disease (COPD); 12% of deaths were caused by acute lower respiratory infections in children; and 6% of deaths were due to lung cancer.
- A 2013 assessment of WHO’s International Agency for Research on Cancer (IARC) concluded that outdoor air pollution is carcinogenic to humans and is particularly associated with an increased incidence of cancer of the lung.
- A study published in the scientific journal Nature in September 2015, found that emissions from residential energy use such as heating and cooking, prevalent in India and China, have the largest impact on premature morality globally. According to the study, more people now die from air pollution than malaria and HIV combined including 1.4 million people a year in China and 650,000 in India.
According to the *Nature* study, agricultural emissions make the largest relative contributions to small particulate matter pollution in eastern USA, Europe, Russia and East Asia.

**Sources of outdoor air pollution**

The main sources of outdoor air pollution are:

- The combustion of fossil fuels including domestic heating, power generation and motor vehicles
- Industrial processes
- Agricultural processes
- Waste incineration
- Natural processes such as volcanic eruptions and thunderstorms

Air pollution levels are closely linked to climate (temperature, prevailing winds & seasonal changes) and topography (hills, valleys & dominant vegetation). Episodes of air pollution can cause particular difficulties if the affected city is located in a valley surrounded by mountains as in the case of Mexico City and La Paz.

**Major outdoor air pollutants and who is particularly at risk**

The significant outdoor air pollutants include particulate matter, ozone, nitrogen oxides, carbon monoxide and sulphur dioxide.

Those at greatest risk from outdoor air pollution exposure include:

- **Babies, children and teenagers.** They are more likely to be exposed to air pollution because they spend more time outdoors playing and engaging in energetic activities. They breathe more air in per kg of body weight than adults and are more susceptible to the effects of air pollution as their airways are still developing. They are also more likely to have asthma which increases their risk.

- **Anyone aged 65 and over.** They are more likely to have undiagnosed cardiovascular disease and multiple risk factors such as high blood pressure, elevated cholesterol, diabetes and smoking.

- **People with lung disease** such as asthma and chronic obstructive pulmonary disease (COPD).

- **People with heart disease or diabetes.** This includes people with known ischaemic heart disease, heart failure, ventricular arrhythmia, peripheral vascular disease, history of stroke, transient ischaemic attack (TIA) or diabetes.

- **People with low incomes.** They are more likely to live in areas of cities with the worst air quality.

- **People who work or take exercise outdoors.**
Particulate matter (PM) air pollution

Particulate matter (PM) is a complex mixture of particles that can be solid, liquid or both. They can vary in size, composition and origin. Their sources include power plants and industry, motor vehicles, domestic coal burning and natural sources (volcanoes & dust storms).

Particle size is the most important factor in determining how PM affects our health. Coughing and sneezing help to stop large coarse particles from going beyond our upper respiratory tract, but they cannot prevent smaller particles which are less than 10 micrometres in diameter, from reaching deep into our lungs. Ultrafine particles are so small they can pass through lung tissue and into the bloodstream.

PM pollution can trigger illness, hospitalisation and premature death particularly during or after peaks or spikes in PM levels and after long-term exposure to fine particle pollution. It can cause coughing, wheezing, more severe asthma attacks, cardiac arrhythmias, heart attacks and strokes, pneumonia, lung cancer, greater use of asthma medications, more visits to emergency rooms at medical centres and increased rates in hospital admissions. This can lead to children missing school and adults too unwell to go to work.

Ozone air pollution

Exposure to ground level ozone can be harmful to your health. Low level ozone is a key component of urban smog and requires sunlight for its formation, so its levels tend to peak on hot summer afternoons.

Urban areas of low- and middle-income countries often experience the highest concentrations of this pollutant. Ozone can worsen the symptoms of those who have asthma, bronchitis or emphysema but can affect anyone. It causes

- Lung inflammation and irritation (‘sunburn of the lungs’)
- Coughing, wheezing and pain when taking a deep breath
- Eye, nose and throat irritation
- Trouble breathing when engaged in outdoor activities and during exercise

High ozone levels may result in an increased risk of heart attacks. The risk of stroke may also be higher in high-risk individuals.

Nitrogen dioxide pollution

Combustion processes are the major source of nitrogen dioxide (NO₂). This may exacerbate asthma.

Carbon monoxide pollution

Carbon monoxide (CO) is an odourless, colourless gas which is produced when fossil fuels are burned in vehicles, stoves, fireplaces, grills, gas ranges and furnaces. Levels of CO can build up indoors causing sudden illness and death without warning. The most common symptoms include headache, weakness, vomiting, confusion and dizziness. Infants, the
elderly and people with chronic heart disease and breathing problems are at higher risk of becoming ill from carbon monoxide poisoning.

A separate resource on carbon monoxide poisoning is available to read or download from our website.

**Sulphur dioxide pollution**

Sulphur dioxide (SO\(_2\)) is produced when fossil fuels such as coal and oil are burned and through mineral ore smelting. Above recommended levels of SO\(_2\) can cause eye irritation and affects the respiratory systems and lung function leading to coughing and the worsening of asthma and chronic bronchitis. More people are admitted to hospital with cardiac problems when SO\(_2\) levels are higher.

**Air quality and emergencies**

During emergencies, air quality may be significantly affected. When volcanoes erupt, harmful gases and ash are released that can make it hard to breathe. Smoke from wildfires can also affect the air that you breathe. Following significant natural disasters such as cyclones and floods, it may be necessary to burn debris and waste. The smoke from these fires can also harm your health.

**Which are the most polluted cities in the world?**

Currently there is no worldwide database providing reliable city air pollution data and in many cities, in Africa in particular, pollution levels are simply not monitored.

In 2014, a WHO urban air quality database covered 1,600 cities across 91 countries (500 more cities than the previous database of 2011). Results from this database revealed that most cities worldwide failed to meet WHO guidelines for safe air quality levels. Only 12% of the people living in cities reporting on air quality resided in cities which complied with WHO air quality guidelines levels. About 50% of the population being monitored in 2014 were exposed to air pollution levels 2.5 times higher than the levels WHO recommends, placing these people at additional risk of serious long-term health problems. A number of cities suspected of having high air pollution levels do not monitor their air quality and could not be included in the database.

Air pollution levels are particularly high in the following cities and towns:

**Asia**

- China: Beijing, Hong Kong, Shijiazhuang, Shanghai
- Mongolia: Ulaanbaatar
- Philippines: Manila
- South Korea: Seoul
- Vietnam: Ha Noi

**South Asia**

- Afghanistan: Herat, Kabul, Kandahar, Jalalabad, Mazar-e-Sharif
Bangladesh
- Dhaka, Gazipur, Idgir, Narayanganj

India
- Agra, Ahmedabad, Allahabad, Amritsar, Delhi, Firozabad, Gwalior, Kanpur, Khanna, Kolkata, Lucknow, Ludhiana, Mumbai, Patna, Raipur

Nepal
- Kathmandu

Pakistan
- Karachi, Peshawar, Rawalpindi

Sri Lanka
- Colombo

Africa

Ghana
- Accra

Nigeria
- Aba, Kaduna, Lagos, Onitsha, Umuahia

Senegal
- Dakar

South Africa
- Pretoria

Latin America

Argentina
- Buenos Aires

Bolivia
- Cochabamba, La Paz, Santa Cruz

Brazil
- Rio de Janeiro, Sao Paulo

Chile
- Santiago de Chile

 Colombia
- Bogotá, Medellín

Mexico
- Guadalajara, Leon, Mexico City, Monterey

Peru
- Lima, La Oroya

Uruguay
- Montevideo

Middle East & North Africa

Bahrain
- Hamad Town, Ma’ameer

Egypt
- Cairo

Iran
- Boshehr, Khormabad, Tehran, Zabol

Jordan
- Amman

Lebanon
- Beirut

Oman
- Muscat

Qatar
- Doha

Saudi Arabia
- Al Jubail, Dammam, Jeddah, Riyadh

Turkey
- Ankara, Idgir

United Arab Emirates
- Abu Dhabi
Europe

Bulgaria   Sofia
Italy      Milan, Naples
Poland     Krakow, Zakopane
Spain      Barcelona

According to the WHO study, the ten worst polluted countries are Pakistan, Afghanistan, Bahrain, Senegal, Qatar, Bangladesh, United Arab Emirates, Mongolia, Egypt and India.

How can I protect myself from outdoor air pollution?

- If you are in one of the risk groups mentioned above, or you’re an older adult, or if you have children, you should talk to your doctor before you travel to a location with potentially hazardous levels of air pollution.

- If available, check out air quality levels and air pollution forecasts at your location. In some cities, e.g. Shanghai, there is an Air Quality Index smartphone application.

- If you are in an ‘at risk group’, don’t wait until pollution levels reach hazardous levels to take action to reduce your exposure. Air quality is unhealthy for you at lower levels than for the rest of the population.

- If you are not in any of the ‘at risk categories’, start taking steps to reduce your exposure when these reach the ‘unhealthy’ range. Listen to the radio/TV, read a local newspaper or search online for details of air pollution forecasts.

- If spending time outside for extended periods during periods of high outdoor air pollution, FFP3 or N95 masks may offer a degree of protection, rather than surgical or dust masks.

- Avoid exercising outdoors including bicycling, walking and running when pollution levels are high.

- Avoid walking, cycling or exercising on routes high volumes of traffic. The air quality is better on quiet residential streets.

- Stay indoors as much as possible when air pollution levels are high and reduce your activity levels indoors. Keep your windows closed.

- If you’re asthmatic or have COPD, carry inhalers with you at all times. If air pollution is high, you may need to use your inhaler more frequently for a while.

- Keep your throat moist by drinking plenty of water.

- If travelling by car, use the recycled air option in your car, rather than drawing air in from the outside. It will introduce fewer particles into your car.

- Keep a close eye on children, the elderly and those with pre-existing cardiovascular and respiratory conditions.
In some cases, you may need to consider moving to a location with better outdoor air quality. Most sources of urban outdoor air pollution are well beyond the control of individuals. This requires action by city planners and local authorities as well as national and international policymakers to promote cleaner transport, more efficient energy production and waste management.

**How can I tell if air pollution is affecting me?**

- You may experience temporary symptoms such as irritation of the eyes, nose and throat, coughing, phlegm, chest tightness and shortness of breath. These symptoms disappear when air quality improves.

- If you have lung disease including asthma and COPD, you may not be able to breathe as deeply or as vigorously as normal and you may also cough, wheeze, be short of breath and be unusually tired. Use your medication as directed by your doctor and follow your asthma management plan. Contact your doctor if your symptoms persist or get worse.

- You should seek emergency medical assistance if you have symptoms of a heart attack or stroke.

**Sources**

- ‘Ambient (outdoor) air quality and health’ World Health Organization Fact sheet No 313 Updated March 2014
- ‘Aemergenir quality deteriorating in many of the world’s cities’ World Health Organization News Release 07/05/14
- ‘Air pollution: Delhi is dirty, but how do other cities fare?’ The Guardian 24/06/15
- ‘Air pollution: a dark cloud of filth poisons the world’s cities’ The Guardian 16/01/16
- American Lung Association
- US Centers for Disease Control & Prevention (CDC)
- ‘Extremely high levels of PM2.5: Steps to reduce your exposure’ Embassy of the United States of America in Beijing, China

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