



Human Health Impacts of Air Pollution.

*Dr. Mina Sadeq
Environmental Epidemiology Unit
Department of Toxicology
National Institute of Hygiene
Rabat, Morocco.*

Exposure to air pollutants has been linked to a broad range of health conditions/effects, varying from mild allergy to lung cancer, or even death. These health conditions are typically assessed through clinical outcomes such as respiratory symptoms, medication use, asthma attacks, doctor visits, school absence, emergency room visits, hospital admissions, chronic diseases (respiratory infection, heart disease and lung cancer), and possibly premature death. Individual reaction to air pollutants depends on many factors including type

of air pollutant one is exposed to (exposure can occur through inhalation, skin contact, or ingestion), degree (quantity and duration) of exposure, genetics, individual health, behavioral patterns (smoking status...) and socio-economic position.

Health effects related to air pollution has also been studied through many scientific approaches including:

1. epidemiologic research (studies that are carried out by selecting a large population in a community setting throughout a specific time period varying from a few months to several years, to examine association between exposure to air pollutants and potential health outcomes such as heart disease and lung cancer),

2. Controlled human exposure studies (studies typically carried out on volunteers to assess mild and reversible health effects. Exposure is controlled: it is for a short duration and at low concentrations)
3. laboratory animal studies,
4. toxicological studies (studies of the adverse effects of chemical air pollutants on biological systems)

Data, related to clinical outcomes, and information issued from scientific approaches are complementary and together help to set air pollutants guidelines.

Air pollution includes both indoor (enclosed environments) and outdoor (or ambient) air pollution. According to WHO (Fact sheet N°313, updated in September 2011), indoor air pollution is estimated to

cause approximately 2 million premature deaths mostly in developing countries. Almost half of these deaths are due to pneumonia in children under 5 years of age. Urban outdoor air pollution is estimated to cause 1.3 million deaths per year worldwide. Those living in middle-income countries disproportionately experience this burden. In Africa some 50,000 people die every year from outdoor air pollution i.e. 140 a day.

Air pollutants include gases, fine particles, and metals. They can be chemical or biological pollutants (such as pollen and mold). There are major ambient air pollutants that are carbon monoxide, lead, nitrogen oxide, ozone and particulate matter (PM with an aerodynamic diameter of 10 microns or less (PM10), and those with an aerodynamic diameter up to 2.5 microns (PM2.5)). The following table provides some of their sources, their health effects, and related WHO guidelines.



Major ambient air pollutants: Common sources, health effects, and WHO guidelines

Pollutant	Dominant Sources	Health effects	World Health Organization (WHO) guidelines
CO ^a	<ul style="list-style-type: none"> Cars and trucks Burning charcoal Wood Gasoline engines Forest fires 	<ol style="list-style-type: none"> Affects cardiovascular system Increases hospital admissions for congestive heart failure Causes low birth weight <p>Symptoms vary from headache, dizziness, weakness, nausea, vomiting, chest pain, confusion, to loss of consciousness and death.</p>	<ul style="list-style-type: none"> 15-minute average: 100 mg/m³ 30-minute average: 60 mg/m³ 1-hour average: 30 mg/m³
Lead ^a	<ul style="list-style-type: none"> leaded gasoline Industrial sources Metals processing Wastes incinerators 	<ol style="list-style-type: none"> Toxic to many organs and tissues (bones, heart, intestines, kidneys, nervous and reproductive systems) Learning and behavior disorders Anemia 	<ul style="list-style-type: none"> Annual: 0.5 µg/m³
NO ₂ ^b	<ul style="list-style-type: none"> Electric power plants Cars and trucks Home heaters Gas stoves 	<ol style="list-style-type: none"> Increases respiratory illness Harms lung function Mortality 	<ul style="list-style-type: none"> 1-hour average: 200 µg/m³ Annual: 40 µg/m³
Ozone ^b	Formed by the reaction of volatile organic compounds (VOCs) and nitrogen oxides (NO _x) in the presence of heat and sunlight.	<ol style="list-style-type: none"> Induction of respiratory symptoms (coughing, throat irritation, chest tightness, shortness of breath) Decrement of lung function Increased asthma attacks Increased hospital admissions Increased daily mortality 	<ul style="list-style-type: none"> 8-hour average: 100 µg/m³
Ozone ^b	Formed by the reaction of volatile organic compounds (VOCs) and nitrogen oxides (NO _x) in the presence of heat and sunlight.	<ol style="list-style-type: none"> Induction of respiratory symptoms (coughing, throat irritation, chest tightness, shortness of breath) Decrement of lung function Increased asthma attacks Increased hospital admissions Increased daily mortality 	<ul style="list-style-type: none"> 8-hour average: 100 µg/m³

Pollutant	Dominant Sources	Health effects	World Health Organization (WHO) guidelines
Particulate Matter (PM) ^b	<ul style="list-style-type: none"> • Motor vehicles • Electric power plants • Wood stoves • Also produced when sulfur oxides react with nitrogen oxides to form PM 	<ol style="list-style-type: none"> 1. Increased emergency rooms visits 2. Asthma attack 3. Decreased lung function 4. Increased respiratory infections 	PM2.5: <ul style="list-style-type: none"> • 24-hour average: 25 µg/m³ • Annual: 10 µg/m³ PM10: <ul style="list-style-type: none"> • 24-hour average: 50 µg/m³ • Annual: 20 µg/m³
Sulfur Dioxide ^b	<ul style="list-style-type: none"> • Combustion of coal and oil • Industrial processing • Metal smelting 	<ol style="list-style-type: none"> 1. Shortness of breath 2. Alteration of the lung's defense 3. Aggravation of existing cardiovascular diseases 	<ul style="list-style-type: none"> • 10-minute average: 500 µg/m³ • 24-hour average: 20 µg/m³

Sources:

a: WHO Air Quality Guidelines. 2000

b: WHO Air Quality Guidelines. 2005 (Fact sheet N°313, updated in September 2011)

Hundreds of other air pollutants exist (benzene, toluene, mercury, dioxin, asbestos, pesticides, herbicides, cadmium, radon...). They are linked to cancer, reproductive effects, neurological damage, and respiratory effects.

It should be recalled that one health effect may be linked to a mixture of air pollutants rather than to solely one air pollutant, and that air pollutants can be transported into an area far from original pollution sources (even from one country to another), which means that health effects can be developed far from the original air pollution source. Much is to be gained from collaboration at national, regional and even international levels.

