My reservoir is like the distance between Aden and Amman in al-Balqa

Al-Balqa Applied University

Faculty of Medicine

Epidemiology and Biostatistics

الوبائيات والإحصاء الحيوي (31505204)

Lecture 23

Current global environmental problems, their causes, effects, and prevention measures

5-8-2019

Environmental risk factors

- **Included environmental factors are the modifiable parts (or impacts) of:**

- Pollution of air, water, or soil with chemical or biological agents.
- Ultraviolet and ionizing radiation
- Noise, electromagnetic fields
- Occupational risks
- Behaviour related to the availability of safe water and sanitation facilities, such as washing hands, and contaminating food with unsafe water or unclean hands.

❑ Behavioral risk factors:

1. Tobacco smoking
2. Excessive alcohol consumption
3. Poor diet and nutrition
4. Physical inactivity
5. Excessive sun exposure
6. Insufficient vaccination
7. Unprotected sexual activity.

❑ Biomedical risk factors

(combination of genetic, lifestyle and other broad factors):

1. Overweight and obesity
2. High blood pressure
3. High blood cholesterol
4. Impaired glucose tolerance

❑ Environmental risk factors:

1. **Social, economic, cultural and political**
2. **Physical, chemical and biological**

❑ Genetic risk factors:

1. Single gene (monogenic) disorders, for example haemophilia
2. Chromosomal abnormalities, for example Down syndrome; and
3. Multi-factorial diseases, such as asthma.

Global environmental problems

1. Global warming

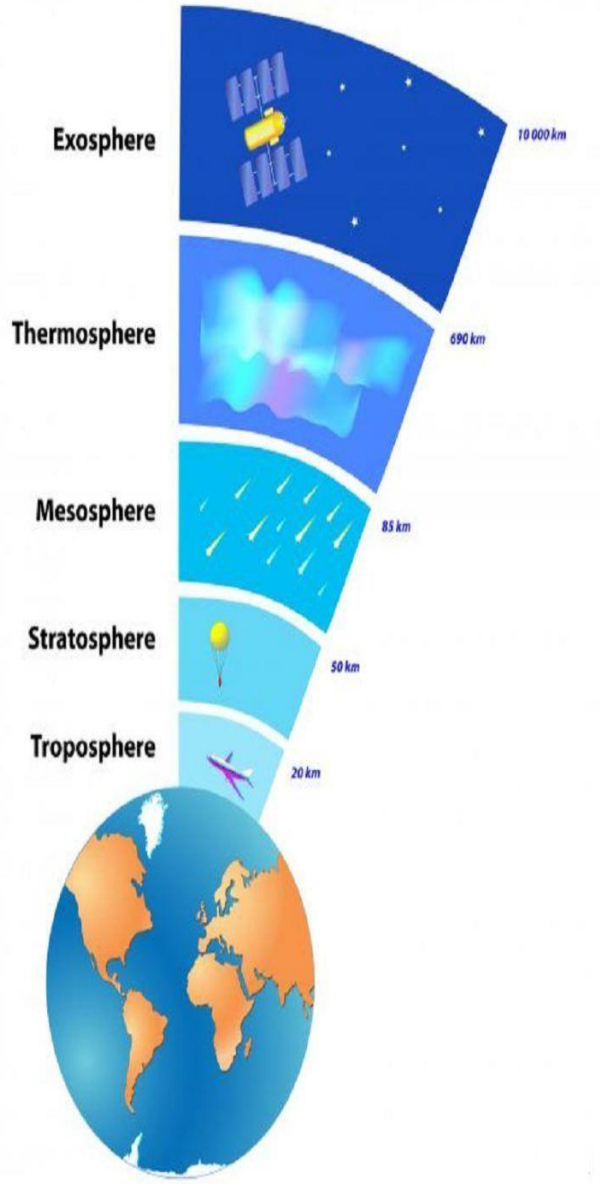
2. Ozone depletion

3. Trans-boundary transmission of pollutants

A. Air pollutants
B. Acid rains
C. Toxic chemicals
D. Radio-active pollutants
E. Sea water pollutants
F. River water pollutants
G. International trading of foods/drinks materials
H. Communication channels, media, misleading data.

The four types of Atmosphere

- **Troposphere:** **8-18 km, close to earth surface.**
- **Stratosphere:** **up to 50km, OZONE- absorbs harmful ultraviolet radiation from sun.**
- **Mesosphere: > 50 km**
- **Thermosphere and Exosphere = upper atmosphere.**



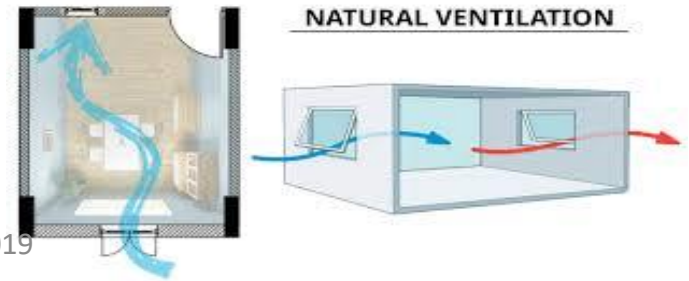
Air pollution and Ventilation

❑ Air pollution;

- **Is the introduction of chemicals, particulate matter, or biological material-- that cause harm discomfort to humans or other living organisms, or damages the natural environment,-- into the atmosphere.**

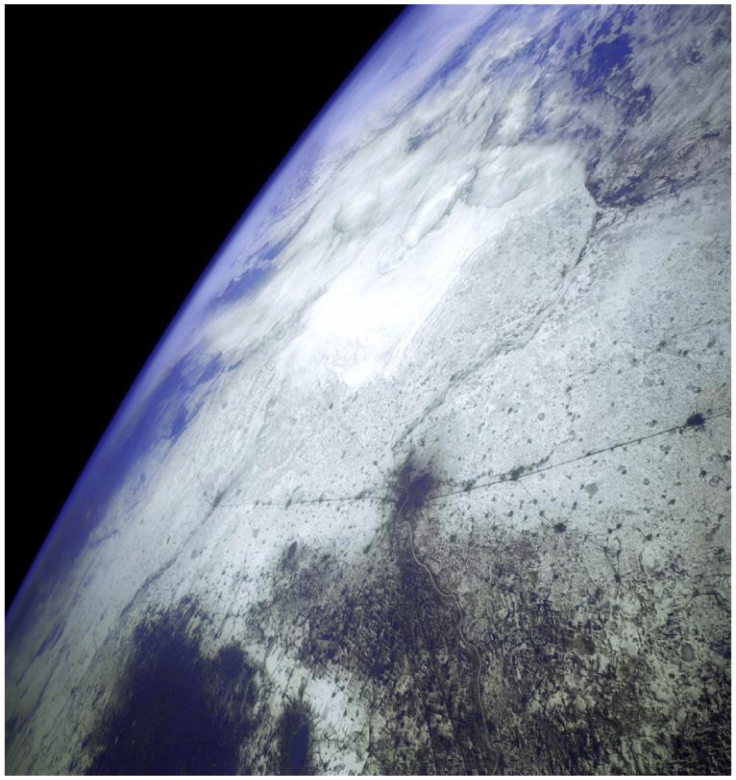
❑ Ventilation :

- **A process, whereby air is supplied and removed from an indoor space by natural or mechanical means.**
- Mainly used to **control indoor air quality** by diluting and displacing indoor pollutants.



Atmospheric Composition

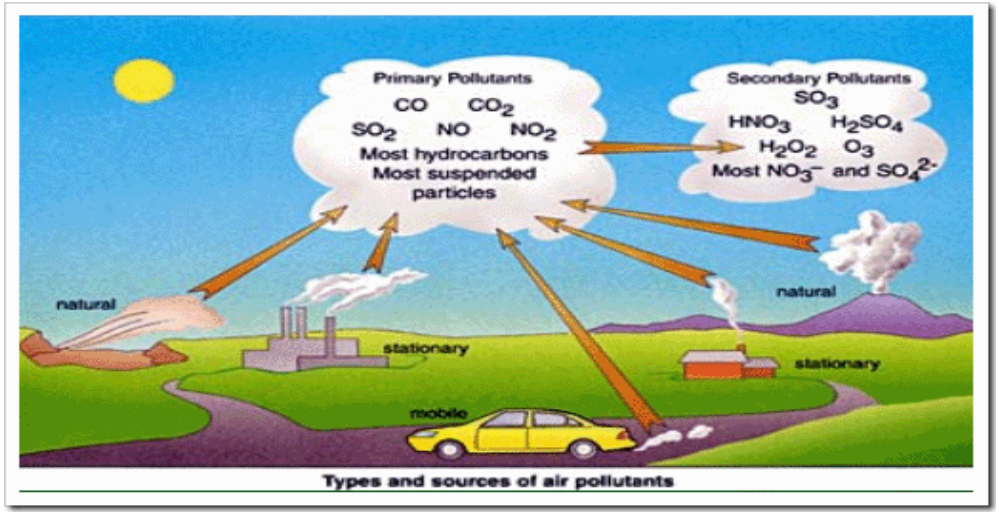
- **Nitrogen 78.08%**
- **Oxygen 20.95%**
- **Argon 0.93%**
- **Carbon dioxide 0.04%**



Types and Sources of Air Pollutants

- **Two categories**

- **Primary Air Pollutant**
  - Harmful substance that is **emitted directly into the atmosphere**.



Types and sources of air pollutants

- **Secondary Air Pollutant**
  - Harmful substance **formed in the atmosphere** when a primary air pollutant **reacts with substances** normally found in the atmosphere or with other air pollutants.

Major Air Pollutants

Table 20.1 Major Air Pollutants

Pollutant	Composition	Primary or Secondary	Characteristics
Particulate matter			
Dust	Variable	Primary	Solid particles
Lead	Pb	Primary	Solid particles
Sulfuric acid	H_2SO_4	Secondary	Liquid droplets
Nitrogen oxides			
Nitrogen dioxide	NO_2	Primary	Reddish-brown gas
Sulfur oxides			
Sulfur dioxide	SO_2	Primary	Colorless gas with strong odor
Carbon oxides			
Carbon monoxide	CO	Primary	Colorless, odorless gas
Carbon dioxide*	CO_2	Primary	Colorless, odorless gas
Hydrocarbons			
Methane	CH_4	Primary	Colorless, odorless gas
Benzene	C_6H_6	Primary	Liquid with sweet smell
Ozone	O_3	Secondary	Pale blue gas with acrid odor
Air toxics			
Chlorine	Cl_2	Primary	Yellow-green gas

* Discussed in Chapter 21.

Source: Environmental Protection Agency.

Major Classes of Air Pollutants

- Particulate Material
- Nitrogen Oxides
- Sulfur Oxides
- Carbon Oxides
- Hydrocarbons
- Ozone

Particulate Material

- Thousands of different **solid or liquid** particles **suspended in air**
  - **Includes:** soil particles, lead, asbestos, sea salt, and sulfuric acid droplets.

- **Dangerous for 2 reasons**
  - May contain materials with **toxic or carcinogenic effects.**
  - **Extremely small particles can become lodged in lungs.**

Nitrogen and Sulfur Oxides

❑ Nitrogen Oxides

- **Gases** produced by the chemical interactions between atmospheric nitrogen and oxygen at high temperature.
- **Problems**
  - ➢ **Greenhouse gases**
  - ➢ **Cause difficulty breathing**

❑ Sulfur Oxides

- **Gases** produced by the chemical interactions between sulfur and oxygen.
- **Causes acid precipitation**

Carbon Oxides and Hydrocarbons

❑ Carbon Oxides

- **Gases** carbon monoxide (CO) and carbon dioxide (CO_2).
- **Greenhouse gases.**

❑ Hydrocarbons

- Diverse group of **organic compounds** that contain only hydrogen and carbon (ex: CH_4- methane).
- Some are related to photochemical smog and **greenhouse gases.**

Ozone

- **Tropospheric O**zone
  - **Man-made pollutant in the lower atmosphere.**

- **Stratospheric Ozone**
  - Essential component that **screens out UV radiation in the upper atmosphere.**

Environmental Risk Factors and Health:

- **The evidence shows that environmental risk factors play a role in *more than 80% of the diseases regularly reported* by the World Health Organization.**

- **Globally, nearly one quarter of all deaths and of the total disease burden can be attributed to the environment.**

Effects of Air Pollution

- **Low level exposure**
  - **Irritates eyes**
  - **Causes inflammation of respiratory tract**
- **Can develop into chronic respiratory diseases**

Table 20.2 Health Effects of Several Major Air Pollutants

Pollutant	*Source*	*Effects*
Particulate	Industries, electric power plants, motor vehicles, construction, agriculture	Aggravates respiratory illnesses; long-term exposure may cause increased incidence of chronic conditions such as bronchitis; linked to heart disease; suppresses immune system; some particles, such as heavy metals and organic chemicals, may cause cancer or other tissue damage
Nitrogen oxides	Motor vehicles, industries, heavily fertilized farmland	Irritate respiratory tract; aggravate respiratory conditions such as asthma and chronic bronchitis
Sulfur oxides	Electric power plants and other industries	Irritate respiratory tract; same effects as particulates
Carbon monoxide	Motor vehicles, industries, fireplaces	Reduces blood's ability to transport oxygen; headache and fatigue at lower levels; mental impairment or death at high levels
Ozone	Formed in atmosphere (secondary air pollutant)	Irritates eyes; irritates respiratory tract; produces chest discomfort; aggravates respiratory conditions such as asthma and chronic bronchitis

Health Effects of Air Pollution

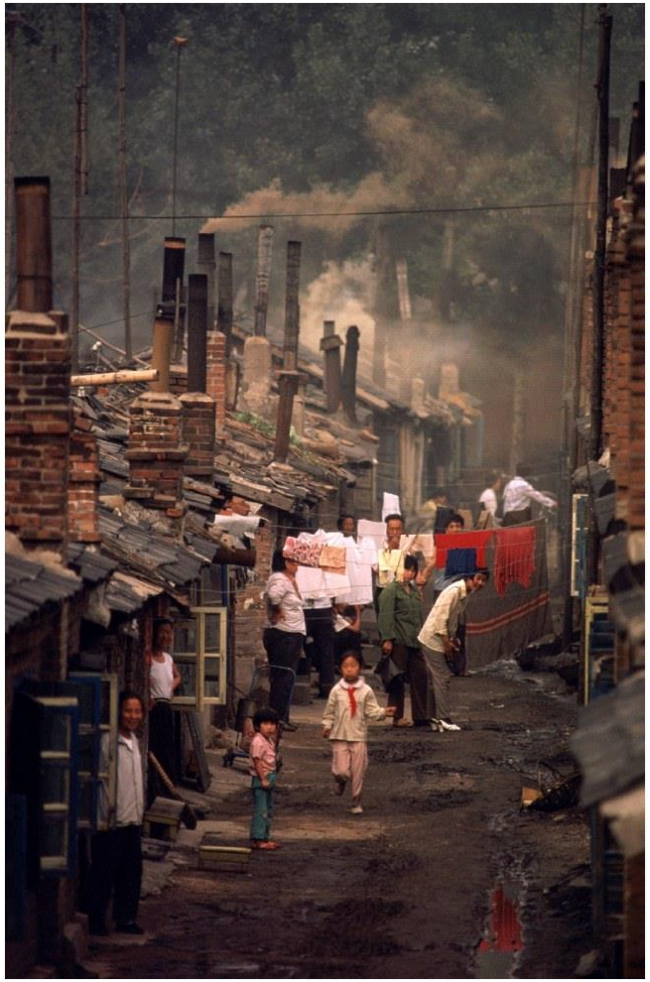
- **Sulfur Dioxide and Particulate material**
  - **Irritate respiratory tract and impair ability of lungs to exchange gases.**
- **Nitrogen Dioxides**
  - **Causes airway restriction.**
- **Carbon monoxide**
  - **Binds with iron in blood hemoglobin.**
  - **Causes headache, fatigue, drowsiness, death.**
- **Ozone**
  - **Causes burning eyes, coughing, and chest discomfort.**

Children and Air Pollution

- **Greater health threat to children than adults**
  - Air pollution can **restrict lung development.**
  - **Children breath more** often than adults.

- **Children** who live in **high ozone areas** are more likely to develop asthma.

Air Pollution Around the World



- Air quality is deteriorating rapidly in developing countries.
- Shenyang, China
  - Residents only see sunlight a few weeks each year.
- Developing countries have **older cars**
  - **Still use leaded gasoline**
- **Worst cities in world**
  - **Beijing, China; Mexico City, Mexico; Shanghai, China; Tehran, Iran; and Calcutta, India**

The Institute for Health Metrics and Evaluation (IHME) estimated number of deaths caused by air pollution in 2010 in 187 countries of the world. Based on these estimates, the below table summarizes the situation in our region.

Country	Annual deaths						
	Ambient PM pollution	Household air pollution	Ambient ozone pollution	Radon	Lead	Second-hand smoke	Occupational air pollution
Afghanistan	18,510	41,164	207	152	5,294	4,330	399
Bahrain	195	36	6	4	7	19	3
Djibouti	222	135	1	1	49	68	3
Egypt	49,756	3,452	944	11	14,151	7,586	942
Iran	32,288	1,886	377	567	5,804	1,933	325
Iraq	11,787	1,406	130	77	1,892	2,262	76
Jordan	1,638	114	35	22	154	247	16
Kuwait	809	143	5	1	6	110	4
Lebanon	1,807	37	27	37	206	445	18

Indoor Air Pollution

- **Indoor air pollutants may be up to *100 times higher than outdoor levels.*** *(Environmental protection agency).*

- **Most people spend 90% of their time indoors** *(American Lung Association).*

- **Dirty ventilation systems are a 50% contributor to sick building syndrome** *(Healthy Buildings International).*

Indoor Air Pollution

- 50% of all illnesses are either **caused or aggravated by polluted indoor air** *(American College of Allergists).*

- **Legionnaire's disease** was spawned in air conditioning ducts.*(American Lung Association).*

- Indoor air pollution is the **primary cause in as many as 50 million cases of occupational chronic respiratory disease each year** *(World Health Organization).*

What Causes Indoor Air Pollution??

- **Air tightness of buildings.**
- **Poorly designed air conditioning and ventilation systems.**
- **Indoor sources of pollution.**
- **Outdoor sources of pollution.**

How can I tell that indoor air is contaminated?

- Sniff the air. **The nose is the best odor and gas detector**, and a good particle detector as well, especially when **first entering** a contaminated environment.

Health Effects of Indoor Air Pollutants

- **Health effects due to indoor air pollutants may be short- as well as long-term.**

- **Short-term problems** include a stuffy, odorous environment and **symptoms** such as burning eyes, skin irritation, and headaches.

- **Long-term health problems** have a longer latency period or are chronic in nature.

What is sick building syndrome ?

- **The feeling of illness among majority of occupants of a conditioned space is called "Sick Building Syndrome".**

- **A variety of illness symptoms reported by occupants in sick buildings are – *Headache, fatigue, irritation in eyes, nose and throat, shortness of breathe etc.***

❑ **Causes**

- Inadequate ventilation.
- Insufficient supply of outside air.
- Fluctuations in temperature & humidity.

Main symptoms of sick building syndrome

- Sore eyes
- Feeling of suffocation
- Dry, sore throat
- Coughing
- Backache
- Intermittent fatigue
- Headache
- Agitation
- Anxiety
- Dizziness
- Sleeplessness
- Psoriasis
- Palpitations
- Nausea
- Cold sensitivity
- Numbness
- Easily fatigued

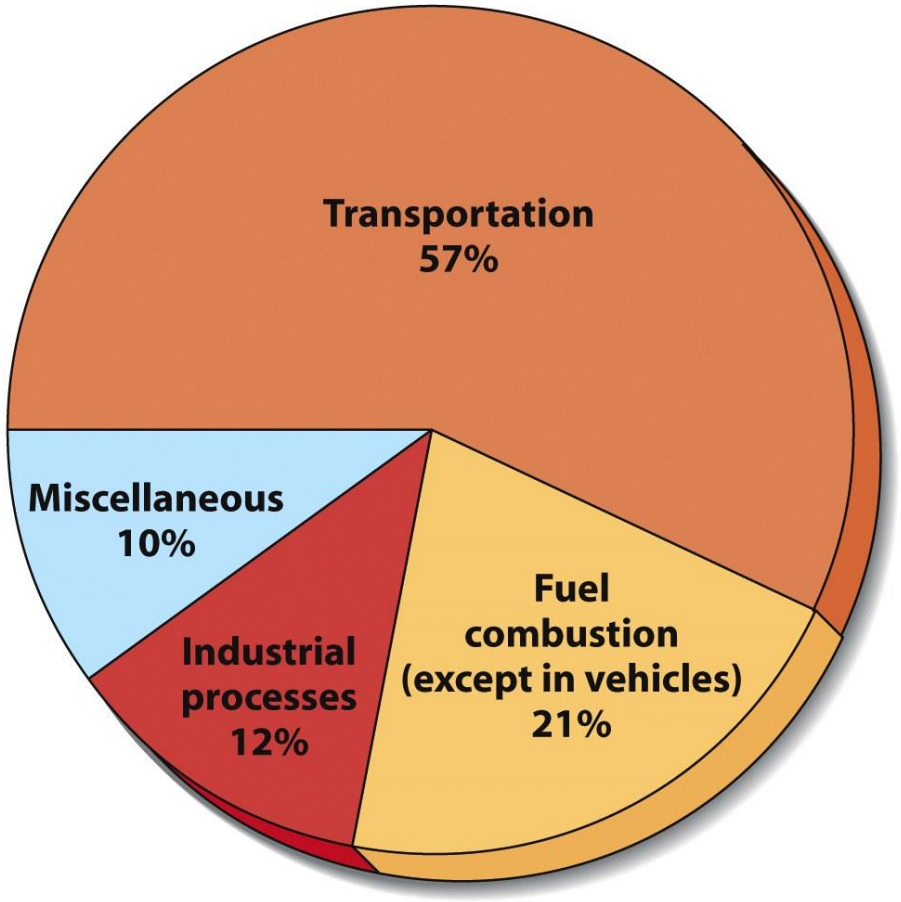
Outdoor Air Pollution

- **Global warming-Climate Change**
- **Ozone Depletion**
- **Temperature Inversion**

Sources of Outdoor Air Pollution

- **Two main sources**
  - **Transportation**
  - **Industry**

- **Intentional forest fires is also high.**



What is Climate Change?

- **Climate change** happens when there are changes to average weather.

- **Climate is the average weather at a given point and time of year, over a long period (typically 30 years).**

- **We expect the weather to change a lot from day to day, but we expect the climate to remain relatively constant.**
  - **Climate** tells you what clothes to buy but **weather** tells you what clothes to wear.

- **If the climate doesn't remain constant, we call it climate change.**

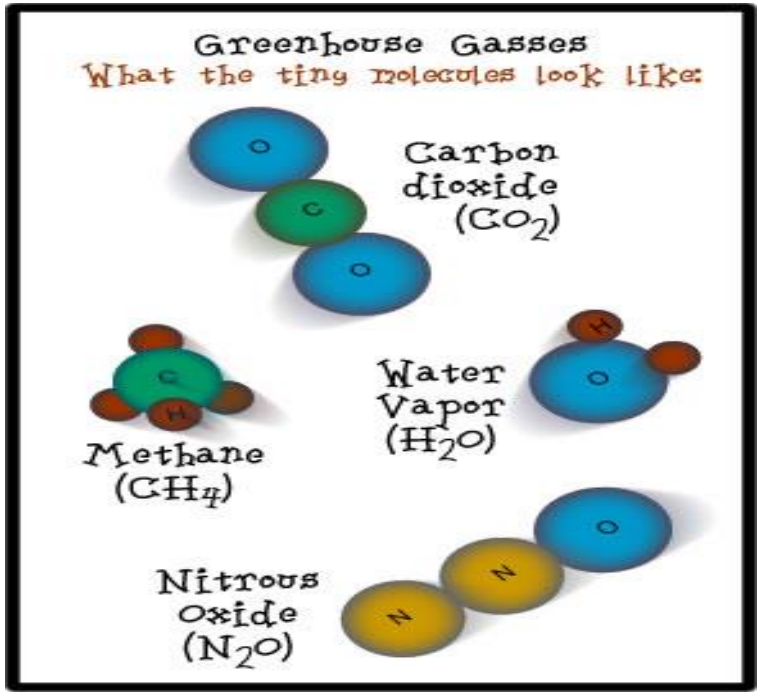
What is causing the Climate to change?

- The Earth is getting warmer because humans are adding heat-trapping gases to the atmosphere.

- Increases in the **amount of greenhouse gases** in the atmosphere enhances the greenhouse effect which is

- **Creating global warming a**nd

- Consequently **climate change.**

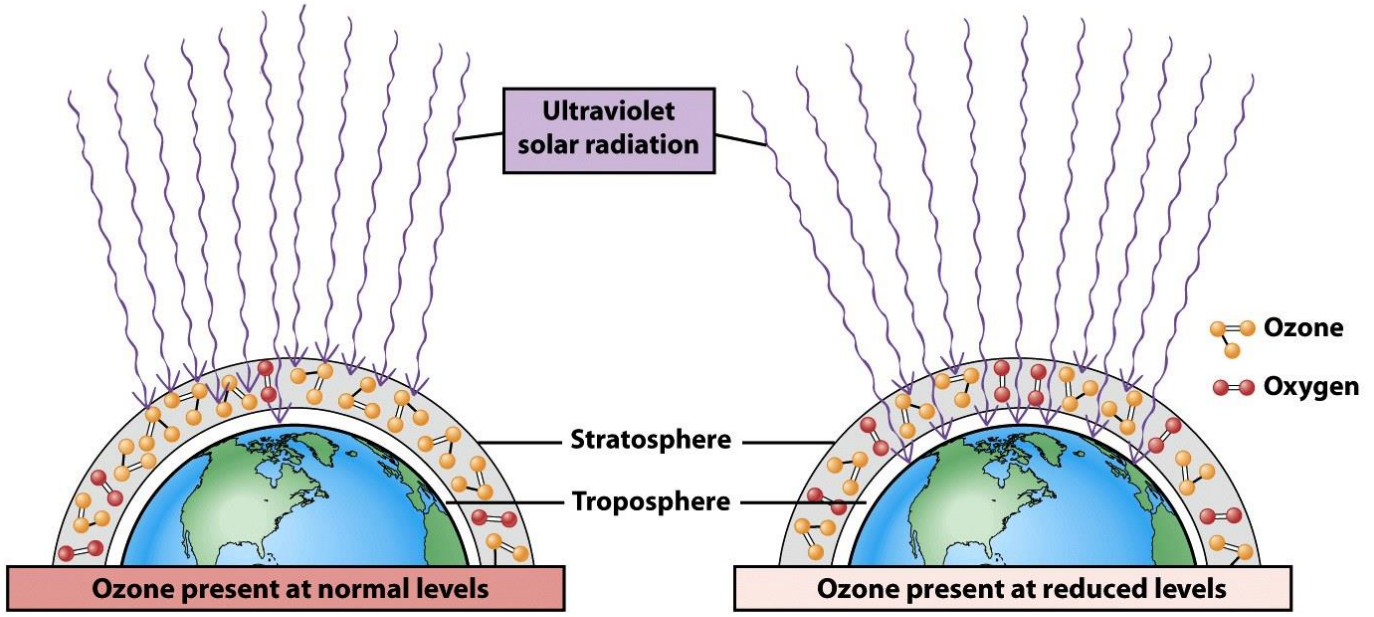


The consequences of global warming phenomenon are:

1. Extreme heat
2. Natural disasters
3. Poor air quality
4. Allergens and other nuisances
5. Spreading diseases

Ozone Depletion in Stratosphere

- Ozone Protects earth from UV radiation
  - Part of the electromagnetic spectrum with wavelengths just shorter than visible light



(a) Stratospheric ozone absorbs about 99% of incoming solar ultraviolet (UV) radiation, effectively shielding the surface.

(b) When stratospheric ozone is present at reduced levels, more high-energy UV radiation penetrates the atmosphere to the surface, where its presence harms organisms.

Effects of Ozone Depletion

- **Higher levels of UV-radiation hitting the earth**
  - **Eye cataracts**
  - **Skin cancer (right)**
  - **Weakened immunity**
- **May disrupt ecosystems.**
- **May damage crops and forests.**

To summarize the health effects of exposure to UVR as a result of Ozone depletion

- 1. **Skin cancer**: Exposure to ultraviolet rays poses an increased risk of developing several types of skin cancers, including malignant melanoma, basal and squamous cell carcinoma.
- 2. **Eye damage**: Direct exposure to UV radiations can result in photo-keratitis (snow blindness), and cataracts.
- 3. **Immune system damage**: Effects of UV rays include impairment of the immune system. Increased exposure to UV rays weakens the response of the immune system.
- 4. **Accelerated aging of skin**: Constant exposure to UV radiation can cause photo allergy, which results in the outbreak of rash in fair-skinned people.
- 5. **Other effects:** Ozone chemicals can cause difficulty in breathing, chest pain, throat irritation, and impede lung functioning.

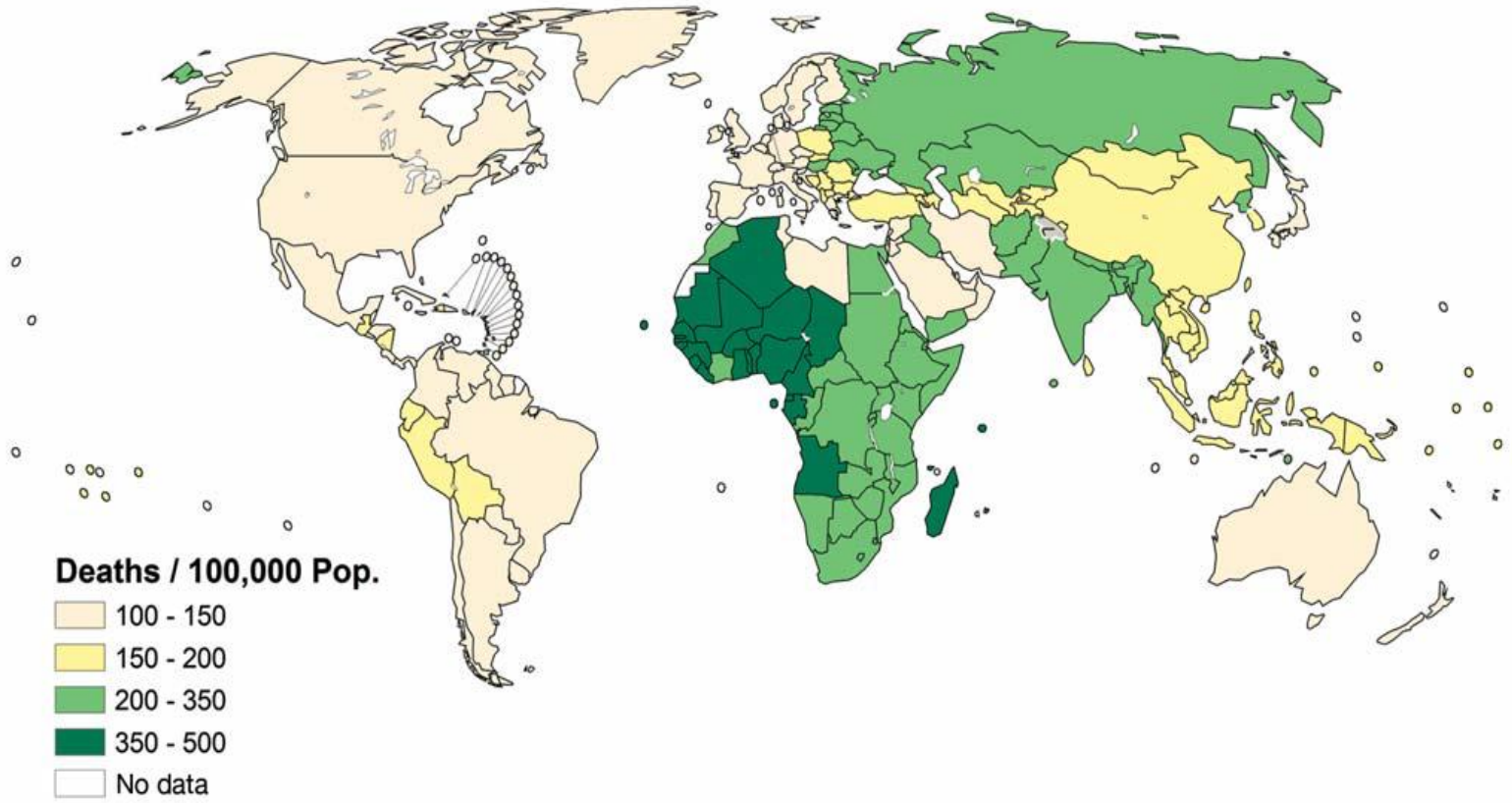
How Significant is the Impact of Environment on Health?

- **An estimated 23% of all deaths** (premature mortality) **can be attributed to environmental factors.**

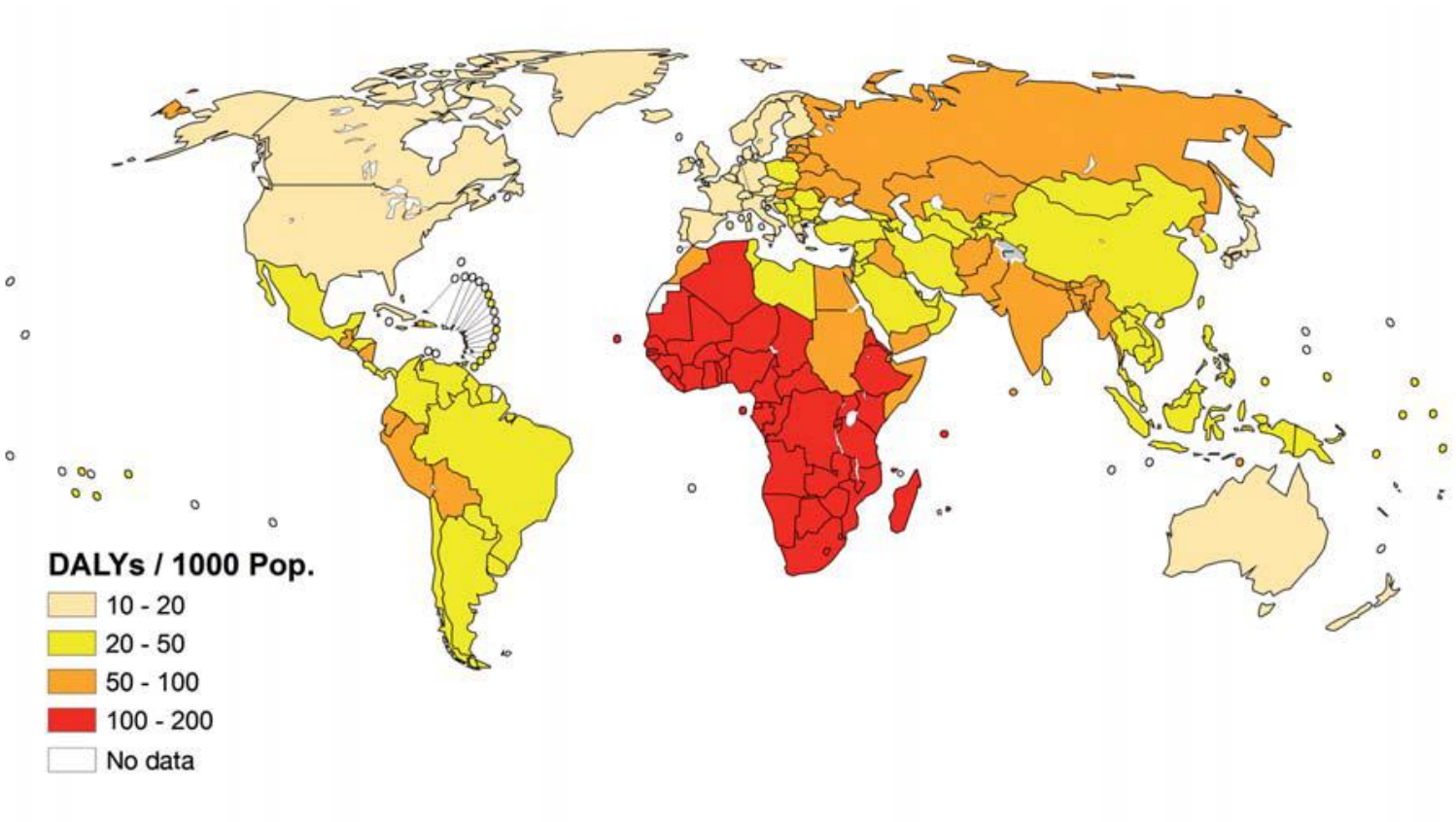
- ***Diseases*** with **the largest absolute burden attributable to modifiable environmental factors** included:

- **Diarrhea**
- **Lower respiratory infections**
- **'other' unintentional injuries**
- **Malaria.**

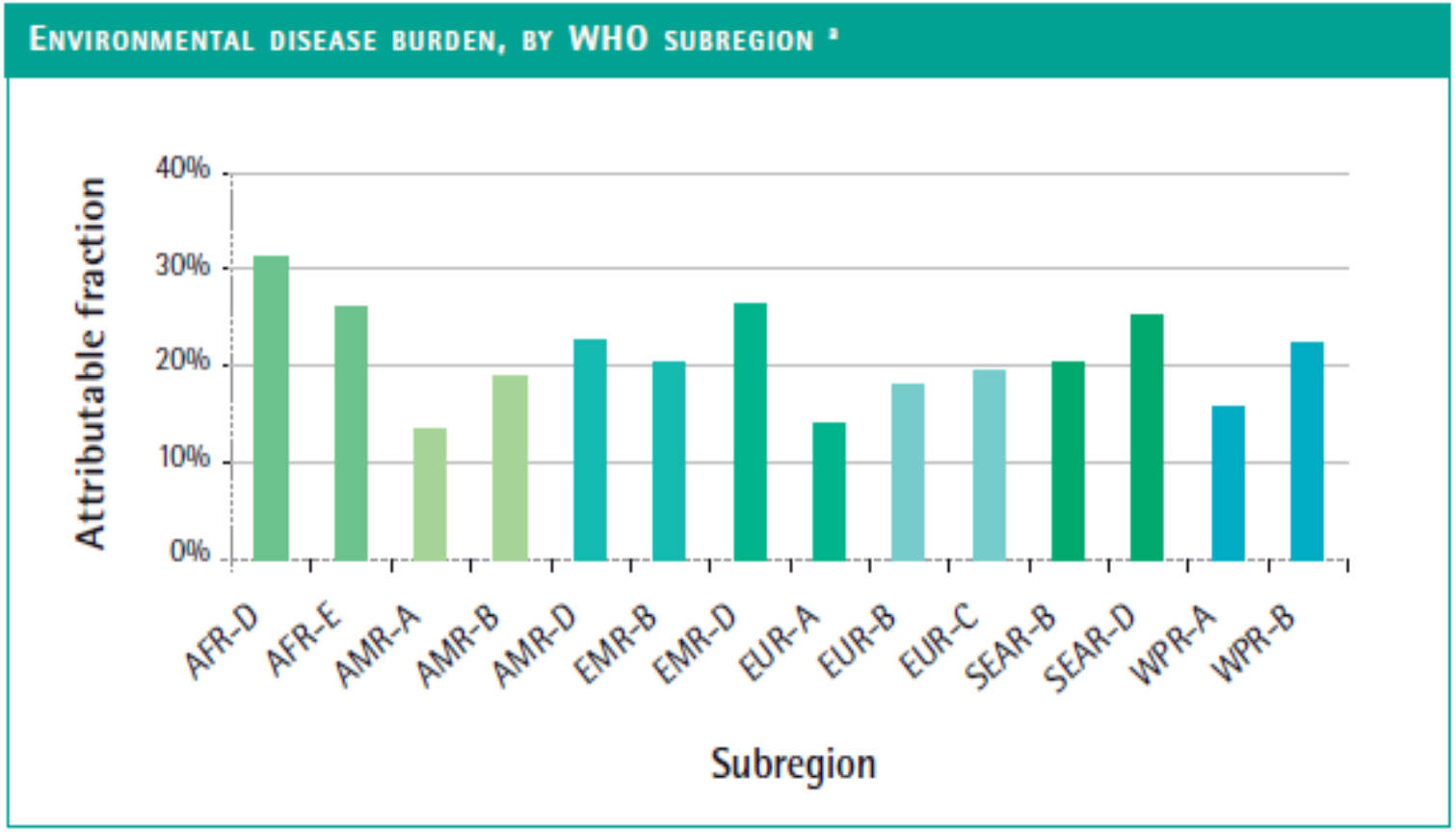
Environmental Disease Burden by WHO Subregion (2002)



Environmental Disease Burden in Dalys Per 1000 People, By WHO Subregion (2002)



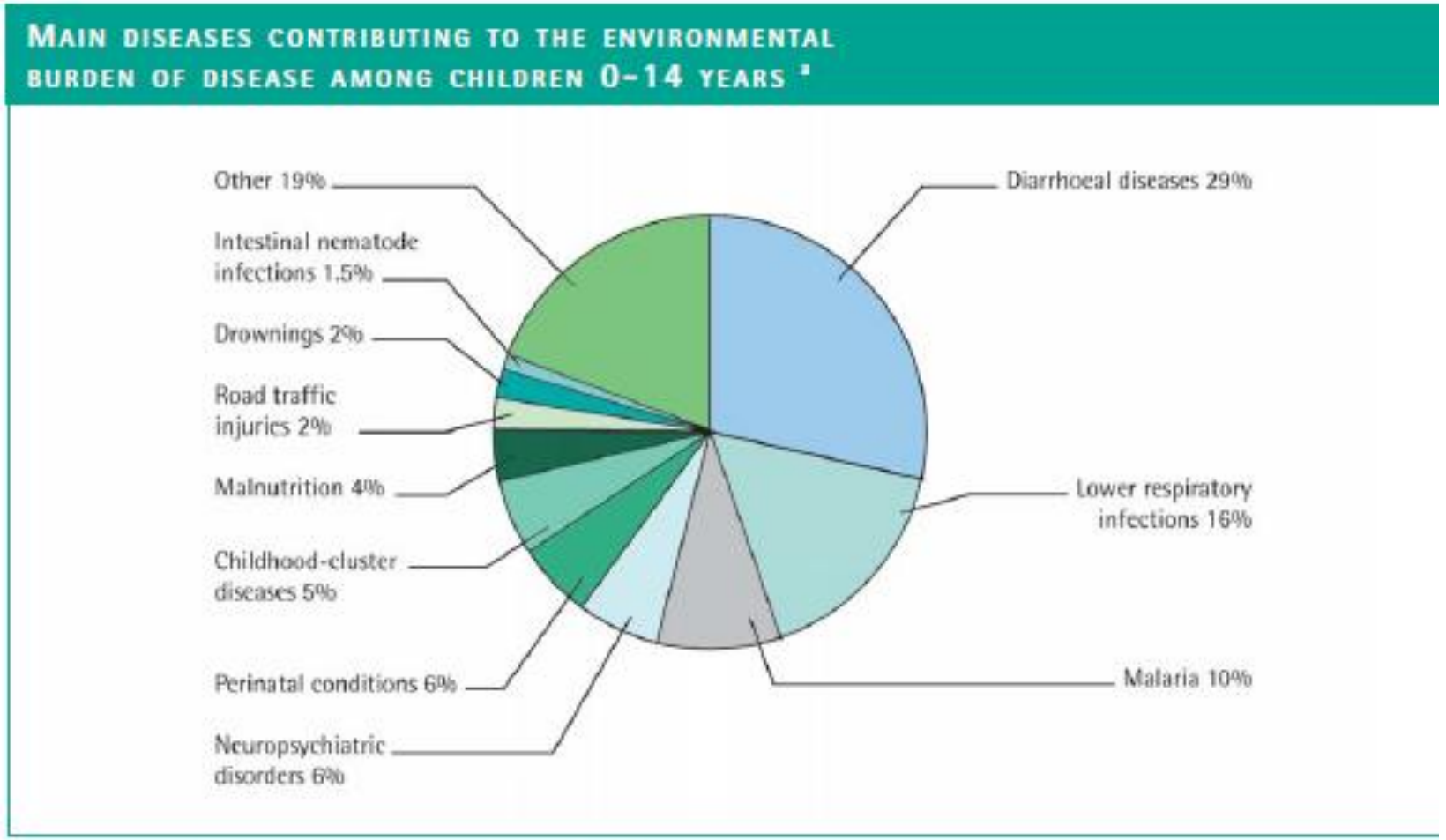
Environmental Disease Burden, by WHO Subregion



[a] The burden of disease is measured in DALYs. See Annex 1 for country groupings within WHO subregions.

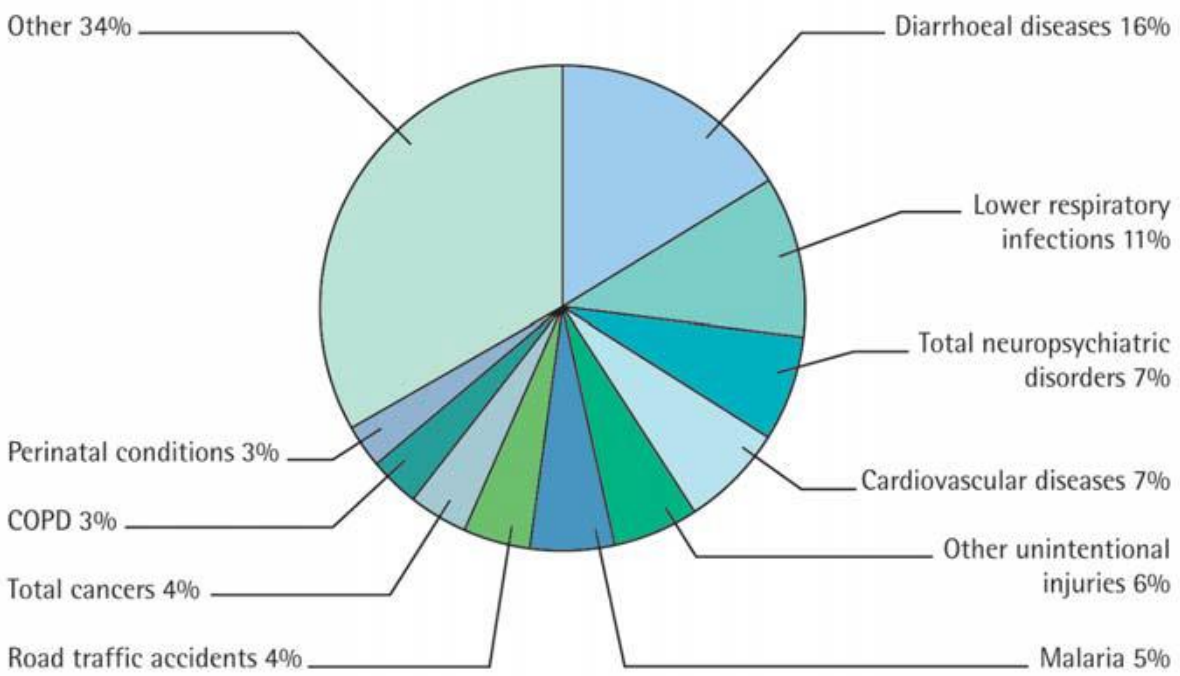
However, in developed countries, the per capita impact of cardiovascular diseases and cancers is higher.

Main Diseases Contributing to The Environmental Burden of Disease among Children 0-14 Years



[a] The environmental disease burden is measured in disability-adjusted life years, a weighted measure of death, illness and disability (DALYs).

Main Diseases Contributing to the Environmental Burden Of Disease, for the Total Population



- **Globally, about 1.5 million deaths per year from diarrhoeal diseases are attributable to environmental factors, essentially water, sanitation and hygiene.**

- **An estimated 42% of the global malaria burden, or half a million deaths annually, could be prevented by environmental management.**

Death rate of asthma in the USA:

- 15 deaths **daily**
- 5,637 per year
- 469 per month
- 108 per week

❑ This disease is caused by genetics, family history, and **our environment.**

❑ *Over half* of these fatalities **are children** under the age of 12

❑ A medical website says that "**Contact with some airborne allergens or exposure to some viral infections in infancy or in early childhood when the immune system is developing**"

http://www.nhlbi.nih.gov/health/dci/Diseases/Asthma/Asthma_Causes.html

Chronic Obstructive Pulmonary Disease

- **An estimated 42% of COPD is attributable to environmental risks.**

- **Occupational exposures to airborne particulates were responsible for 12% of this global COPD disease burden.**

- **Environmental factors contribute to 23% of all deaths worldwide and 36% of all deaths among children 0-14 years old.**