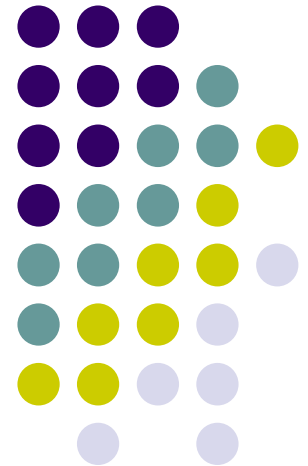
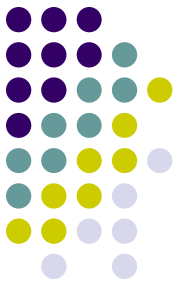


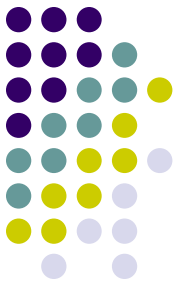
AIR POLLUTION



Air pollution



- Contamination of air due to the presence of substances called pollutants in the atmosphere
- Harmful to the health of humans and other living beings
- Damage to the climate or to materials
- Contamination by chemical, physical
- or biological agents
- Alters the natural features of the atmosphere



Different types of air pollutants

Gases :

- ammonia
- carbon monoxide
- sulfur dioxide
- nitrous oxides
- methane and chlorofluorocarbons

Particulates : organic and inorganic

Biological molecules



The Problem

- Air pollution can cause diseases, allergies, and even death to humans
- Harm to living organisms such as animals and crops
- May damage the natural environment (climate change, ozone depletion or habitat degradation)
- Built environment (for example, acid rain)
- Air pollution can be caused by both human activities and natural phenomena



The Problem

- Air quality is closely related to the Earth's climate and ecosystems globally.
- Many of the contributors of air pollution are also sources of greenhouse emission i.e., burning of fossil fuel



The Problem

- Air pollution is a significant risk factor for:
- Respiratory infections,
- Heart disease,
- COPD
- Stroke
- Lung cancer.



The Problem

Individual reactions depend on :

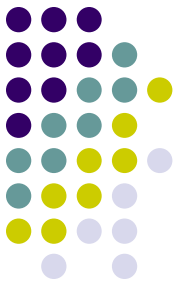
- The type of pollutant
- The degree of exposure
- The individual's health status
- Genetics



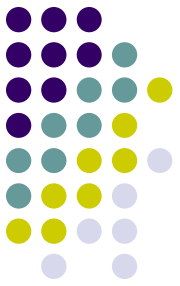
The Problem

- Outdoor air pollution attributable to fossil fuel use alone causes ~3.61 million deaths annually
- Anthropogenic ozone and $PM_{2.5}$ causes ~2.1 million

Air pollution



- Air pollution causes the deaths of around 7 million people worldwide each year
- A global mean loss of life expectancy (LLE) of 2.9 years
- the world's largest single environmental health risk



Air pollution

- The scope of the air pollution crisis is large:
- In 2018, WHO estimated that "9 out of 10 people breathe air containing high levels of pollutants"



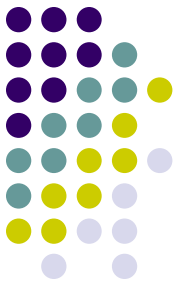
Costs

- Productivity losses and degraded quality of life caused by air pollution are estimated to cost the world economy \$5 trillion per year.



Air Pollution

- Sources of Air Pollution
 - Stationary Sources
 - Factories, power plants, smelters
 - Area Sources (smaller stationary sources)
 - Dry cleaners, degreasing operations
 - Mobile Sources
 - Cars, buses, planes, trucks, trains
 - Natural Sources
 - Windblown dust, volcanic eruptions



Air Pollution

- Principal Pollutants
 - **Particulate Matter**
 - **Sulfur Dioxide**
 - **Nitrogen Dioxide**
 - **Ozone**



Air Pollution

- Particulate Matter
 - Nature and Sources
 - Particulate matter (PM) is a general term used for a mixture of solid particles and liquid droplets found in the air.
 - Some can be seen in smoke or soot while others can only be viewed under an electron microscope..



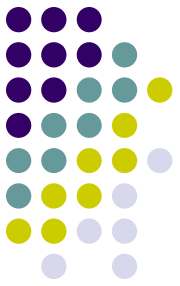
Air Pollution

- 1. Particulate Matter (PM – 10)
 - Nature and Sources
 - Coarse Particles (PM – 10)
 - are composed primarily of crustal (rock, soil), biologic (pollen, spores), windblown dust and industrial components;
 - they are formed primarily by mechanical processes that produce small particles from larger particles



Air Pollution

- Particulate Matter (PM – 2.5)
 - Nature and Sources
 - Fine Particles (PM – 2.5)
 - Result from fuel combustion from motor vehicles, power generation, industrial facilities, residential fireplaces and wood stoves.
 - (PM_{2.5}) are composed mainly of varying amounts of water and several major components (sulfates, acids, nitrates, elemental carbon, organic carbon, and trace metals) depending on their sources
 -



Air Pollution

- 1. Particulate Matter (PM – 0.1)
 - Nature and Sources
 - **Ultrafine particles** are typically generated from combustion processes

■



Air Pollution

- Particulate Matter (PM – 10)
- **Larger(coarse) particles** are filtered in the nose and throat.
- particles less than 10 μm in diameter (PM10) can be deposited in the respiratory tract.
- **Fine particles less than 2.5 μm** in diameter (PM2.5), penetrate to the alveoli.
- **ultrafine particles (PM0.1)** can pass through the alveoli and spread to other organs.



Particulate Matter (PM – 10)

- Size also determines how far particles travel and persist in the environment.
- **Coarse particles (>2.5 to 10 μm)** travel for rather short distances and have atmospheric half-lives of minutes to hours.
- **Fine particles** can travel for long distances and remain in the atmosphere for days to weeks
- **Ultrafine particles** are typically generated from combustion processes and, due to their high reactivity, have short atmospheric half-lives.



● Particulate Matter

- Health and Environmental Effects
 - Exposure to coarse particles is primarily associated with the aggravation of respiratory conditions such as **asthma**.
 - Fine particles are more closely associated with such health effects as **increased hospital admissions and emergency room visits for heart and lung disease**, increased respiratory symptoms and disease, **decreased lung function and premature death**.
 - Elderly with cardiopulmonary disease and children are at the greatest risk.
 - PM is the major cause of reduced visibility



Effects of PM on allergic respiratory diseases

- PM triggers a series of biological processes:
- Innate immunity inflammation,
- Oxidative stress,
- Apoptosis
- Autophagy
- An imbalance of T helper cells
- All of which are associated with pathological changes in allergic respiratory disease



Air Pollution

- Sulfur Dioxide (SO_2)
 - Nature and Sources
 - Gases formed when fuel containing sulfur (mainly coal and oil) is burned and during metal smelting and other industrial processes.
 - Health and Environmental Effects
 - High concentrations can result in temporary breathing impairment for asthmatic children and adults who are active outdoors.
 - Short term exposures to elevated levels may result in reduced lung function accompanied by wheezing, chest tightness and shortness of breath

2. Sulfur Dioxide (SO₂)



- Health and Environmental Effects
 - Longer term exposure of high levels of SO₂, in conjunction with high levels of PM, include respiratory illness, alternations in the lungs' defenses and aggravation of existing cardiovascular disease.
 - Together SO₂ and NO_x are the major precursors to acidic deposition (acid rain)
 - Sulfur dioxide is also a major precursor to PM 2.5



Sulfur dioxide (SO₂)

- A clear, highly water-soluble gas
- Effectively absorbed by the mucosal surfaces of the upper airways
- Only a small proportion of inhaled SO₂ reaches the distal regions of the lungs
- Susceptible persons, such as those with **asthma**, may still suffer adverse respiratory health effects.



Sulfur dioxide (SO₂)

- The mixture of sulfur oxides and small particles may be blown great distances from its source, undergoing the continuous transformation from a gas to a particle phase and ultimately becoming **acid rain**.

Air Pollution



- Nitrogen Dioxide (NO₂)
 - Nature and Sources
 - A reddish brown, highly reactive gas that is formed in the ambient air through the oxidation of nitric oxide (NO).
 - Plays a major role in the formation of ozone.
 - Major source of man-made are emissions are high-temperature combustion processes – automobiles and power plants.

Air Pollution



- Nitrogen Dioxide (NO₂)
 - Health and Environmental Effects
 - **Short term exposure** (less than 3 hrs.)
 - Changes in airway responsiveness and lung function in individuals with pre-existing respiratory illnesses and increases in respiratory illnesses in children.
 - **Long term exposure** may lead to increased susceptibility to respiratory infection and may cause alternations in the lung.
 - Atmospheric transformation of nitrogen oxides (NO_x) can lead to the formation of ozone and nitrogen-bearing particles.

Air Pollution



- Ground-Level Ozone (O_3)
 - Nature and Sources
 - Primary constituent of smog
 - Is not emitted directly into the air but rather is formed by the reaction of VOCs (volatile organic compounds) and NO_2 in the presence of heat and sunlight.
 - Forms readily in the atmosphere, usually during hot summer weather.



Air Pollution

- Ground Level Ozone (O_3)
- Health and Environmental Effects
 - Short term (1 – 3 hours) Exposure
 - Repeated exposures make people more susceptible to **respiratory infection** and aggravate pre-existing respiratory diseases.
 - Decreases lung function and increases respiratory symptoms such as chest pain and cough.
 - Long-term (6 – 8 hours) Exposure
 - Present the possibility of irreversible changes in the lungs which can lead to premature aging of the lungs and/or chronic respiratory illnesses.



Air Pollution

- Additional Pollution Concerns
 - Acidic Deposition or Acid Rain
 - Nature and Source
 - Occurs when sulfur dioxide and oxides of nitrogen in the atmosphere react with water, oxygen and oxidants to form acidic compounds.
 - Components can be dry (gas or particles) or wet in the form of rain, snow or fog.

Air Pollution



- Additional Pollution Concerns

- Acidic Deposition or Acid Rain

- Health and Environmental Effects

- Before falling to earth, SO_2 and NO_x gases and related particulate matter contribute to poor visibility.
 - Acid rain raises the acid levels in soils and water bodies (making the water unsuitable for some fish and other wildlife) and damages trees at some elevations.
 - Also speeds the decay of buildings, statues and sculptures

Air Pollution



- Carbon Monoxide (CO)
 - Colorless, odorless and at high levels a poisonous gas.
 - Formed when carbon fuel is not burned completely.
 - Motor vehicle exhaust accounts for ~60% of all CO emissions nationwide. As much as 95% in cities.

Air Pollution



- Carbon Monoxide (CO)
 - Health Effects
 - Reduces oxygen perfusion to organs and tissues
 - Low levels
 - Most serious for people suffering from cardiovascular disease
 - High levels
 - Poisonous
 - Visual impairment, reduced work capacity, reduced manual dexterity, poor learning ability and difficulty in performing complex tasks

Air Pollution



- Lead (Pb)
 - Nature and Sources
 - Past – automotive sources were major contributor
 - Today – highest concentrations are found in the vicinity of nonferrous and ferrous smelters and battery manufacturers.
 - Health and Environmental Effects
 - Occurs mainly through inhalation of air and ingestion of Pb in food, water, soil or dust.

Air Pollution



- Lead (Pb)
 - Health and Environmental Effects
 - Can adversely affect the kidneys, liver, nervous system, may cause neurological impairments, such as seizures, mental retardation and behavioral disorders
 - Low doses associated with damage to the nervous systems of fetuses and young children, resulting in learning deficits and lowered IQ.
 - May be a factor in high blood pressure and subsequent heart disease

OUTDOOR AIR POLLUTION: Carcinogens



- Polycyclic aromatic hydrocarbons (PAHs)
- N-nitroso compounds
- Asbestos.
- Their concentrations in ambient air are quite low.
- Several large population-based epidemiologic studies have also linked lung cancer to long-term exposure to PM and traffic-related air pollution



Air Pollution

- Visibility
 - Visibility impairment occurs as a result of the scattering and adsorption of light by air pollution, including particles and gases.
 - Nature and Sources of the Problem
 - Primary emissions (particles) such as dust from roads or elemental carbon (soot) from wood combustion.
 - Secondary emissions (particles) are formed in the atmosphere from primary gaseous emissions
 - Sulfate from sulfur dioxide
 - Nitrates from nitrogen oxides
 - Humidity can significantly increase the effect of pollution on visibility



Air Pollution

- Toxic Air Pollutants
 - Nature and Sources
 - Examples include:
 - benzene (found in gasoline),
 - perchloethylene (emitted from dry cleaning facilities), methylene chloride (solvent and plant stripper)
 - Also includes natural sources such as volcanic eruptions and forest fires.
 - Most originate from human-made mobile sources (cars, trucks, etc.) and stationary sources (factories, refineries, power plants)

Air Pollution



- Toxic Air Pollutants
 - Health and Environmental Effects
 - Exposure at sufficient concentrations and duration increases the risk of
 - cancer
 - damage to the immune system
 - neurological damage
 - reduced fertility
 - developmental problems
 - respiratory problems

Air Pollution

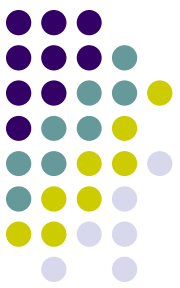


- Toxic Air Pollutants
 - Health and Environmental Effects
 - Persistent toxic air pollutants can accumulate in plants and animals magnifying up the food chain
 - A particular concern in aquatic ecosystems where greater magnification can occur
 - In animals
 - toxic pollutants disrupt the endocrine system
 - decreased fertility
 - decreased hatching success
 - damaged reproductive organs
 - Altered immune systems

INDOOR AIR POLLUTION



- Sources of Indoor Pollution
- Indoor Combustion: Major Source
- Secondhand Smoke and Obstructive Lung Disease
- Gas Stove Exposure: Cause of Asthma Exacerbation?
- Wood Smoke Exposure: Respiratory Health Effects
- Respiratory Effects of Kerosene Heater Use



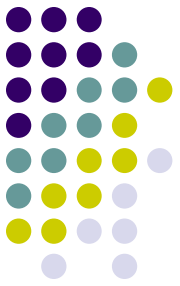
INDOOR AIR POLLUTION

Category of Pollutant	Indoor Pollution Source
Combustion (e.g., NO ₂ , CO, PM _{2.5} , PAHs)	Secondhand smoke Gas stoves, ovens, heaters, and fireplaces Wood smoke (stoves, fireplaces) Kerosene heaters Candles and incense
Building materials (e.g., formaldehyde, volatile organic compounds)	Plywood Particle board Carpeting Paints
Cleaning materials (e.g., ammonia gas, chlorine gas, chloramine)	Bleach, ammonia, detergents

SECONDHAND SMOKE



- lung cancer, coronary heart disease, and decreased life span
- SHS is a complex mixture containing thousands of gas-phase and particulate substances.
- In homes where smoking is allowed, PM2.5 levels are found up to 10 times higher than in nonsmoking homes
- new-onset asthma among children and adult-onset asthma
- Asthma exacerbation
- Impaired lung function among nonasthmatic individuals
- COPD



Air Pollution

- Conclusion
 - Principal Pollutants
 - 1. Particulate matter (PM-10) and PM-2.5)
 - 2. Sulfur Dioxide and Sulfur oxides Lead
 - 3. Nitrogen dioxide and Nitrogen oxides
 - 4. Ozone



Air Pollution

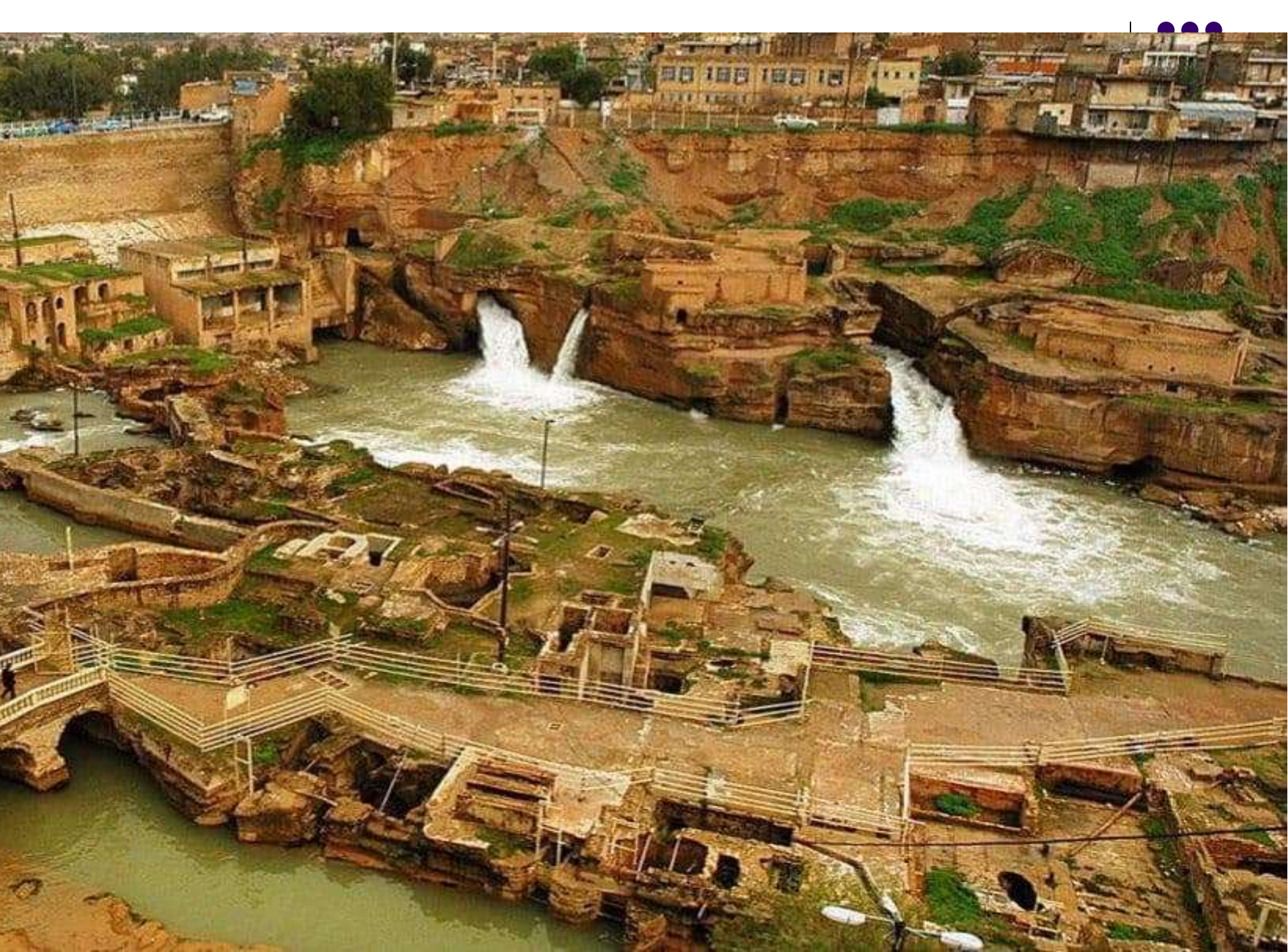
- Conclusion
 - Other Pollutants
 - Chlorofluorocarbons
 - Methane
 - Carbon dioxide
 - Hydrofluocarbons
 - Nitrous oxide
 - Perfluorinated carbons
 - Volatile organic compounds

Pollutant-Specific Sensitive Groups



When this pollutant has an AQI above 100...	Report these Sensitive Groups
Ozone	People with lung disease, children, older adults, people who are active outdoors (including outdoor workers), people with certain genetic variants, and people with diets limited in certain nutrients are the groups most at risk
PM2.5	People with heart or lung disease, older adults, children, and people of lower socioeconomic status are the groups most at risk
PM10	People with heart or lung disease, older adults, children, and people of lower socioeconomic status are the groups most at risk
CO	People with heart disease is the group most at risk
NO2	People with asthma, children, and older adults are the groups most at risk
SO2	People with asthma, children, and older adults are the groups most at risk

Notes: Statements may be combined so that each group is mentioned only once.





THUNDERSTORM ASTHMA

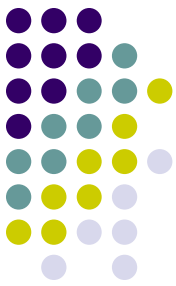


➤ در روز دوشنبه 21 نوامبر 2016، در ملبورن استرالیا، بیمارستان ها آنچنان مملو از بیماران اورژانسی با حملات شدید آسم 8500 (>) بیمار در دوشنبه شب و سه شنبه 9 نفر از آنها فوت کردند (بودند که آتش نشانان و پلیس برای کمک به پزشکان و متخصصان، پاسخگوی هزاران تماس شهروندان با مشکلات تنفسی بودند

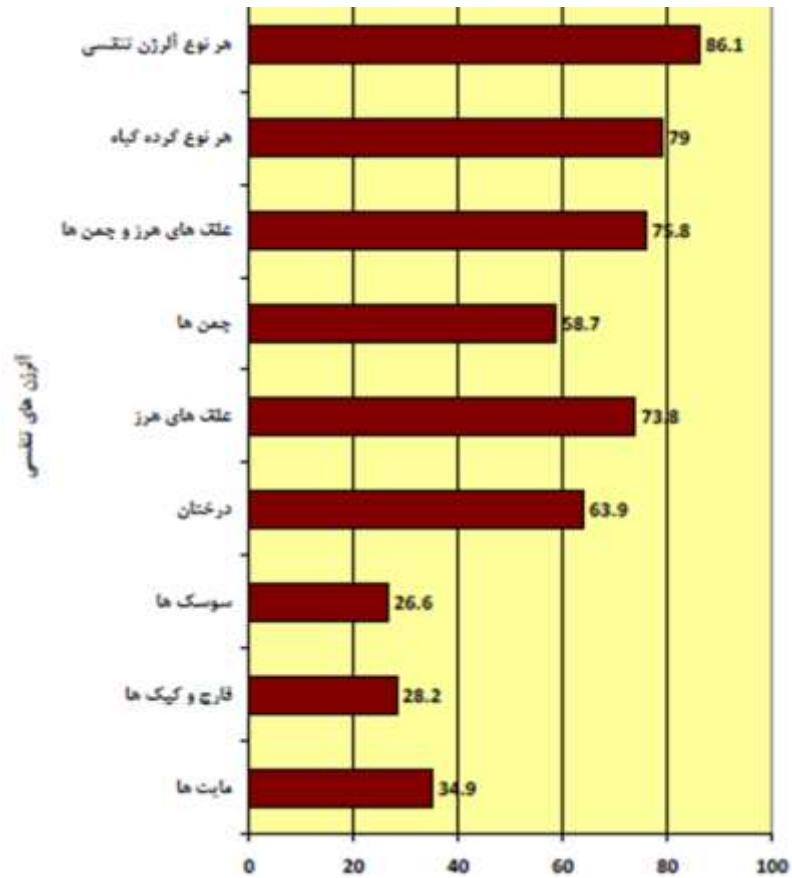


Ahvaz thunderstorm asthma

- افزایش مراجعات اورژانس از حدود ساعت ۲۲:۰۰ جمعه، دهم آبان ماه ۱۳۹۲
- علایم بیماران: تنگی نفس ، سرفه، خس خس سینه
- تعداد مراجعات در شهر اهواز با يك يا چند مورد از علائم فوق در همان شب و ساعات اولیه روز بعد(نیمه شب) : ۲۶۰۰ نفر
- در مجموع بالغ بر ۲۰ هزار مورد مراجعه ناشی از ناراحتی های تنفسی مشابه (در فاصله زمانی دهم تا سی ام آبان ماه ۹۲) در اورژانس های بیمارستانی اهواز انجام شده است.
- آمار تقریبی ۲۰ هزار نفری ذکر شده مربوط به بار مراجعه بیماران به اورژانس ها بوده.
- درموردی برخی از بیماران (حتی تا ۵ نوبت) مراجعه نموده اند .
- این آمار شامل موارد مراجعه به مطب ها و کلینیک های سرپایی نمی شد.



(CONT)





Research Article

An Overview of Thunderstorm-Associated Asthma Outbreak in Southwest of Iran

**Arash Forouzan,¹ Kambiz Masoumi,¹ Maryam Haddadzadeh Shoushtari,²
Esmaeil Idani,² Fatemeh Tirandaz,¹ Maryam Feli,¹
Mohammad Ali Assarehzadegan,³ and Ali Asgari Darian¹**

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- 2000 patients
- majority of subjects was aged 20–40 years (60.5%) and had no history of asthma in most cases (60.0%)
-



Pulmonary Function Tests in Thunderstormassociated Respiratory Symptoms: A cross-sectional study

- Out of 584 subjects, 300 and 284 participants were in thunderstorm-associated and non-thunderstorm-associated groups, respectively
- After the final analysis, 87 (30.6%) and 89 (33.3%) of the thunderstorm-associated subjects and nonthunderstorm-associated group, respectively, had pieces of evidence of airflow limitation ($P=0.27$)
- Among the patients with normal spirometry, 161 (81.72%) of the thunderstorm-associated patients and 100 (56.17%) patients of the non-thunderstormassociated symptoms group had a positive methacholine challenge test result ($P<0.001$).







Pollutant-Specific Sub-indices and Cautionary Statements for Guidance on the Air Quality Index (AQI)



AQI Categories (Index Values)	Ozone (ppm)		Particulate Matter (µg/m ³)		Carbon Monoxide (ppm) [8-hour]	Sulfur Dioxide (ppb) [1-hour]	Nitrogen Dioxide (ppb) [1-hour]
	[8-hour]	[1-hour]	PM _{2.5} [24-hour]	PM ₁₀ [24-hour]			
Good (Up to 50)	0 - 0.054 None		0 – 12.0 None	0 - 54 None	0 – 4.4 None	0 - 35 None	0 - 53 None
Moderate (51 - 100)	0.055 - 0.070		12.1 – 35.4	55 – 154	4.5 – 9.4 None	36 - 75 None	54 - 100 Unusually sensitive individuals should consider limiting prolonged exertion especially near busy roads.
	Unusually sensitive people should consider reducing prolonged or heavy outdoor exertion.		Unusually sensitive people should consider reducing prolonged or heavy exertion.				
Unhealthy for Sensitive Groups (101 - 150)	0.071 - 0.085	0.125 - 0.164	35.5 – 55.4	155 – 254	9.5 – 12.4 People with heart disease, such as angina, should limit heavy exertion and avoid sources of CO, such as heavy traffic.	76 - 185 People with asthma should consider limiting outdoor exertion.	101 - 360 People with asthma, children and older adults should limit prolonged exertion especially near busy roads.
	People with lung disease (such as asthma), children, older adults, people who are active outdoors (including outdoor workers), people with certain genetic variants, and people with diets limited in certain nutrients should reduce prolonged or heavy outdoor exertion.		People with heart or lung disease, older adults, children, and people of lower socioeconomic status should reduce prolonged or heavy exertion.				



Unhealthy (151 - 200)	0.086 - 0.105	0.165 - 0.204	55.5 - 150.4	255 - 354	12.5 - 15.4	186 - 304	361 - 649
	People with lung disease (such as asthma), children, older adults, people who are active outdoors (including outdoor workers), people with certain genetic variants, and people with diets limited in certain nutrients should avoid prolonged or heavy outdoor exertion; everyone else should reduce prolonged or heavy outdoor exertion.		People with heart or lung disease, older adults, children, and people of lower socioeconomic status should avoid prolonged or heavy exertion; everyone else should reduce prolonged or heavy exertion.		People with heart disease, such as angina, should limit moderate exertion and avoid sources of CO, such as heavy traffic.	Children, people with asthma, or other lung diseases, should limit outdoor exertion.	People with asthma, children and older adults should avoid prolonged exertion near roadways; everyone else should limit prolonged exertion especially near busy roads.
Very Unhealthy (201 - 300)	0.106 - 0.200	0.205 - 0.404	150.5 - 250.4	355 - 424	15.5 - 30.4	305 - 604 [24-hour]	650 - 1249
	People with lung disease (such as asthma), children, older adults, people who are active outdoors (including outdoor workers), people with certain genetic variants, and people with diets limited in certain nutrients should avoid all outdoor exertion; everyone else should reduce outdoor exertion.		People with heart or lung disease, older adults, children, and people of lower socioeconomic status should avoid all physical activity outdoors. Everyone else should avoid prolonged or heavy exertion.		People with heart disease, such as angina, should avoid exertion and sources of CO, such as heavy traffic.	Children, people with asthma, or other lung diseases should avoid outdoor exertion; everyone else should reduce outdoor exertion.	People with asthma, children and older adults should avoid all outdoor exertion; everyone else should avoid prolonged exertion especially near busy roads.
Hazardous (301 - 500)	-	0.405 - 0.604	250.5 - 500.4	425 - 604	30.5 - 50.4	605 - 1004 [24-hour]	1250 - 2049
	Everyone should avoid all outdoor exertion.		Everyone should avoid all physical activity outdoors; people with heart or lung disease, older adults, children, and people of lower socioeconomic status should remain indoors and keep activity levels low.		People with heart disease, such as angina, should avoid exertion and sources of CO, such as heavy traffic; everyone else should limit heavy exertion.	Children, people with asthma, or other lung diseases, should remain indoors; everyone else should avoid outdoor exertion.	People with asthma, children and older adults should remain indoors; everyone else should avoid all outdoor exertion.