Chapter 5 - Health Effects

Questions & Answers

1. What is the public health significance of air pollution episodes?

   **Air pollution episodes are periods of elevated pollutant levels that pose immediate health risks to exposed sensitive individuals.**

2. Describe differences between acute and chronic health effects.

   **Acute health effects result from short-term, high-level exposures. Symptoms are usually experienced within hours. Chronic effects result from low-level, long-term exposures, with disease syndromes developing several decades later.**

3. How do environmental/public health authorities establish a cause and effect relationship between observed symptoms/disease in a community and exposure to atmospheric pollutants?

   **Such relationships are determined from evaluations of epidemiological and toxicological studies. The stronger the evidence, the more likely a cause-effect relationship exists.**

4. Describe additive, synergistic, and antagonistic interactions associated with human exposures to pollutants.

   **Additive effects result when exposure to two or more pollutants having a similar effect occurs, with the total response the sum of individual effects.**
   **Synergistic effects result when exposure to two pollutants results in a response that is much greater than the sum of individual effects.**
   **Antagonistic effects result when exposure to two or more pollutants occurs, with the total response less than the sum of individual effects.**

5. The human respiratory system has defense mechanisms that protect it from airborne particles. Describe each of these mechanisms and how they function.

   **Nasal hairs prevent the passage of large particle into the respiratory system. Smaller particles are removed in the nasal turbinates and cleared from respiratory airways by the cilia-mucus escalator. Small particles deposited in air sacs are removed by macrophages and the cilia-mucus escalator.**

6. Asthma is a very common and severe respiratory disease. How is asthma affected by exposure to ambient pollutants?

   **Exposure to air pollutants such as SO₂, O₃, and particles can result in asthmatic attacks.**
7. What, if any, is the relationship between exposure to atmospheric pollution and infectious respiratory disease?

Exposure to certain air pollutants can increase the severity of infectious respiratory disease or increase the probability that infection may take place.

8. Describe evidence to support a causal relationship between exposure to atmospheric pollutants and the development of lung cancer in humans.

Most evidence is indirect. It includes higher rates of cancer in urban non-smokers, higher rates of cancer in migrants from high-pollution areas, etc. Recent epidemiological evidence shows a direct link with exposures to fine particles.

9. Describe adverse health effects associated with exposure to CO.

Carbon monoxide binds with human hemoglobin, rendering it unable to bind with O₂. This may result in central nervous system effects. There is also evidence to indicate that CO exposures can contribute to heart disease and elevated risk of heart attack and premature mortality.

10. Describe health effects associated with exposures to SO₂ and acid sulfates.

Both SO₂ and acid sulfates are irritants of the upper airways. Exposure to SO₂ may cause asthmatic attacks and contribute to chronic bronchitis. Though acid sulfates are strong irritants, consistent causal disease relationships have not been demonstrated.

11. Describe relationships reported for particle size and human health effects.

The smaller the particle size, the more likely it will be deposited in lung tissue where adverse effects may occur. Ultrafine particles are particularly harmful to lung tissue.

12. Distinguish between inhalable, respirable, and thoracic particulate matter.

Inhalable particulate matter includes particles that enter the upper airways. Thoracic particles enter the airways and gas exchange regions of the lungs; respirable particles are a subset of thoracic particles that have a high probability of being deposited in lung tissue.

13. What is chronic bronchitis? What causes and/or exacerbates it?

Chronic bronchitis is a progressive disease of the respiratory airways caused by exposure to harmful substances in tobacco smoke and ambient pollution.
The lining of the airways is subject to inflammation, excessive mucus production, and decreased ciliary activity.

14. Exposure to elevated levels of fine particles has been observed to be statistically associated with premature mortality. What biological mechanisms are likely responsible?

   Inflammatory response caused by exposure to ultrafine particles may produce pro-coagulant factors locally or by stimulating the liver to do so. These factors may contribute to heart failure.

15. What are the health concerns associated with regulation of emissions of non-methane hydrocarbons under air quality standard provisions of clean air legislation?

   Non-methane hydrocarbons are not considered to pose health risks directly. They are controlled to reduce O₃ production in the atmosphere.

16. What are the primary health concerns associated with exposures to hazardous or “toxic” air pollutants?

   A very large percentage of regulated “hazardous” or “toxic” pollutants are known or suspected human carcinogens.

17. Describe health concerns associated with exposures to ambient O₃ levels.

   Long-term exposures to O₃ may decrease lung elasticity. It appears to cause asthmatic attacks, interfere with the body’s ability to defend itself from infection, and increase the risk of premature mortality.

18. Describe how lead exposures have changed over the past three decades in North America and the health benefits of such changes.

   Lead exposures, and consequently blood Pb levels, have dramatically declined (from ~14 μg/dl to 2.5 μg/dl). The apparent threshold for Pb health effects, e.g., hypertension, is ≥7 μg/dl and the concern level in children is 10 μg/dl.

19. Asbestos is regulated as a hazardous air pollutant. Why?

   It causes human cancer and there is no known safe level of exposure. Due to the latter, it could not be regulated under an air quality standards approach.

20. Compare health risk associated with exposures to ambient air pollution and tobacco smoking.
The risk of disease from exposure to ambient air pollutants compared to tobacco smoking is small from a public health standpoint. The former, however, is an involuntary risk.

21. What are the differences between risk assessment and risk management?

Risk assessment attempts to identify and quantify risks associated with pollutant exposures. Risk management describes efforts to reduce or manage such risks using regulatory and/or non-regulatory approaches.

22. Describe how exposure/disease risks are evaluated and quantified.

Such risks are evaluated from a review of dose-response, exposure assessment, and risk characterization studies. They may be quantified by means of model calculations.

23. Describe the public health/regulatory significance of voluntary and involuntary risk.

Involuntary risks, e.g., exposure to ambient pollutants, are more likely to be regulated than voluntary risks (e.g., smoking)

24. What is a comparative risk assessment?

Comparative risk assessment attempts to compare risks from pollutant exposures to other life risks such as driving a motor vehicle, etc.