

THE EFFECT OF AIR POLLUTION ON HUMAN HEALTH

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Abstract

The Air pollution is a major environmental problem that affects people's health all over the world. Breathing polluted air that contains harmful substances like particulate matter (PM_{2.5} and PM₁₀), nitrogen oxides, sulfur dioxide, ozone, carbon monoxide, and heavy metals can cause many short-term and long-term health problems. This paper explains the common air pollutants, where they come from, and how they affect the lungs, heart, brain, and overall human development. The review shows the need for better safety measures, stricter laws, and public health efforts to reduce pollution and protect people from its harmful effects.

1. Introduction

The Air pollution means harmful chemicals or particles present in the air. Due to fast industrial growth, more vehicles, and burning of fossil fuels, the air quality around the world is getting worse. Every year, millions of people die early because of polluted air.

This paper explains how air pollution affects human health, the biological processes involved, and which groups of people are most at risk.

2. Types of Air Pollutants

2.1 Particulate Matter (PM_{2.5} and PM₁₀)

The Very tiny particles; PM_{2.5} is especially dangerous because it can go deep into the lungs and even mix with blood.

2.2 Nitrogen Oxides (NO_x)

Mostly released from vehicles and industries; causes breathing problems.

2.3 Sulfur Dioxide (SO₂)

Comes from burning coal and industrial activities; causes asthma symptoms and breathing issues.

2.4 Ozone (O₃)

Found in smog; forms when chemicals react in sunlight. Causes coughing, chest pain, and lung irritation.

2.5 Carbon Monoxide (CO)

Released from vehicles and incomplete burning; reduces oxygen in the blood, causing dizziness and, in high amounts, death.

2.6 Heavy Metals (Lead, Mercury)

Released from industries and waste; affect the brain and development in children.

3. Sources of Air Pollution

- Vehicles
- Industries
- Burning coal, petrol, diesel
- Crop burning
- Construction dust
- Burning garbage
- Natural events like wildfires and dust storms

4. Effects of Air Pollution on Human Health

4.1 Effects on the Respiratory System

Polluted air affects the lungs and airways, causing:

- Asthma
- Chronic bronchitis
- COPD
- Lung infections
- Reduced lung function
- Lung cancer

Children and older adults are more affected.

4.2 Effects on the Heart (Cardiovascular System)

Very small particles enter the blood and cause:

- High blood pressure
- Hardening of arteries
- Stroke
- Irregular heartbeat
- Heart attack

Long-term exposure increases the risk of heart-related deaths.

4.3 Effects on the Brain (Neurological Effects)

Research shows air pollution affects brain function:

- Memory issues
- Declining thinking ability
- Risk of Alzheimer's and dementia
- Behavioral problems in children
- Brain inflammation

PM_{2.5} and lead are especially harmful.

4.4 Reproductive and Developmental Effects

Pollution affects pregnancy and child development:

- Premature birth
- Low birth weight
- Poor lung development
- Birth defects
- Reduced sperm quality in men

4.5 Vulnerable Groups

People who are more affected:

- Children
- Elderly
- Pregnant women

- People with asthma/COPD
- Outdoor workers

5. Mechanisms of Toxicity

Pollution harms the body through:

- Oxidative stress (damaging cells)
- Inflammation
- Circulation of toxic particles in blood
- DNA damage
- Weakening of the immune system

These processes lead to chronic diseases.

6. Preventive Measures

6.1 Individual Measures

- Wear N95 masks
- Avoid exercising near busy roads
- Use air purifiers
- Use public transport and electric vehicles
- Check Air Quality Index (AQI) regularly

6.2 Government and Community Measures

- Stricter emission laws
- Promote renewable energy
- Reduce industrial pollution
- Ban waste burning
- Plant more trees
- Raise public awareness

Conclusion

Air pollution is a major threat to human health and contributes to many serious diseases. Reducing pollution requires efforts from governments, industries, healthcare workers, and ordinary people. Cleaner air is necessary for good health and sustainable development.

References

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8. Xu et al. (2024) compute national, regional, socioeconomic disparities in mortality due to ambient air pollution. Highlights that low- and middle-income countries carry a disproportionate burden.
9. Mao et al. conducted a systematic analysis using GBD 2021 data to estimate CVD burden attributable to air pollution, and projected future trends (till ~2050) via ARIMA modeling.
10. Shows how aging, population growth, and epidemiological shifts contribute to DALY changes.
11. Oh et al. (2025) performed a meta-analysis of cohort studies linking long-term exposure to PM_{2.5} and PM₁₀ with mortality (all-cause, lung cancer, etc.) in Asia-Pacific.
13. Bergmann et al. (2025) provide a systematic review and meta-analysis on short-term exposure to UFP (ultrafine particles) and health impacts (natural, cardiovascular).
14. UFP is emerging as an important but less-studied component in ambient air pollution research.
15. Respiratory Health and Asthma (Frontiers in Environmental Health, 2024)
16. Abbah et al. (2024) review long-term exposure to PM_{2.5} and its association with *asthma risk*, particularly in low- and middle-income countries (LMICs).
17. They note that while evidence supports a link, there is a paucity of longitudinal studies in LMICs.