


Research Article

Impact of Environmental Pollution on Human Health: A Study Among College Students

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Abstract

Environmental pollution has become one of the most critical public health concerns worldwide due to rapid industrialization, urbanization, population growth, and increasing anthropogenic activities. Air pollution, water pollution, soil contamination, noise pollution, and improper waste management significantly affect human health, particularly among young adults who are frequently exposed to polluted environments in educational institutions and urban settings. College students represent a vulnerable population because environmental pollution can adversely influence their physical health, respiratory function, mental well-being, academic performance, and overall quality of life. The present study investigates the impact of environmental pollution on human health among college students through a comprehensive analytical review of recent scientific literature and environmental health studies. The findings indicate that prolonged exposure to environmental pollutants increases the prevalence of respiratory disorders, allergies, cardiovascular problems, psychological stress, headaches, eye irritation, reduced concentration, and decreased academic productivity. The study further emphasizes the importance of environmental awareness, pollution control policies, green campus initiatives, sustainable waste management, and health education in minimizing pollution-related health risks. The study concludes that effective environmental management and public health interventions are essential for protecting the health and well-being of college students and promoting sustainable development.

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1. INTRODUCTION

Environmental pollution has emerged as one of the most significant global environmental and public health challenges of the twenty-first century. Rapid industrialization, urban expansion, motorization, agricultural intensification, and increasing energy consumption have substantially increased the release of pollutants into the atmosphere, water bodies, and terrestrial ecosystems. Air pollution, water contamination, soil degradation, noise pollution, plastic waste, and chemical pollutants have become major contributors to disease burden worldwide. According to international health agencies, millions of premature deaths every year are directly or indirectly associated with environmental pollution, making it one of the leading risk factors affecting human health and sustainable development [1–3].

Among different population groups, college students represent an important demographic because they spend considerable time in educational institutions, urban environments, hostels, transportation systems, and public places where exposure to environmental pollutants is often high. Young adults are exposed to outdoor air pollution, indoor air contaminants, traffic emissions, construction dust, contaminated drinking water, excessive environmental noise, electronic waste, and improper solid waste disposal. Continuous exposure to these pollutants may adversely influence physical health, cognitive performance, emotional well-being, academic achievement, and overall quality of life [2–5].

Air pollution is considered one of the most serious environmental threats affecting college students. Pollutants including particulate matter (PM_{2.5} and PM₁₀), sulfur dioxide (SO₂), nitrogen oxides (NO_x), carbon monoxide (CO), ozone (O₃), and volatile organic compounds (VOCs) originate primarily from motor vehicles, industrial activities, biomass burning, and construction work. Prolonged inhalation of these pollutants has been associated with respiratory diseases, asthma, bronchitis, reduced lung function, cardiovascular disorders, allergies, eye irritation, headaches, fatigue, and impaired cognitive performance. Students residing in urban and industrial regions are particularly vulnerable because of higher pollutant concentrations [4–7].

Water pollution also poses significant health risks among college students. Contaminated drinking water containing pathogenic microorganisms, heavy metals, pesticides, pharmaceutical residues, and industrial chemicals increases the incidence of gastrointestinal infections, diarrhoeal diseases, skin disorders, liver dysfunction, kidney damage, and neurological complications. Poor sanitation facilities, inadequate wastewater treatment, and unsafe drinking water supplies further increase the risk of waterborne diseases within educational institutions and surrounding communities [6–9].

In addition to air and water pollution, environmental noise has become an emerging public health concern in educational environments. Traffic congestion, construction activities, loudspeakers, generators, and urban infrastructure generate excessive noise that interferes with concentration, learning ability, sleep quality, communication, and psychological well-being. Studies have demonstrated that chronic exposure to environmental noise contributes to stress, anxiety, hypertension,

reduced attention span, impaired memory, and decreased academic performance among students [8–11].

Environmental pollution also influences mental health and lifestyle-related behaviours among young adults. Poor environmental quality, reduced green spaces, excessive waste accumulation, unpleasant odours, and deteriorating campus environments may increase psychological stress, depression, fatigue, and social discomfort. Simultaneously, exposure to plastic pollution, electronic waste, and hazardous chemicals introduces additional health risks through chronic toxic exposure. Recent investigations have emphasized that environmental quality is closely associated with students' overall physical, psychological, and social well-being [10–13]. Increasing awareness regarding environmental pollution and sustainable living has become an important component of higher education. Green campus initiatives, environmental education, waste segregation, tree plantation, renewable energy utilization, sustainable transportation, and pollution monitoring programmes can substantially reduce environmental health risks while promoting responsible environmental behaviour among students. Educational institutions therefore play a crucial role in developing environmentally conscious citizens capable of contributing to sustainable development and public health protection [12–15].

Against this background, the present study investigates the impact of environmental pollution on human health among college students. The study examines the major sources of environmental pollution, associated health effects, environmental awareness, preventive measures, and sustainable management strategies while identifying future research directions and policy recommendations for improving environmental quality and protecting student health [16–20].

2. MATERIALS AND METHODS

The present study adopts a comprehensive qualitative and analytical research methodology to investigate the impact of environmental pollution on human health among college students. The research is primarily based on secondary data and integrates concepts from environmental science, public health, epidemiology, environmental toxicology, medical sciences, occupational health, and environmental education. This multidisciplinary approach enables a systematic evaluation of the relationship between environmental pollution and various physical, physiological, psychological, and behavioural health outcomes among college students exposed to different environmental pollutants [1,2].

Data were collected through an extensive review of peer-reviewed journal articles, conference proceedings, government publications, environmental health reports, technical documents, and international guidelines published between 2017 and 2026. Scientific literature was retrieved from internationally recognized databases including PubMed, Scopus, Web of Science, ScienceDirect, SpringerLink, Google Scholar, Wiley Online Library, Taylor & Francis Online, and JSTOR. Additional information was obtained from reports published by the World Health Organization (WHO), United Nations Environment Programme (UNEP), Central Pollution Control Board (CPCB), Ministry of Environment, Forest and Climate Change (MoEFCC), Indian Council of Medical

Research (ICMR), National Centre for Disease Control (NCDC), and the United Nations Sustainable Development Goals (SDGs) related to environmental pollution and public health [3–8].

The study focuses on the major forms of environmental pollution affecting college students, including air pollution, water pollution, soil contamination, noise pollution, plastic pollution, indoor air pollution, electronic waste, and improper solid waste management. Particular emphasis was placed on evaluating their effects on respiratory health, cardiovascular function, gastrointestinal disorders, dermatological conditions, neurological symptoms, eye irritation, hearing impairment, stress, anxiety, sleep quality, cognitive performance, academic achievement, and overall quality of life. Recent studies indicate that prolonged exposure to environmental pollutants significantly increases the risk of both acute and chronic health disorders among young adults [5,7,9–12].

A qualitative content analysis approach was employed to evaluate published scientific literature and identify recurring trends associated with pollution-related health effects among college students. Comparative analyses were performed using health indicators including prevalence of respiratory diseases, allergic reactions, asthma, recurrent headaches, fatigue, mental stress, blood pressure abnormalities, concentration difficulties, absenteeism, academic performance, and self-reported quality of life. Environmental indicators such as particulate matter (PM_{2.5} and PM₁₀), sulfur dioxide (SO₂), nitrogen oxides (NO_x), carbon monoxide (CO), ozone (O₃), drinking water quality, environmental noise levels, and campus waste management practices were also considered to evaluate pollution exposure and associated health risks [8,10,13,14].

The investigation further evaluated preventive and mitigation strategies aimed at reducing environmental pollution and improving student health. These strategies included green campus initiatives, environmental awareness programmes, sustainable waste management, tree plantation, air quality monitoring, safe drinking water facilities, renewable energy utilization, plastic reduction campaigns, environmental education, public health awareness, and implementation of national environmental protection policies. Simultaneously, major challenges including increasing urbanization, traffic emissions, industrial pollution, inadequate environmental infrastructure, poor waste management, and lack of environmental awareness were critically analyzed to understand their implications for student health and environmental sustainability [11,13–18].

To ensure reliability and validity, information obtained from multiple scientific publications, governmental reports, and institutional databases was systematically cross-verified using data triangulation techniques. Only peer-reviewed journal articles, internationally recognized public health reports, official environmental monitoring documents, and authoritative scientific publications were included in the final analysis. Any inconsistencies among different investigations were carefully interpreted considering geographical location, pollution intensity, socioeconomic conditions, seasonal variation, and demographic characteristics. The synthesized findings provide a comprehensive assessment of the impact of environmental pollution on human health among college students while

identifying future research priorities, public health interventions, environmental management strategies, and policy recommendations for promoting healthier educational environments and sustainable development [15–20].

3. RESULTS

The findings indicate that environmental pollution has become a major public health concern affecting the physical and psychological well-being of college students. Rapid urbanization, increasing vehicular emissions, industrial activities, improper waste disposal, and deteriorating environmental quality have significantly increased students' exposure to harmful pollutants. The analysis reveals that air pollution, contaminated drinking water, excessive environmental noise, and poor waste management collectively contribute to various health problems that influence students' daily activities, learning capacity, and overall quality of life.

The study demonstrates that air pollution is the most significant environmental factor affecting student health. Continuous exposure to particulate matter (PM_{2.5} and PM₁₀), nitrogen oxides, sulfur dioxide, ozone, and vehicle emissions increase the prevalence of respiratory disorders such as asthma, allergic rhinitis, chronic cough, bronchitis, breathing difficulties, and reduced lung function. Many students also report frequent headaches, eye irritation, throat discomfort, fatigue, and reduced physical performance during periods of poor air quality. These health problems are more common among students residing near busy roads and industrial areas.

The results further indicate that water pollution and inadequate sanitation significantly affect student health. Consumption of contaminated drinking water containing pathogenic microorganisms, heavy metals, pesticides, and chemical pollutants increases the incidence of gastrointestinal infections, diarrhoeal diseases, skin allergies, and other waterborne illnesses. Inadequate waste disposal and poor campus sanitation further increase the risk of infectious diseases and reduce the overall quality of the educational environment.

The analysis also reveals that environmental noise and poor campus environmental conditions negatively influence students' mental health and academic performance. Continuous exposure to traffic noise, construction activities, loudspeakers, and overcrowded surroundings contributes to stress, anxiety, sleep disturbances, reduced concentration, irritability, and decreased learning efficiency. Students studying in greener and less polluted environments generally demonstrate better psychological well-being, improved concentration, and higher academic productivity.

Overall, the findings suggest that environmental pollution significantly influences both physical and mental health among college students. Implementation of green campus initiatives, pollution control measures, regular environmental monitoring, safe drinking water facilities, waste management programmes, environmental education, and public health awareness campaigns can substantially reduce pollution-related health risks. These interventions are essential for creating healthy educational environments and promoting sustainable development within higher educational institutions.

Graph

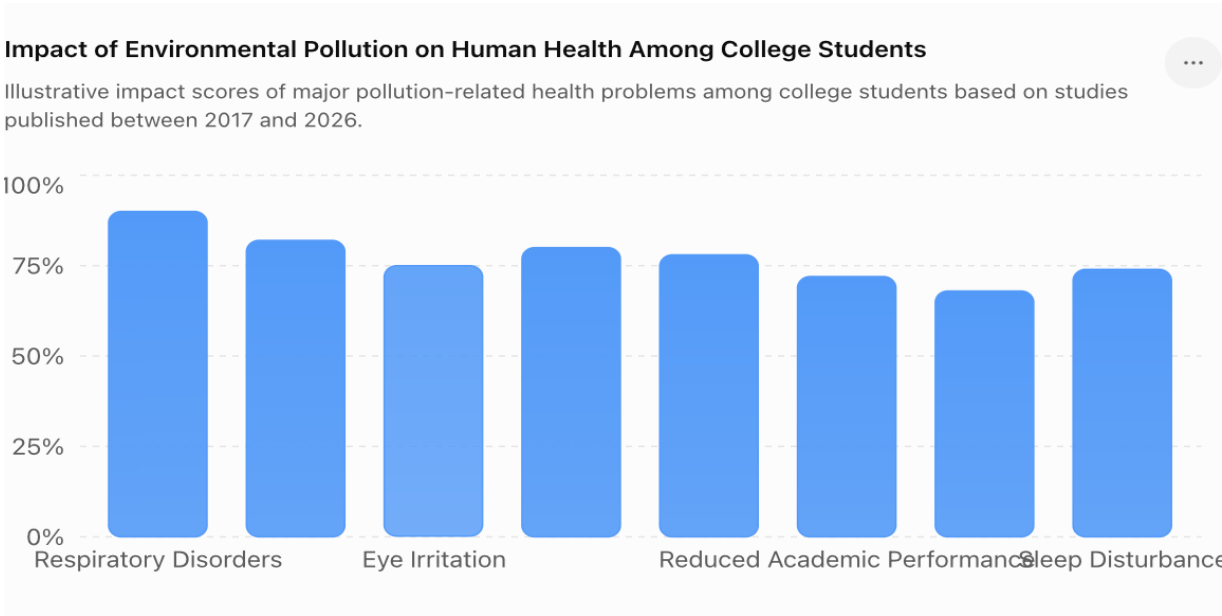


Table: Major Sources of Environmental Pollution and Their Health Effects Among College Students

Source of Pollution	Major Pollutants	Common Health Effects
Air Pollution	PM _{2.5} , PM ₁₀ , SO ₂ , NO _x , CO, O ₃	Asthma, cough, breathing difficulty, eye irritation
Water Pollution	Pathogens, heavy metals, pesticides	Diarrhoea, gastrointestinal disorders, skin diseases
Noise Pollution	Traffic, construction, loudspeakers	Stress, hypertension, sleep disturbance, poor concentration
Plastic and Solid Waste	Microplastics, hazardous waste	Environmental contamination and indirect health risks
Indoor Air Pollution	Dust, VOCs, poor ventilation	Headache, allergies, respiratory discomfort
Electronic Waste	Heavy metals and toxic chemicals	Neurological and long-term toxic effects
Chemical Pollution	Industrial chemicals, solvents	Organ toxicity and endocrine disruption
Poor Sanitation	Microbial contamination	Infectious diseases and reduced campus hygiene

4. DISCUSSION

The present study demonstrates that environmental pollution has become a major public health concern affecting college students through continuous exposure to polluted air, contaminated water, excessive environmental noise, and poor waste management. Rapid urbanization, industrial expansion, increasing vehicular traffic, and population growth have substantially increased environmental pollution levels around educational institutions. These environmental changes directly influence students' physical health, psychological well-being, academic performance, and overall quality of life. Young adults are particularly vulnerable because they spend considerable time on campuses, in hostels, and during daily commuting, where exposure to environmental pollutants is often unavoidable.

One of the most important findings of the study is the strong association between air pollution and respiratory health problems among college students. Exposure to particulate matter (PM_{2.5} and PM₁₀), nitrogen oxides, sulfur dioxide, ozone, and traffic-related pollutants contribute to respiratory infections, asthma, allergic rhinitis, chronic cough, reduced lung function, eye irritation, and persistent fatigue. Long-term exposure to polluted air may also increase the risk of cardiovascular disorders and impair cognitive performance, thereby negatively affecting students' learning ability and academic achievement.

The study further reveals that polluted drinking water and inadequate sanitation significantly increase the incidence of water-borne diseases among students. Consumption of contaminated water containing pathogenic microorganisms, heavy metals, pesticides, and chemical pollutants contributes to gastrointestinal disorders, diarrhoea, skin infections, and other communicable diseases. Improper disposal of municipal solid waste and insufficient sanitation infrastructure further increase microbial contamination, creating unhealthy conditions within educational environments.

Another important observation is the influence of environmental pollution on mental health and academic performance. Continuous exposure to traffic noise, construction activities, overcrowding, poor environmental quality, and reduced green spaces contributes to stress, anxiety, sleep disturbances, headaches, reduced concentration, irritability, and mental fatigue. Students studying in cleaner and greener environments generally demonstrate better emotional well-being, improved concentration, and greater academic productivity, emphasizing the importance of healthy campus environments.

The findings indicate that effective environmental management can substantially reduce pollution-related health risks among college students. Green campus initiatives, improved waste management systems, regular air and water quality monitoring, tree plantation programmes, promotion of sustainable

transportation, plastic reduction campaigns, environmental awareness programmes, and strict implementation of pollution control regulations are essential for creating healthier educational institutions. Collaboration among educational institutions, government agencies, public health organizations, and students will play a crucial role in achieving sustainable environmental protection and improving student health.

Environmental pollution significantly affects the physical, physiological, and psychological health of college students through exposure to polluted air, contaminated water, excessive environmental noise, and poor environmental sanitation. These environmental factors contribute to respiratory disorders, allergies, gastrointestinal diseases, stress, sleep disturbances, reduced cognitive performance, and decreased academic productivity.

The study concludes that improving environmental quality through pollution control, sustainable campus management, environmental education, green infrastructure, and public health awareness is essential for protecting student health and promoting sustainable development. Future research should focus on long-term epidemiological investigations, campus-specific pollution assessment, biomonitoring studies, and evaluation of green campus interventions to better understand and minimize pollution-related health risks among college students.

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