

Environmental Health: Diverse Threats, Equity, Action

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Introduction

Contemporary environmental challenges pose significant and complex threats to global public health, necessitating a comprehensive understanding of their pathways, impacts, and potential mitigation strategies. This body of research delves into various facets of these environmental determinants of health, ranging from microscopic pollutants to global climate shifts and their profound implications for human well-being. A critical area of concern involves emerging and pervasive contaminants that infiltrate our daily lives. Microplastics, for instance, are increasingly recognized as a significant environmental contaminant with potential implications for human health. Research synthesizes existing findings, highlighting pathways of human exposure through ingestion and inhalation, and discusses potential adverse health effects such as inflammation, oxidative stress, and genotoxicity. Although more direct human studies are needed to establish definitive causal links, the evidence points to a growing concern [1].

Further emphasizing the challenge of pervasive chemicals, per- and polyfluoroalkyl substances (PFAS) represent widespread contaminants, particularly concerning in drinking water. A systematic review details their global occurrence in various drinking water sources and the significant human exposure resulting from it. The persistent nature and potential health risks associated with PFAS necessitate global monitoring and mitigation efforts to safeguard public health effectively [4]. Complementing this, the broader issue of human-related emerging contaminants in drinking water systems poses a global health challenge. Investigations into their widespread prevalence and subsequent health implications highlight a diverse range of contaminants, from pharmaceuticals to microplastics, emphasizing the need for advanced monitoring and treatment technologies to ensure safe drinking water supplies worldwide and mitigate potential long-term health risks [7].

Beyond water-based threats, air quality remains a paramount concern. Am-

bient air pollution continues to be a leading global health risk factor. Comprehensive analyses, often part of major global studies, quantify the burden of disease attributable to air pollution across various countries and territories. These studies reveal persistent disparities and emphasize the urgent need for effective pollution control strategies to mitigate impacts on cardiovascular, respiratory, and other health outcomes [2]. Equally vital for health is indoor air quality, given the significant time individuals spend indoors. Reviews explore the diverse array of indoor air pollutants, such as particulate matter, volatile organic compounds, and biological agents, and their associated health effects, including respiratory illnesses, cardiovascular problems, and neurological impacts. This highlights the urgent need for improved ventilation and source control strategies in various indoor environments [10].

The overarching threat of climate change intersects with and exacerbates many of these issues. Reports from initiatives like The Lancet Countdown underscore the severe and escalating impacts of climate change on human health, asserting that health is increasingly at the mercy of fossil fuels. These reports detail how rising temperatures, extreme weather events, and ecological disruptions are exacerbating health inequalities, food insecurity, and the spread of infectious diseases, calling for a rapid and equitable transition away from fossil fuels to protect global health [3].

Additional environmental stressors, often less visible but equally impactful, are also investigated. Noise pollution, for example, is an often-overlooked environmental stressor with significant health consequences. Umbrella reviews consolidate findings from numerous meta-analyses, confirming a strong association between environmental noise (from traffic, industry, etc.) and adverse health effects like cardiovascular disease, sleep disturbance, and mental health issues. This evidence calls for more stringent noise reduction policies to protect public well-being [6]. Furthermore, foodborne contaminants, ranging from microbial pathogens to chemical residues, remain a critical public health concern. Comprehensive reviews examine recent trends in food contamination, delve into advanced detection methods, and thoroughly discuss their health implications, including acute illnesses and chronic diseases. This underscores the importance of stringent food safety regulations and continuous monitoring to protect consumers globally [9].

Addressing these multifaceted environmental challenges also requires a focus on equitable solutions. Environmental injustice, where marginalized communities bear disproportionate environmental burdens, necessitates robust tools for assessment. Systematic reviews explore the application of cumulative impact assessment as a critical method to address environmental injustice, highlighting how considering multiple exposures and vulnerabilities collectively can lead to more equitable environmental policies and improved health outcomes in affected communities [5]. In contrast to these adverse exposures, spending time in nature offers substantial health benefits, a fact increasingly supported by scientific evidence. Systematic reviews compile clinical and psychological research, demonstrating that nature experiences can reduce stress, improve mood, enhance cognitive function, and foster social connections. The findings advocate for incorporat-

ing natural environments into public health strategies to promote mental and physical well-being [8]. Collectively, these studies paint a picture of intricate environmental health challenges and opportunities, demanding integrated, science-backed solutions.

Description

The intricate relationship between environmental factors and human health is a subject of intense scientific scrutiny, revealing both profound risks and significant opportunities for intervention. A substantial body of recent research underscores the global prevalence and diverse impacts of environmental contaminants and stressors on human populations. Microplastics, for instance, are no longer a nascent concern; they are now firmly established as a pervasive environmental contaminant with growing implications for human health. Studies meticulously detail the various pathways through which humans are exposed, primarily ingestion and inhalation, and begin to unravel the potential adverse health effects, which include inflammatory responses, oxidative stress, and genotoxicity. While definitive causal links in humans are still being sought, the accumulated evidence warrants serious attention to this ubiquitous pollutant [1]. This issue is further compounded by the widespread presence of other persistent chemicals, such as Per- and Polyfluoroalkyl Substances (PFAS). These substances are found extensively in global drinking water sources, leading to considerable human exposure. Given their persistent nature and the potential long-term health risks, there is an urgent call for expanded global monitoring and robust mitigation efforts to safeguard public health against these contaminants [4]. The broader category of human-related emerging contaminants in drinking water systems, encompassing everything from pharmaceuticals to additional microplastic variants, represents a significant and escalating global health challenge, demanding advanced monitoring technologies and innovative treatment solutions to secure safe water supplies worldwide [7]. Furthermore, food safety is persistently highlighted as a critical public health concern, with comprehensive reviews detailing the trends of foodborne contaminants, from microbial pathogens to chemical residues, and their acute and chronic health implications, emphasizing the necessity of stringent regulations and continuous oversight [9].

Beyond chemical and biological contaminants, air quality continues to be a primary determinant of health. Ambient air pollution stands as a leading global health risk factor, its burden quantified extensively across numerous countries. The data consistently reveals profound disparities in exposure and health outcomes, highlighting an urgent, ongoing need for effective pollution control strategies to alleviate impacts on cardiovascular, respiratory, and other systemic health outcomes globally [2]. In parallel, indoor air quality, often overlooked due to its localized nature, is equally crucial. Considering the significant proportion of time individuals spend indoors, understanding the diverse array of indoor air pollutants – including particulate matter, volatile organic compounds, and biological agents – and their associated health effects, such as respiratory illnesses, cardiovascular problems, and neurological impacts, becomes imperative. This knowledge drives the urgent call for improved ventilation systems and proactive source control strategies across various indoor environments to protect inhabitants [10].

The broader context of climate change profoundly amplifies many of these environmental health challenges. Seminal reports, such as those from The Lancet Countdown, assert that human health is increasingly at the mercy of

fossil fuels, vividly detailing how escalating temperatures, more frequent and intense extreme weather events, and widespread ecological disruptions are worsening health inequalities. These factors also contribute to increased food insecurity and facilitate the spread of infectious diseases. The compelling evidence within these reports advocates for a rapid and equitable global transition away from fossil fuels as a fundamental measure to protect global health and prevent further catastrophic health consequences [3].

Other critical environmental stressors, while perhaps less discussed than climate change or chemical pollutants, also exert significant health burdens. Noise pollution serves as an often-underestimated environmental stressor with clear and substantial health consequences. Extensive umbrella reviews, synthesizing numerous meta-analyses, unequivocally confirm a strong association between environmental noise, stemming from sources like traffic and industry, and a range of adverse health effects, including cardiovascular disease, sleep disturbance, and various mental health issues. This robust body of evidence clearly mandates the implementation of more stringent noise reduction policies to protect public well-being and enhance quality of life [6].

Addressing these multifaceted environmental health issues also necessitates a strong emphasis on social equity. Environmental injustice, characterized by marginalized communities disproportionately bearing environmental burdens, requires sophisticated tools for assessment and rectification. Systematic reviews focusing on cumulative impact assessment demonstrate its utility as a critical method to address environmental injustice. By collectively considering multiple exposures and vulnerabilities, this approach can lead to the formulation of more equitable environmental policies and, critically, improved health outcomes for affected communities, ensuring that environmental protection benefits all segments of society [5]. In a contrasting and positive vein, scientific literature increasingly supports the substantial health benefits derived from spending time in nature. Comprehensive systematic reviews, compiling both clinical and psychological research, consistently show that nature experiences can effectively reduce stress, significantly improve mood, enhance cognitive function, and foster stronger social connections. These compelling findings strongly advocate for the integration of natural environments into public health strategies, recognizing nature as a powerful, accessible resource for promoting holistic mental and physical well-being across populations [8]. The synthesis of these findings highlights a holistic approach to environmental health, where recognizing both threats and protective factors is key to building resilient and healthy communities.

Conclusion

The provided research collection highlights a spectrum of critical environmental health concerns impacting human well-being globally. A significant focus is on pervasive contaminants. Microplastics are increasingly recognized as a major environmental contaminant, with studies detailing human exposure through ingestion and inhalation and linking them to potential adverse health effects like inflammation and oxidative stress. Similarly, per- and polyfluoroalkyl substances (PFAS) are widespread in drinking water, posing significant exposure risks and necessitating global monitoring and mitigation efforts. Beyond specific chemicals, the broad issue of emerging contaminants in drinking water systems, ranging from pharmaceuticals to microplastics, is explored, underscoring the need for advanced monitoring and treatment. Foodborne contaminants, including microbial pathogens

and chemical residues, remain a critical public health concern, requiring stringent safety regulations.

Air quality is another central theme. Ambient air pollution continues to be a leading global health risk factor, with analyses quantifying the burden of disease and emphasizing the urgent need for effective control strategies. Indoor air quality is equally paramount, given the substantial time individuals spend indoors, revealing health effects from diverse pollutants and advocating for improved ventilation. Climate change emerges as an overarching threat, with reports underscoring its severe impacts on human health, exacerbating inequalities, food insecurity, and disease spread, calling for a rapid transition away from fossil fuels.

Environmental stressors like noise pollution, often overlooked, are strongly associated with cardiovascular disease, sleep disturbance, and mental health issues, demanding more stringent noise reduction policies. The intersection of environment and social equity is addressed through environmental injustice, where marginalized communities bear disproportionate burdens, highlighting cumulative impact assessment as a tool for more equitable policies. Amidst these challenges, the substantial health benefits of nature experiences are emphasized, advocating for their integration into public health strategies to promote mental and physical well-being. This body of work collectively calls for urgent, comprehensive interventions to protect global health.

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