

CLIMATE CHANGE AND POLLUTION AND THE AGGRAVATION OF HUMAN HEALTH PROBLEMS

MUDANÇAS CLIMÁTICAS, POLUIÇÃO E O AGRAVAMENTO DOS
PROBLEMAS DE SAÚDE HUMANA

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ABSTRACT

JUSTIFICATION: Planet Earth has always coexisted with natural pollution; however, after the Industrial Revolution, some anthropogenic factors were added to that and have contributed detrimentally to human health, sometimes aggravating pathologies and/or influencing the emergence of others. Some areas of science have monitored the evolution of these anthropogenic and natural environmental impacts, seeking solutions that can contribute to a healthier life on the planet. However, some actions are still insufficient given the large scale of anthropogenic impacts on the climate, resulting in anthropogenic environmental disasters and significant climate change. **OBJECTIVE:** through a multidisciplinary approach to show the environmental impacts and their harmful aspects to respiratory system human health. **METHODOLOGY:** explanatory, with research on the platforms: Medscape, SciELO and Virtual Health Library with the descriptors: Climate Change, Environment/and/human health, Environmental impacts/+/Human health, Environmental disasters/and/Human health, in English, Portuguese, Spanish and Italian, at any time, in addition to the authors' practical knowledge on the subject. **CONCLUSION:** climate change, which is warming the planet and causing storms and floods that favor the spread of various diseases and their vectors, results in socioeconomic, public health, and environmental impacts. There is an urgent need for more research and efficient and effective public and private policies that provide immediate action to eliminate or at least mitigate the environmental impacts of climate change, since the consequences are increasing, including environmental disasters and impacts on human and animal health that, in many cases, may be irreversible.

Keywords: Environmental Impacts; Environment; Human Health; Geomedicine; Environmental and anthropogenic disasters.

RESUMO

JUSTIFICATIVA: O planeta Terra sempre coexistiu com a poluição natural; no entanto, após a Revolução Industrial, alguns fatores antropogênicos se somaram a esse cenário e têm contribuído de forma prejudicial à saúde humana, por vezes agravando patologias e/ou influenciando o surgimento de outras. Algumas áreas da ciência têm monitorado a evolução desses impactos ambientais antropogênicos e naturais, buscando soluções que possam contribuir para uma vida mais saudável no planeta. Contudo, algumas ações ainda são insuficientes, dada a grande escala dos impactos antropogênicos sobre o clima, resultando em desastres ambientais antropogênicos e mudanças climáticas significativas.

OBJETIVO: através de uma abordagem multidisciplinar, mostrar os impactos ambientais e seus aspectos nocivos à saúde humana.

METODOLOGIA: explicativa, com pesquisa nas plataformas Medscape, SciELO e Biblioteca Virtual em Saúde, utilizando os descritores: Mudanças Climáticas, Meio ambiente/e/saúde humana, Impactos ambientais/+/Saúde humana, Desastres ambientais/e/Saúde humana, em inglês, português, espanhol e italiano, a qualquer momento, além do conhecimento prático dos autores sobre o tema. **CONCLUSÃO:** As mudanças climáticas, que

aquecem o planeta e causam tempestades e inundações que favorecem a propagação de diversas patologias e seus vetores, resultando impactos socioeconômicos, saúde pública e ambiental. Há necessidade urgente de mais pesquisas e políticas públicas e privadas, eficientes e eficazes que forneçam ações imediatas para eliminar ou, pelo menos, mitigar os impactos ambientais das mudanças climáticas, uma vez que as consequências estão aumentando, inclusive por desastres ambientais e impactos na saúde humana e animal que, em muitos casos, podem ser irreversíveis.

Palavras-chave: Impactos Ambientais; Meio-ambiente; Saúde humana; Geomedicina; Desastres ambientais e antrópicos.

1. INTRODUCTION

Planet Earth has always coexisted with natural pollution resulting from volcanism, forest fires, sandstorms, among others, some of which have even led to the extinction of certain species. However, after the industrial revolution, some anthropogenic factors have contributed detrimentally to human health, sometimes aggravating pathologies and/or influencing the emergence of others.

Some sciences have been monitoring the evolution of these anthropogenic and natural environmental impacts, including environmental epidemiology, geomedicine, medicine, environmental chemistry, medicinal chemistry, among others, seeking solutions that can contribute to a healthier life on the planet.

Therefore, the objective of this paper is through a multidisciplinary approach to show the environmental impacts and their harmful aspects to human health, adopting an explanatory methodology, with research on the platforms: Medscape, SciELO and Virtual Health Library with the descriptors Environment/and/human health, Environmental impacts/+/Human health, Environmental disasters/and/Human health, Polymers/and/Environmental impacts, Micropolymers/and/Human health, in English, Portuguese, Spanish and Italian, at any time, in addition to the authors' practical knowledge on the subject.

2. CLIMATE CHANGE AND HUMAN HEALTH

The concurrent pressures of rising global temperatures, rates and incidence of species decline, and emergence of infectious diseases represent an unprecedented planetary crisis^[1].

Climate change is redefining every aspect of healthcare delivery. Clinical care will need to address environmental determinants in order to maintain health outcomes, ranging from medical screening to intervening to prevent heat-related illness for everyone — because everyone is only one power outage away from not having health-protective cooling in their home. The skills that clinicians need are also evolving. For example, with increased climate-related disasters, whether we are talking about wildfires or hurricanes or floods, all clinicians may increasingly find themselves in mass-casualty scenarios^[2].

Even with current regulations limiting levels of certain air pollutants, many adverse health effects resulting from exposure to these agents persist. Several epidemiological studies have observed an association between air pollution levels and hospital admissions for various causes, including respiratory diseases, as well as increased morbidity and mortality associated with various respiratory conditions and diseases^[3].

Climate change, wildfires, floods, and other extreme weather events can contribute to the development of chronic diseases, and this phenomenon is expected to become more common^[4]. According to the World Health Organisation (WHO), climate change is one of the biggest threats to global health in the twenty-first century. The WHO also links the climate crisis to an increase in deaths from extreme heat and respiratory or cardiovascular diseases linked to air pollution. It is estimated that 99% of the world's population breathes air with

levels of pollutants higher than those recommended, with the burning of fossil fuels being the main risk factor for air contamination. Climate change favours the proliferation of infectious diseases, aggravates food insecurity, affects mental health, and increases the vulnerability of populations subject to floods, droughts, and landslides^[5].

Our planet's health is intimately connected to our own, and the medical community must step up to address the consequences of the current environmental crisis, experts said at the European Respiratory Society (ERS) 2025 International Congress. They framed climate change, pollution, and biodiversity loss not just as environmental issues but as a profound public health crisis^[6].

Ozone pollution is characterised by physiochemical reactions to certain gases, such as methane (CH₄), carbon dioxide (CO₂), nitrogen dioxide (NO₂), among others. Dearborn and colleagues indicate a relationship between O₃ exposure and paediatric asthma and wheezing in early childhood^[7]. Reports that a study found that prolonged exposure to ambient air pollutants over 48 months was associated with an increased risk of asthma exacerbation in women, even at low concentrations, where nitrogen dioxide (NO₂) showed the strongest association with increased chances of exacerbation^[8].

Exposure to fine particulate matter (PM_{2.5}) is associated with respiratory dysfunction and increased risk of death, the risk of mortality increases at even small magnitudes of increased PM_{2.5} concentrations in people with COPD. The risk was higher for those with comorbid lung cancer, coronary arterial disease, and chronic

kidney disease. The current standard of $9 \mu\text{g}/\text{m}^3$ for the general population should be re-evaluated for those with existing COPD^[9].

According to Mary McGowan, CEO of the Foundation for Sarcoidosis Research (FSR), wildfire smoke is not a fleeting inconvenience. It is a lasting, insidious threat. As the smoke settles, it brings with it a long tail of health consequences, including the risk of chronic inflammatory diseases such as sarcoidosis. Exposure to environmental toxins — especially inhaled fine particulate matter like that found in wildfire smoke — is widely recognised as a contributing factor to this disease^[10].

Sørensen and colleague analysed associations between long-term residential exposure to road traffic noise and particulate matter with a diameter $< 2.5 \mu\text{m}$ (PM_{2.5}) with infertility in men and women, through a cohort of approximately 900,000 people. Linked to the Danish Cancer Institute, Roskilde University, University Hospital of Herlev and Gentofte, Researchers at Aarhus University and the University of Surrey, both in Denmark, showed that men exposed to air pollution had a 24% higher risk of infertility, and that noise pollution from road traffic is associated with infertility in women^[11].

Climate change is increasing risk to eye health in multiple ways. First, it is making the planet warmer — Earth's average surface temperature in 2024 was the warmest on record. Body temperatures reaching 40 degrees Celsius (104 degrees Fahrenheit) can cause heatstroke, a condition that disrupts biological processes throughout the body. In the eyes, heatstroke damages the natural defense systems that normally counteract the buildup of harmful molecules called reactive oxygen species, explains Lucía Echevarría-

Lucas, an ophthalmologist at the Hospital of La Axarquía in Spain's Málaga province^[12].

Plastic materials discarded into the environment have a certain relationship with global warming due to their chemical alteration and decomposition process, which releases substances into the environment. According to the United Nations Regional Information Centre for Western Europe, "...in addition to contributing negatively to the climate crisis (due to greenhouse gas emissions from its entire production process), plastic can seriously harm ecosystems"^[13].

Patients with chronic diseases—particularly those diagnosed with asthma—are notably more vulnerable to environmental and social factors. Thus, extreme weather changes can exacerbate airway hyperreactivity in these individuals, both directly, as in the case of cold air, and indirectly, through increased inhalation exposure to pollution and other aeroallergens^[14].

In a cross-sectional study, a total of 27 environmental toxins across 6 categories were associated with the prevalence of depressive symptoms. Susceptibility to environmental toxins varied across populations, particularly among men and individuals under 65 years of age, compared to women and older individuals. Systemic inflammation, assessed by total leukocytes, may mediate multiple associations between environmental toxins and depressive symptoms^[15].

Dirofilariasis, popularly known as heartworm disease, is a disease transmitted by mosquitoes. Proximity to water, flooding, and agricultural irrigation are risk factors for the disease in humans.

Rising temperatures and humid weather are also risk factors, as they contribute to mosquito reproduction^[4].

Coccidioidomycosis, known as valley fever, is a disease caused by fungi of the genus *Coccidioides*. The fungi inhabit the soil in arid and semiarid regions of the southwestern United States, northern Mexico, and parts of Central and South America. Although most cases are asymptomatic, patients with signs and symptoms may present with isolated pulmonary disease. However, regional climate patterns influence the transmission of *C. immitis*, as fungal spores remain dormant during dry periods, reemerging during rains, floods, and when the soil is disturbed by human activity^[4].

A review of the literature on climate change and atopic dermatitis found evidence of a broad and negative impact of climate risks on various aspects of the disease, addressing prevalence, severity/attacks, and health care utilisation related to the condition. Recently, dermatologists have published on the environmental impact of professional practices such as printing journals and collecting samples using single-use plastics^[16].

Potential climate change scenarios could nearly double the global incidence of obstructive sleep apnoea (OSA), based on estimates from a new study presented at American Thoracic Society (ATS) 2025 International Conference. Although high ambient temperatures have been linked to negative health outcomes including reduced sleep duration and quality, the association between increased average ambient temperatures and the severity of OSA remains unclear, wrote Bastien Lechat, PhD, a research fellow in sleep health at Flinders University, Adelaide, Australia, and colleagues, in their abstract^[17].

Children are particularly vulnerable to climate change impacts because they have a higher risk for developing asthma, allergic disease, and infections. Childhood is a critical period for lung and immune development, and the Environmental Protection Agency's 2023 Climate Change and Children's Health and Well-Being report projects that an increase of 2°C in global warming will result in an additional 34.500 paediatric asthma cases and 228.000 allergic rhinitis cases per year, driven largely by predicted increases in ozone and 2.5-µm particulate matter. The report also forecasts an increase in 6240 asthma emergency department visits and 332 additional respiratory hospitalisations per year^[18].

Another factor resulting from climate change is flooding, especially in tropical and equatorial climate regions that already face torrential rains and floods due to their geographical location. Adding to these changes, the situation worsens, particularly where asphalt, soil cementation, and pollution processes affect the soil, further exacerbating the problem.

Floods can increase the transmission of viral diarrheal diseases, hepatitis A and E, cholera, and vector-borne diseases such as yellow fever, West Nile fever, and dengue fever. In these cases, contaminated waters often contain bacteria from faeces, such as *Escherichia coli* and *Enterococcus spp.*, which can cause gastrointestinal illnesses and various infections, including skin infections^[19].

Flood-related skin diseases encompass a range of conditions related to exposure to contaminated floodwater and subsequent environmental changes. Floods can increase the risk of skin infections, traumatic skin diseases, reactions to insect bites, primary

skin diseases aggravated by psycho-emotional factors, among others^[20].

According to psychiatrist Marcos Gebara, it is crucial that we are increasingly prepared to assist people who experience extreme events such as the floods in Rio Grande do Sul (Brazil), because they will continue to happen. In catastrophes of this magnitude, with many victims and material loss, it is undeniable that we will see an outbreak of mental illnesses, because the stressors are very intense and directly affect individuals^[21].

Floods are the most frequent natural disaster, with approximately 23% of the global population exposed to flooding with depths greater than 0.15 m during once-in-100-year flood events. Projections indicate an escalation in the severity, duration and frequency of flooding due to increasingly frequent extreme precipitation events and rising sea levels caused by global warming. In addition to the direct health impacts caused by the physical force of floods or related accidental events, emerging evidence suggests that floods can have wide-ranging indirect impacts on human health. Current epidemiological evidence on the health impacts of floods focuses mainly on the risks of disease incidence, covering mainly digestive diseases, infectious diseases, and mental disorders^[22].

3. MITIGAÇÃO

Interventions fall into three main buckets, Matsui said: mitigation, adaption, and resilience. For those living in areas of exposure to wildfires and/or their cleanup, McGowan emphasised precautions including monitoring air quality and avoiding outdoor activities when air quality is poor if possible. Other precautions include

wearing a N95 or P100 respirator when outdoors, as these products are designed to filter fine particles effectively. Staying hydrated, continuing with prescribed medications such as oxygen therapy and inhaler use, and sealing indoor spaces add a level of protection as well, McGowan told Medscape Medical News^[10].

"Mitigation means reducing greenhouse gas and air pollution production and trying to enhance sinks for greenhouse gases," she said. Mitigation strategies primarily occur at the policy level, with improved regulation, treaties, and market-based approaches, such as carbon tax and cap and trade. Adaptation includes actions that lessen the impact on health and environment, such as infrastructure changes and implementation of air conditioning. Examples of climate change adaptation strategies also mostly come from policy but largely at state and local levels, where individual paediatricians have a greater voice and influence. These can include changes in urban planning to address heat islands, flooding risk, and public transportation's contribution to air pollution and climate change. It can also include changes in housing regulation and policy and investments in healthcare, such as expanded Medicaid and health insurance and investing in disaster planning and readiness. "Resilience is a more holistic concept," Matsui said, "which advocates for system-wide, multilevel changes and involves a range of strategies to enhance social, human, natural, physical, and financial capacities"^[18].

According to the 2024 Global Report of the Lancet Countdown "While people in every country face unprecedented health threats from the changing climate, continued investment in fossil fuels and lagging funding for action to protect health persist. Urgently redirecting resources from the fossil fuel-based economy towards a

zero-emissions, healthy future will deliver rapid health and economic benefits”^[23].

Climate change is redefining every aspect of healthcare delivery. Clinical care will need to address environmental determinants in order to maintain health outcomes, ranging from medical screening to intervening to prevent heat-related illness for everyone — because everyone is only one power outage away from not having health-protective cooling in their home. The skills that clinicians need are also evolving. For example, with increased climate-related disasters, whether we're talking about wildfires or hurricanes or floods, all clinicians may increasingly find themselves in mass-casualty scenarios^[2].

Important issues need to be addressed to further advance the integration of research on climate change, biodiversity, and infectious diseases, and to address the combined pressures they pose to ecosystem integrity and human well-being^[1].

Reducing greenhouse gases and ozone-depleting chemicals, which increase UV exposure, are key to protecting eye health at a global level. But even under the best climate scenarios, intense climate-driven heat, droughts, and other eye irritants will continue to affect people^[12].

Policies aimed at reducing human health risks from EDCs have included the 2022 Plastics Treaty, a resolution adopted by 175 countries at the United Nations Environmental Assembly that "may be a significant step toward global control of plastics and elimination of threats from exposures to EDCs in plastics," the report said^[24]. Manufacturers can significantly reduce microplastic levels

by implementing simple measures like washing caps before sealing bottles^[25].

It's worth remembering that many polymers can be reused, giving them a different purpose than environmental pollution. Recycling these materials result in a variety of products, such as: non-ceramic bricks, pipes, doors and windows for use in civil construction, vehicle parts, furniture for homes and offices, broom bristles made from recycled polyethylene terephthalate from soft drink bottles, among many others. However, there are still polymers that are not recyclable or are difficult to recycle^[26].

Eating less meat and more fruits and vegetables or walking and cycling more — these recommendations benefit both health and the climate^[27]. Many national and foreign research shows that anthropic pollution causes changes in the various processes of biosphere dynamics. However, consumerism leads the environment to an unsustainable degree of aggression^[28].

4. CONCLUSION

Climate change, which is making the planet warmer and causing storms and floods in some regions, favours the reproduction of various vectors, increasing cases of chikungunya, malaria, dengue, zika, Lyme borreliosis, giardiasis, gastroenteritis, hepatitis A, dermatitis, acute diarrhoea, among others, as well as the proliferation of pathogenic microorganisms such as: *Thermoresistant coliforms*, *Escherichia coli*, *Leptospira interrogans*, *Salmonella*, *Shigella spp.*, *Vibrio cholerae*, etc., resulting in a strong socioeconomic, public health, and environmental impact.

The increased rainfall levels resulting from global warming have caused destruction in urbanised areas, including drownings and landslides on waterlogged hills, mountains, and cliffs, as well as the collapse of simple houses lacking adequate infrastructure for these new climatic conditions, resulting in pathologies, physical and psychological trauma, and financial losses.

There is an urgent need for more research and effective public policies that can provide solutions to eliminate or at least mitigate the environmental impacts of climate change, as the consequences are increasingly growing, including environmental disasters and impacts on human and animal health that, in many cases, can be irreversible.

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