

Environmental Effects on Immune – Mediated Diseases: A Literature Review and Comprehensive Analysis

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Abstract

Environmental factors significantly impact human health, particularly in immune-mediated diseases resulting from immune system dysregulation. This review synthesizes current research on the influence of air and water pollution, climate change, urbanization, and other environmental stressors on immune health, aiming to elucidate underlying mechanisms that could inform public health strategies. Air pollution, recognized as a primary environmental health risk, is associated with various immune-mediated diseases, including asthma, allergies, and autoimmune disorders, with pollutants such as PM_{2.5}, nitrogen dioxide, and ozone exacerbating inflammatory responses. Children, whose immune systems are still developing, are

especially vulnerable. Additionally, water pollutants, including heavy metals and microbial contaminants, contribute to immune dysregulation and chronic inflammatory diseases, while endocrine-disrupting compounds (EDCs) interfere with hormonal regulation, further impacting immune responses. Climate change aggravates these risks by worsening air quality, extending pollen seasons, and altering ecosystems. These changes contribute to an increase in allergies and autoimmune diseases. Biodiversity loss also affects immune development, as reduced microbial exposure may weaken immune resilience, particularly in early childhood. Furthermore, urbanization and indoor air

pollution—linked to cooking fuels, tobacco smoke, and household products—pose health risks through prolonged exposure to harmful substances, leading to chronic inflammation and immune dysregulation.

The review also addresses emerging concerns about pesticide exposure, particularly in agricultural regions. Recent studies indicate a strong association between pesticides and cancer risk, notably for colorectal and pancreatic cancers, with some data suggesting pesticide exposure could pose a greater cancer risk than smoking. This underscores the necessity for stringent regulations and public health measures to mitigate exposure.

In conclusion, these findings highlight the profound impact of environmental factors on immune health and disease development. Targeted interventions, regulatory policies, and continued research are essential to mitigate these risks and protect public health. This synthesis provides an evidence base to support preventive measures aimed at reducing environmental exposures, thereby fostering resilience against immune-mediated diseases and promoting community well-being.