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Dust Storms in Tehran: An Environmental and Health Challenge

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Letter to the Editor

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Dear Editor,

This letter highlights key scientific and analytical considerations regarding the phenomenon of dust storms in Tehran, presented as a representative case of the environmental and health challenges faced by megacities located in arid and semi-arid regions. Over recent decades, the increasing frequency and intensity of dust storms worldwide—particularly across the Middle East—have emerged as a major concern in the context of health, urban sustainability, and environmental management. As a significant source of air pollution, dust storms impose substantial health, social, economic, and environmental burdens (1).

The World Health Organization has identified particulate matter as one of the leading environmental risk factors for human health and has emphasized its contribution to the growing burden of non-communicable diseases (2).

Tehran, the capital of Iran and one of the most densely populated metropolitan areas in the region, is particularly vulnerable to dust pollution due to its distinctive geographical and climatic characteristics. Its location along the foothills of the Alborz mountain range, proximity to arid and semi-arid plains, declining precipitation patterns, climate change, and rapid urban expansion collectively create conditions conducive to the accumulation and intensification of airborne dust particles (3). Evidence suggests that dust pollution in Tehran is not solely driven by local sources—such as soil erosion, vegetation degradation, and desertification—but is also significantly influenced by regional and transboundary dust sources that contribute to elevated particulate matter concentrations (4).

In recent years, advances in environmental monitoring technologies—particularly satellite-based remote sensing—have enabled more precise and systematic assessment of dust storm activity. Indicators such as aerosol optical depth (AOD) derived from MODIS products have been widely used to characterize the spatiotemporal dynamics, intensity, and spatial extent of dust events (5,6). In addition, atmospheric trajectory models, including the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model, have played a critical role in tracing dust transport pathways and identifying regional and transboundary source contributions affecting urban areas such as Tehran (7,8).

From a health perspective, a growing body of evidence demonstrates that elevated concentrations of particulate matter—particularly PM and PM . —are associated with increased incidence of cardiovascular and respiratory diseases, higher rates of emergency department visits, hospital admissions, and premature mortality (9,10). These adverse outcomes disproportionately affect vulnerable populations, including children, older adults, and individuals with pre-existing chronic conditions. Beyond direct health effects, dust storms also lead to reduced visibility, disruptions to urban and intercity transportation systems, increased accident risk, and an overall deterioration in urban quality of life (11).

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Given the multifactorial and transboundary nature of dust storm phenomena, effective mitigation and management require a comprehensive, integrated, and evidence-based approach. Key strategies include controlling and reducing dust generation through soil stabilization and vegetation restoration, promoting sustainable land and water resource management, expanding the use of advanced monitoring and forecasting technologies, developing early warning systems, and enhancing public awareness. Collectively, these measures represent essential components for mitigating the adverse impacts of dust storms in large urban centers (12,13).

It is hoped that the issues raised in this letter will draw increased attention from the scientific community, policymakers, and urban managers to the necessity of continuous monitoring and scientifically grounded management of dust storms in Tehran. More broadly, the discussion underscores the relevance of this case for other dust-affected cities across arid and semi-arid regions worldwide, supporting informed decision-making aimed at protecting public health and promoting urban environmental sustainability.

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