IRASS Journal of Multidisciplinary Studies
https://irasspublisher.com/journal-details/IRASSJMS
ISSN *(Online) 3049-0073*

Recurrent Sandstorms and Their Impact on Occupational and Public Health in the Middle East, Qatar: A Comprehensive Review of Risks, Interventions, and Policy Implications

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Article History

Received: 13 / 08 / 2025

Accepted: 28 / 08 / 2025

Published: 02 / 09 /2025

Abstract: Climate change, desertification, and rapid urbanization are driving an increase in the frequency and severity of sandstorms in the Middle East, making an important contribution to atmospheric particulate matter (PM10 and PM2.5) and posing threats to public and occupational health. This paper reviews evidence from peer-reviewed articles, policy reports, and health databases on the health impacts of sandstorm-associated pollution and the effectiveness of interventions to reduce them. The focus is on respiratory, cardiovascular, and psychosocial health outcomes, and current strategies are assessed, including early-warning systems, personal protective equipment (PPE), and occupational safety and health (OSH) frameworks. Results show consistent associations between sandstorm events and increased rates of hospital admissions, occupational injuries, and lost productivity, with a particular impact on outdoor workers and at-risk populations. Nevertheless, regional responses to the health risks of sandstorms are inconsistent and often fragmented, with low levels of public awareness and preparedness, sporadic use of PPE, and weak enforcement of OSH standards. Recommendations for research and practice are provided to inform more integrated, cross-sectorial approaches to reduce health risks and build resilience to sandstorms in affected regions.

Keywords: Sandstorms, particulate matter, occupational safety, public health, Middle East, air pollution, respiratory illness, environmental hazards.

How to Cite in APA format: Juba, O. O. (2025). Recurrent Sandstorms and Their Impact on Occupational and Public Health in the Middle East, Qatar: A Comprehensive Review of Risks, Interventions, and Policy Implications. *IRASS Journal of Multidisciplinary Studies, 2(9)5-7.*

Introduction

Sandstorms, a common environmental phenomenon, occur in arid and semi-arid regions, where high-speed winds pick up and transport fine dust particles into the atmosphere. Sandstorms in the Middle East, have increased in frequency and intensity in recent years, due to a variety of factors including climate change, land degradation, and rapid industrialization (Goudie, 2014; Middleton, 2017). The delicate particulate matter (PM10 and PM2.5) released during sandstorms can be inhaled deep into the lungs and enter the bloodstream, leading to respiratory and cardiovascular diseases, hospitalizations, and premature deaths (Brook et al., 2010; Al-Taiar et al., 2013).

This literature review aims to synthesize the current state of knowledge on the public and occupational health impacts of sandstorms in the Middle East, Qatar. The review will cover epidemiological evidence, occupational health risks, public health impacts, existing mitigation measures, and policy frameworks. The review will also highlight important research gaps and provide recommendations for future interventions.

Methods

A systematic review approach was used to identify and review literature on sandstorms and health outcomes in the Middle East. The PubMed, Scopus, and Web of Science databases were searched using combinations of the keywords *sandstorm, dust storm, particulate matter, PM10, PM2.5, air pollution, occupational health, and Middle East*. The inclusion criteria included peer-reviewed articles, government reports, and WHO publications from 2003 to 2024, focusing on air pollution, health impacts, and occupational health and safety related to sandstorms. Titles and abstracts were screened for relevance, and full-text articles were reviewed for eligibility. Data were extracted on study location, design, health outcomes, and key findings. The evidence was synthesized narratively, and results are presented in summary tables.

Epidemiological Evidence of Health Impacts

Available studies have indicated that sandstorms are associated with PM10 and PM2.5 concentrations much higher than the WHO guidelines. Higher exposures are related to increased hospital admissions due to respiratory and cardiovascular diseases, particularly in children, the elderly, and people with existing health problems (Kanatani et al., 2010).

Table 1: Selected Studies on Sandstorms and Health Outcomes in the Middle East

Author (Year)	*Country*	*Study Type*	*Health Outcome*	*Key Findings*
Al-Taiar et al. (2013)	Kuwait	Time-series	Asthma admissions	Significant increase in asthma ER visits during dust events
Brook et al. (2010)	Multi-country	Review	Cardiovascular disease	PM2.5 exposure linked to stroke and heart disease
Middleton (2017)	Saudi Arabia	Observational	PM10 exposure	PM10 concentrations during sandstorms exceeded WHO thresholds

Occupational Health Risks

Outdoor workers are at an increased risk during sandstorms, especially in industries such as construction, oil and gas, and logistics, among others. Some of the leading problems and risks include:

- Inadequate use of PPE on account of either poor training, lack of enforcement, or supervision.
- Elevated risk of workplace accidents during sandstorms due to decreased visibility, and other unsafe conditions and hazards.
- Limited employer guidelines about work/rest cycles during a sandstorm.

Table 2: Occupational Risks Reported in Existing Studies

Risk Factor	*Evidence*	*Impact*
Lack of PPE	Multiple interview-based studies	Increased respiratory irritation and eye infections
Inadequate training	Case studies in Gulf states	Low awareness of preventive measures
Poor enforcement	Regional policy reviews	Inconsistent implementation of safety protocols

Public Health Outcomes

Sandstorms have been associated with increases in hospital emergency department visits for asthma, bronchitis, and COPD. Cardiovascular events, such as myocardial infarctions and strokes, have also been found to increase after major dust events. Psychological health effects, such as stress and anxiety due to disruption in people's natural environment, have also been documented, but are understudied.

Policy and Intervention Strategies

A few countries, such as Qatar in the Middle East, have developed air quality monitoring networks and implemented early-warning systems. However, these systems have not consistently been well implemented or made publicly available. Awareness efforts and information dissemination to the public have also been occasional and limited by available resources. Guidelines on occupational safety and regulation during sandstorms have also been inconsistently enforced.

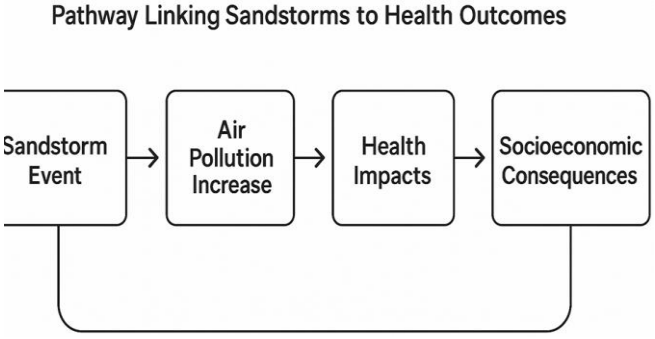

Figure 1: Pathway Linking Sandstorms to Health Outcomes

(Sandstorm Event → Air Pollution Increase → Human Exposure → Health Impacts → Socioeconomic Consequences)

Table 3: *Intervention Strategies and Effectiveness*

Intervention	*Evidence of Effectiveness*	*Limitations*
Early-warning systems	Effective in reducing exposure	Limited regional coverage
PPE distribution and enforcement	Reduces inhalation of particulates	Poor compliance, cost barriers
Public education	Improves knowledge and risk perception	Sporadic campaigns, low reach

Research Gaps and Future Directions

- Absence of long-term cohort studies regarding chronic consequences of sandstorm encounters.
- Scarce investigation into the economic burden of health effects.
- Limited data on psychosocial outcomes associated with recurrent sandstorms.
- Unclear region-specific occupational health recommendations with enforceable standards.

Conclusion

The document provides a critical analysis of public health interventions and policies related to sandstorms in the Middle East. The evidence of health impacts of sandstorms is consistent across studies, suggesting increased hospitalizations, work-related injuries, and psychosocial distress. However, the current interventions are fragmented and limited in scope, with gaps in early-warning systems, occupational health regulations, and public awareness campaigns.

Recommendations for improvement include a need for more cross-sectoral coordination among policymakers, public health officials, and occupational safety agencies. Future research should focus on longitudinal health studies, economic evaluations of interventions, and the development of context-specific mitigation strategies.

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