Using time series studies to unravel the short-term health effects of particulate matter air pollution in Eastern Mediterranean Region

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Background

Particulate matter (PM) air pollution poses a significant threat to public health globally, with numerous studies linking it to adverse health outcomes *(1–3)*. Time series regression studies have been widely used in investigating the short-term mortality and morbidity due to PM, providing substantial information to derive and upgrade the WHO air quality guidelines values for acute exposure to PM < 2.5 µm (PM2.5) and PM < 10 µm (PM10) *(4)*. The Eastern Mediterranean Region (EMR) is characterized by countries with varying levels of air pollution exposure, industrialization, socio-economic gradients, and population density. A common environmental challenge shared by EMR countries is the direct influence of sand and dust storms, and there is no precise distinction between sand and dust storms, because there is a continuum of particle sizes in any storm. Desert dust events are often associated with substantial increases in measured concentrations of both PM10 and PM2.5 size fractions *(4)*.

Understanding the health effects of PM air pollution is particularly challenging due to the complexity of the air quality mixture from composite source profiles *(5,6)*. Although the region has the highest levels of PM air pollution, there are very few studies evaluating its acute health effects. Among the 66 studies in a systematic review commissioned by WHO to inform the air quality guidelines, none was conducted in the EMR *(2)*. Similarly, the most extensive study ever conducted, with data from 652 cities, to assess the association of short-term mortality with PM, only included data from one site (Kuwait City) in the region *(7)*.

Challenges in assessing the health effects of PM air pollution

Considering the lack of robust evidence from studies in dusty environments, the health impact assessment of ambient air pollution is being conducted using exposure-response functions of non-dusty environments *(8)*. Unless additional evidence is forthcoming, this approach relies on the assumption that the health risk per microgram of dust is comparable to that of other PM constituents, with the exception of sulphates and elemental carbon, for which there is good evidence of greater effects than other constituents *(9)*. The question of including/excluding the dust fraction of PM in the health assessments remains unanswered; time series studies conducted in dusty environments will partially answer the question. However, the frequent presence of sand and dust storm introduces several challenges in assessing the short-term effects of PM pollution in the EMR. First, sand and dust storms can significantly increase PM concentrations, leading to acute health impact, mainly exacerbation of cardiovascular events and respiratory diseases *(10)*. Second, the composition of PM during dust events is diverse, containing not only mineral dust but also pollutants from anthropogenic sources, making it challenging to attribute health effects solely to PM exposure *(5)*. Third, the interaction between desert dust particles and other pollutants may alter their physical and chemical properties, further complicating the estimation of health effects *(5,6)*. Among these complexities, epidemiological time series studies offer a critical approach to disentangling the immediate health consequences of PM pollution from different sources during sand and dust storm events *(6)*.

Promoting international collaboration and building capacity

Insights from multilocation time series studies have helped in developing appropriate evidence-based policies and interventions to mitigate the health impacts of PM pollution. There are numerous examples of multi-location global *(7)* and regional studies in Europe *(11,12)*, United States *(13)*, Latin America *(14)*, and Asia *(15)*. However, no collaborative effort has yet been made to conduct a multi-location study in the EMR. Given the transboundary nature of sand and dust storms, international collaboration is essential for conducting comprehensive time series studies and addressing the health impacts of PM air pollution in this region *(16)*. Collaborative research initiatives can facilitate data sharing, harmonize methodologies and strengthen research capacities across countries in the region.

It is important to note that daily mortality counts for time series studies are not encumbered by confidentiality or ethical concerns, because they represent aggregate statistics and not individualized information. Open data sharing and transparency will be essential for fostering collaborative efforts that will facilitate comprehensive understanding of the complex interplay between air quality and public health in the region. Therefore, engaging governments, regulatory agencies and other stakeholders in this research endeavour would enhance understanding of the socioeconomic and cultural factors influencing vulnerability to PM air pollution, thereby enabling more targeted interventions and adaptation strategies in the current climate change scenario *(17)*.

Conclusion

Despite the abundance of evidence on the short-term health effects of PM air pollution, there is an urgent need to conduct epidemiological studies to elucidate the health consequences in specific environments like the WHO EMR. The complexity of PM exposure exacerbated by frequent sand and dust storms underscores the importance of conducting time series studies to elucidate its immediate health effects. Although this commentary focuses on the short-term health impact of PM pollution in the EMR, we acknowledge the need for cohort epidemiological studies to understand the long-term health impact. There is a clear need to study the long-term health impact of chronic PM exposure to complement our understanding of the health burden associated with sand and dust storms. Using rigorous methodologies and fostering international collaboration, stakeholders in the region can generate actionable insights to inform policy decisions, protect public health and build resilience against the impacts of PM air pollution in this unique environmental context.

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