

The Effect of Air Pollution on Pediatric Respiratory Hospital Admissions During Hajj in Makkah, Saudi Arabia: A Time-Series Study

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Abstract:

Air pollution is a major public health concern, particularly for children, who are more vulnerable to respiratory illnesses. Makkah hosts one of the largest annual mass gatherings in the world, with millions of pilgrims arriving during the Hajj season within a short period of time. This exceptional increase in population density is accompanied by heavy traffic and extensive transportation activity, leading to heightened urban emissions that substantially elevate air pollution levels. Despite these unique conditions, evidence on the respiratory health effects of air pollution among children in Makkah remains scarce. To our knowledge, this is the first study to specifically investigate the short-term association between air pollution and pediatric acute lower respiratory infections in this setting.

This study examined the association between selected air pollutants, specifically PM₁₀ and NO₂, and hospital admissions for acute lower respiratory infections (ALRI) among children in Makkah, Saudi Arabia, from January 2021 to December 2022. Time-series Poisson regression models adjusted for long-term trends and seasonal variation were used to assess these relationships. The models also included interaction terms to explore whether the Hajj period modified the effects of air pollution on pediatric ALRI admissions.

The findings showed that exposure to NO₂ was significantly associated with an increased risk of ALRI admissions in children, particularly on the same day of exposure (lag 0) during the Hajj period (Model 3: RR = 1.028; 95% CI: 1.002–1.053). In contrast, PM₁₀ did not demonstrate a statistically significant association with pediatric ALRI admissions.

Overall, the results indicate that NO₂ plays a more important role than PM₁₀ in short-term respiratory risks for children, especially during periods of extreme population influx such as Hajj. These findings provide critical evidence to support policymakers and public health authorities in designing targeted air quality control strategies, improving traffic and emission management during mass gatherings, and implementing preventive measures to reduce avoidable hospital admissions. Ultimately, this evidence can help protect public health, reduce the burden on healthcare systems, and safeguard vulnerable populations, particularly children, in Makkah.