Abstract

Air pollution, specifically fine particulate matter (PM2.5), is a critical global health concern, contributing to an estimated 4.2 million premature deaths annually. PM2.5 exposure is strongly linked to elevated risks of cardiorespiratory diseases, including cardiovascular conditions, chronic respiratory illnesses, and lung cancer. Thailand's urban and industrialized areas, in particular, face deteriorating air quality, with PM2.5 concentrations often exceeding national and international safety standards. Despite extensive documentation of air pollution's health effects, a significant research gap persists in understanding the long-term mortality impacts of PM2.5 exposure across diverse Thai regions.

This study investigates the relationship between PM2.5 pollution and cardiorespiratory mortality in Thailand from January 2015 to December 2019. Utilizing high-resolution satellite-based PM2.5 data, mortality records, and population statistics, the research employs advanced statistical methodologies, including Poisson regression modeling and Moran's I spatial analysis, to assess regional variations in air pollution and its association with mortality rates.

Findings indicate a significant correlation between PM2.5 exposure and increased cardiorespiratory mortality, with the highest risks observed in the central and northern regions, which experience the most severe pollution levels. Seasonal analysis reveals peak mortality rates during the dry season (November to April), coinciding with heightened air pollution from biomass burning, industrial emissions, and meteorological conditions that worsen pollutant accumulation. Specifically, monthly PM2.5 concentrations above 30 $\mu g/m^3$ are associated with a 1%-7% increase in mortality risk, while levels below 20 $\mu g/m^3$ correlate with a 3%-6% reduction.

These results underscore the urgent need for comprehensive air quality management strategies, stricter emission controls, and enhanced monitoring systems to mitigate air pollution's health impacts. Furthermore, spatial analysis identifies high-risk areas, emphasizing the necessity of targeted policy interventions and region-specific mitigation measures. This study contributes to the growing evidence supporting the implementation of more stringent air pollution regulations and public health initiatives to safeguard vulnerable populations in Thailand.

Keywords: Air pollution, PM2.5, Cardiorespiratory mortality, Spatiotemporal analysis, Thailand, Poisson regression, Moran's I spatial analysis, Public health, Satellite-based monitoring, Remote sensing, Environmental health