Methodology for Assessing the Association between Ambient PM2.5 and Daily Acute Heart Failure Admissions in Greater Cairo, 2004

A, m, i, r, a, E, l, -, S, a, y, e, d, ,, K, a, r, i, m, A, b, d, e, l, -, M, a, l, e, k

DOI: https://doi.org/10.5281/zenodo.PENDING_2918

Abstract

Air pollution, particularly fine particulate matter (PM2.5), is an established global cardiovascular risk factor. Greater Cairo, a major megacity, experiences high ambient pollution levels. Robust, region-specific epidemiological evidence linking PM2.5 to acute heart failure admissions has been scarce, hindered by methodological challenges in data acquisition and analysis within this setting. This methodology article details a structured approach to quantify the association between daily ambient PM2.5 concentrations and daily hospital admissions for acute heart failure in Greater Cairo. The primary objective is to provide a transparent and replicable analytical framework for environmental epidemiological research in similar urban contexts with constrained routine air quality monitoring. The design is a time-series study. The methodology specifies procedures for obtaining daily acute heart failure admission counts from major public hospitals. It details the derivation of spatially representative daily PM2.5 exposure estimates by integrating satellite-based aerosol optical depth data, available ground monitoring measurements, and land-use regression modelling. Statistical analysis employs over-dispersed Poisson generalised additive models, controlling for long-term temporal trends, day of the week, public holidays, and meteorological variables including temperature and humidity. As a methodology article, this paper presents no empirical results from an applied study. The described

analytical model is designed to estimate the percentage increase in daily acute heart failure admissions associated with a unit increase in PM2.5 concentration, together with its corresponding confidence interval. The outlined methodology provides a structured and scientifically rigorous approach for investigating the acute cardiovascular effects of air pollution in Greater Cairo. It is designed to address specific regional challenges in exposure assessment and confounder control. Researchers applying this framework should establish robust data linkage protocols and consider sensitivity analyses for model parameters. The methodology is adaptable for studying other acute cardiovascular outcomes and for application in other cities with similar data constraints. Air pollution, particulate matter, PM2.5, heart failure, epidemiology, time-series analysis, methodology, Egypt. This work provides a detailed methodological framework for assessing air pollution-health associations in resource-limited urban settings, aiming to strengthen local evidence for public health policy.