

## **A Stratified Meta-Analysis of Source-Specific Particulate Matter (PM10) and Its Health Effects**

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Earlier epidemiological studies have consistently found that airborne particulate matter less than or equal to 10  $\mu\text{m}$  in diameter (PM10) can affect people's health in many ways, such as respiratory and cardiovascular diseases, and related premature deaths. In recent years, studies are increasingly addressing the sources of particles as a factor that plays an important role in the health effects. For instance, some argued that particles from different sources are not equally toxic to the exposed population, but some of them such as particles from combustion-related sources may pose a greater health risk. Given this evidence, it is not appropriate to assume that every pollution abatement strategy has the same health impact per unit change in the mass concentrations. However, currently the source-specific PM10 health risks are not yet sufficiently understood due to the difficulty in source apportionment.

To compare the source-specific PM10 health risk quantitatively based on earlier epidemiological evidence, this study conducted a stratified meta-analysis by grouping similar time-series studies and pooling their estimates of the association between short-term exposure to PM10 and mortality. Based on the most commonly reported particle sources in epidemiological studies, the sources of particles are classified into three categories: mobile, industrial and crustal, and separate meta-analyses were performed within each source group, as well as heterogeneity tests. In performing this meta-analysis, the author reviewed all accessible time-series studies on acute PM10 and mortality from Medline (National Library of Medicine) database, U.S. EPA's particulate matter research publication list, as well as references of published articles (including individual analyses and meta-analyses). There was no restriction on the location of studies.

The criteria to evaluate and select studies that will be included in the meta-analysis include: (1) Including studies in which a single major source of PM10 was reported in the study area, but excluded studies that did not report the sources of PM10 as well as studies that reported more than one major sources; (2) Coal combustion is considered as industrial sources; (3) Including studies on mortality of all age (excluding studies focusing on infants, children or elderly mortality); (4) Including studies that reported both the mean estimates of effect and the precision of estimation (confidence intervals); and (5) If more than one study have been conducted using the same population, include the most recent one, regardless whether the research groups are the same. Moreover, a minimum of four available estimates is required to conduct a meta-analysis. In addition, the estimated health effects of PM10 were converted into a common metric of the percentage change of mortality per 10- $\mu\text{g}/\text{m}^3$  increase in ambient PM10 concentrations.

The pooled estimates were: a 10  $\mu\text{g}/\text{m}^3$  increase in PM10 from mobile sources were associated with a 1.22% (95% CI, 0.41-2.04%; Random Effects Model) increase in daily all-cause, non-accidental mortality, whereas an equivalent increase in PM10 from industrial and crustal sources were associated with 0.58% (95% CI, 0.08-1.07%; Random effects model) and 0.55% (95% CI, 0.19-0.92%; Fix Effect Model) increases in daily all-cause, non-accidental mortality, respectively. Therefore, the pooled estimates indicate that the acute health effects of particles from mobile sources in terms of mortality are more than two times larger than the effects particles from industrial or crustal sources, whereas no appreciable difference between the effects of industrial and crustal sources was found.

These results provide valuable evidence for future health benefit analyses of particulate matter abatement strategies. Overall, this study suggests that particles from mobile sources may pose the greatest health risk, but particles from industrial and crustal sources are not ruled out either. Given this, PM10 air quality management should not only focus on a national ambient standard, but also sources of particle, in particular traffic-related sources.