A call for epidemiology where the air pollution is

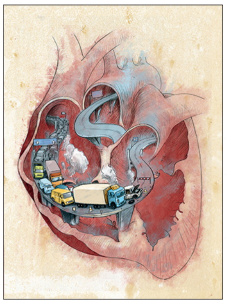
The global burden of disease from ambient air pollution is substantial (nearly 8% of all deaths), and increasing with time—largely due to increases in fine particulate matter ($PM_{2·5}$) and the number of deaths from non-communicable diseases, especially in large low-income and middle-income countries (LMICs) experiencing population growth and ageing.[1] Increased awareness of air pollution as a major global public health issue is reflected in the inclusion of air pollution-related mortality and morbidity in targets to meet the health-focused Sustainable Development Goal 3. Despite the large burden of disease from ambient air pollution and evidence of the cost-effectiveness of mitigation measures,[2] surprisingly it remains largely absent from guidance on non-communicable disease prevention.[3]

The body of epidemiological evidence regarding the health effects of air pollution is now large; evidence has emerged that air pollution is associated with every major organ system.[4] Nonetheless, the evidence is conspicuously incomplete; a point clearly illustrated by the systematic review and meta-analysis by Katherine Newell and colleagues[5] of the effects of particulate matter (PM_{10} and $PM_{2·5}$) on cardiovascular and respiratory mortality and hospital admissions. Previous systematic reviews have yielded convincing evidence of the effect of short-term exposure to particulate matter on cardiorespiratory mortality and hospital admissions, including for myocardial infarction, heart failure, and stroke.[6–8] Newell and colleagues add to the scientific literature by focusing specifically on LMICs and potential variations in magnitude across LMIC regions.

The most notable finding from the systematic review is the very small number of studies of long-term exposure. Of 91 studies meeting the eligibility criteria, only four were studies of long-term exposure derived from two Chinese populations, providing estimates based on PM_{10} but not $PM_{2·5}$. The meta-analysis included only studies relating day-to-day variation in air pollution and daily counts of deaths and hospital admissions from time-series and case-crossover studies. Among the studies included in the meta-analysis, only one was available for Africa. In cases for which enough studies were available to compare estimates between LMIC regions, estimates were larger for Latin America and the Caribbean compared with east Asia and the Pacific for several outcomes, including respiratory and stroke mortality. Whether observed differences in effects are due to differences in particle concentrations or composition, population vulnerability, or cause of death determination across countries is unclear and warrants further research.

This systematic review[5] brings the paucity of studies linking long-term exposure to $PM_{2·5}$ and cardiorespiratory mortality and morbidity at exposure levels above those seen in North American and western Europe into sharp focus. This paucity of research in LMICs is one of the main limitations in the evolving Global Burden of Disease effort to estimate attributable burdens to air pollution.[1] At present, the Global Burden of Disease estimates for $PM_{2·5}$ are based on integrated exposure response functions combining estimates from cohort studies of long-term exposure in high-income countries (with relatively low exposures) with passive and active smoking to approximate the global exposure range.[9] A clear need exists for more direct epidemiological evidence of long-term exposure at high pollution levels in view of the high likelihood that relationships are not linear. Estimates from short-term exposure studies, such as those included in the meta-analysis by Newell and colleagues, shed limited light on the burden of disease in LMICs because the effects from short-term exposures are smaller than the effects from long-term exposures,[10] resulting in an underestimation of the full effect of air pollution on cardiorespiratory health.

Filling this gap in the epidemiological evidence will require advances in the estimation of long-term exposure to particulates in LMICs. Substantial challenges remain in the adaptation of exposure models used for large population studies in high-income countries to LMIC settings. Ambient monitoring is less available in LMICs than in high-income countries, and what is available, rarely covers rural areas. Additionally, LMICs tend to have greater diversity of local sources of air pollution (eg, crop and trash burning, biomass-fuel use, and culturally specific sources), which are difficult to capture with routinely available land-use or remote-sensing data.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See **Articles** page e368

Present knowledge suggests the relation between particulate matter and cardiovascular and respiratory mortality flattens out at higher exposure levels.[1] The systematic review by Newell and colleagues[5] covered cities with mean $PM_{2·5}$ levels ranging from 56 μg/m³ to 179 μg/m³ (43–142 μg/m³ for PM_{10}). The authors could have taken their analysis further to investigate the shape of the exposure–response relationship over this broad range, shedding light on the extent to which mean concentration contributed to the substantial heterogeneity reported across studies.

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I declare no competing interests.

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