Keeping an Eye on $PM_{2.5}$

Satellite Data Reveal Global Picture of Particulate Pollution

Scientists are using satellite observations to provide estimates of air quality with increasing reliability. For the first time researchers have now used satellite data to provide long-term air quality estimates of fine particulate matter ($PM_{2.5}$) that span the globe [*EHP* **118:847–855; van Donkelaar et al.**]. The study showed that many developing countries have high long-term levels of $PM_{2.5}$, which is produced by sources such as forest fires, coal-fired power plants, vehicles, and industrial facilities. These particles pose a health concern because of their ability to penetrate deep into the lungs.

The study used satellite data gathered over 6 years, remarkably providing some of the first long-term measurements of air quality for many regions where ground-level sampling stations are few or nonexistent. The scientists combined data gathered from two different NASA satellite instruments with different capabilities—MODIS (Moderate Resolution Imaging Spectroradiometer) and MISR (Multiangle Imaging Spectroradiometer)—to generate a more accurate estimate of $PM_{2.5}$. The satellite data yield a measurement called aerosol optical depth (AOD), which relates to the total amount of aerosol particles in the air between the ground and the satellite. The scientists combined AOD from the two satellites, then applied a chemical-transport model that integrated details about atmospheric structure and chemistry. The authors validated this approach by comparing their estimates to those taken from actual sampling performed at the ground level and found a statistically significant level of agreement.

The estimates showed that 80% of the global population lives in places where concentrations of $PM_{2.5}$ exceed the World Health Organization (WHO) air quality guideline of 10 μg/m^3. The WHO has set an interim target of 35 μg/m^3, which is exceeded over central and eastern Asia for 38% and 50% of the population, respectively. (The WHO guideline sets an ultimate goal for national air standards, whereas the interim target is proposed as an incremental reduction that could achieve significant, though not optimal, reductions in pollution-related health effects.) Eastern China showed a very high level of pollution—an estimated annual average of more than 80 μg/m^3.

The authors state that the methods described and validated by the study could be applied to studies of health effects from exposure to air pollution around the world. This is particularly true for areas where ground-based sampling is lacking, many of which are sites of rapid urbanization, where large populations are exposed to high levels of air pollution. They note that additional work is needed to address issues that may limit the accuracy of the satellite-based estimates, such as non-uniform satellite sampling and the satellites' inability to retrieve AOD under cloudy conditions.

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A Marked Disadvantage

Rapid Urbanization and Mortality of Young Children in Nigeria

Individual-level socioeconomic position has long been recognized as a factor in childhood mortality, with lower position carrying a higher risk of death before age 5. Recent research suggests that living in a socioeconomically disadvantaged area increases a child's risk even after adjusting for factors such as mother's education or income. A new study using data from Nigeria shows higher rates of under-5 mortality coincided with increased urbanization and uniquely accounts for the impact of disadvantaged neighborhoods on mortality in this age group [*EHP* **118:877–883; Antai and Moradi**].

The pace of urbanization in low- and middle-income countries, paired with inadequate economic performance and other constraints, can result in urban residents increasingly living in areas with overcrowded or deteriorating housing, few social amenities, poor environmental and sanitary conditions, and a lack of economic opportunities. Such conditions are associated with an increased risk of infectious disease and death, with under-5 mortality rates in particular reflecting the degree of socioeconomic development in specific geographic areas.

Nigeria has very rapidly shifted from a mostly rural nation to a heavily urbanized one. In 1970 only 16% of the population lived in an urban area compared with an estimated 40% or more today. The current study used cross-sectional data from the 2003 Nigeria Demographic and Health Survey to assess how urbanization related to under-5 mortality rates and to evaluate the influence of area-level socioeconomics. A subsample of 1,350 mothers and 2,118 of their children, representing 165 administratively defined communities, was selected from the data, which provided demographic and socioeconomic information as well as children's birth order and time intervals between siblings' births. Neighborhoods were ranked by "urban area disadvantage index" scores, calculated by the percentage of children living in households without piped water, flush toilets, electricity, or nonpolluting cooking fuel; whose mothers were unemployed or uneducated; and whose households were overcrowded or among the poorest 40%.

Analysis revealed that under-5 mortality increased in the periods 1979–1983 and 1999–2003. Additionally, after controlling for individual child and maternal factors, under-5 mortality rose with urban area disadvantage index score. The researchers concluded that living in a socioeconomically disadvantaged neighborhood independently increased mortality for children under 5 years old. Additionally, they confirmed other research showing that first-born status and short interval between births increased the risk of early childhood death. This study highlights a need for data to better define relationships between urban environments and health, a focus on reducing inequalities, and a promotion of longer birth intervals.

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Children play in the Lagos slum of Ajegunle, known locally as AJ City.

George Osodi/Panos Pictures