

NO₂ increases the risk for childhood asthma: a global concern



In the past decade, studies and statements from international agencies on the relationship between ambient air pollution and human health have raised the call for action. An analysis¹ of the data from the Global Burden of Diseases Study 2015 indicated that approximately 4·2 million deaths and 103 million disability-adjusted life-years were attributable to exposure to particulates, with similar data available from WHO.² The Lancet Commission on Air Pollution and Health³ stated that 16% of all premature deaths in 2015 were attributable to pollution. Among these alarming statistics, adverse respiratory health assumes a priority position, particularly among children.

Childhood asthma has reached global epidemic proportions⁴ and, although the evidence for a causal relationship with ambient pollution is still emerging, studies have repeatedly shown associations of pollution with various asthma phenotypes and proxy markers, such as emergency room visits, school absenteeism, and steroid dependency. However, a level of inconsistency exists across various pollutants for these outcomes. For example, a 2017 meta-analysis⁵ reported the varying risk for asthma incidence across studies, with odds ratios ranges of 0·93–1·25 for each 4 µg/m³ increase in nitrogen dioxide (NO₂) concentrations and 0·84–1·32 for each 1 µg/m³ increase in fine particulate matter (PM_{2·5}) concentrations. Despite these inconsistencies, meta-analyses^{5,6} of traffic-related air pollution and childhood asthma incidence provide convincing evidence for increased risk of exposure, particularly for NO₂. These effects are seen at concentrations below the ambient air quality guidelines recommended by WHO⁷ of 40 µg/m³ (21 ppb) annual average NO₂ concentrations. A better understanding of the pollutant-related effects on childhood asthma incidence at a global level is crucial to addressing interventions and policy initiatives. In *The Lancet Planetary Health*, Pattanun Achakulwisut and colleagues⁸ provide a novel approach to this challenge.

By use of well validated global datasets for both exposure and outcome and with estimates of risk derived from the scientific literature, the authors modelled childhood asthma incidence attributable to NO₂. Concentration-response functions were derived from a meta-analysis that reported a relative risk of 1·26 (95% uncertainty interval (UI) 1·10–1·37) for

every 10 ppb increase in NO₂ concentrations. Global NO₂ surface concentrations were derived from a land use regression model that extracted data from over 5000 ground-level monitors in 58 countries, as well as satellite-available pollution data.⁹ The 2015 Global Human Settlement population grid provided population distribution and density information, and country-specific and age-group-specific asthma incidence rates were obtained from the Institute for Health Metrics and Evaluation for 194 countries. The major advance of Achakulwisut and colleagues' study, compared with previous works, was the ability to estimate this incidence at very fine spatial resolution of 250×250 m across 21 regions, 194 countries, and 125 major cities globally. The advantage of this resolution allowed for determining within-city variation, differentiating between urban risk zones.

On the basis of their analysis, the authors reported that 4·0 million (95% UI 1·8–5·2) new childhood asthma cases could be attributable to NO₂ pollution annually, accounting for 13% (6–16) of the incidence worldwide. Attributable burden varied across regions, ranging from 340 cases per year per 100 000 children (95% UI 150–440) in Andean Latin America to 76 cases (33–100) in eastern sub-Saharan Africa. Large-city variation was also evident, ranging from 690 cases per year per 100 000 children (330–870) in Lima, Peru, to 83 cases (36–110) in Orlu, Nigeria, with Chinese cities mostly in the 400–650 range. A substantial percentage of childhood asthma incidence was attributed to NO₂ exposure, globally, but this was most striking for the Chinese cities: Shanghai (48%, 95% UI 25–57), Tianjin (43%, 16–42); Beijing (42%, 21–51) and Shenyang (41%, 21–50).

Despite providing a novel approach to understanding the relationship between traffic-related air pollution and childhood asthma, Achakulwisut and colleagues' study brings forth important epidemiological challenges. The lower estimates of risk seen in south Asia and sub-Saharan Africa, compared with those in other regions, are largely driven by data availability. Exposure data is sparse for these regions, influencing the development of exposure models from these countries.⁹ Additionally, asthma incidence data are likely to be very scarce, particularly with the use of

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so-called doctor-diagnosed asthma outcome definition in countries with poor health-care access, resulting in caregivers and children not being aware that their, or their children's, symptoms might be typical of asthma. These issues are likely to bias the findings from these regions. A better understanding of the risk in such regions is necessary, because research findings might have policy implications for interventions in these low-middle-income countries.

An important outcome from this study is the further evidence that the existing WHO standards are not protective against childhood asthma. Achakulwisut and colleagues estimated that approximately 92% of the childhood asthma incidence attributable to NO₂ exposure was in areas with NO₂ concentrations below the values of the WHO annual average guidelines. This strengthens the case for the downward revision of these global standards and for stronger national policy initiatives in countries without air quality standards. Furthermore, these findings not only support the association of NO₂ exposure with childhood asthma incidence, but also, because this pollutant serves as an important proxy for broader traffic related air pollutants, highlight that urgent intervention is necessary to protect the health of those most vulnerable in society: children, particularly those with pre-existing respiratory disease.

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I declare no competing interests.

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