Potential Health Benefit of NO₂ Abatement in China’s Urban Areas: Inspirations for Source-specific Pollution Control Strategy

Haikun Wang, Rong Tang, and Yifan Liu

Abstract

“Restrictions on indoor and outdoor NO₂ emissions to reduce disease burden for pediatric asthma in China: a modeling study” by Hu et al. estimates the pediatric asthma incidence and corresponding economic losses attributable to NO₂ from indoor and outdoor sources in urban areas of China, and provides insight into the effectiveness of controlling NO₂ from different sources to protect human health. Such evaluations of health risk from air pollution and related economic losses are important impetuses for governments to adopt rigorous pollution abatement policy, and assessing the source-specific risks could help find the most cost-effective way.

Abundant corroborating evidence has shown the damages of air pollution on human health, at even lower concentrations than previously understood. Accordingly, WHO has tightened the air quality guidelines in 2021, in which the NO₂ guideline level decreased by 75% compared to the last global update in 2005 as the maximum adjustment. However, comparing to PM₁₀ and O₃ pollution, the NO₂-attributable disease burden remains poorly quantified and missing from the Global Burden of Disease (GBD) assessment, let alone the specific burden of NO₂ from indoor sources.

Indoor NO₂ comes from both infiltration of ambient air and indoor emissions. The contribution of outdoor-to-indoor penetration is usually significant in urban areas, since major anthropogenic sources of ambient NO₂ is fossil fuel combustion, especially fuel used in vehicles. Indoor sources (e.g., cooking and smoking) contribute ~33% of human exposure to NO₂ in China’s urban areas, and their contribution might increase as people spend more time within the room, especially in the post-pandemic era.

China, with dense population, high NO₂ emission and huge health risks in urban areas, may serve as a strong case to blaze a trail in health-oriented strategy on NO₂ pollution control. Hu et al. find that both indoor and outdoor sources contribute to the high pediatric asthma incidence attributable NO₂ exposure in China. In turn, a substantial portion of the health and economic loss could be avoided by specific emission restrictions. We learn that abatements in outdoor NO₂ emissions could reduce pediatric asthma incidences effectively in densely populated cities, such as those in eastern China. And restricting indoor NO₂ emissions could significantly reduce the incidences in most areas of China, with especially good performance (i.e., more than 80% reduction) in northern cities. It inspires us that more attention should be paid to NO₂-attributed health burden especially in urban areas. Moreover, the household environment should no longer be outside the jurisdiction. Regulations on indoor emitting sources and standards governing indoor pollution should be published and put into practice. We see opportunity that source-specific health impact evaluation could provide valuable information for designing the most cost-effective strategy in air pollution control.

Win-win opportunities for climate change mitigation also lie in relieving NO₂-related health burden, as highlighted in this paper. Concerning the lion share of ambient-NO₂-related health impacts in China’s urban areas, traffic emissions should still be a target for exposure-mitigation strategies. Alongside regulation of vehicular emission standards and fuel quality, deploying clean electricity (e.g., wind and solar) and related power systems, including the systems for transportation, would help further reduce NO₂ exposure in urban areas. In addition, the formulation of policies to restrict the most important indoor NO₂ contributors in urban areas (e.g., substituting gas stoves with electric stoves for cooking), may well be an essential initiative to reduce the disease burden attributable to NO₂ exposure.

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These measures are in line with low carbon development paths in the urban areas.

Air quality and health co-benefits of climate policies is an important driving force of coordinating air pollution control and climate change mitigation measures, and calling for vigorous climate actions in more countries.9 Yet, health burden of NO2 is rarely covered in relevant studies, not to mention its source-specific impacts. The restrictions by simply removing certain source emissions in this study allow us to catch a glimpse of source-specific potentials in NO2-related health benefit. To go a step further, integrated scenarios of climate change and air quality control can help us understand the multi-objective nexus in depth and seek for more possibilities of cost-effective counter measures.

As for health impact assessment itself, some compromises in this study could be refined in the future. Concentration-response curves built on ambient NO2 pollution were applied in the health impact assessment of indoor NO2 exposure as an imperfect alternative. Developing integrated exposure-response functions by considering both indoor and outdoor exposure to NO2 would help a lot. And there is an additional opportunity to refine the assessment — finer ambient NO2 concentration from cutting edge of air quality modeling, rather than discontinued site-observations, may better depict the NO2 exposure levels in urban areas and identify source-specific contributions.10

Contributors

HW conceived this paper. HW, RT and YL wrote the paper and agreed with the final version of it.

Declaration of interests

The authors declare no conflicts of interest.

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References

1 Hu Y, Ji JS, Zhao B. Restrictions on indoor and outdoor NO2 emissions to reduce disease burden for pediatric asthma in China: a modeling study. The Lancet Regional Health - Western Pacific. 2022. https://doi.org/10.1016/j.lanwpc.2022.100463.
2 Murray CJL, Aravkin AY, Zheng P, et al. Global burden of 87 risk factors in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. The Lancet. 2020;396(10258):1223–1249.
3 Achakulwisut P, Brauer M, Hystad P, Anenberg SC. Global, national, and urban burdens of paediatric asthma incidence attributable to ambient NO2 pollution: estimates from global datasets. The Lancet Planetary Health. 2019;3(4):e166–e178.
4 Hu Y, Zhao B. Indoor sources strongly contribute to exposure of Chinese urban residents to PM2.5 and NO2. Journal of Hazardous Materials. 2022;416: 127829.
5 Chen R, Yin P, Meng X, et al. Associations Between Ambient Nitrogen Dioxide and Daily Cause-specific Mortality. EPIDEMIOLOGY. 2018;29(4):482–489.
6 Zhang Q, Zheng Y, Tong D, et al. Drivers of improved PM2.5 air quality in China from 2013 to 2017. PNAS. 2019;116(49):24465.
7 Khreis H, Kelly C, Tate J, Parcel R, Lucas K, Nieuwenhuijsen M. Exposure to traffic-related air pollution and risk of development of childhood asthma: A systematic review and meta-analysis. Environ Int. 2017;100:1–31.
8 Wang H, He X, Liang X, et al. Health benefits of on-road transportation pollution control programs in China. PNAS. 2020;117 (41):25370–25377.
9 Tang R, Zhao J, Liu Y, et al. Air quality and health co-benefits of China’s carbon dioxide emissions peaking before 2030. NAT COMMUN. 2022;13(1):1008.
10 Liang F, Xiao Q, Huang K, et al. The 17-y spatiotemporal trend of PM2.5 and its mortality burden in China. PNAS. 2020;117 (41):25601–25608.