

A systematic review and meta-analysis of intraday effects of ambient air pollution and temperature on cardiorespiratory morbidities: First few hours of exposure matters to life

Keyu Wu ^{a,b,1}; Hung Chak Ho ^{c,1}; Hong Su ^{a,b}; Cunrui Huang ^d; Hao Zheng ^e; Wenyi Zhang ^f; Junwen Tao ^{a,b}; Mohammad Zahid Hossain ^g; Yunquan Zhang ^h; Kejia Hu ⁱ; Min Yang ^{a,b}; Qiyue Wu ^{a,b}; Zhiwei Xu ^{j,*}; Jian Cheng ^{a,b,*}

^a Department of Epidemiology and Biostatistics, School of Public Health, Anhui Medical University, Hefei, China; ^b Anhui Province Key Laboratory of Major Autoimmune Disease, Hefei, China; ^c Department of Anaesthesiology, School of Clinical Medicine, The University of Hong Kong, Hong Kong, China; ^d Vanke School of Public Health, Tsinghua University, Beijing, China; ^e Department of Environmental Health, Jiangsu Provincial Center for Disease Control and Prevention, Nanjing, China; ^f Chinese PLA Center for Disease Control and Prevention, Beijing, China; ^g International Centre for Diarrhoeal Disease Research, Bangladesh (icddr, b), Dhaka, Bangladesh; ^h Department of Epidemiology and Biostatistics, School of Health, Wuhan University of Science and Technology, Wuhan, China; ⁱ Department of Big Data in Health Science, School of Public Health, Zhejiang University, Hangzhou, China; ^j School of Medicine and Dentistry, Griffith University, Gold Coast, Queensland 4214, Australia.

* Corresponding author: Department of Epidemiology and Biostatistics, School of Public Health, Anhui Medical University, 81 Meishan Road, Hefei, Anhui Province, 230032, China. Email: jiancheng_cchh@163.com

Introduction

A growing number of studies have reported an increased risk of cardiovascular disease (CVD) and respiratory disease (RD) within hours after exposure to ambient air pollution or temperature. We assemble published evidence, aiming to answer three key questions:

- Which air pollutant(s) or temperature exposure could increase risks of CVD or RD within 24 h?
- Which cause-specific CVD or RD could be triggered within 24 h after exposure to air pollution or temperature?
- What is the susceptible time window?

Methods

- Databases of PubMed and Web of Science were searched for original case-crossover and time-series designs of English articles examining the intra-day effects of ambient air pollution (PM_{2.5}, PM₁₀, PM_{10-2.5}, SPM, O₃, SO₂, NO₂, CO, and NO) and temperatures (heat and cold) on cardiorespiratory diseases within 24 h after exposure in the general population.
- Meta-analyses were conducted to pool excess risks (ERs) of CVD and RD morbidities associated with an increase of 10 µg/m³ in particulate matters, 0.1 ppm in CO, and 10 ppb in other gaseous pollutants.



Results

- 33 studies from North America, Europe, Oceania, and Asia.
- Risk of total CVD morbidity increased within 3 h after exposure to PM_{2.5} [ER%: 2.65% (95% CI: 1.00% to 4.34%)], PM_{10-2.5} [0.31% (0.02% to 0.59%)], O₃ [1.42% (0.14% to 2.73%)], and CO [0.41% (0.01% to 0.81%)].
- Risk of total RD morbidity elevated at lag 7–12 h after exposure to PM_{2.5} [0.69% (0.14% to 1.24%)] and PM₁₀ [0.38% (0.02% to 0.73%)] and at lag 12–24 h after exposure to SO₂ [2.68% (0.94% to 4.44%)].
- Risk of myocardial infarction morbidity increased within 6 h after exposure to PM_{2.5}, PM₁₀, and NO₂, and the risk of out-of-hospital cardiac arrest morbidity increased within 12 h after exposure to CO.
- Risk of total CVD increased within 24 h after exposure to heat.

Conclusion

This study supports a sudden risk increase of cardiorespiratory diseases within a few hours after exposure to air pollution or heat, and some acute and highly lethal diseases such as myocardial infarction and cardiac arrest could be affected within a shorter time.

Funding

The National Natural Science Foundation of China (Grant No. 42105165; 81773518), the High-level Scientific Research Foundation of Anhui Medical University (Grant No. 0305044201), and the Discipline Construction of Anhui Medical University (Grant No. 0301001836).

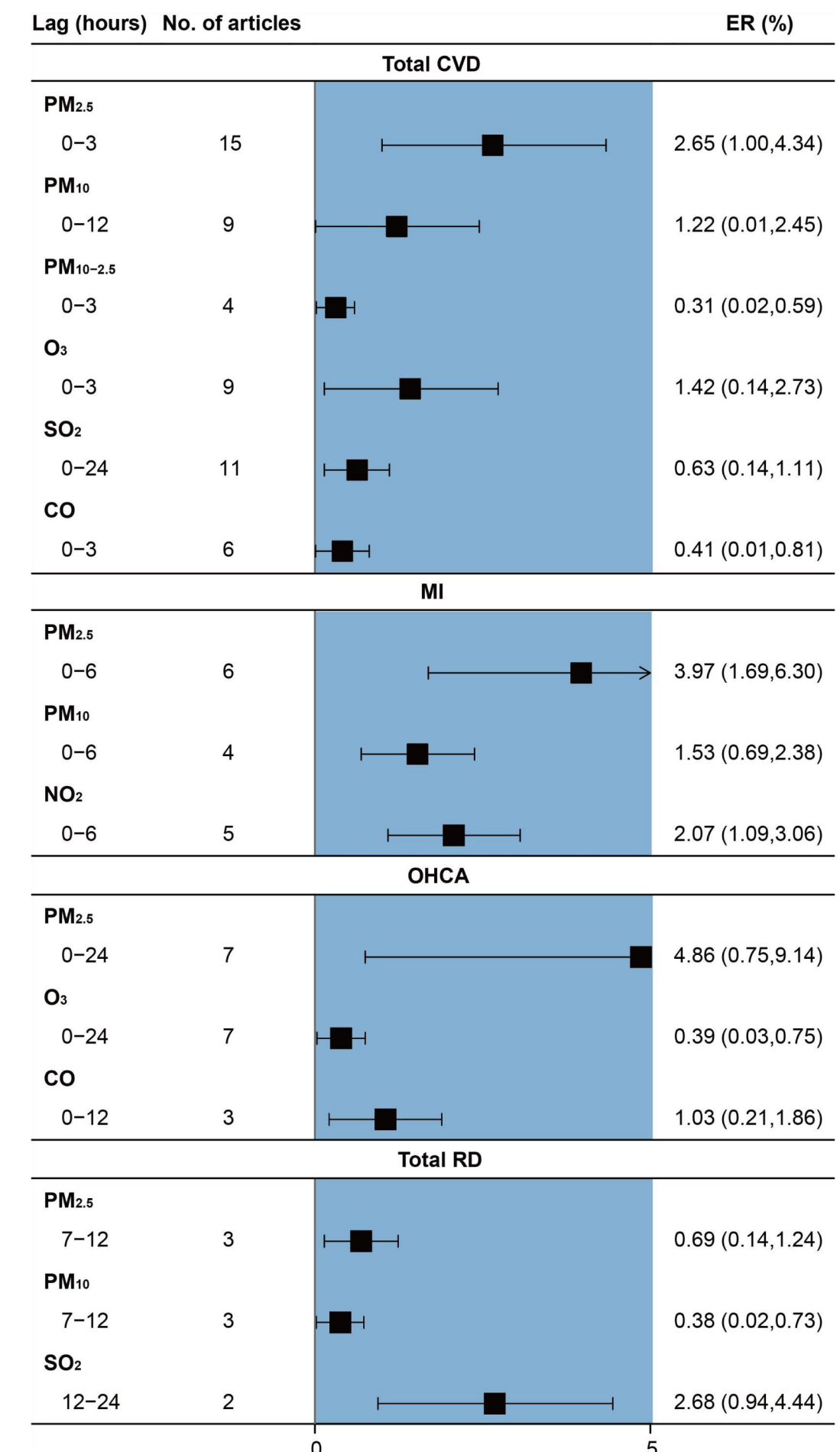


Figure 2. Pooled associations between air pollution and cardiovascular and respiratory morbidities.

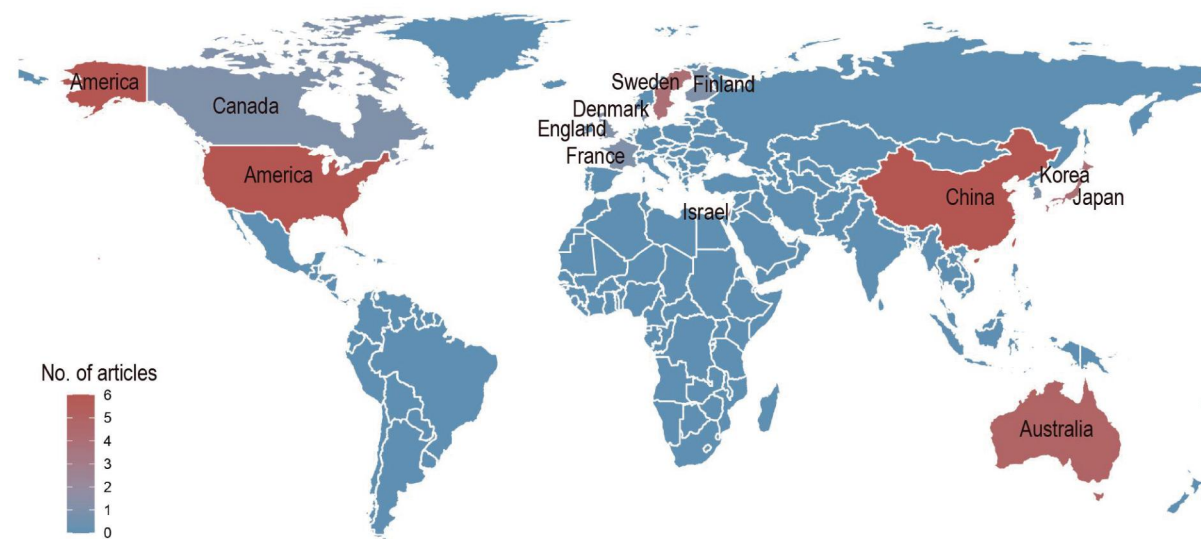


Figure 1. The geographical distribution of eligible studies by country.