Air pollution and human health in China

Haidong Kan
School of Public Health, Fudan University
kanh@fudan.edu.cn

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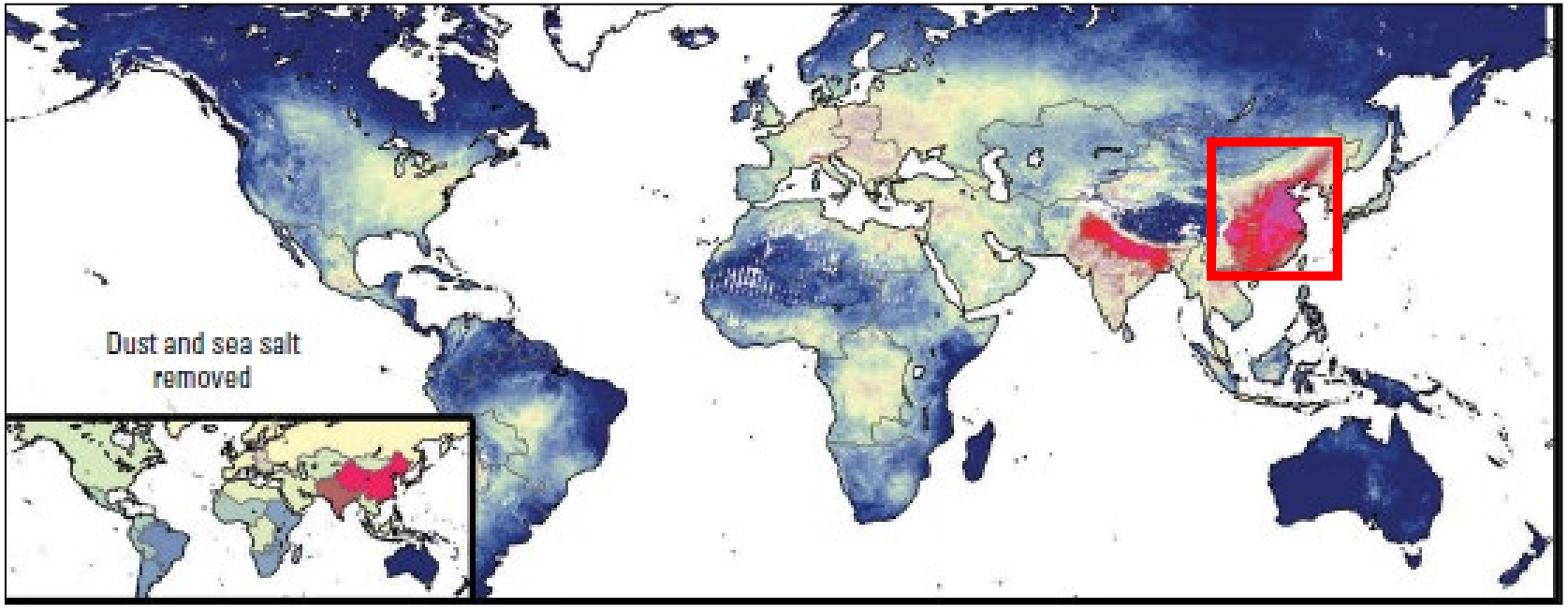
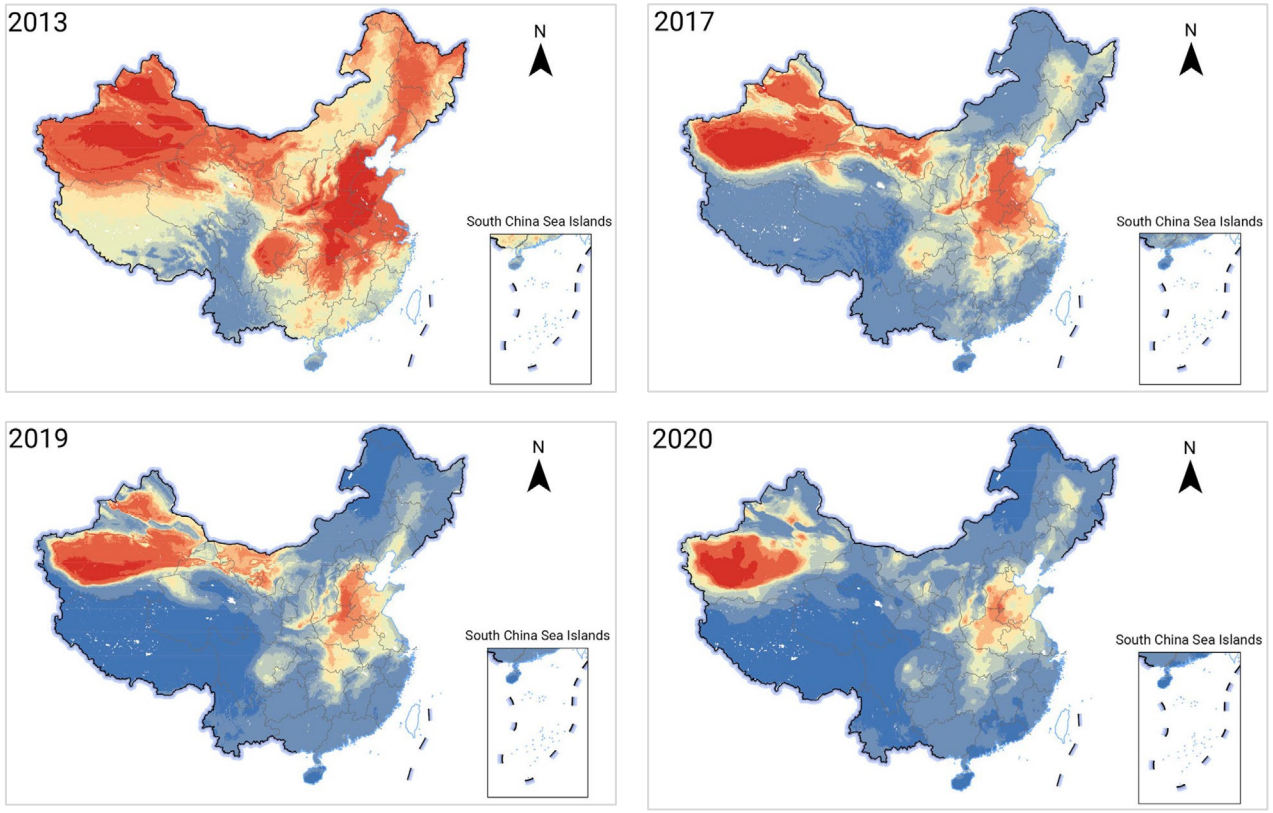
Air pollution has been a long-lasted problem in China



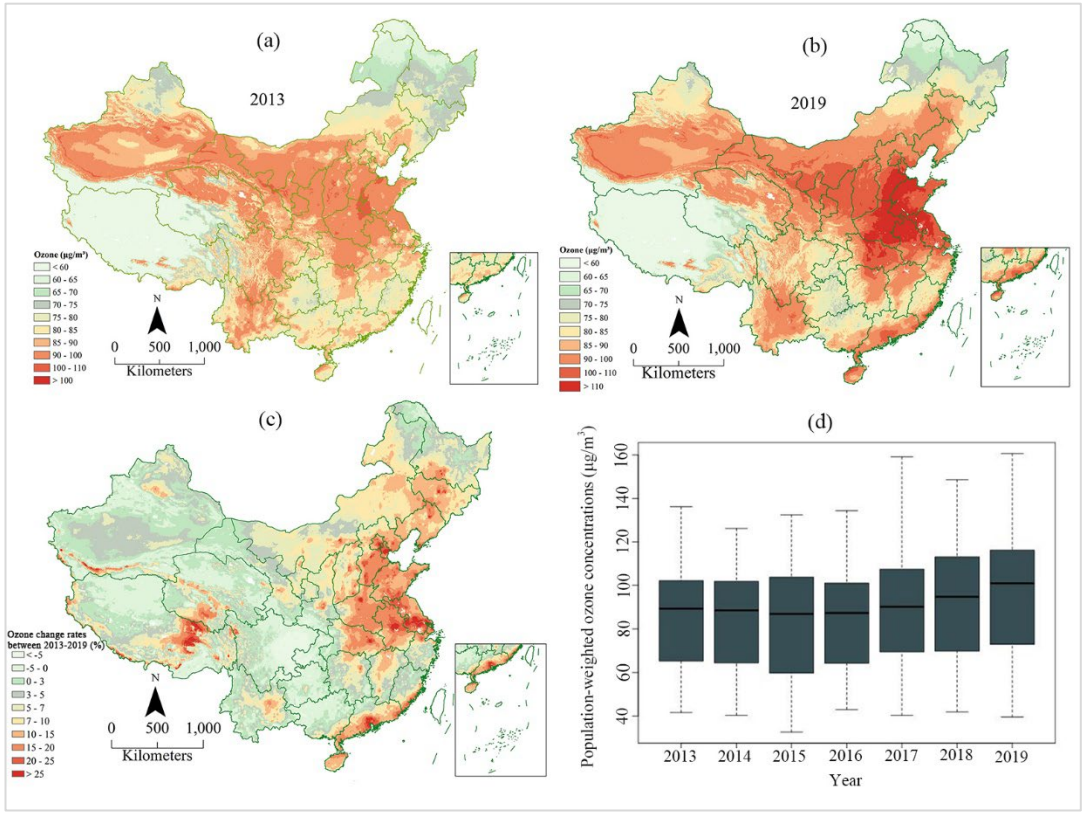
Donkelaar et al, *EHP*, 2015

China Air Pollution Prevention and Control Action Plan (2013-2017)
China Blue Sky Protection Campaign (2018-2020)



$PM_{2.5}$

Zhang et al, *Innovation*, 2022

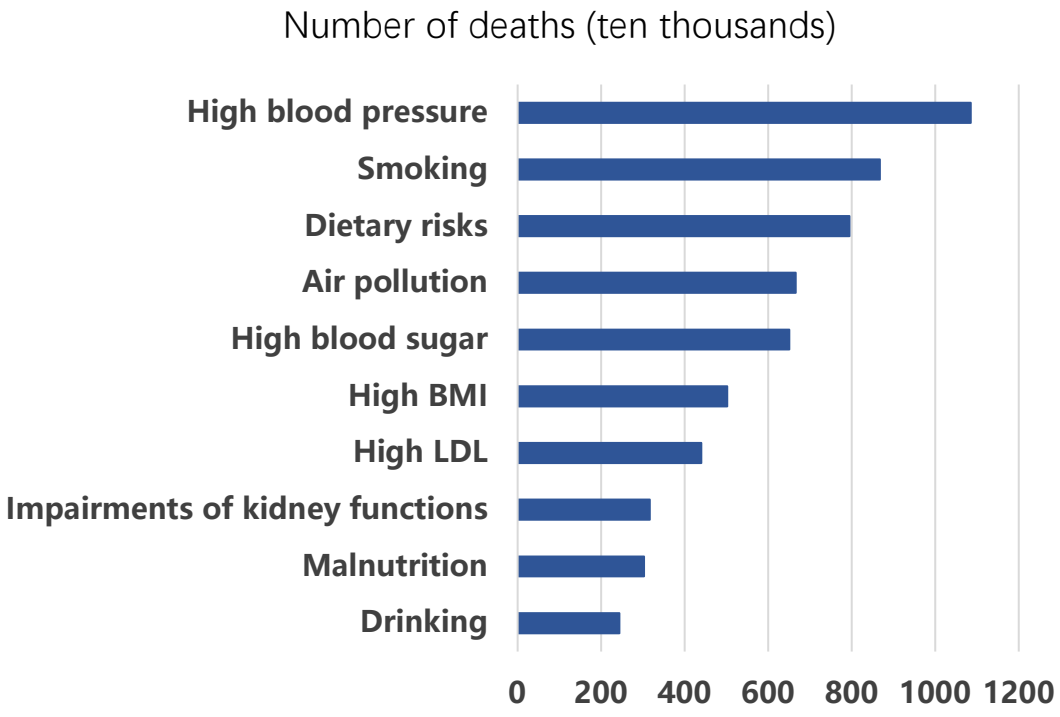


Ozone

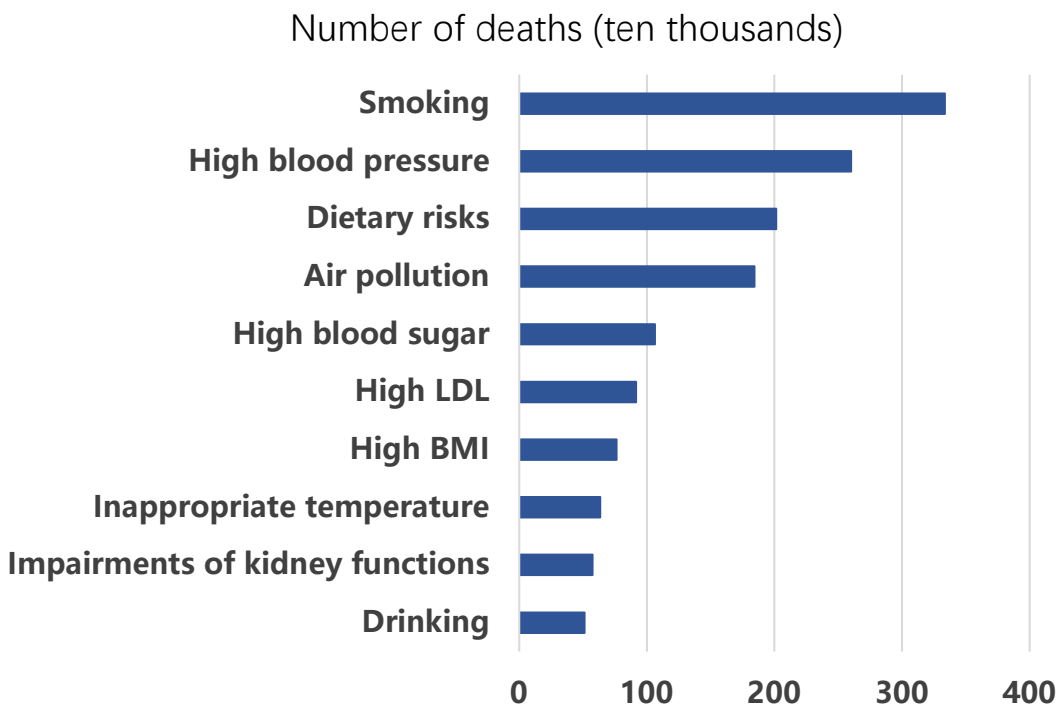
Meng et al, *Environ Pollut*, 2022

Air pollution remains a major public health challenge

Top 10 causes of death in the world in 2019



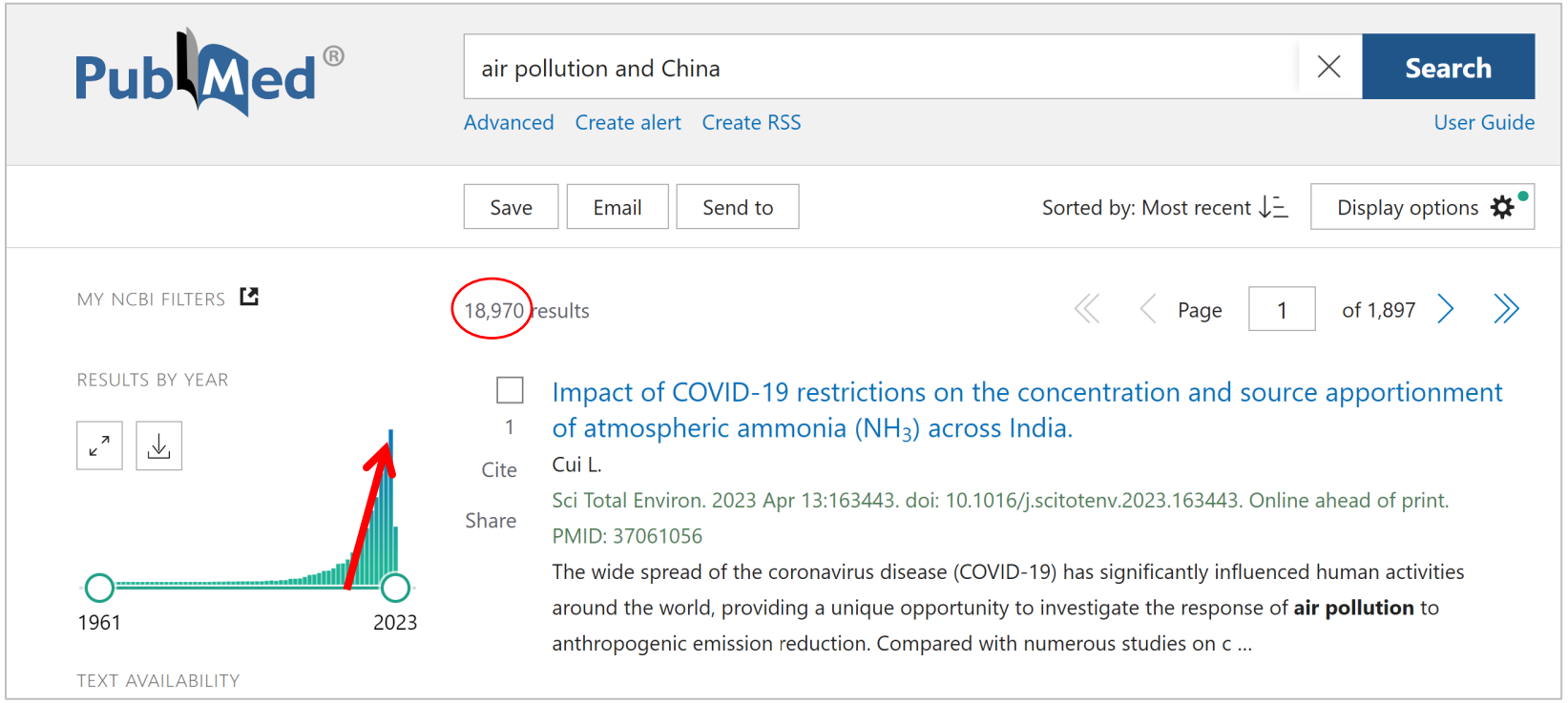
Top 10 causes of death in China in 2019



"In 2019, 1.42 million and 90 thousands Chinese people died from $PM_{2.5}$ and O_3 pollution respectively"

—— Global Burden of Disease Study 2019

Air pollution and health is a hot research topic



China

2022: 3,773 papers
2015: 905 papers
2010: 337 papers

Global

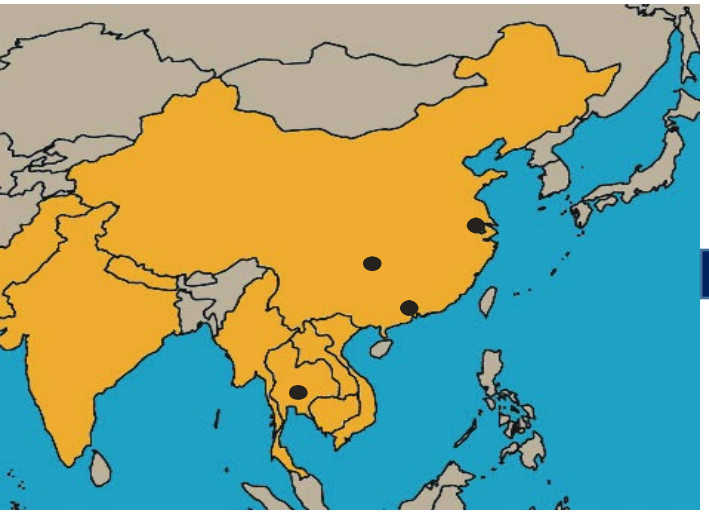
2022: 8,197 papers
2015: 4,125 papers
2010: 2,781 papers

Selected air pollution epidemiologic studies in China

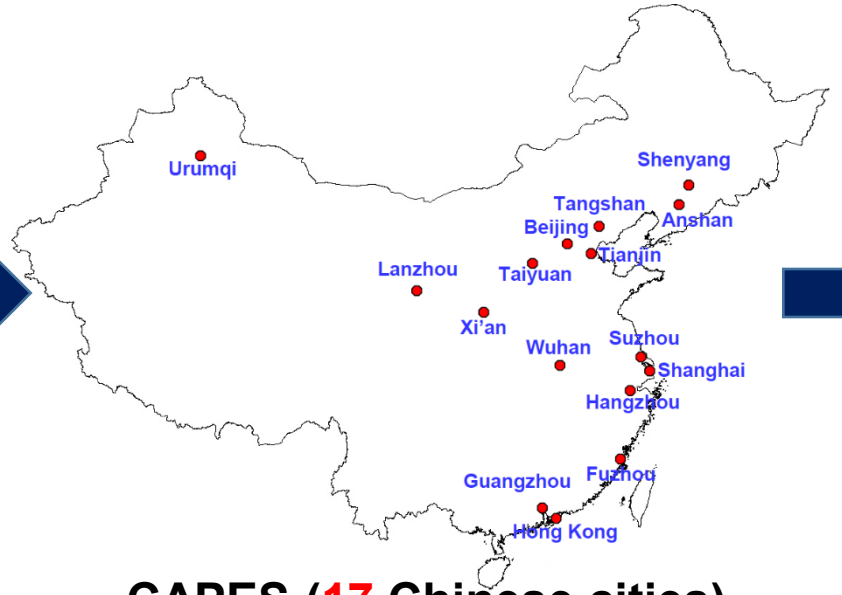
- **Short-term exposure (time-series/case crossover) studies**
  - **Single-city analysis: Beijing, Hong Kong, Shanghai, etc.**
  - **Multi-city analysis: PAPA (3 Chinese cities), CAPES, 272 cities**
- **Long-term exposure (cohort) study**
  - **China PAR** (Prediction for ASCVD Risk in China)
  - **CKB** (China Kadoorie Biobank)
- **Intervention study**
  - **Population level: Beijing Olympics**
  - **Individual level: air purifier, mask, dietary supplementation**

HEI-supported studies

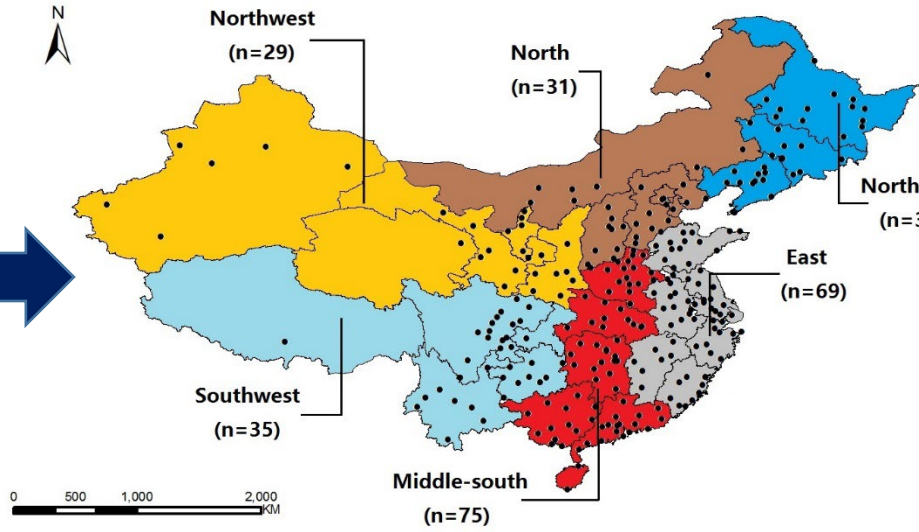
Short-term exposure studies



PAPA (3 Chinese cities)



CAPES (17 Chinese cities)



272 Chinese cities

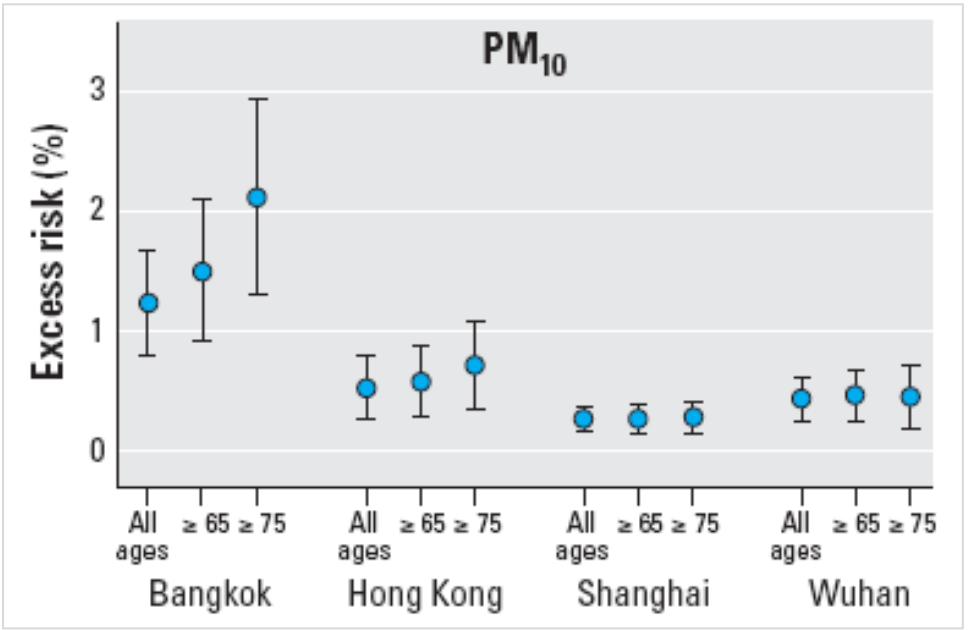
- PM Coefficients **LOWER** than in Europe and North America

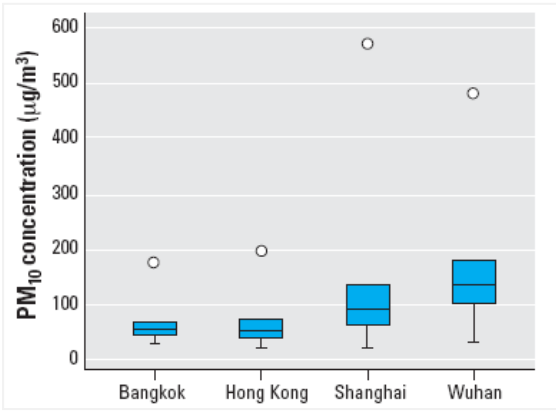
Wong et al, *EHP*, 2008

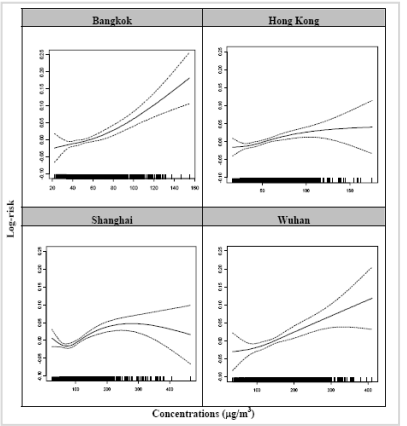
Chen et al, *AJE*, 2012

Chen et al, *AJRCCM*, 2017

PAPA (Public Health and Air Pollution in Asia)





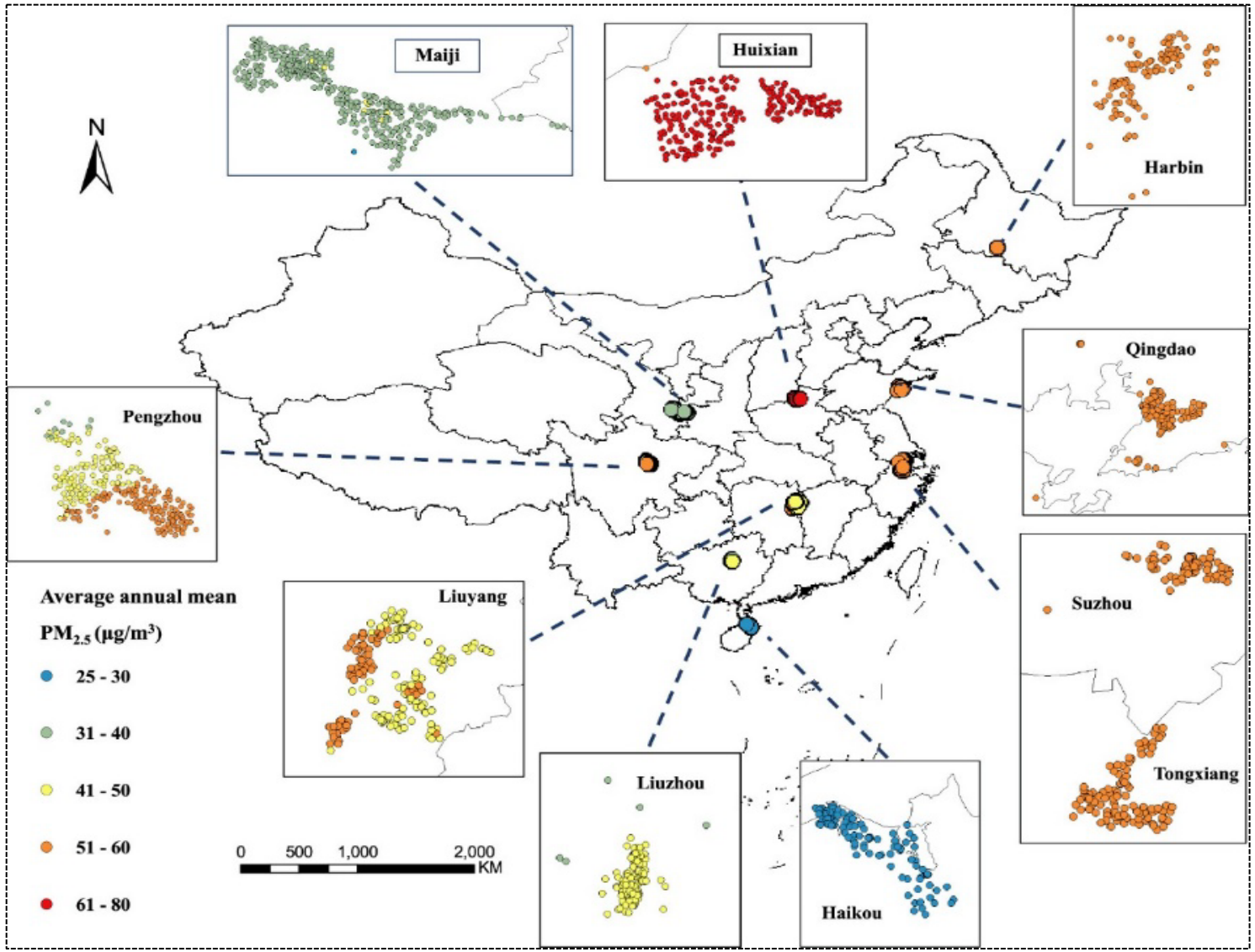


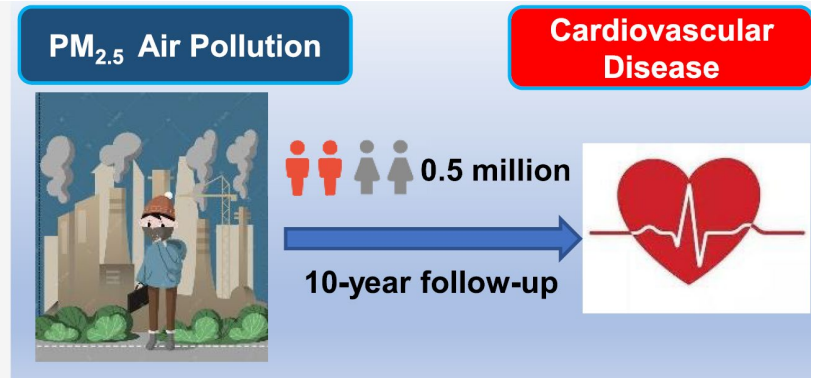
http://www.healtheffects.org/international.htm

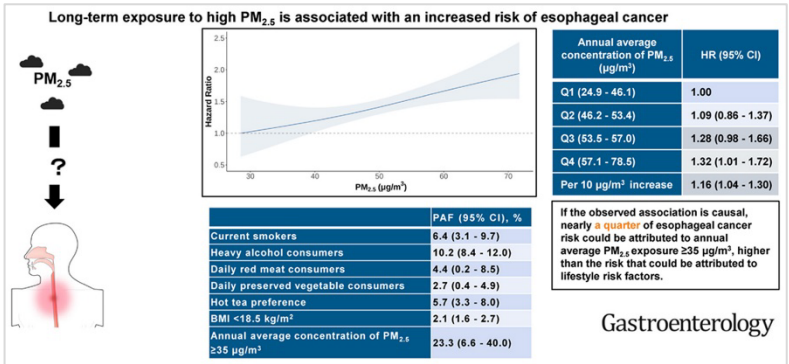
Wong et al, *EHP*, 2008

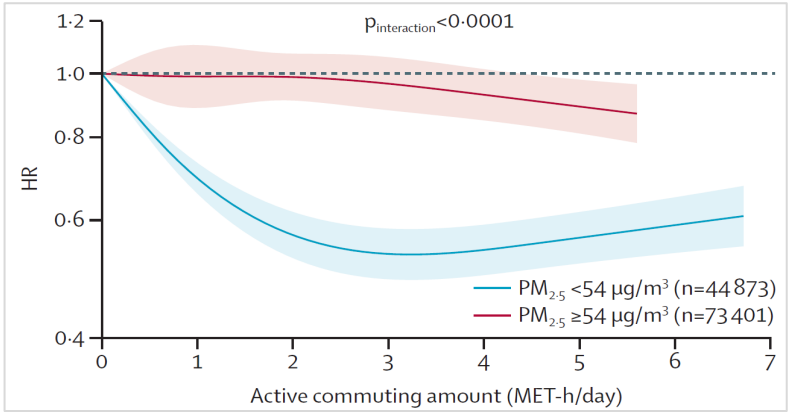
PAPA: network and capacity building not only in China, but also in other Asian counties

Long-term exposure: CKB-Air cohort









Liu et al, *EST*, 2022; Sun et al, *Gastroenterology*, 2023; Sun et al, *Lancet Planet Health*, 2023

Intervention study: Beijing Olympics (2008)

Typical air pollution in Beijing

Good air quality during the Beijing Olympics

Intervention study: Beijing Olympics (2008)

The Beijing HEART Study

HEART-BEIJING-2008-CAREBEIJING

Health Effects of Air Pollution Reduction Trial

HEART Study Schedule

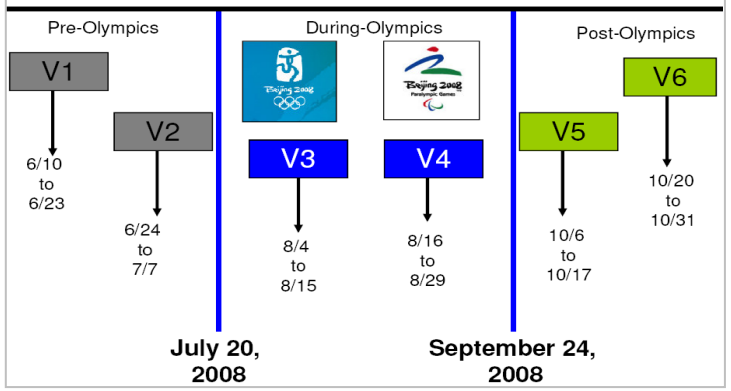


Table 3. Biomarker Concentrations by Period and Between-Period Change in Participant-Specific Biomarker Concentrations, Adjusted for Temperature and Relative Humidity

	Olympic Period, Mean (95% CI)			Between-Period Percentage Change			
Biomarker, Units	Before	During	After	Before to During, Mean (95% CI), %	*P* Value[b]	During to After, Mean (95% CI), %	*P* Value[b]
sCD62P, ng/mL[a]	6.29 (5.97 to 6.63)[a]	4.16 (3.86 to 4.48)[a]	5.36 (5.10 to 6.05)[a]	−34.0 (−38.4 to −29.2)	<.001	33.7 (17.7 to 51.8)	<.001
sCD40L, ng/mL[a]	1.86 (1.79 to 1.94)[a]	1.76 (1.66 to 1.86)[a]	1.92 (1.77 to 2.07)[a]	−5.7 (−10.5 to −0.7)	.03	9.1 (−3.7 to 23.5)	.17
von Willebrand factor, %	106.4 (98.5 to 114.4)	92.6 (82.6 to 102.5)	79.5 (66.9 to 92.1)	−13.1 (−18.6 to −7.5)	<.001	−14.2 (−29.9 to 1.6)	.19
Heart rate/min	66.5 (65.0 to 68.1)	65.4 (63.8 to 67.0)	66.1 (64.2 to 68.1)	−1.7 (−3.4 to −0.1)	.04	1.1 (−2.5 to 4.9)	.54
Fibrinogen, mg/dL	250 (242 to 258)	250 (240 to 259)	261 (249 to 273)	0.1 (−2.5 to 2.2)	.90	4.3 (−1.7 to 10.2)	.21
Blood pressure, mm hg							
Systolic	102.5 (99.9 to 105.2)	100.9 (97.4 to 104.4)	110.5 (105.9 to 115.0)	−1.8 (−3.9 to 0.4)	.10	10.7 (2.8 to 18.6)	.01
Diastolic	60.2 (57.9 to 62.6)	60.1 (57.0 to 63.1)	60.1 (56.2 to 64.0)	−0.3 (−3.0 to 2.5)	.86	0.1 (−9.7 to 9.9)	.99
White blood cell count, μL	5290 (5050 to 5540)	5400 (5100 to 5700)	5210 (4890 to 5530)	2.2 (−2.3 to 6.6)	.34	−3.9 (−11.5 to 3.6)	.44

Abbreviations: sCD40L, soluble CD40 ligand; soluble P-selectin sCD62P

[a] Biomarker was log-transformed. Geometric means and its 95% confidence interval.

[b] Significance is established if *P* value <.003, the individual significance level needed to maintain a family-wise Type I error rate of 0.05.

Rich et al, *JAMA*, 2012

Intervention study: personal intervention

Mask (outdoor)

Air purifier (indoor)

Dietary supplement

Beijing Residents:

- Air purifiers at home: 60%
- Air purifiers at work: 40%
- Wear mask: 30%
- Take anti-haze food: 30%

Chen et al, *JACC*, 2015; Li et al, *Circulation*, 2017; Lin et al, *JACC*, 2019

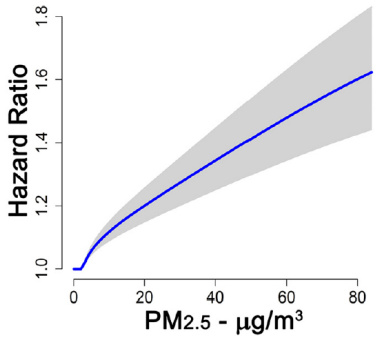
Implications of Chinese studies

China

- To provide local evidence for air quality management
- China AQS

Globally

- Global exposure-mortality model (GEMM)
- WHO AQG



Burnett et al, 2018

Limitations of Chinese studies

- Most in cities
- Most on PM, few on ozone and NO_2
- Few on specific sources, such as traffic
- Be careful of environmental disparities from individual interventions

Future research needs in China

- $PM_{2.5}$ & ozone cohort studies
- Intervention studies:
  - accountability study;
  - Longer intervention period, more outcomes (e.g. morbidity and mortality changes)
- New technologies in air pollution epidemiology
  - Sensors, big data
  - Source apportionment
  - Satellite data, air pollution modelling
  - Omics technology (e.g. exposome)

Acknowledgement

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CHINA MEDICAL BOARD

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Thank you!

kanh@fudan.edu.cn