Health Effects of Air Pollution

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Research background

- 2000-2005 Peking University, School of Public Health, BM
- 2005-2010 Peking University, College of Environmental Science & Engineering, PhD
- 2010-2013 Institute for Risk Assessment Science (IRAS), Utrecht University, the Netherlands, Postdoctoral Fellow
- 2014~present SYSU, School of Public Health, Associate Professor

Research Interest

- Environmental Epidemiology
- Air pollution health effects
- Indoor air quality and health effects
- Panel study
- Analysis of trace gases & biomarkers
Health effects

Indoor air pollution
  - Birth cohort
    - PIAMA cohort
      - NO₂
      - Gas cooking
        - Children

Ambient air pollution
  - Panel study
    - Air quality Intervention during the 2008 Beijing Olympics
      - Children
      - Young adults

Ambient PM pollution were the fourth leading risk in China in 2010: 1.2 million premature deaths

Yang. et al. the Lancet, 2013
Satellite readings of average PM$_{2.5}$ levels around the world between 2001-2006

(graph showing a world map with high PM$_{2.5}$ levels in Eastern China)

(van Donkelaar EHP 2010)
Summary of studies on exposure to PM$_{2.5}$

Current evidence is insufficient to infer a causal relationship.

Results of studies in children are inconsistent.

Critical gaps exist in our knowledge of the biological mechanisms underlying the effects of PM.

Peter Møller & Steffen Loft, EHP, 2010
The Beijing HEART study
Health Effect of Air Pollution Reduction Trial
Air Quality Control Intervention in Beijing and Its Surroundings

**Inner Mongolia:**
1. Install and operating pollution prevention and control measures

**Hebei:**
1. Shift of energy structure
2. Restructuring of the industry
3. Install and operating pollution prevention and control measures
4. Traffic control

**Shandong:**
1. Install and operating pollution prevention and control measures

**Tianjin:**
1. Shift of energy structure
2. Restructuring of the industry
3. Install and operating pollution prevention and control measures
4. Traffic control

**Beijing:**
1. Shift the energy structure
2. Restructure the industry
3. Install emission control devices
4. Traffic control (~50% reduction in vehicle numbers)
A unique opportunity to assess the acute health response to the reduced pollution levels during the Olympics
Research hypotheses

- PM$_{2.5}$ and other air pollution components would drastically decline during the Olympic period, relative to the pre-Olympic period.

- Biomarkers of pulmonary and systemic oxidative stress and inflammation would change significantly during the Olympic air pollution reduction period, compared to the pre-Olympic period.

- Air pollution components would each be associated with specific biomarkers across the whole study period.

*(EHP 2011, AJRCCM 2012, AJE 2015)*
Study design

- Sample size: 36 schoolchildren (Boy : Girl = 17:19)
- Average age: 10.6
- Study period: (a wide range of air pollutant concentrations)

Oxidative stress biomarkers in urine sample:
- 8-oxo-7,8-dihydro-2’-deoxyguanosine (8-oxodG)
- Malondialdehyde (MDA)

Inflammatory biomarker in exhaled air: exhaled nitric oxide (eNO)

Five time periods: For each period - Monday through Friday during the school lunch break over a 2-week period
CHS panel
Air pollution before & during the 2008 Beijing Olympics

- **PM$_{2.5}$**: Before vs during: -72%
- **Black carbon**: Before vs during: -65%
- **SO$_2$**: Before vs during: -66%
- **CO**: Before vs during: -48%

(Lin et al. EHP 2011, AJE 2015)
The substantially lower levels of black carbon were associated with reduced acute respiratory inflammation in children.

Two pollutant model

Lin et al. EHP 2011
Exposure to black carbon leads to systemic oxidative stress in children

Black carbon and 8oxodG

Lin et al. AJE 2015
Air pollution adversely affects *young and healthy individuals* through acute changes in *pulmonary inflammation, airway, and systemic oxidative damage*. 

**Pre**
- visit1
- visit2

**Dur**
- visit3
- visit4

**Post-**
- visit5
- visit6


125 medical residents/students, with 2 repeated measurements of biomarkers during each study period.

*HEART collaborative study team, JAMA 2012; AJRCCM 2012*
Selected Publication

Acute Respiratory Inflammation in Children and Black Carbon in Ambient Air before and during the 2008 Beijing Olympics

Weiwei Lin,1 Wei Huang,1 Tong Zhu,1 Min Hu,1 Bert Brunekreef,2 Yuanhang Zhang,1 Xingang Liu,1 Hong Cheng,1

ORIGINAL ARTICLE

Gas cooking, respiratory and allergic outcomes in the PIAMA birth cohort study

Weiwei Lin,1 Ulrike Gehring,1 Marieke Oldenwening,1 Johan C de Jongste,2

Meta-analysis of the effects of indoor nitrogen dioxide and gas cooking on asthma and wheeze in children

Weiwei Lin,1 Bert Brunekreef1,2 and Ulrike Gehring1*

Inflammatory and Oxidative Stress Responses of Healthy Young Adults to Changes in Air Quality during the Beijing Olympics

Wei Huang1*, Guangfa Wang2*, Shou-En Lu3,4, Howard Kipen3,5, Yuedan Wang6, Min Hu1, Weiwei Lin1, David Rich7, Pamela Ohman-Strickland3,4, Scott R. Diehl8, Ping Zhu9, Jian Tong10, Jicheng Gong11, Tong Zhu1, and Junfeng Zhang10,11

Environmental Health Perspectives, 2011

Occup Environ Med, 2013

International Journal of Epidemiology, 2013

Am J Respir Crit Care Med, 2012

Am J Epi, 2015

Original Contribution

Association Between Changes in Exposure to Air Pollution and Biomarkers of Oxidative Stress in Children Before and During the Beijing Olympics
Research plan

- Impact of air pollution on pregnancy period (preterm birth)
- Impact of air pollution on birth weight (low birth weight)
- Impact of living style during pregnancy (smoking, ETS exposure, traffic-related pollution exposure et al) on newborns

- Impact of air pollution on lung function development
- Effect of air pollution on respiratory illnesses, allergy and oxidative stress.
- Effect of environment on autism
- To evaluate exposure for large population combination with GIS model
- Use panel study to study the acute health effects
Guangdong Atmospheric Supersite of China