Shanghai Birth Cohort

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Environmental Pollution: a prominent issue
Global Mercury Emission

Fig. 1: Global anthropogenic emissions (tons/year).

Dastoor & Larocque, 2004

China accounts for ¼ of global mercury emission

Table 5. Global emissions of total mercury from major anthropogenic sources (Mg yr$^{-1}$).

<table>
<thead>
<tr>
<th>Source</th>
<th>SC</th>
<th>NFMP</th>
<th>FISP</th>
<th>CP</th>
<th>CSP</th>
<th>MP</th>
<th>GP</th>
<th>WD</th>
<th>O</th>
<th>T</th>
<th>Reference year</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. Africa</td>
<td>22.6</td>
<td>0.3</td>
<td>1.3</td>
<td>3.8</td>
<td>0.0</td>
<td>0.0</td>
<td>0.3</td>
<td>0.6</td>
<td>1.2</td>
<td>49.2</td>
<td>2004</td>
<td>(1)</td>
</tr>
<tr>
<td>China</td>
<td>268.0</td>
<td>233.3</td>
<td>8.9</td>
<td>35.0</td>
<td>6.0</td>
<td>27.5</td>
<td>44.7</td>
<td>14.1</td>
<td>7.6</td>
<td>609.1</td>
<td>2003</td>
<td>(2)</td>
</tr>
<tr>
<td>India</td>
<td>124.6</td>
<td>15.5</td>
<td>4.6</td>
<td>4.7</td>
<td>6.2</td>
<td>0.0</td>
<td>0.5</td>
<td>77.4</td>
<td>7.5</td>
<td>240.9</td>
<td>2004</td>
<td>(3)</td>
</tr>
<tr>
<td>Australia</td>
<td>2.2</td>
<td>11.6</td>
<td>0.8</td>
<td>0.9</td>
<td>6.0</td>
<td>0.0</td>
<td>0.3</td>
<td>0.2</td>
<td>0.6</td>
<td>16.6</td>
<td>2005</td>
<td>(4)</td>
</tr>
<tr>
<td>Europe</td>
<td>76.6</td>
<td>18.7</td>
<td>0.0</td>
<td>18.8</td>
<td>6.3</td>
<td>0.0</td>
<td>0.0</td>
<td>10.1</td>
<td>14.7</td>
<td>145.2</td>
<td>2005</td>
<td>(5)</td>
</tr>
<tr>
<td>Russia</td>
<td>46.0</td>
<td>5.2</td>
<td>2.6</td>
<td>3.9</td>
<td>2.8</td>
<td>0.0</td>
<td>4.3</td>
<td>3.5</td>
<td>1.5</td>
<td>69.8</td>
<td>2005</td>
<td>(5)</td>
</tr>
<tr>
<td>N. America</td>
<td>65.2</td>
<td>34.7</td>
<td>12.8</td>
<td>15.1</td>
<td>10.3</td>
<td>0.0</td>
<td>0.0</td>
<td>13.0</td>
<td>1.7</td>
<td>152.8</td>
<td>2005</td>
<td>(6)</td>
</tr>
<tr>
<td>S. America</td>
<td>8.0</td>
<td>12.6</td>
<td>1.8</td>
<td>6.4</td>
<td>2.2</td>
<td>0.0</td>
<td>16.2</td>
<td>0.0</td>
<td>1.5</td>
<td>49.7</td>
<td>2005</td>
<td>(5)</td>
</tr>
<tr>
<td>Total</td>
<td>623.2</td>
<td>302.9</td>
<td>32.8</td>
<td>88.0</td>
<td>27.8</td>
<td>27.5</td>
<td>66.3</td>
<td>118.9</td>
<td>36.4</td>
<td>1324.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rest of the world</td>
<td>186.8</td>
<td>7.1</td>
<td>10.4</td>
<td>147.1</td>
<td>135.1</td>
<td>22.5</td>
<td>333.7</td>
<td>68.5</td>
<td>28.2</td>
<td>939.4</td>
<td>2006</td>
<td>(7)</td>
</tr>
<tr>
<td>Total</td>
<td>810.0</td>
<td>310.0</td>
<td>43.2</td>
<td>235.7</td>
<td>162.9</td>
<td>59.0</td>
<td>400.4</td>
<td>187.4</td>
<td>64.6</td>
<td>2319.7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Impact on Pregnancy Outcomes

**Miscarriage**
- Lead, arsenic
- DDT/DDE
- MCPA
- Ethylene oxide
- Drinking water DBPs
- Chlorinated solvents

**Fetal Growth Restriction**
- Lead
- DDT/DDE
- Smoking, passive smoking
- Drinking water disinfection by-products (DBPs)
- Drinking water nitrate

**Preterm Birth**
- Lead
- DDT/DDE
- Smoking
- Passive smoking
- Air pollution

Maternal DDT level and fertility rate in daughters

Emerging Exposures

Flame retardants

Electronic waves

Plastic additives
PFOS(A)
Triclosan

Formaldehyde, flame retardants

Environmental endocrine disruptors have serious impact

- Widely used with high quantity
- Hard to degrade and excrete
- Long-term, low dose exposure may have cumulative effects

Pregnant women are widely exposed

<table>
<thead>
<tr>
<th>chemicals</th>
<th>selected percentiles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50th</td>
</tr>
<tr>
<td>Bisphenol A (双酚)</td>
<td>0.60</td>
</tr>
<tr>
<td>Pentachlorophenol</td>
<td>0.39</td>
</tr>
<tr>
<td>Benzophenol-3</td>
<td>0.08</td>
</tr>
<tr>
<td>4-tert-octylphenol</td>
<td>0.19</td>
</tr>
<tr>
<td>4-n-octylphenol</td>
<td>0.01</td>
</tr>
<tr>
<td>4-n-nonylphenol</td>
<td>0.01</td>
</tr>
<tr>
<td>2,3,4-trichlorophenol</td>
<td>0.17</td>
</tr>
<tr>
<td>2,4,5-trichlorophenol</td>
<td>0.10</td>
</tr>
<tr>
<td>Sum(Trichlorophenol)²</td>
<td>0.34</td>
</tr>
</tbody>
</table>

Toxicol Sci, 2011
Environmental insults in early life can be damaging

- Fetus undergoes rapid growth and development
- Organs, systems and detoxification functions are immature

Possible Impact on Reproductive Health

- In 1988, infertility rate in a national survey was 6.9%
- In 2010, primary infertility rate was 12%
- 40 million infertile people

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In 2010, primary infertility rate was 12%
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Incidence of birth defects is increasing

![Graph showing the increase in birth defects](image)

Source: 中国卫生部和中国国家统计局 2008

Environmental impact on young life is greater

- Larger absorption area
- More food, water, air intake per body weight unit
- Higher rate of intestinal absorption
- Faster breath with mouth
- Crawl and hand-to-mouth behavior
Chemical Pollutants and Child Health

- Birth defects
- Neurological development
  - Mental retardation, autism, ADHD
- Development of immune system
  - Asthma, food allergy, atopic dermititis
- Reproductive endocrine system
  - Sexual prematurity

Childhood Diseases in China

- Asthma survey
  - Chongqing 3.34% in 2000; 7.45% in 2010
- Between 1996 and 2006, prevalence of overweight and obesity in children aged 0 – 6 years increased 4-5 times
  - In 2006, overweight = 19.8%; obese = 7.2%

中华儿科杂志 2008;46:179-84.
Earlier onset of menarche

Fig. 3 Changes by year in girl's age at first menstrual period and average height in adulthood in Chinese cities since 1979

Developmental Origins of Health and Diseases (DOHaD)

- **Pediatric diseases**
  - congenital malformation, mental retardation, asthma, autism, ADHD

- **Adulthood diseases**
  - cardiovascular disorders, diabetes, tumor, mental disorders, osteoporosis
Shanghai Birth Cohort

To study the effects of genetic, environmental and behavioral factors on reproductive health, pregnancy outcomes, child growth, development and risks of diseases.

Study Flow: pregnancy

Preconception: consent, interview, sample
Partner Telephone follow-up

Early: (≤ 16 weeks) consent, interview, sample

Mid, late: (22-28, 32-36 weeks) interview, sample

Birth: physical measures, chart abstraction, samples

Hospital
Samples visit
Home

Blood, urine
Blood, urine
Blood, urine, hair, nail
Cord blood, placenta, blood spot, father buccal swab

Environmental sampling
Diet, nutrition, environment questionnaire

miscarriage, prematurity, fetal growth restriction, stillbirth
birth defect, mental retardation
mental, behavioral disorders
infertility, asthma, ADHD, autism, obesity, precocious puberty, puberty
Study Flow: child

**Hospital**
42 day:
- Postpartum health
- Feeding, habit
- Physical measure
- Neonatal diseases

6-month:
- Feeding, habit
- ASQ
- Physical measure
- Disease history

12-month:
- Feeding, habit, environment
- ASQ
- Physical measure
- Disease history

24-month:
- Feeding, habit, environment
- ASQ, M-CHAT
- Intelligence test
- Physical measure
disease history

**Sample**
- milk
- Urine
- Blood, urine, hair, nail
- Psychology & behavior
- Family environment

**Tier II**

Rigorous data and sample collection process
Phase I Timeline

- **Dec. 2012** Complete study design to 2 years old
- **July. 2013** Start pilot study in 2 hospitals
- **Dec. 2013** Launch the full Shanghai Birth Cohort
- **One year for recruitment of the first 4000 women/couples**
- **Follow up to 2 years of age**

Key scientific questions proposed

- Impacts of emerging environmental endocrine disrupters on infertility, abortion and adverse pregnancy outcomes
- Impacts of environment-gene interaction on birth defects
- Impacts of mental stress and micronutrients during pregnancy on child development and diseases
- Impacts of early life exposure to environmental pollutants on children’s neurological and mental development and allergies
- Impacts of environmental endocrine disrupters on child obesity and Child Precocious Puberty
- Impacts of early life familial and social environment on adolescent psychological and behavioral development

Provide evidence for environment and health-related policy making
For Healthier Future Generations!