Urbanization and Health

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April 4th, 2017
“Cities offer the lure of better employment, education, health care, and culture. However, rapid and often unplanned urban growth is often associated with poverty, environmental burden and population demands that outstrip service capacity. These conditions place human health at risk.”

---Dr. Jacob Kumaresan,
Director, Centre for Health Development, the World Health Organization
Urban expansion in China

Urbanization population concentrate in the eastern part of the mainland.

Sources: 1, China Statistical Yearbook; 2, National Bureau of Statistics of China
This project investigates how to create healthier places in the future. It creates a forum for understanding the multiple issues that face cities in light of rapid urbanization and an aging population worldwide.
HAPI components

- Region
- Metro
  - 10 City Study
  - Healthy Case Studies
  - Research Briefs
  - Prototypes
    - Healthy Places Class
    - Studio
    - Health Assessment Tools
  - Planning and Design Guidelines
    - Prototypes
  - Chinese Neighborhoods
  - Comfort in Public Places
    - Comfort in Public Places
    - Energy-Efficient Housing
      - Energy-Efficient Housing

- Scale
- Neighborhood
- Block
- Building

- Research
- Education
- Tools
- Guidelines
- Books • Articles
- Events

Webinar Series and Healthy Future Cities: Scoping Conference
Background

• Objective:
  – to investigate the associations between residential housing, surrounding neighborhoods, life styles, residential status and their associations with health in a diverse city

• Study Design
  – A cross-sectional study
  – School-based
  – Survey-based
Old town vs. New town
School Location

Health Focus

10 cities (from north to south):

- Harbin
- Urumqi
- Beijing
- Taiyuan
- Xi’an
- Nanjing
- Shanghai
- Wuhan
- Chongqing
- Changsha

Zhang et al. 2013
Study Design

- Questionnaire Design: June 2014
- Data Collection: October 2014
- Data Entry: February 2015
- Data Analysis: September 15
Exposure Assessment

Questions about home environment, neighborhood environment, commuting pattern, physical activity, social relations, migration history, and life satisfaction

Acknowledgement: Dr. Yuexia Sun, Dr. Jan Sundell, Dr. Dong Zhao, Dr. Peter James
Urbanization and Health

Aim 1
Household Policy

Aim 2
Economic Growth

Aim 3
Urban Form

Household Policy → Education and Lifestyle → Urban Planning

Domestic Migration

Life Style delivery mode

Green Space
Study Population

Focus: Middle School
Sample Size: 5891
Gender: Male (51.6%)
Age: 12-14
Response rate: 82%
Aim 1 - Introduction

• Healthy immigrant effect
  – where immigrants are on average healthier than the native-born (less asthma and allergic symptoms)
  – There are many competing explanations
    • Environmental exposure, hygiene improvement
    • Genetic difference

• China has a longstanding household registration system, or Hukou system
  – Domestic migrant within cities

Ballin et al. 1998; Migliore et al. 2007; Pereg et al. 2008; Ventura et al. 2004; Wang et al. 2008
Aim 1 - Methods

• Exposure

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Both local parents</th>
<th>Only migrant</th>
<th>Both migrant</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(N=2213)</td>
<td>mother (N=461)</td>
<td>father (N=460)</td>
<td>parents (N=2556)</td>
</tr>
<tr>
<td></td>
<td>38%</td>
<td>8%</td>
<td>8%</td>
<td>43%</td>
</tr>
<tr>
<td></td>
<td>(N=5891)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

• Outcomes

- Father’s asthma, rhinitis, and eczema
- Mother’s asthma, rhinitis and eczema
- Child’s asthma, rhinitis, eczema and pneumonia
- Symptoms questions (wheezing, sneezing, itchy rash)

• Univariate and multivariate logistic regression
Aim 1 – Children of migrant parents are healthier

- Dx-diagnosed asthma: Both local parents <0.001
- Dx-diagnosed pneumonia: Both local parents <0.001
- Dx-diagnosed rhinitis: Both local parents <0.001
- Dx-diagnosed eczema: Both local parents <0.001
- Current wheeze: Both migrant parents 0.096
- Ever wheeze: Both local parents <0.001

P-value
Aim 1 – Both the first and second generation of migrant population have lower asthma rates
Aim 1 - Multivariate logistic regression model for the associations between migrant status and health

<table>
<thead>
<tr>
<th></th>
<th>Asthma</th>
<th>Pneumonia</th>
<th>Rhinitis</th>
<th>Eczema</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both local parents (ref)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

| Only migrant mother      | 1.07 (0.74, 1.50) | 0.91 (0.70, 1.19) | 1.02 (0.77, 1.35) | 0.79 (0.59, 1.07) |
| P-value                  | 0.72        | 0.51        | 0.88        | 0.13        |

| Only migrant father      | 0.80 (0.55, 1.14) | 0.76 (0.58, 0.99) | 1.27 (0.97, 1.65) | 1.02 (0.77, 1.33) |
| P-value                  | 0.22        | 0.05        | 0.08        | 0.91        |

| Both migrant parents     | 0.56 (0.42, 0.73) | 0.60 (0.49, 0.72) | 0.63 (0.52, 0.77) | 0.73 (0.60, 0.89) |
| P-value                  | <0.001       | <0.001       | <0.001       | 0.002       |

Adjusted for children’s gender, children’s age, family asthma history, parental education level, environmental tobacco smoking at home, home ownership status
Aim 1 - Discussions

• Lower prevalence of asthma and other respiratory symptoms in migrant population compared to local population
  – Children of Turkish origin living in Germany were found to have lower asthma rates (Grüber et al. 2002)
  – 84.3% of immigrants to Milan claimed developing allergy/asthma symptoms after they arrive in Italy (Tedeschi et al. 2003)
  – The prevalence of asthma and wheezing higher in Canadian-born Chinese adolescents than Chinese immigrants (Wang et al. 2008)

• The prevalence of asthma and respiratory symptoms increased sharply in the children’s generation compared to the parents’.

• Mechanism: Hygiene Hypothesis
  – Poorer hygiene during childhood stimulates the correct development of the immune system
  – Less exposure to environmental pollutants reduces sensitization and development of asthma and allergic symptoms

Grüber et al. 2002; Tedeschi et al. 2003; Wang et al. 2008
Urbanization and Health

Aim 1
Household Policy
Household Registration -> Domestic Migration

Aim 2
Education and Lifestyle
Economic Growth -> Life Style delivery mode

Aim 3
Urban Planning
Urban Form -> Green Space
Aim 2 - Introduction

• Mode of delivery will influence a baby's first exposure

• C-section rate in China was second highest in the World, especially in cities (2010)
  – there was substantial variation across regions, with rates ranging from 4% to 63% in 2014.
  – 72 % unnecessary cesarean section

Kolokotroni et al. 2012; Neu and Rushing 2011; Penders et al. 2006; Hu et al. 2015
Aim 2 - C-section rate by parental education level

- **Primary school**: 83.3% Natural Birth, 16.7% C-section
- **Middle School**: 76.6% Natural Birth, 23.4% C-section
- **High School**: 63.1% Natural Birth, 36.9% C-section
- **College and above**: 49.9% Natural Birth, 50.1% C-section
Aim 2 - Prevalence of health outcomes by two delivery modes (unadjusted)
### Aim 2 - Univariate and multivariate logistic regression results for children born via two delivery mode

<table>
<thead>
<tr>
<th>Condition</th>
<th>Univariate Model</th>
<th>P-value</th>
<th>Full Model</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr dx asthma</td>
<td>1.59 ( 1.33 , 1.90 )*</td>
<td>&lt;0.001</td>
<td>1.24 ( 1.00 , 1.52 )*</td>
<td>0.046</td>
</tr>
<tr>
<td>Dr dx pneumonia</td>
<td>1.56 ( 1.36 , 1.78 )*</td>
<td>&lt;0.001</td>
<td>1.28 ( 1.10 , 1.49 )*</td>
<td>0.001</td>
</tr>
<tr>
<td>Dr dx rhinitis</td>
<td>1.51 ( 1.32 , 1.73 )*</td>
<td>&lt;0.001</td>
<td>1.16 ( 0.99 , 1.36 )</td>
<td>0.059</td>
</tr>
<tr>
<td>Dr dx eczema</td>
<td>1.41 ( 1.23 , 1.62 )*</td>
<td>&lt;0.001</td>
<td>1.13 ( 0.96 , 1.33 )</td>
<td>0.128</td>
</tr>
</tbody>
</table>

Adjusted for children’s age and gender, parental education, breastfeeding, preterm birth, and Environmental Tobacco Smoking at home.
Aim 2 - Discussions

- The C-section rate was found to be higher in families with higher socioeconomic status
  - C-sections by maternal requests
  - mothers seek a specific date of birth or want to avoid the pain
- C-section is a risk factor for developing asthma and pneumonia
  - Consistent with literature results (Neu et al. 2011; Bager et al. 2008; Debley et al. 2005)
- Mechanism: the different microbiota to which the infant is initially exposed
  - Infants born by C-section are primarily exposed to bacteria from the hospital environment, causing delayed microbiota establishment and less diversity
- Public education & Microbial establishing procedure
  - Babies were exposed to maternal vaginal fluids by being swabbed with wipes incubated in the vagina of mothers
Urbanization and Health

Aim 1
Household Registration -> Domestic Migration

Aim 2
Economic Growth -> Life Style delivery mode

Aim 3
Urban Form -> Green Space
Aim 3 - Background

Greenness Exposure

- Increased physical activity
  - Reduce overweight and obesity
  - Improve birth outcome

- Heat and humidity regulation
  - Reduce Cardiovascular disease
  - Reduce psychiatric morbidity, including anxiety and depression

- Stress reduction, cognitive restoration
  - Reduce cardiovascular disease
  - Improved birth outcome

- Air pollution filtration
  - James et al., 2015
Aim 3 - Background

- North America
  - 4 studies in US
  - 2 studies in Canada

- Europe
  - 6 studies in the UK
  - 1 study in Netherlands
  - 1 study in Spain

- Asia
  - None

- Australia
  - 1 study in Australia
  - 1 study in New Zealand

- South America
  - None

References:
Lachowycz and Jones, 2011; James et al., 2015
Aim 3 - Greenness

• Limited studies in Asia
• The urban form of Chinese cities is quite different from developed countries with its high urban density and intensively mixed land-use
• In addition, China is going through rapid urbanization, and only recently, has national policy encouraged more green spaces be included in urban development
China is going through rapid urbanization and its building types, and urban infrastructure are different from western countries.
Geocoded Home Address

Legend
- Middle School Residents
- Kindergarten Residents
- Major Roads
Aim 3 - Methods (Exposure Assessment)

- Distance to the nearest parks (~300 Parks)
  - 300 meter as walking distance
  - Quartile/spline analysis

- Normalized Difference Vegetation Index (NDVI).
  - Values range between -1 and 1
  - Residential surrounding greenness as the average of (NDVI) in buffers
    - 100 m, 200 m, 500 m, and 1,000 m around each home address
  - Annual average in 2014

Dadvand et al. 2014
Aim 3 - Overall and season-specific NDVI values

![Graph showing NDVI values for different buffers and seasons.](image-url)
### Aim 3 - Results

#### NDVI vs. Outcomes (per interquartile)

<table>
<thead>
<tr>
<th></th>
<th>100m buffer</th>
<th>200m buffer</th>
<th>500m buffer</th>
<th>1000m buffer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Asthma</strong></td>
<td>1.06 (0.97, 1.16)</td>
<td>1.05 (0.93, 1.20)</td>
<td>1.00 (0.87, 1.17)</td>
<td>0.96 (0.85, 1.09)</td>
</tr>
<tr>
<td><strong>Pneumonia</strong></td>
<td>1.04 (0.98, 1.11)</td>
<td>1.05 (0.96, 1.15)</td>
<td>1.01 (0.91, 1.13)</td>
<td>0.98 (0.89, 1.08)</td>
</tr>
<tr>
<td><strong>Rhinitis</strong></td>
<td>1.01 (0.95, 1.07)</td>
<td>1.01 (0.92, 1.11)</td>
<td>0.98 (0.88, 1.10)</td>
<td>0.96 (0.88, 1.07)</td>
</tr>
<tr>
<td><strong>Eczema</strong></td>
<td>1.03 (0.97, 1.11)</td>
<td>1.04 (0.95, 1.15)</td>
<td>1.03 (0.92, 1.17)</td>
<td>1.00 (0.90, 1.11)</td>
</tr>
</tbody>
</table>

- **a:** The median values within 100-meter buffer, 200-meter buffer, 500-meter buffer and 1,000-meter buffer are 0.187, 0.187, 0.190 and 0.187, with interquartile range (IQR) as 0.1008, 0.0877, 0.073 and 0.055, respectively.
- **b:** adjusted for children’s age, environmental tobacco smoking at home, parental education, and parental history of asthma
Aim 3 -
Park (<300m) vs. Outcomes

<table>
<thead>
<tr>
<th></th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asthma</td>
<td>1.75 (1.33, 2.38) *</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>1.35 (1.11, 1.64) *</td>
</tr>
<tr>
<td>Rhinitis</td>
<td>1.37 (1.11, 1.67) *</td>
</tr>
<tr>
<td>Eczema</td>
<td>1.52 (1.23, 1.85) *</td>
</tr>
</tbody>
</table>

adjusted for children’s gender, age, environmental tobacco smoking at home, parental education, and parental history of asthma
Aim 3 - Discussions

• No association between NDVI and respiratory and allergic outcomes
  – Pilat et al. observed no association between NDVI and asthma in Texas, USA
  – Dadvand et al. observed no association between asthma and NDVI in a Barcelona-based cohort

• Living closer to parks appeared to be a risk factor for asthma and allergic diseases
  – A study in Spain found that living close to a park was associated with increased doctor-diagnosed asthma (Dadvand et al. 2014)
  – A US study observed asthma prevalence was positively associated with greenness in most urban areas (Gray 2014)

• Mechanism: Living close to park elevated asthma rates due to pollen production (Lovasi et al. 2013)

• Urban planners need to take this complexity into consideration

(Pilat et al. 2012; Dadvand et al. 2014; Lovasi et al. 2013, Gray 2014)
Ongoing & Future Direction

• Master Thesis
  – Shengyao Jiang – Smoking; Li Zhang – Building Materials; Yingshuo Zhang – Cleaning Products

• Ambient environment; Other early life exposure factors; Indoor environment, etc

• Intervention Studies
Acknowledgement

Committee
Dr. Jack Spengler
Dr. Gary Adamkiewicz
Dr. Brent Coull

Soochow University
Dr. Shijie Cao
Yuwei Dai
Yu Zhou
Pengfei Lu
Chunnan Ma

Harvard T.H. Chan School of Public Health
Dr. Jamie Hart
Joan Arnold
Marty Alvarez-Reeves
Fellows and friends

HAPI
Health And Places Initiative
Thank You