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

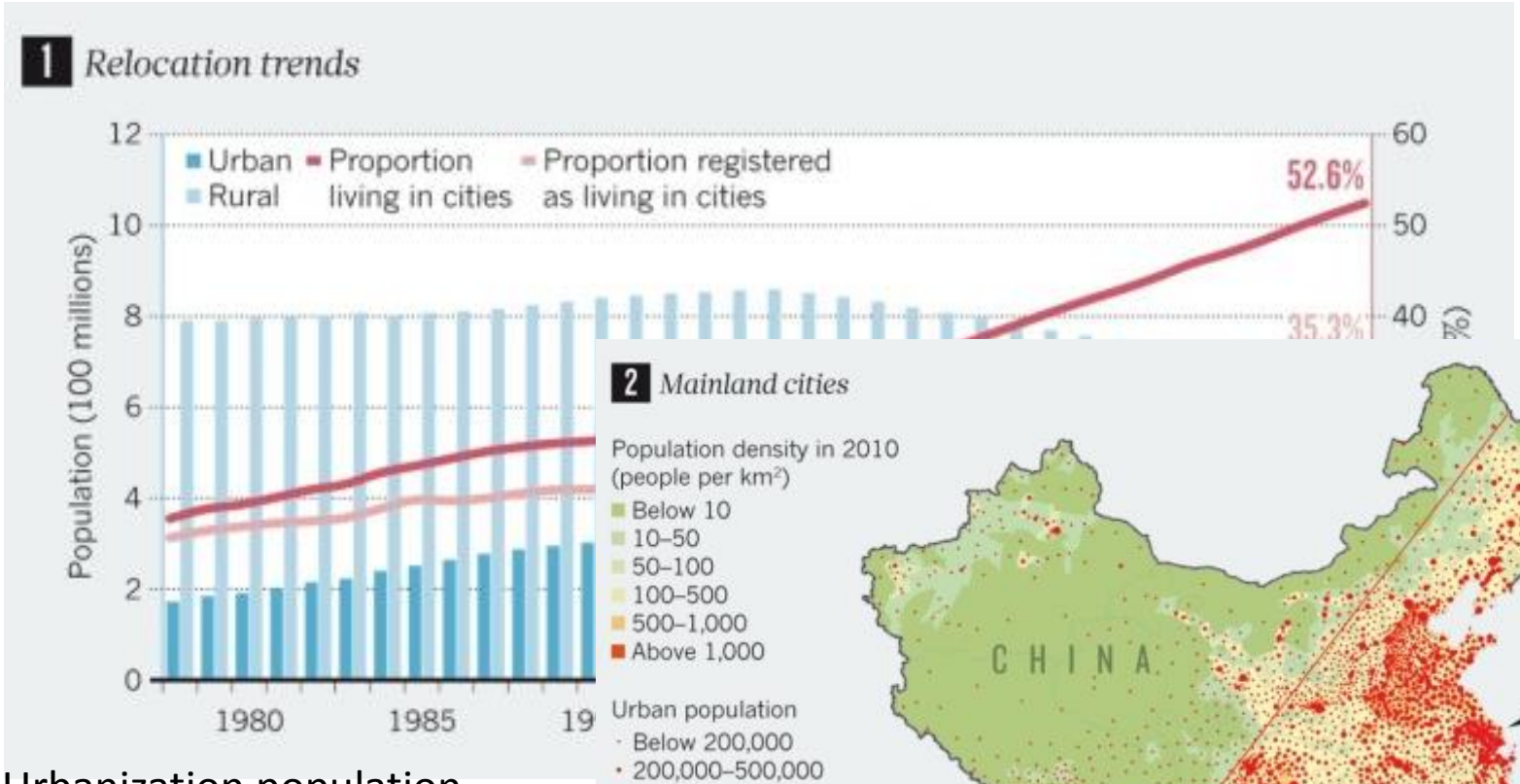
WHO/SEARO

Motor vehicles are a major contributor to air pollution.

WHO/PAHO

Many cities are planning outdoor exercise classes as part of World Health Day.

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

Project Background

HAPI

Health And Places Initiative 怡城

About HAPI / Research / Education / Resources / Contact

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.

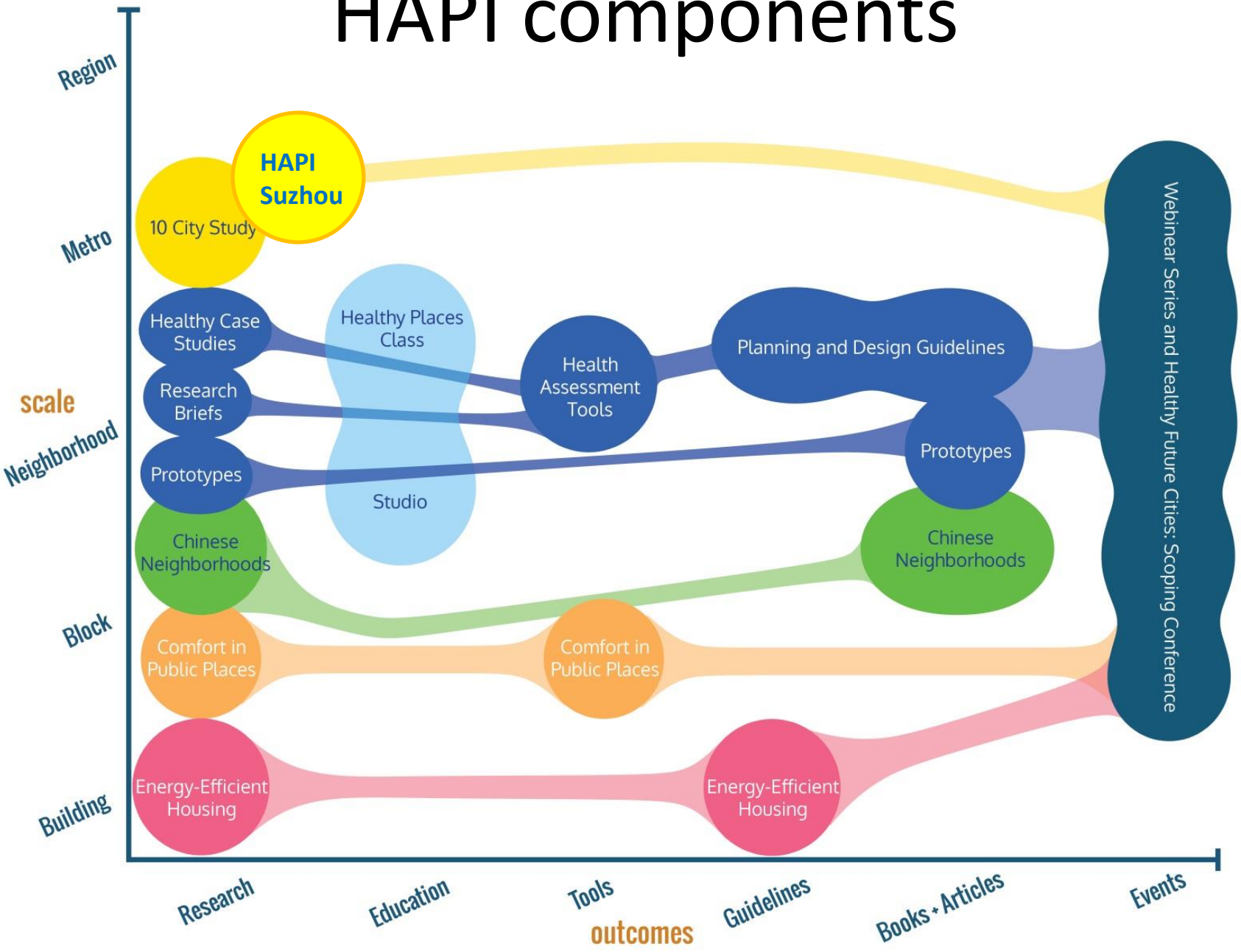
Harvard University Graduate School of Design

HARVARD T.H. CHAN SCHOOL OF PUBLIC HEALTH

The President and Fellows of Harvard College

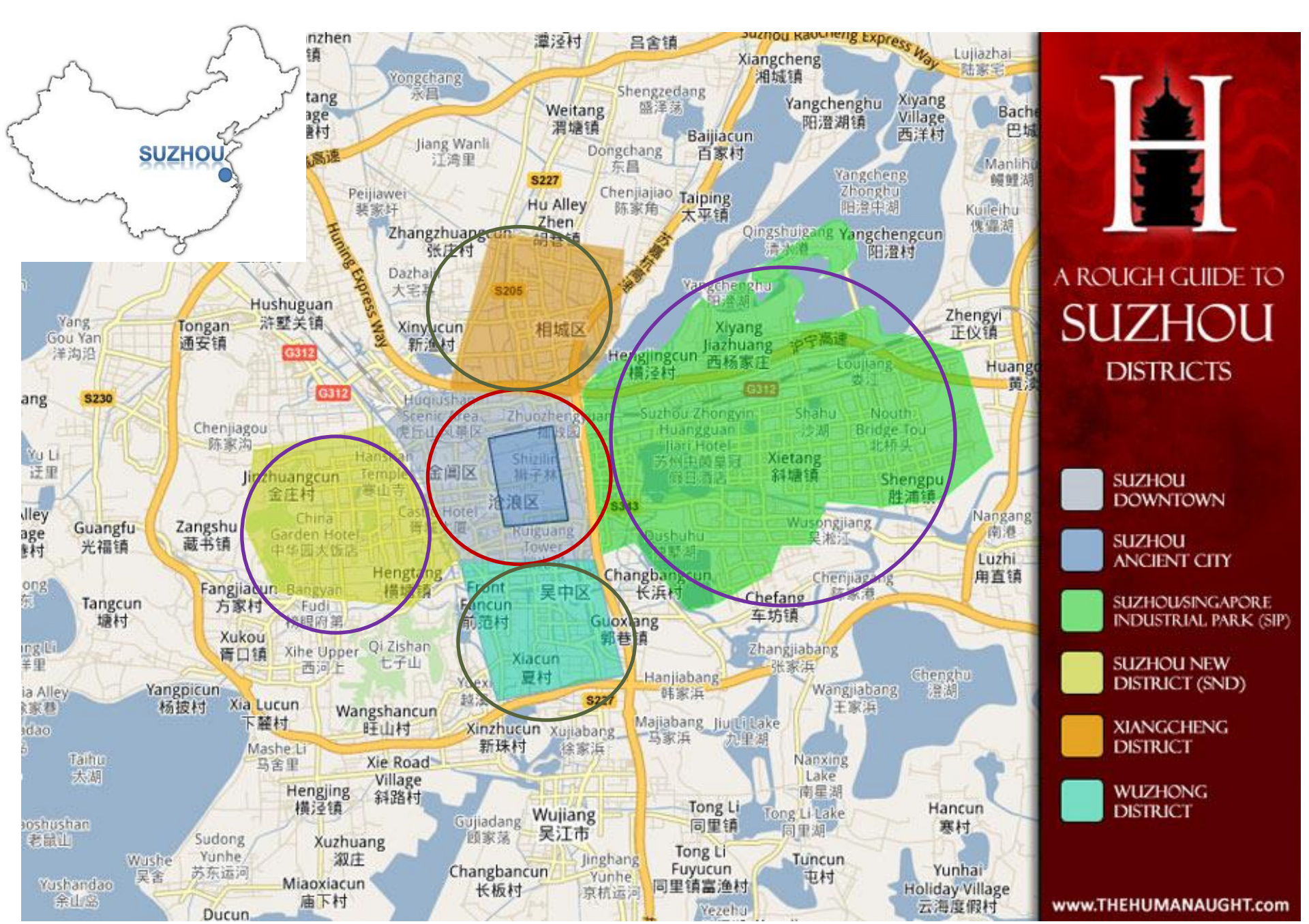
Privacy Policy

HAPI components



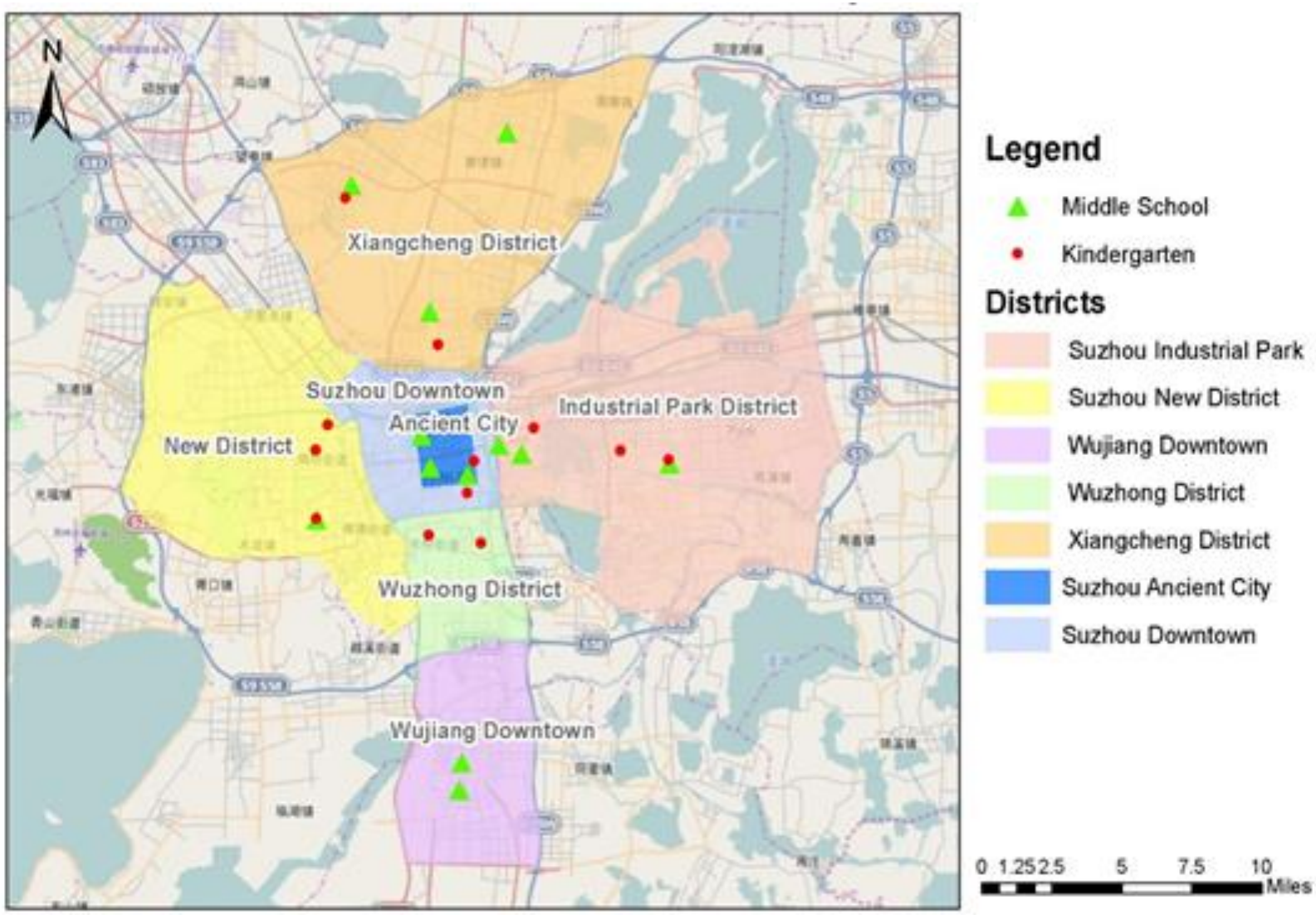
Background

- 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


SUZHOU
A ROUGH GUIDE TO
SUZHOU
DISTRICTS
SUZHOU DOWNTOWN
SUZHOU ANCIENT CITY
SUZHOU/SINGAPORE INDUSTRIAL PARK (SIP)
SUZHOU NEW DISTRICT (SND)
XIANGCHENG DISTRICT
WUZHONG DISTRICT
www.THEHUMANAUGHT.com

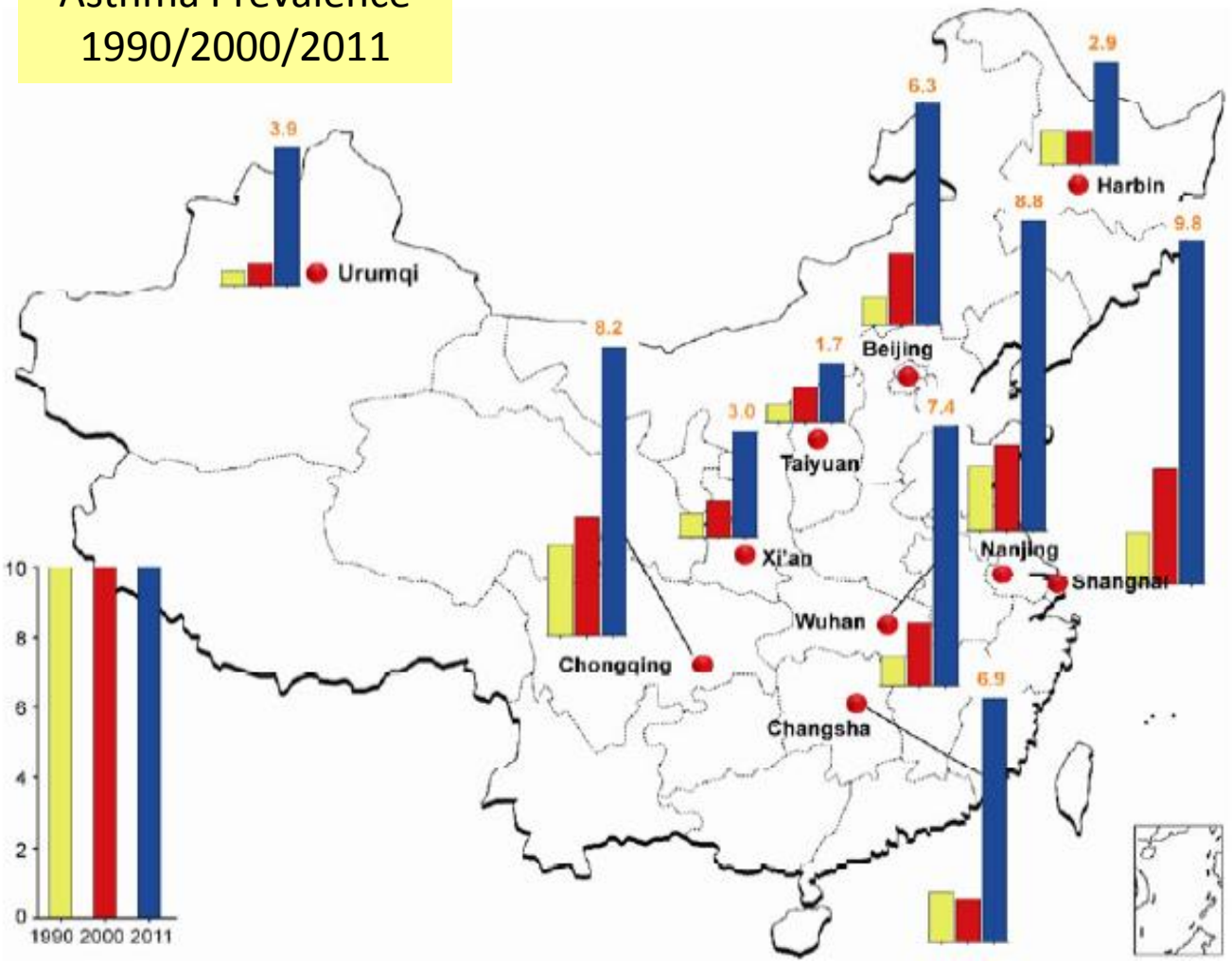
Old town vs. New town

School Location



Health Focus

Asthma Prevalence
1990/2000/2011



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

Data Collection

Data Entry

Data Analysis

Q1 | Q2 | Q3 | Q4

June 2014

October 2014

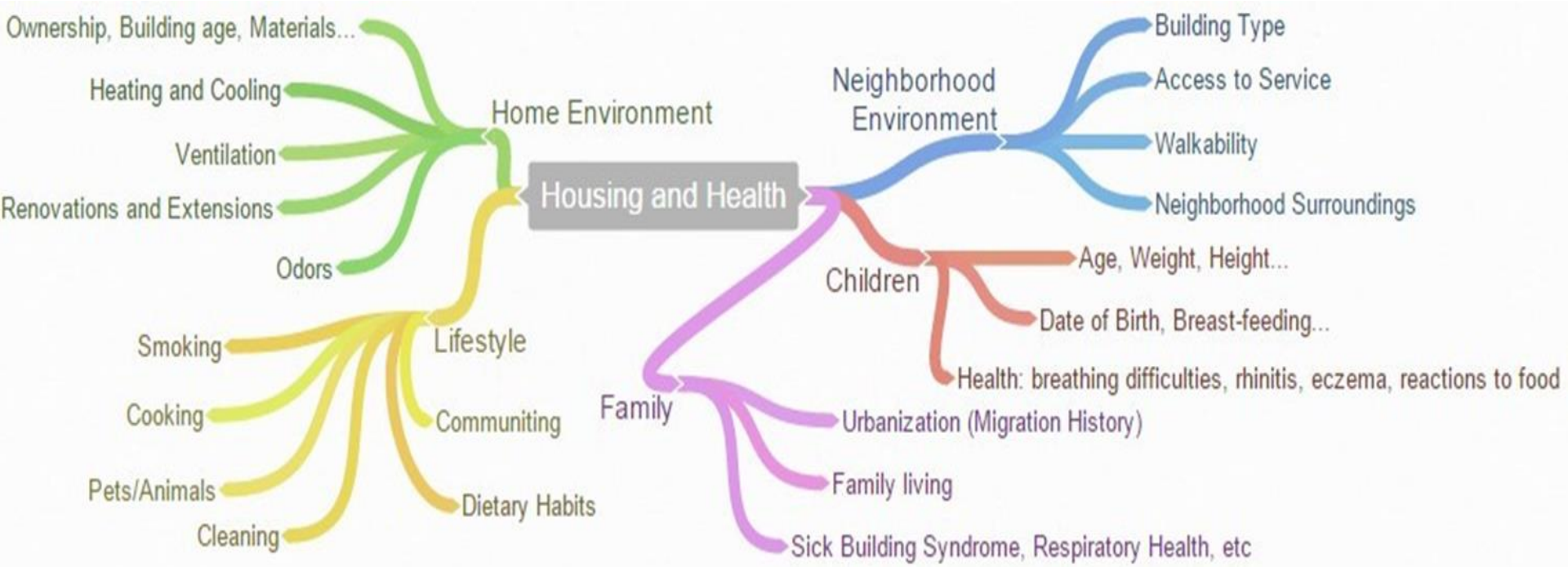
February 2015

September 15


PHILIPS

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

Household Policy | Education and Lifestyle | Urban Planning

Aim 1

Household Registration ->

Domestic Migration

Aim 2

Economic Growth ->

Life Style delivery mode

Aim 3

Urban Form ->

Green Space

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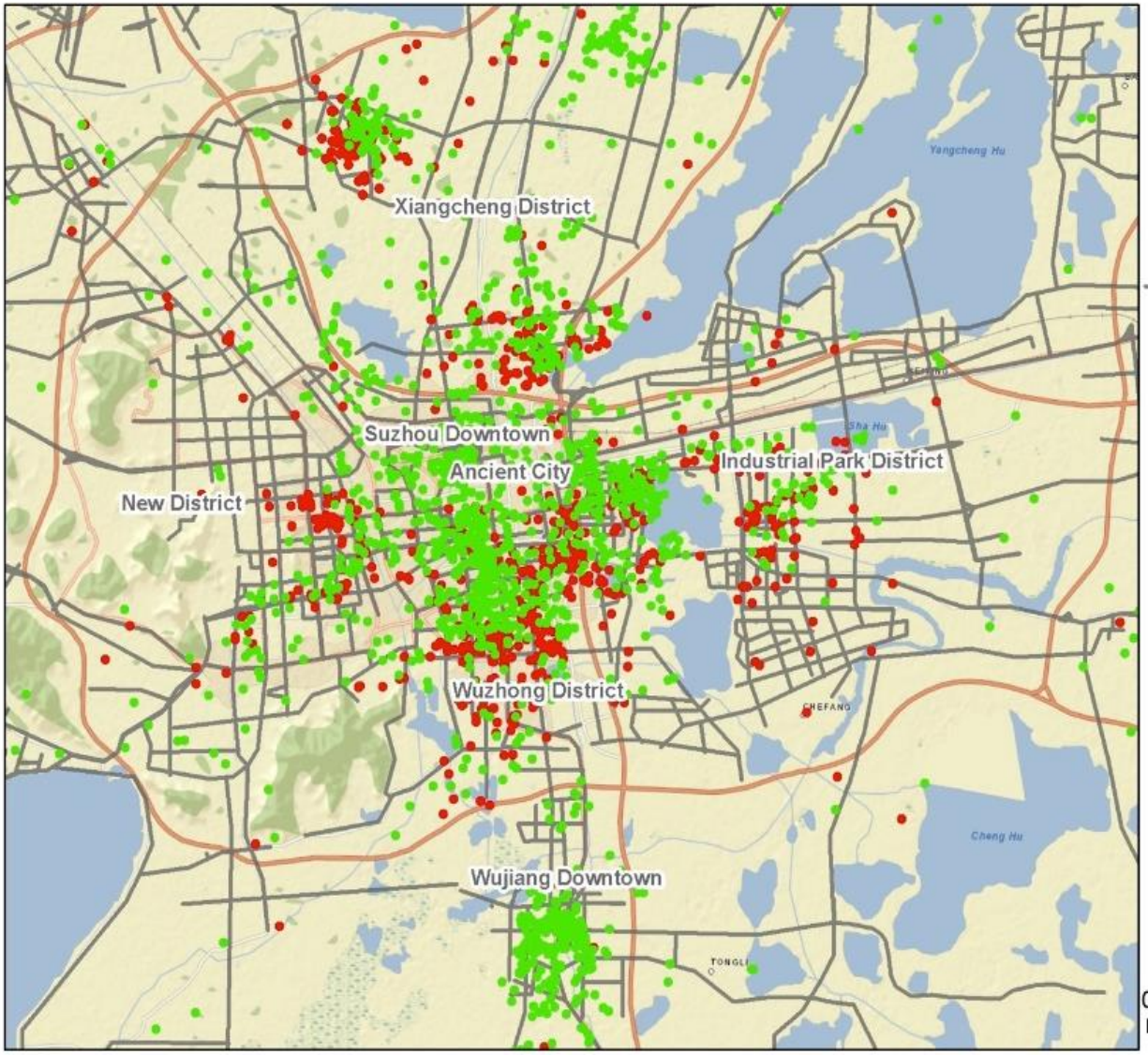
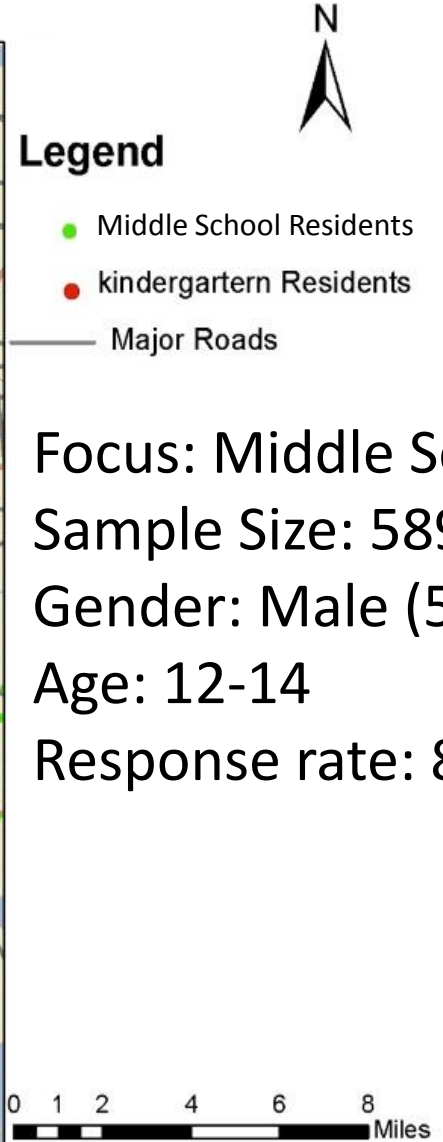
Study Population





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

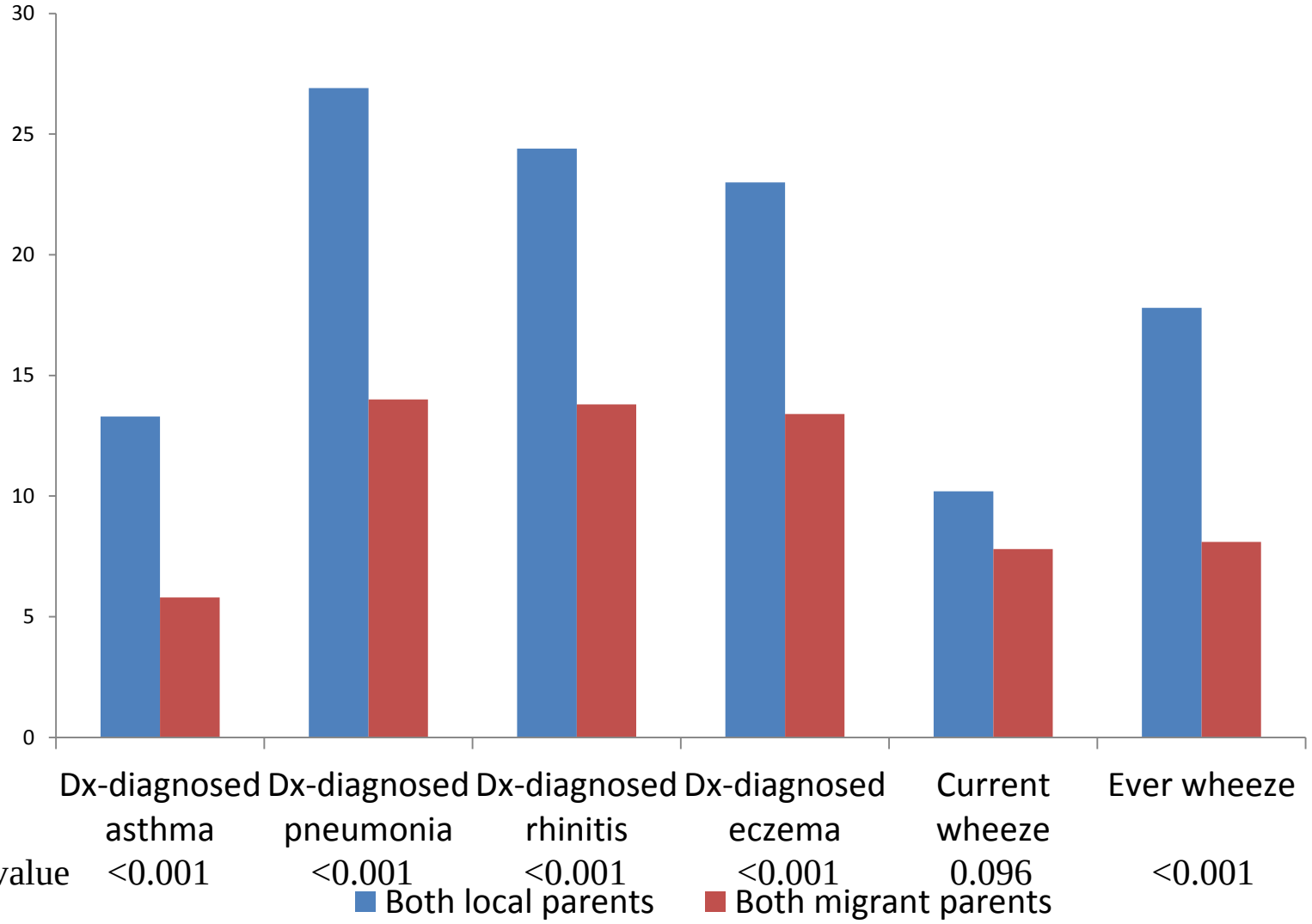
Aim 1 - Methods

- Exposure

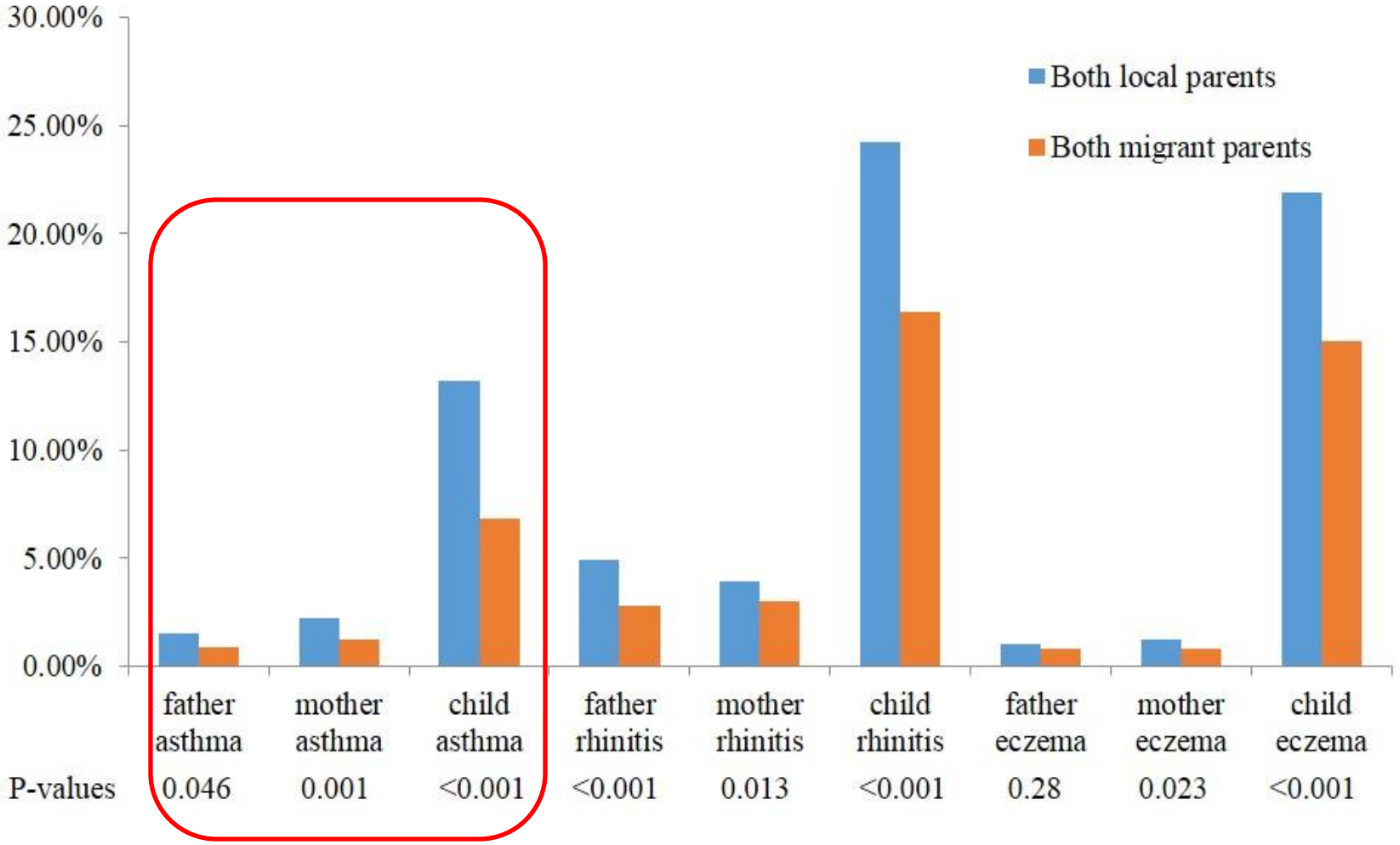
Both local parents (N=2213)	Only migrant mother (N=461)	Only migrant father (N=460)	Both migrant parents (N=2556)	Overall (N=5891)
38%	8%	8%	43%	

- 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



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

	Asthma	Pneumonia	Rhinitis	Eczema
Both local parents (ref)	1	1	1	1
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

Household Policy Education and Lifestyle Urban Planning

Aim 1

Household Registration ->

Domestic Migration

Aim 2

Economic Growth ->

Life Style delivery mode

Aim 3

Urban Form ->

Green Space

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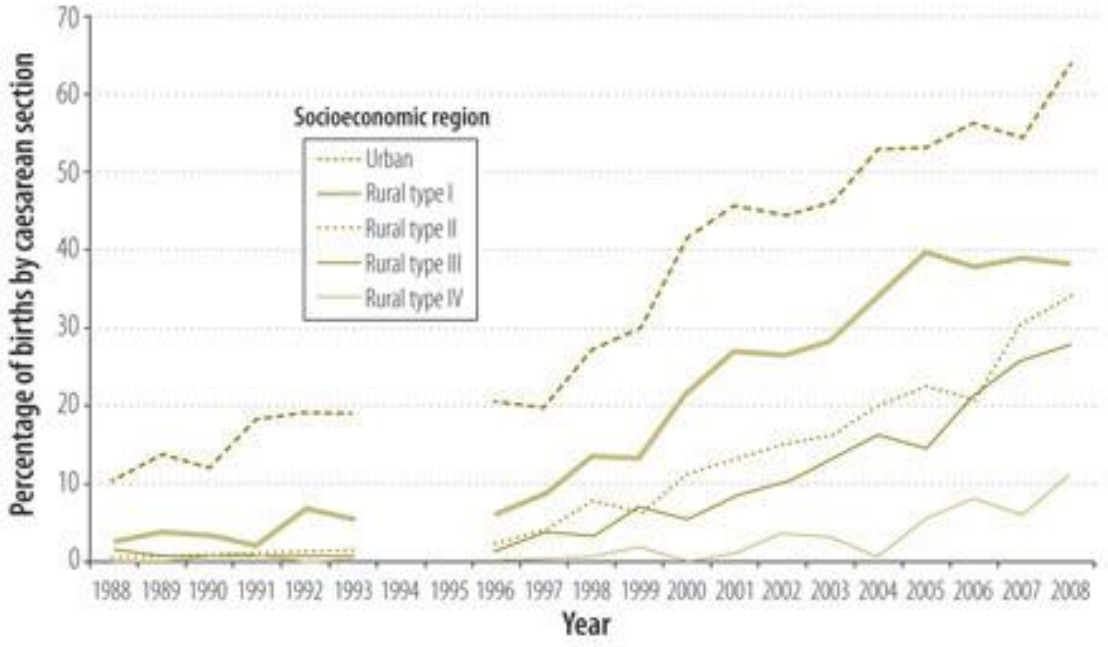
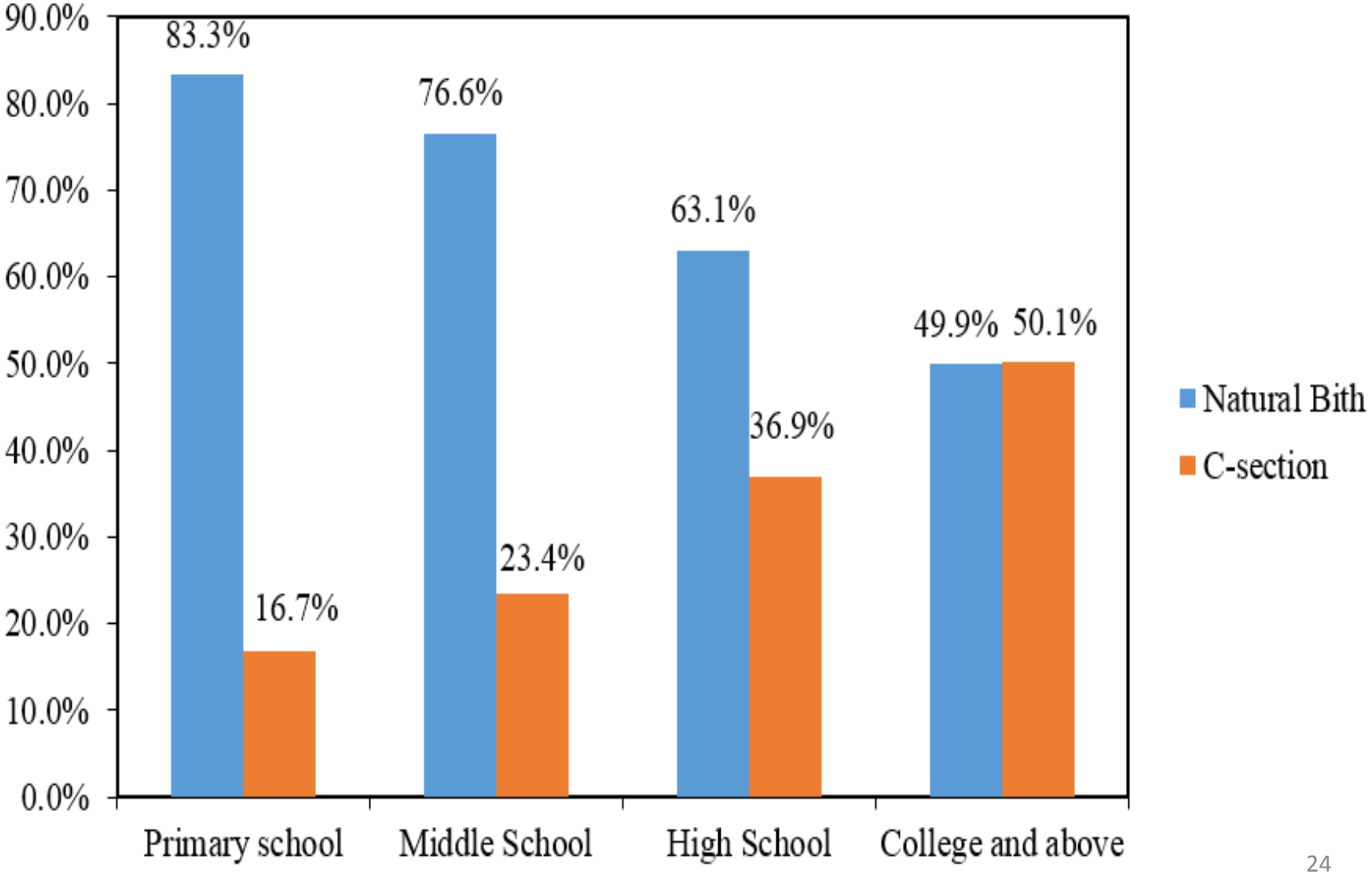
Aim 2 - Introduction

- 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

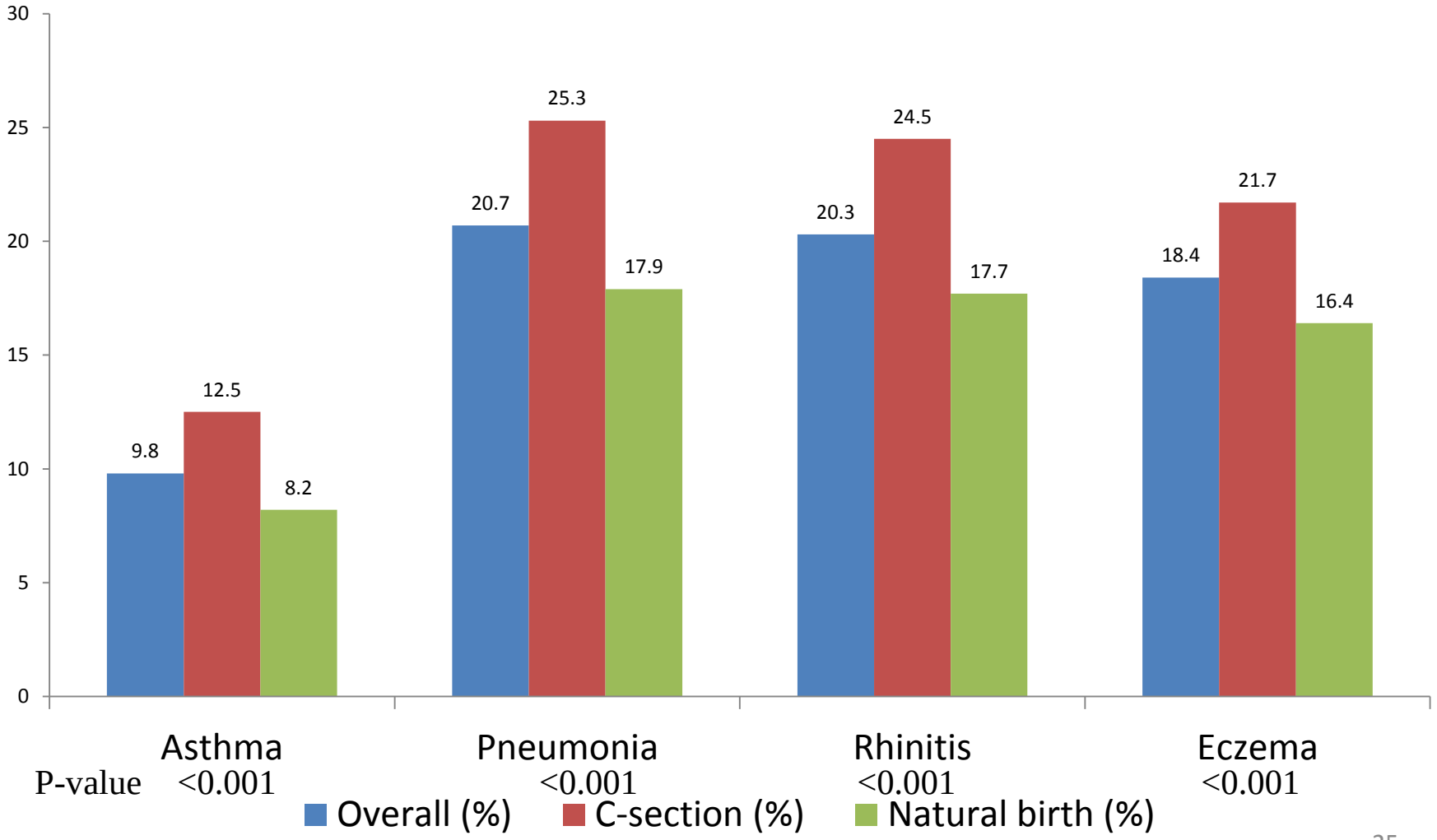


Kolokotroni et al. 2012; Neu and Rushing 2011; Penders et al. 2006; Hu et al. 2015

Aim 2 - C-section rate by parental education level



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

	Univariate Model	P-value	Full Model	P-value
Dr dx asthma	1.59 (1.33 , 1.90)*	<0.001	1.24 (1.00 , 1.52)*	0.046
Dr dx pneumonia	1.56 (1.36 , 1.78)*	<0.001	1.28 (1.10 , 1.49)*	0.001
Dr dx rhinitis	1.51 (1.32 , 1.73)*	<0.001	1.16 (0.99 , 1.36)	0.059
Dr dx eczema	1.41 (1.23 , 1.62)*	<0.001	1.13 (0.96 , 1.33)	0.128

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

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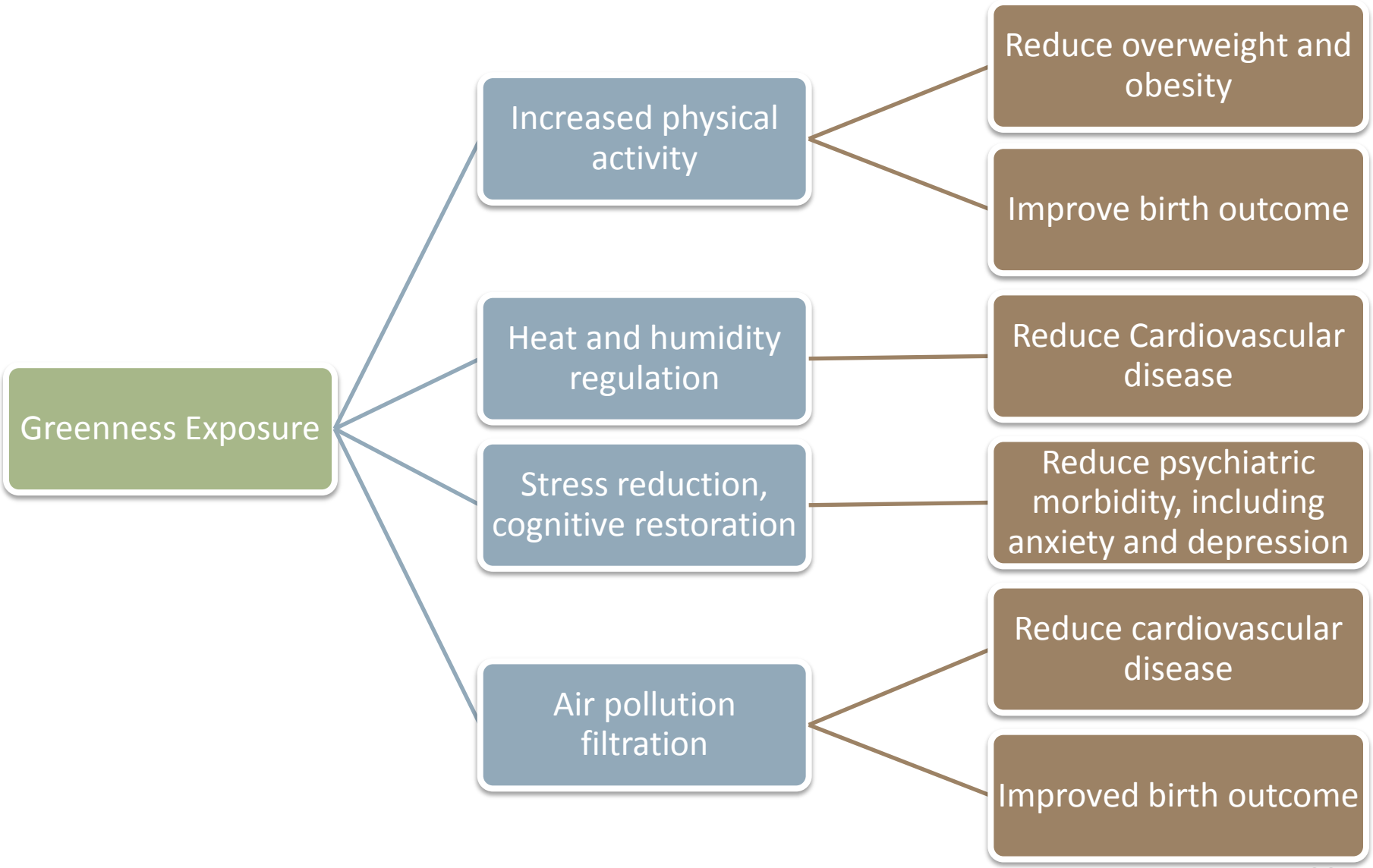
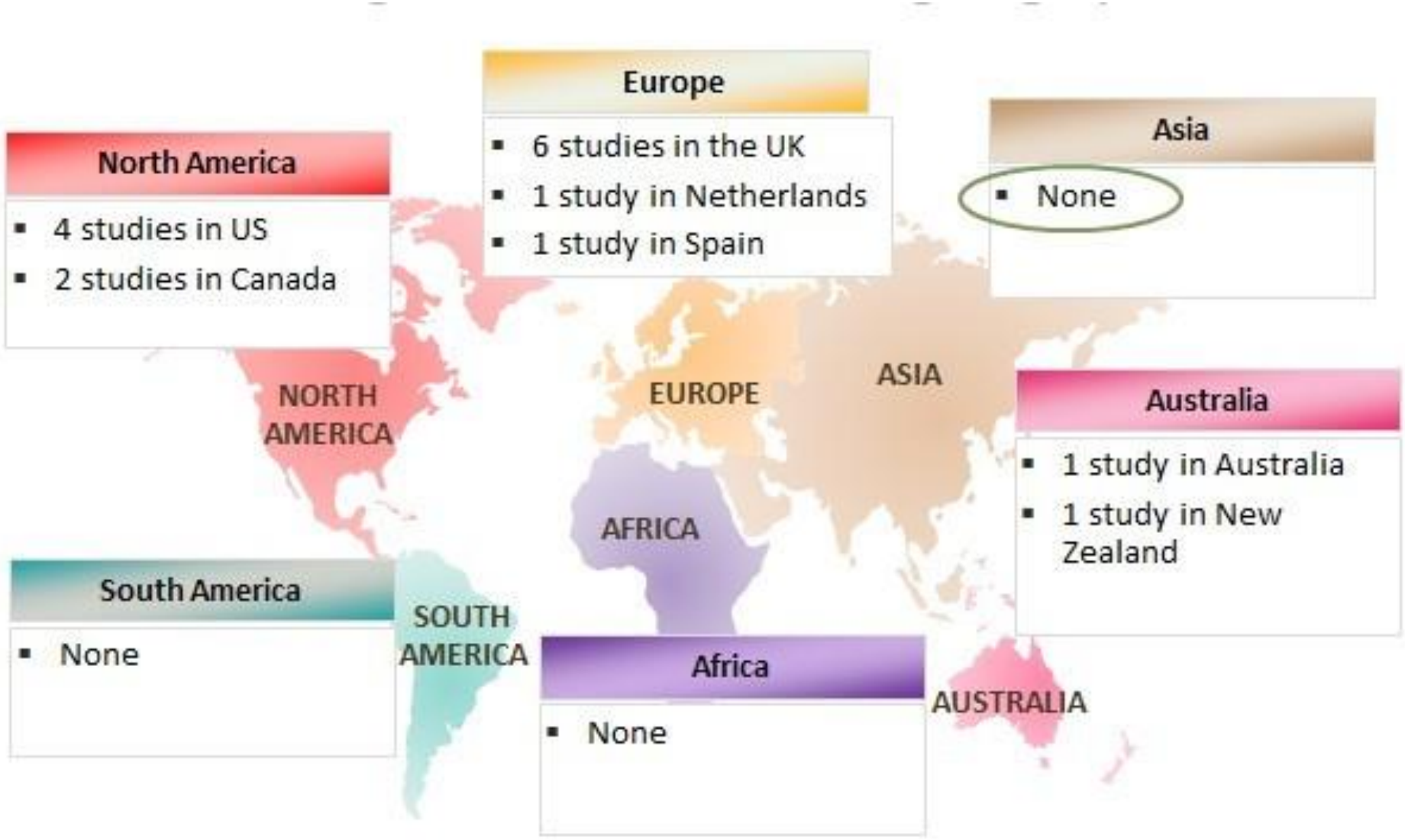
Aim 3 - Background



James et al., 2015

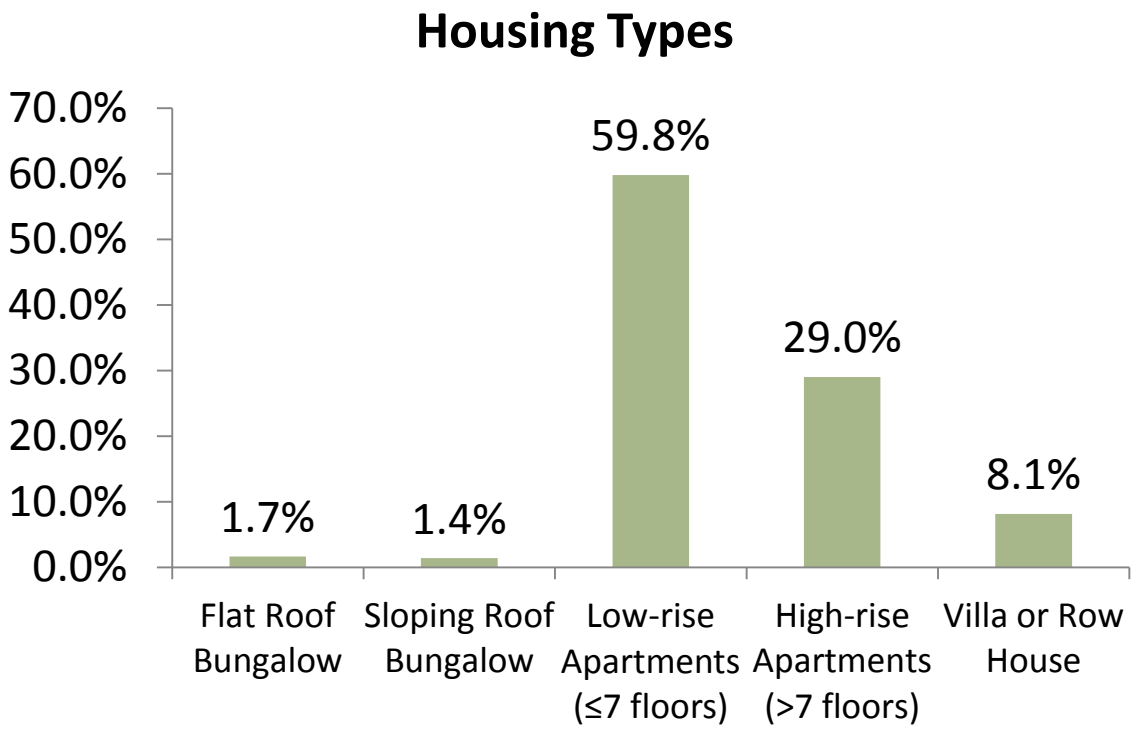
Aim 3 - Background



Lachowycz and Jones, 2011; James et al., 2015

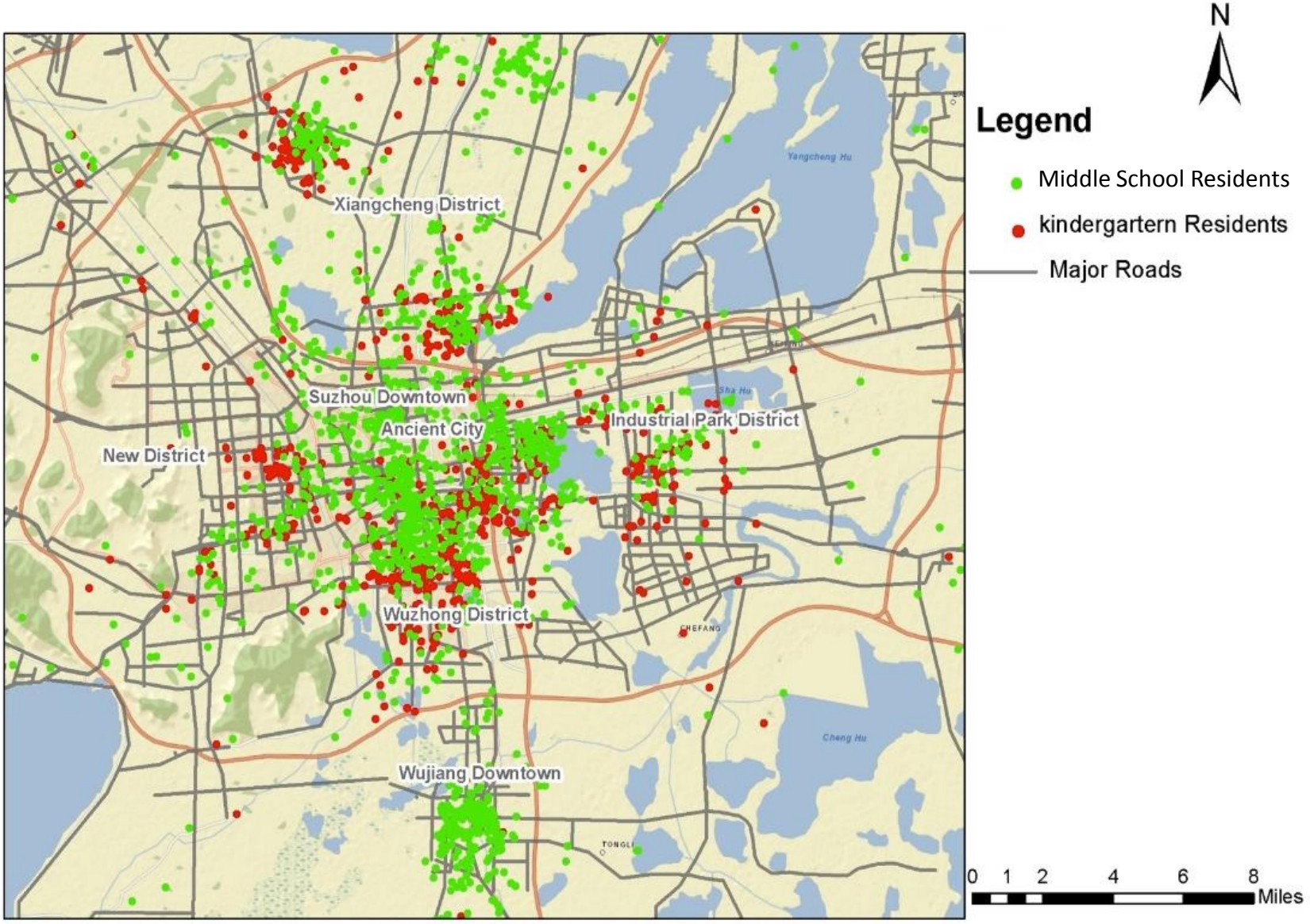
Aim 3 - Greenness

- 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



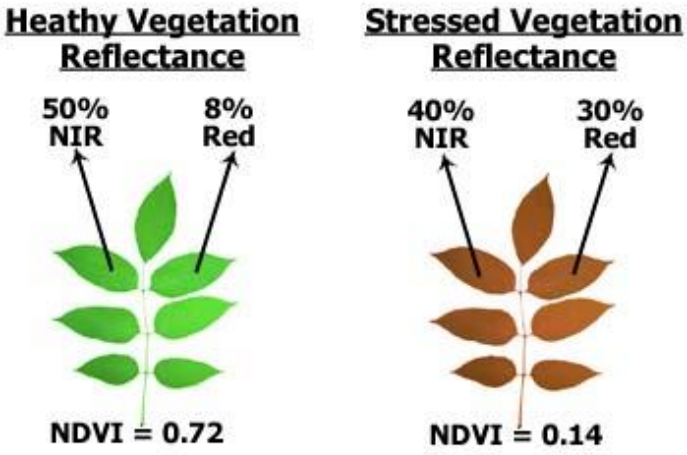
China is going through rapid urbanization and its building types, and urban infrastructure are different from western countries

Geocoded Home Address



Aim 3 - Methods (Exposure Assessment)

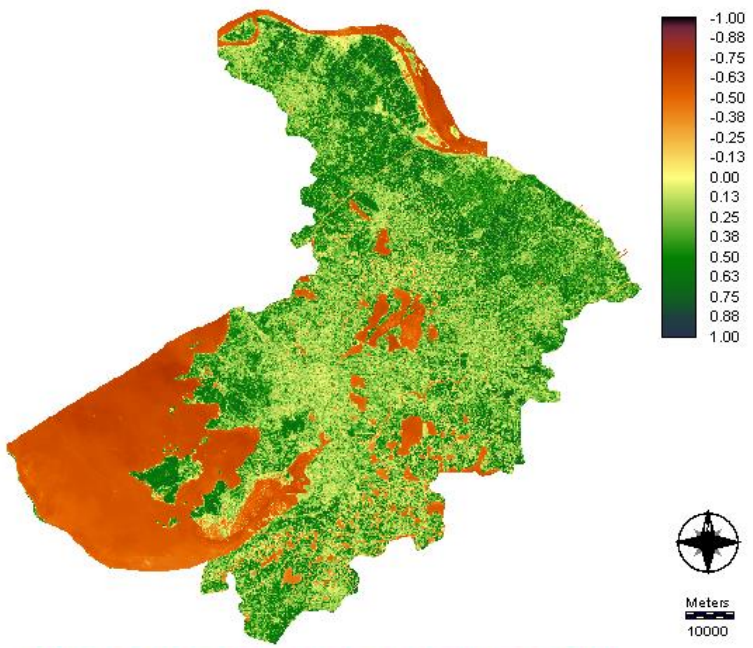
- Distance to the nearest parks (~300 Parks)
  - 300 meter as walking distance
  - Quartile/spline analysis
- Normalized Difference Vegetation Index (NDVI).
  - Values range between -1 and 1
  - Residential surrounding greenness as the average of (NDVI) in buffers
    - 100 m, 200 m, 500 m, and 1,000 m around each home address
  - Annual average in 2014



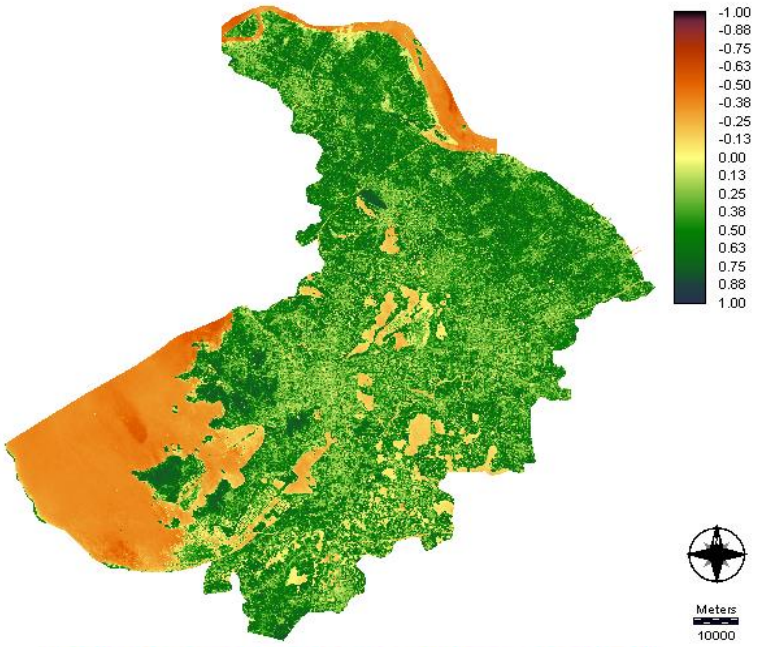
$$NDVI = \frac{NIR - Red}{NIR + Red}$$

Dadvand et al. 2014

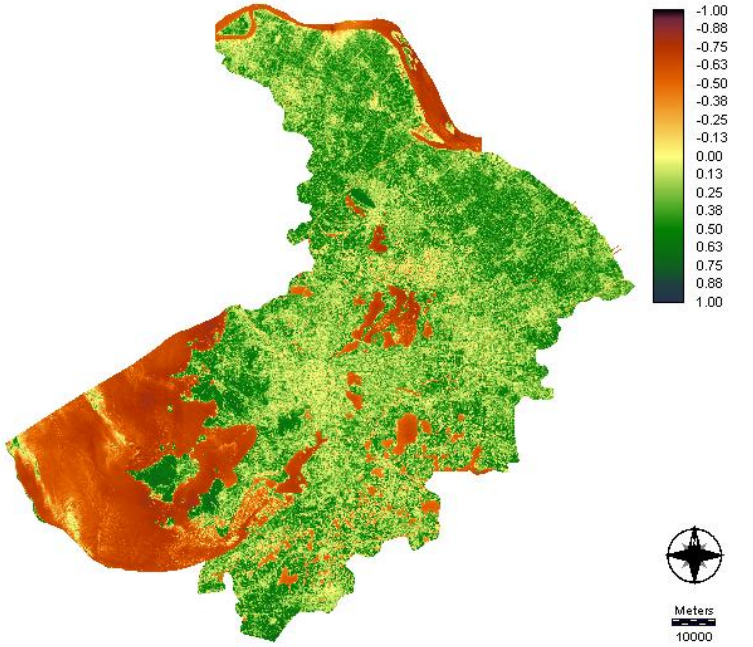
NDVI Values for Year 2014 (March 16th)



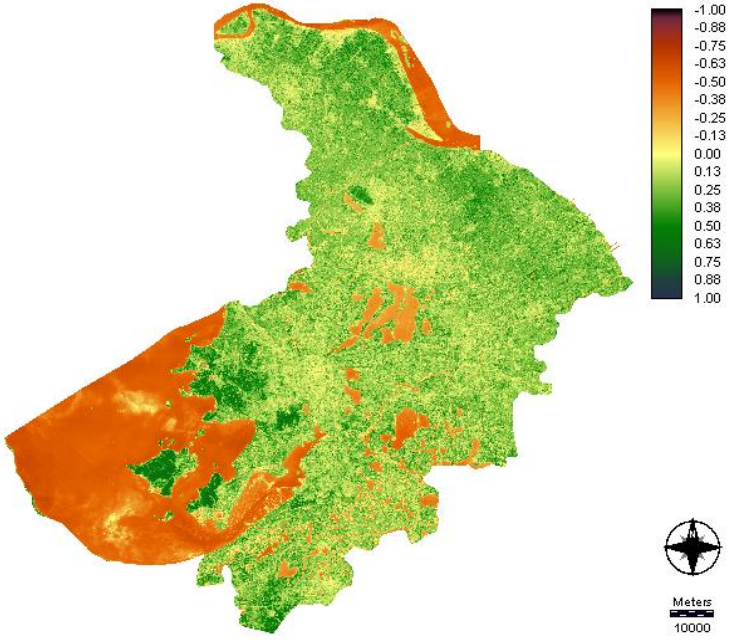
NDVI Values for Year 2014 (June 22th)



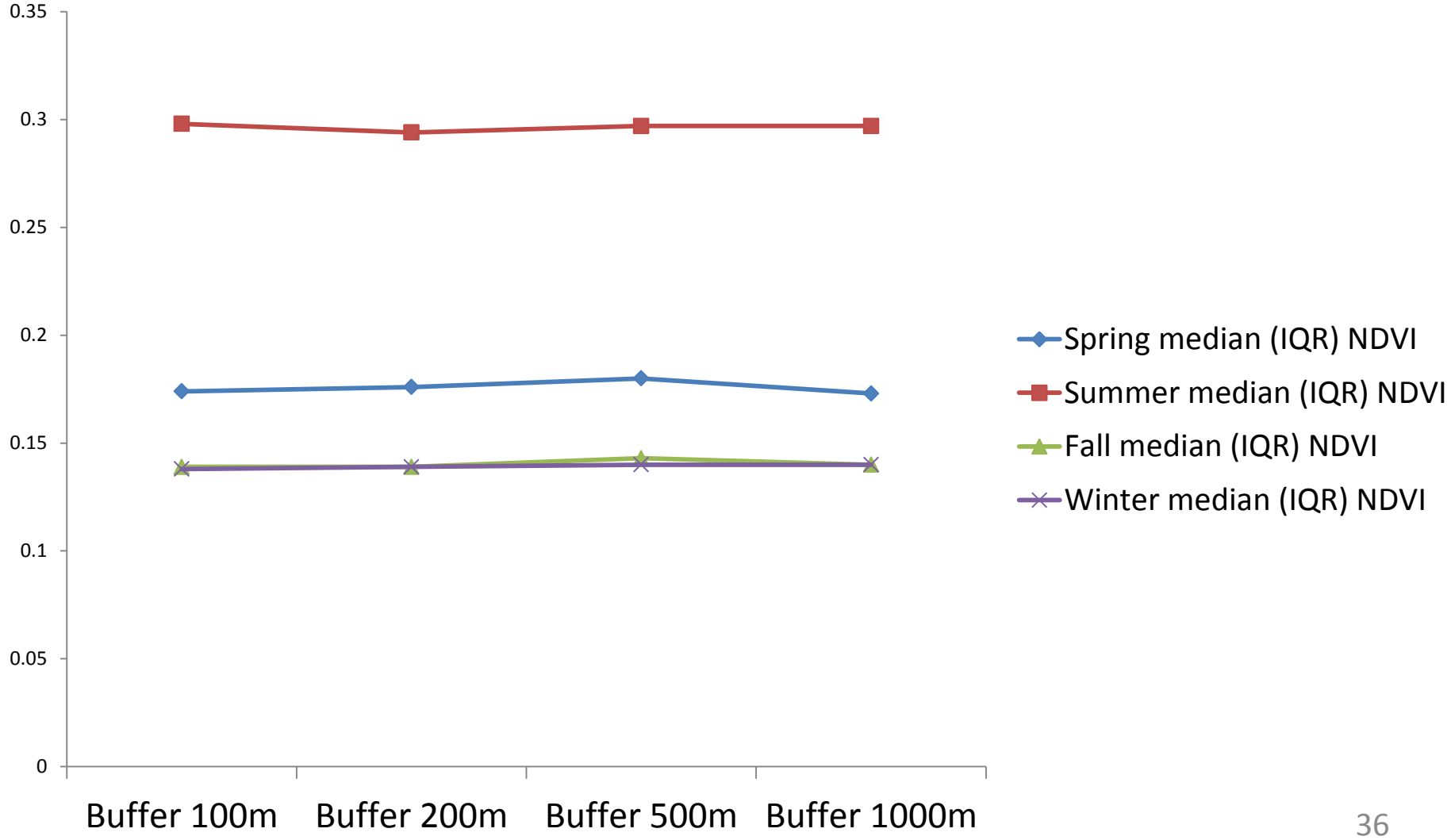
NDVI Values for Year 2014 (October 26th)



NDVI Values for Year 2014 (December 29th)



Aim 3 - Overall and season-specific NDVI values



Aim 3 - Results

NDVI vs. Outcomes (per interquartile)

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

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

	Odds Ratio
Asthma	1.75 (1.33, 2.38)*
Pneumonia	1.35 (1.11, 1.64)*
Rhinitis	1.37 (1.11, 1.67)*
Eczema	1.52 (1.23, 1.85)*

adjusted for children's gender, age, environmental tobacco smoking at home, parental education, and parental history of asthma

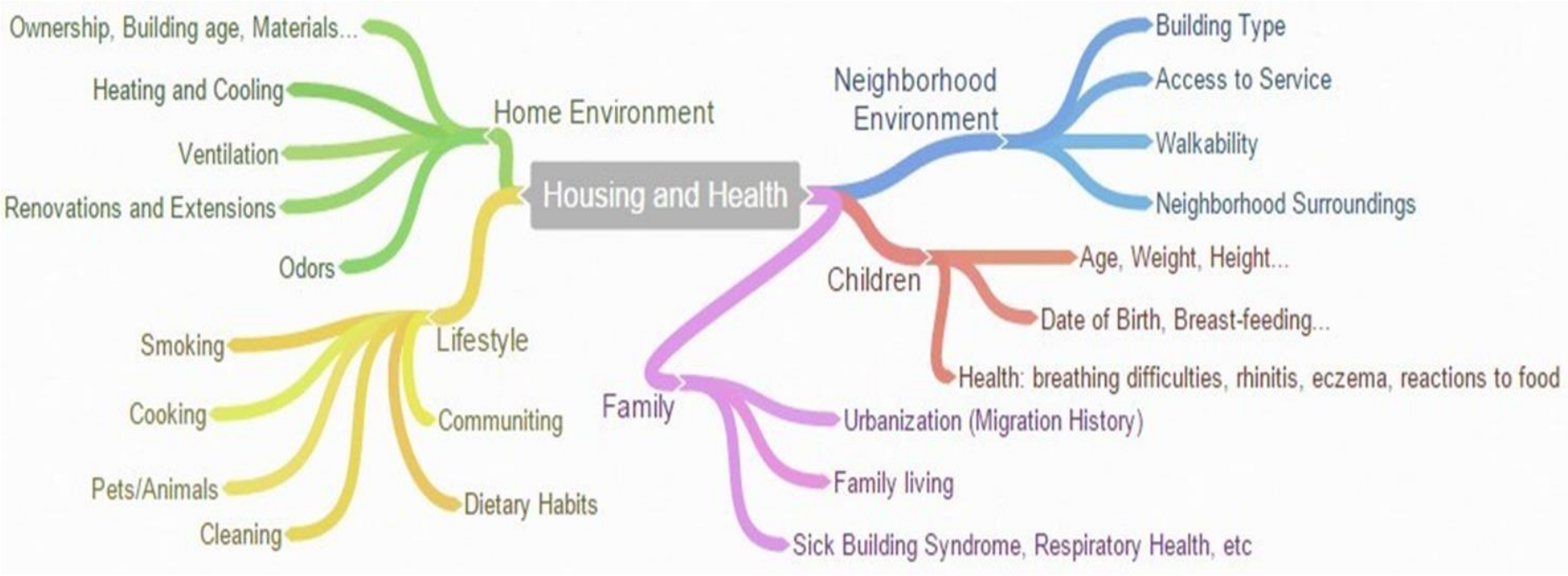
Aim 3 - Discussions

- 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



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Chunnan Ma

HAPI Health And Places Initiative


Thank You