NYU POLYTECHNIC SCHOOL OF ENGINEERING

Association between walking, bicycling and built environment features in Shanghai

Kristen Day, Ph.D., NYU
Mariela Alfonzo, Ph.D., NYU
Zhan Guo, Ph.D., NYU
Lin Lin, Ph.D., East China Normal University

The problem

Growing obesity epidemic in China

- 34% of adults age 20-69 are overweight
- 15% of children age 10–12 are overweight
- **1/5** of overweight people = Chinese
- Most affected: cities, affluent, boys

Serious impacts

- Noncommunicable diseases = 80% deaths
  Cost $550 billion (USD) in lost productivity from 2010-15

The causes

Western diets

Low awareness of noncommunicable disease

Reduced physical activity

- PA dropped 33% in China from 1991–2000
- Changing work, leisure

Increased car travel

- 35% of travel in central Beijing = by car; 3X rate in Manhattan
- Share of bicycle trips dropped 63% to 18%, 1986–2009

One-child policy

Chinese associations w/overweight

Rapid urbanization, massive city building

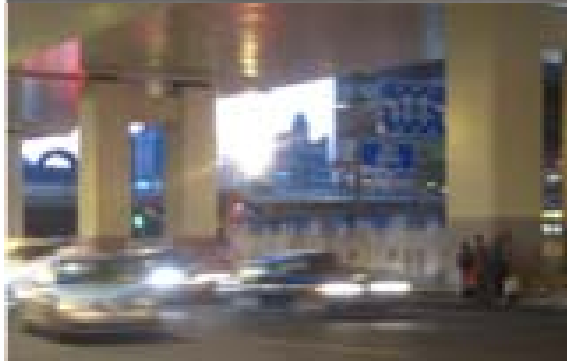
- Over 50% of population (622 million) in cities
- By 2025: 350 million MORE urban residents

To accommodate new urban residents:

- 170 new mass-transit systems
- 5 billion sq. meters new roads
- 40 billion sq. meters new floor space

Development patterns discourage PA

- Sprawl, lower density (down 67% 2000-2005)
- Gated communities
- Build for cars over peds, bicycles
- High rates of air pollution



Our study

RQ: What is the relationship between built environment features and physical activity in three Shanghai neighborhoods?

- Also collected data in 3 Hangzhou neighborhoods, analyzing now

Methods:

(1) Typology of built environment features in Chinese cities tied to physical activity

- Used typology to select three neighborhoods

(2) Environmental audit of 3 neighborhoods

Modified Irvine-Minnesota Inventory (IMI) to add features of Chinese cities = IMI-China (IMI-C)

•Literature review*, interviews, observation of features of several Chinese cities

286 features: Visible air pollution, car parking on sidewalks, pedestrian tunnels, etc.

Neighborhoods: 1 km area each, centered on subway station

- Observed all segments in each

**Day, K., Alfonzo, M., Chen, Y., Guo, Z. & Lee, K. (2013). Overweight, obesity, and inactivity and urban design in rapidly growing Chinese cities. Health & Place, 21, 29–38.*

Health survey

(3) Health survey of neighborhood residents
Shortened version of 2012 China Health and Nutrition Survey

Questions:

- Rates of walking, bicycling for travel and recreation; other physical activities; health outcomes (BMI, other); demographics

Intercepted in public places outside grocery store, farmers market

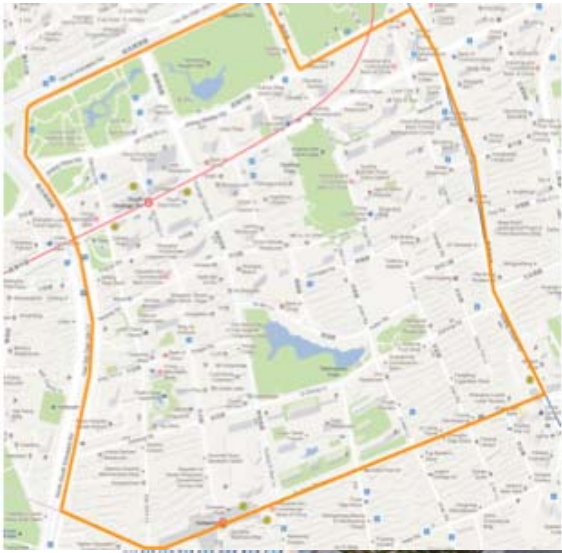
Data collected on iPads by students at East China Normal University

The sites

Neighborhood 1: Xintiandi (“high walkable”)

- Mixed use neighborhood
- Upscale shopping area
- Tall luxury towers
- Traditional low rise courtyard housing

- N= 129 segments
- N=129 resident surveys

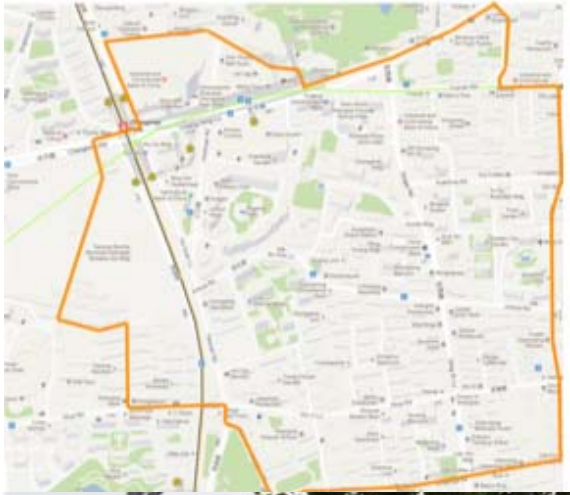


The sites

Neighborhood 2: Zhongshan Park ("medium walkable")

- Bustling mixed use
- Superblocks with retail perimenter
- Gated residential towers in center of blocks
- Wide busy streets
- Large public park

- N= 60 segments
- N = 243 resident surveys

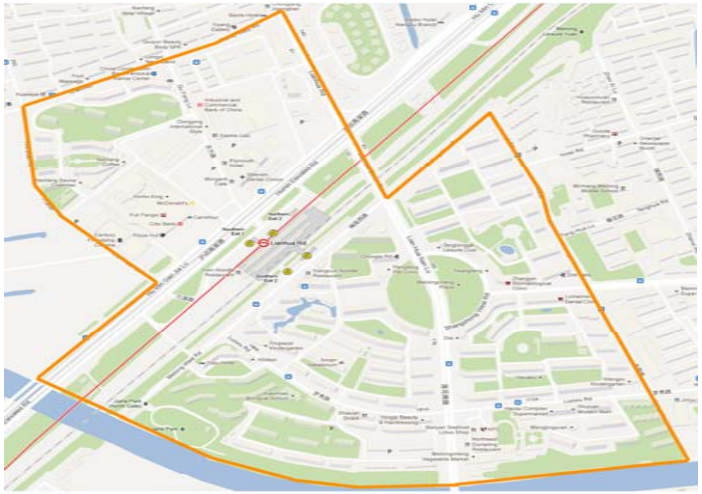


The sites

Neighborhood 3: Lianhua Lu (“low walkable)

- Suburban area in southwest Shanghai
- Gated communities
- Tall residential buildings
- Regional shopping center
- Small retail outside gates
- Internal open spaces for residents

- N = 97 segments
- N = 291 resident surveys



Analysis

Characterize built environment of three neighborhoods

- Analyze environmental audit data using State of Place Index™
  - Proprietary algorithm, calculates overall "walkability" score
  - 11 subscores measure urban design dimensions linked empirically to walking, bicycling
  - Calculated for each block, aggregated to neighborhood
  - Individual t-tests: do mean scores of two groups differ significantly?

Examine differences in health outcomes across neighborhoods

- Descriptive analysis
- Ordinary least squares (OLS) regression to examine differences in health outcomes (PA, BMI) across three neighborhoods

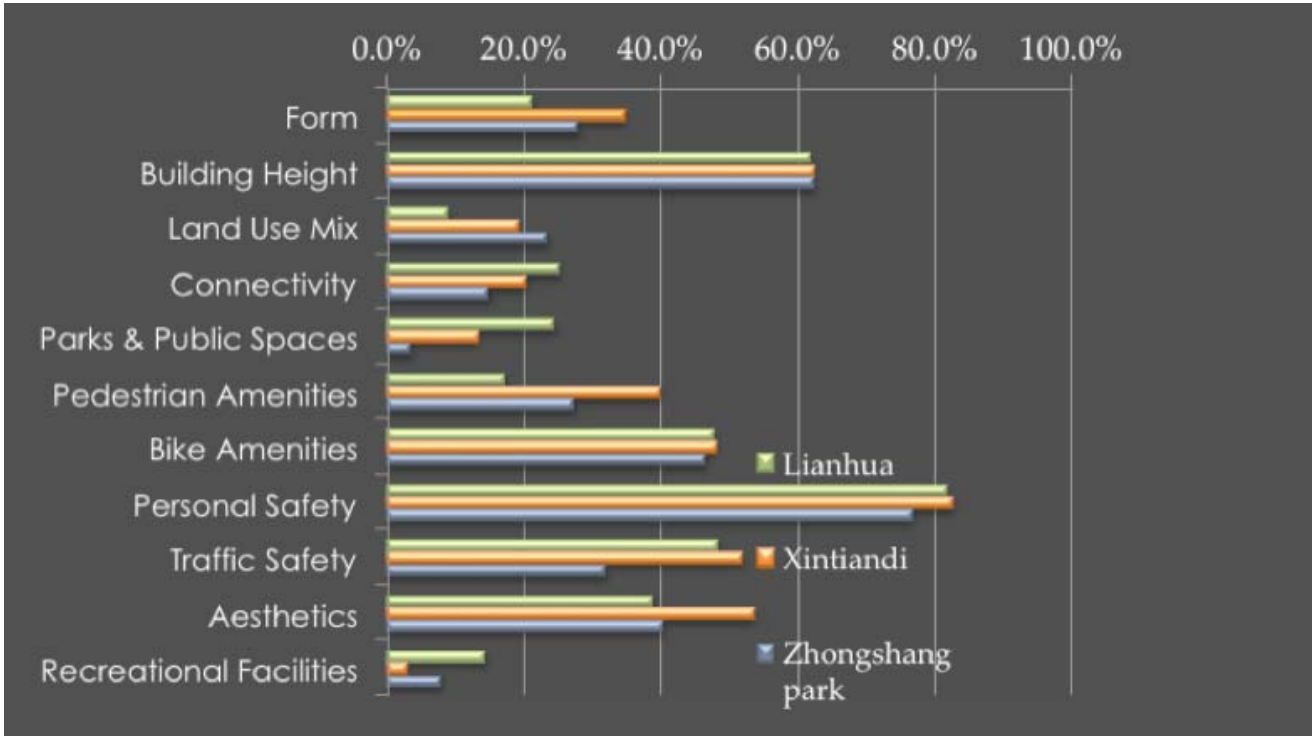
Findings

Three neighborhoods vary in State of Place score. (100% = maximum observed State of Place score at block level for 286 blocks observed.)

(1) Xiantindi = significantly higher index that (2) &(3)

(2) Zhongshang Park &

(3) Lianhua Lu = no significant difference in index



Findings

Compared to other two districts:

- Xiantindi (“high walkable”) = more **destinations, amenities**
- More inviting **pedestrian realm**; better upkeep, more pleasing character

Compared to Lianhua Lu (“low walkable”):

- Zhongzhan Park (“medium walkable”) = more **destinations, amenities**
- More **connectivity**; better sense of **enclosure**

Compare to Zhongzhan Park and Xintiandi:

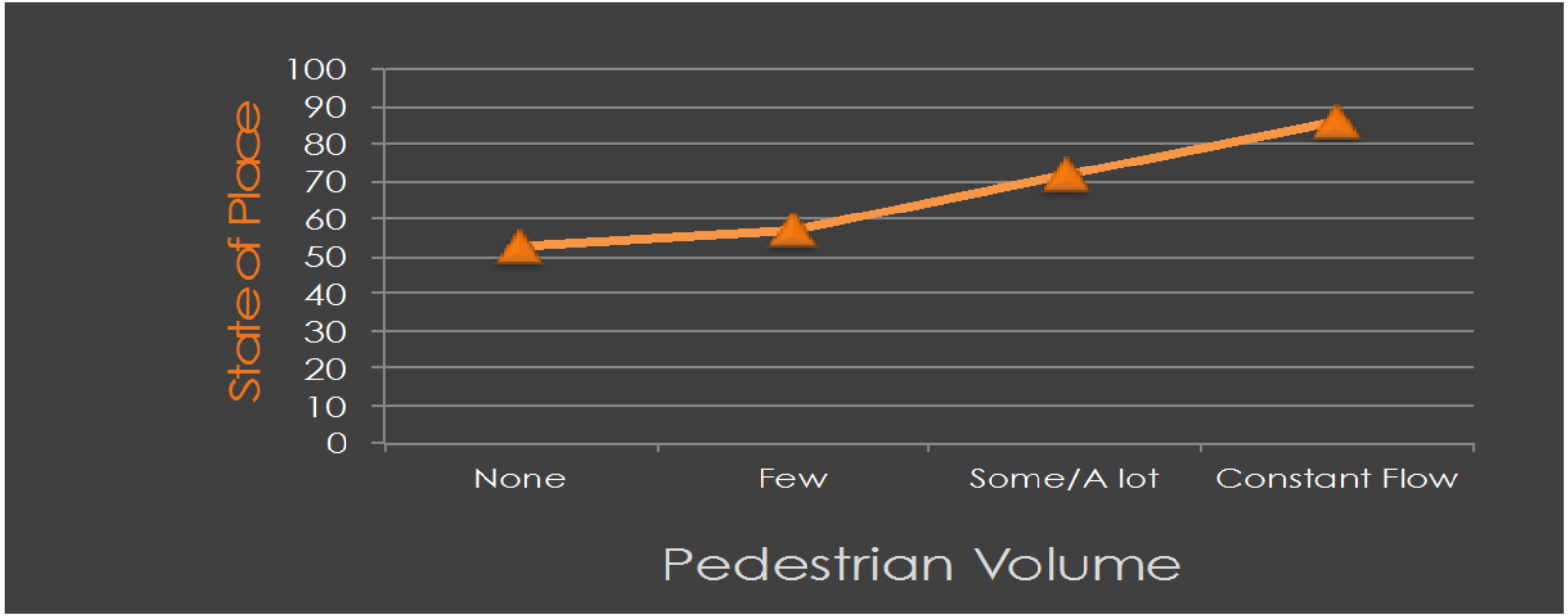
- Lianhua Lu =more **recreational facilities, parks, public space**

Xintiandi and Lianhua Lu =

- More features tied to **perceived traffic and crime safety**

Findings

Average State of Place Index for each block is associated with # of observed pedestrians on each block.



Respondent demographics and BMI

District	N	BMI	Age	Years Lived in District	Income	Yrs. education	% Female	Marital Status	Rural resident status	House-hold Size	Own Auto	Work for Wage
Xintiandi	129	22.62	42.45	11.14	1.99	3.18	0.53	0.71	0.24	2.79	0.19	0.45
Zhongshan Park	243	22.10	32.60	6.48	2.44	4.02	0.39	0.48	0.27	3.38	0.35	0.68
Lianhua Lu	291	24.06	33.76	6.16	2.50	4.17	0.40	0.67	0.19	3.68	0.39	0.59
P value		0.003	0.000	0.000	0.002	0.000	0.025	0.000	0.092	0.273	0.000	0.000

Findings

BMI ≥ 25:

- Xiantiandi = 14.05%
- Zhongshan Park = 14.2%
- Lianhua Lu = 23.5%

Mode share and travel time

Mode share										
District	Walk - commute	Walk – non-commute	Rode Bike - commute	Rode Bike non-commute	E-Bike - commute	E-Bike - non-commute	Car - commute	Car - non-commute	Bus - commute	Bus - non-commute
Lianhua Lu	0.14	0.13	0.04	0.04	0.09	0.04	0.12	0.10	0.28	0.35
Xintiandi	0.25	0.35	0.10	0.05	0.03	0.04	0.02	0.03	0.25	0.27
Zhongshan Park	0.24	0.17	0.08	0.05	0.05	0.03	0.09	0.08	0.37	0.41
P value	0.005	0.000	0.026	0.684	0.029	0.785	0.008	0.054	0.030	0.026
Average time spent in travel										
Lianhua Lu	17.63	38.08	16.36	21.82	16.65	24.85	38.12	48.33	47.00	49.17
Xintiandi	26.72	30.71	15.77	60.83	23.75	44.00	25.00	20.25	45.97	39.60
Zhongshan Park	15.69	30.54	25.15	45.46	33.64	26.25	34.57	49.79	41.21	45.66
P value	0.016	0.008	0.050	0.235	0.480	0.524	0.042	0.007	0.407	0.003

Findings

Travel mode, time spent in active travel varied by neighborhood

Xintiandi:
More walking; less cars, transit. Spent more time walking (commuting)

Zhongshan Park:
More bicycling; more transit. Spent more time bicycling (commuting)

Lianhua Lu:
Less walking, less bicycling; more car travel

Summary of Regression Results, BMI = DV

Lower BMI:

- Higher income
- Better education
- Females
- Spent more time in public transit
- Worked for labor-intensive jobs
- Viewed physical activity as important

Higher BMI:

- Middle aged respondents
- Likely to alter outdoor exposure to avoid air pollution

Summary of regression results, Physical activity = DV

Comparing Zhongshan Park and Lianhua Lu to Xintiandi,

Lianhua Lu:

- Less likely to walk to work
- Spend less time on physical exercise
- Spend more time on sedentary activities

Differences in physical activity between Zhongshan Park & Xintiandi not significant

Questions?

Next steps:

- Are patterns the same in Hangzhou neighborhoods?
- Seek support to expand to Southern China cities

Thank you to

- Council on Tall Buildings and Urban Habitat
- NYU Global Health Research Seed Grant program