Association between walking, bicycling and built environment features in Shanghai

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Growing obesity epidemic in China
  
  • 34% of adults age 20-69 are overweight
  • 15% of children age 10–12 are overweight
  • \( \frac{1}{5} \) 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
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
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

(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
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
Neighborhood 2: Zhongshan Park ("medium walkable")
• Bustling mixed use
• Superblocks with retail perimeter
• Gated residential towers in center of blocks
• Wide busy streets
• Large public park

• N= 60 segments
• N = 243 resident surveys
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
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
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
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

<table>
<thead>
<tr>
<th>District</th>
<th>N</th>
<th>BMI</th>
<th>Age</th>
<th>Yrs Lived in District</th>
<th>Income</th>
<th>Yrs. education</th>
<th>% Female</th>
<th>Marital Status</th>
<th>Rural resident status</th>
<th>Household Size</th>
<th>Own Auto</th>
<th>Work for Wage</th>
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</thead>
<tbody>
<tr>
<td>Xintiandi</td>
<td>129</td>
<td>22.62</td>
<td>42.45</td>
<td>11.14</td>
<td>1.99</td>
<td>3.18</td>
<td>0.53</td>
<td>0.71</td>
<td>0.24</td>
<td>2.79</td>
<td>0.19</td>
<td>0.45</td>
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<tr>
<td>Zhongshan Park</td>
<td>243</td>
<td>22.10</td>
<td>32.60</td>
<td>6.48</td>
<td>2.44</td>
<td>4.02</td>
<td>0.39</td>
<td>0.48</td>
<td>0.27</td>
<td>3.38</td>
<td>0.35</td>
<td>0.68</td>
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<tr>
<td>Lianhua Lu</td>
<td>291</td>
<td>24.06</td>
<td>33.76</td>
<td>6.16</td>
<td>2.50</td>
<td>4.17</td>
<td>0.40</td>
<td>0.67</td>
<td>0.19</td>
<td>3.68</td>
<td>0.39</td>
<td>0.59</td>
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<tr>
<td>P value</td>
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<td>0.000</td>
<td>0.000</td>
<td>0.002</td>
<td>0.000</td>
<td>0.025</td>
<td>0.000</td>
<td>0.092</td>
<td>0.273</td>
<td>0.000</td>
<td>0.000</td>
<td></td>
</tr>
</tbody>
</table>
**BMI ≥ 25:**

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

## Mode share and travel time

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Lianhua Lu</td>
<td>0.14</td>
<td>0.13</td>
<td>0.04</td>
<td>0.04</td>
<td>0.09</td>
<td>0.04</td>
<td>0.12</td>
<td>0.10</td>
<td>0.28</td>
<td>0.35</td>
</tr>
<tr>
<td>Xintiandi</td>
<td>0.25</td>
<td>0.35</td>
<td>0.10</td>
<td>0.05</td>
<td>0.03</td>
<td>0.04</td>
<td>0.02</td>
<td>0.03</td>
<td>0.25</td>
<td>0.27</td>
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<tr>
<td>Zhongshan Park</td>
<td>0.24</td>
<td>0.17</td>
<td>0.08</td>
<td>0.05</td>
<td>0.05</td>
<td>0.03</td>
<td>0.09</td>
<td>0.08</td>
<td>0.37</td>
<td>0.41</td>
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<tr>
<td>P value</td>
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<td>0.000</td>
<td>0.026</td>
<td>0.684</td>
<td>0.029</td>
<td>0.785</td>
<td>0.008</td>
<td>0.054</td>
<td>0.030</td>
<td>0.026</td>
</tr>
</tbody>
</table>

## Average time spent in travel

<table>
<thead>
<tr>
<th>District</th>
<th>Lianhua Lu</th>
<th>Xintiandi</th>
<th>Zhongshan Park</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>17.63</td>
<td>38.08</td>
<td>16.36</td>
<td>21.82</td>
<td>0.016</td>
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<tr>
<td>26.72</td>
<td>30.71</td>
<td>15.77</td>
<td>60.83</td>
<td>0.008</td>
</tr>
<tr>
<td>15.69</td>
<td>30.54</td>
<td>25.15</td>
<td>45.46</td>
<td>0.235</td>
</tr>
</tbody>
</table>

| Lianhua Lu      | 48.33 | 47.00 | 49.17 |
| Xintiandi       | 20.25 | 45.97 | 39.60 |
| Zhongshan Park  | 49.79 | 41.21 | 45.66 |
| P value         | 0.042 | 0.007 | 0.407 |

P values indicate statistical significance at the 0.05 level.
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
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