The Association Between Built Environments and Crime Around Low-Income and Minority Schools

Sungmin Lee\textsuperscript{a} PhD Candidate, MLA
Chanam Lee\textsuperscript{a} PhD, MLA | Ji Won Nam\textsuperscript{b} MLA | Jason A. Mendoza\textsuperscript{c} PhD

\textsuperscript{a}Department of Landscape Architecture and Urban Planning
Center for Health Systems and Design
Texas A&M University

\textsuperscript{b}Department of Recreation, Park and Tourism Science
Texas A&M University

\textsuperscript{c}Department of Pediatrics, University of Washington
Seattle Children’s Hospital

Council of Educators in Landscape Architecture
May 28, 2017 | Beijing, China
This study is a part of the Walking School Bus study funded by the National Institute of Health grant (1R01CA163146-01A1, PI: Jason Mendoza)
Contents

1. Introduction
2. Study Design
3. Results
4. Discussions
Active Commute to School

- Active commute to school can help increase physical activity and reduce obesity among school-aged children. However, only 13% of children walk or bike to school in 2009 compared to 42 percent in 1969 (McDonald et al., 2011).

- Safe Routes to School (SRTS) program, created by the US congress in 2005, has contributed to increasing rates of walking and biking and improving safety through educational efforts, encouragement programs, and road improvements near schools (Hoelscher et al., 2016).
Factors Associated with Walking to School
(Chillón et al., 2014)

- Socio-demographic characteristics (e.g., ethnicity, income),
- Physical settings (e.g., distance, sidewalk width, weather),
- Safety (e.g. traffic, crime)
Crime in School Neighborhoods

- ~12% of parents have reported that crime danger is a major barrier to letting their children walk to/from school (CDC, 2004).

- Among children, parental perception of safety from crime is a leading barrier to outdoor activity and walking to school (Zhu & Lee, 2008).

- Parents who reported that their neighborhood was unsafe may limit their children’s time in outdoor activities, which in turn decreasing the child’s opportunities for physical activity, social interactions, and even academic performance (Broyles et al., 2016).
Low-Income Children and Crime Exposure

- Low-income and minority children are more likely to live in neighborhoods with high crime rates.
- They are twice more likely to walk to school, compared to high-income and white children (Gavin and Pedroso, 2010).

Victimization Rates for Persons Age 12 or Older, by Type of Crime and Annual Family Income, 2008

In 2008, individuals with annual family incomes of less than $15,000 were at least three times more likely to be victims of personal crimes—such as rape and assault—than were individuals with annual family incomes of $75,000 or more.

---

*Source: DOJ 2010a, authors’ calculations.*

Note: The victimization rate is defined as the number of individuals who were victims of crime over a six-month period per every 1,000 persons age twelve or older.

Built Environment and Crime

- Environmental determinants of crime have been well documented in the field of sociology and criminology. For example, physical disorder (e.g., litter, graffiti, and vandalism) can not only amplify fear of insecurity but also increase actual crime incidence.

- Jacobs (1961) highlighted the role of good visibility and natural surveillance as a deterrent to crime.

- Recent research has focused on the micro-level environmental intervention of crime familiar to planners, including defensible space and crime prevention through environmental design (CPTED).
HOWEVER,

Little has been researched about the detailed aspects of the **built environment** captured at the **street level** that may be linked to **crime incidences in school neighborhoods** (areas around elementary schools).
Research Question & Purpose

Which built environmental variables are associated with crime at the street segment levels around minority schools?

To examines the associations between built environments and the street-level distribution of crimes around 14 elementary schools with high proportions of low-income and minority students.

1. Introduction
2. Study Design

• **Setting**
  ¼ mile buffer from the minority schools (n=14) in the city of Seattle, WA.

• **Unit of Analysis**
  To analyze street-level crime incidents, we used street segment as the unit of analysis. **661 street segments** within ¼ mile buffer from the minority schools (n=14).

• **Crime Data**
  This study examined the locations of **violent and property crime incidents** occurred over five years (2011-2015) as reported to the Seattle Police Department.
2. Study Design

- **Low-income schools**
  The selected low-income schools commonly serve mostly ethnic-minority children, which are disproportionately vulnerable to childhood obesity and exposure to crime.

<table>
<thead>
<tr>
<th>SCHOOLS</th>
<th>NAME</th>
<th>CODE</th>
<th>YEAR</th>
<th>NAME CODE YEAR NUMBER</th>
<th>STREET SEGMENTS WITHIN ¼ MILE</th>
<th>Free/Reduced Lunch</th>
<th>Black</th>
<th>Hispanic</th>
<th>Asian</th>
<th>Non-White*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graham Hill</td>
<td>GR</td>
<td>2014</td>
<td>47</td>
<td>37 37 37%</td>
<td>90% 24% 78%</td>
<td>61%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rainier View</td>
<td>RA</td>
<td>2014</td>
<td>14</td>
<td>33 46%</td>
<td>11% 27% 92%</td>
<td>69%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West Seattle</td>
<td>WS</td>
<td>2014</td>
<td>71</td>
<td>45 47%</td>
<td>22% 16% 91%</td>
<td>88%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emerson</td>
<td>EM</td>
<td>2014</td>
<td>46</td>
<td>34 53%</td>
<td>14% 24% 95%</td>
<td>85%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>John Muir</td>
<td>JO</td>
<td>2014</td>
<td>83</td>
<td>39 54%</td>
<td>38% 70% 23%</td>
<td>80%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sanislo</td>
<td>SA</td>
<td>2014</td>
<td>39</td>
<td>19 55%</td>
<td>21% 14% 27%</td>
<td>73%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wing Luke</td>
<td>WI</td>
<td>2015</td>
<td>49</td>
<td>57 36%</td>
<td>9% 47% 98%</td>
<td>82%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kimball</td>
<td>KI</td>
<td>2015</td>
<td>61</td>
<td>87 20%</td>
<td>12% 43% 81%</td>
<td>58%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beacon Hill</td>
<td>BH</td>
<td>2016</td>
<td>75</td>
<td>69 10%</td>
<td>35% 35% 87%</td>
<td>63%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highland Park</td>
<td>HI</td>
<td>2016</td>
<td>45</td>
<td>55 16%</td>
<td>29% 27% 83%</td>
<td>78%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maple</td>
<td>MP</td>
<td>2016</td>
<td>55</td>
<td>46 14%</td>
<td>20% 49% 89%</td>
<td>63%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concord</td>
<td>CO</td>
<td>2016</td>
<td>55</td>
<td>38 12%</td>
<td>62% 11% 89%</td>
<td>79%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leschi</td>
<td>LE</td>
<td>2016</td>
<td>70</td>
<td>75 47%</td>
<td>8% 5% 73%</td>
<td>55%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Van Asselt</td>
<td>VS</td>
<td>2016</td>
<td>35</td>
<td>37 32%</td>
<td>11% 49% 97%</td>
<td>81%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
• **Environmental Audit**
We used the environmental audit instruments to capture physical activity behavior occurring in the micro-level built environment, and it conducted by two trained and certified auditors.

The field audit instrument and auditor training protocol was developed by Dr. Lee’s team, based on previously validated audit instruments *(Clifton et al, 2007)* and tested to have acceptable inter-rater (k=0.839, ICC=0.602) and test-retest reliability (k=0.903, ICC=0.774).

### What training you should receive

1. **Review Instrument and Manual** (2 hours):
   - Request a copy of the Instrument and Manual to Chanam Lee, chanam@tamu.edu and review before attending the training session
   - Prepare a list of questions to ask during the Training session

2. **Attend Training Session** (2 hours):
   - Attend a pre-scheduled group training session that includes a PowerPoint presentation by a trainer, followed by a Q&A session.
   - Make sure that all your questions are answered

3. **Attend Field Practice** (2 hours):
   - Test out the Instrument as a small group activity led by the trainer, immediately following the training session

4. **Get Certification** (2 hours):
   - Independently perform the audit on an assigned site and submit the results to the trainer who will review your audit results and inform you about your certification status (you may be asked to re-take this certification activity until your audit results are satisfactory)
2. Study Design

- **Independent variable**: Built Environment along the street segment
  (a) land uses and housing types
  (b) street characteristics (e.g., school zones, sidewalks, amenities, etc.)
  (c) neighborhood perceptions (e.g., surveillance, street maintenance, etc.)

- **Exposure variable**
  Street segment length (to control for the fact that longer streets tend to have more crime).

- **Statistical Analysis**
  A *negative binomial regression* was used to identify significant environmental variables associated with the number of crime incidents on streets in school neighborhoods.
3. Results

- **Outcome: Crimes (2011-2015)**
  - **Violent crime**: homicide, assaults, robbery and rape;
  - **Property crime**: burglary, theft
- **Sample size: 661** (only within ¼ buffer)

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>Min.</th>
<th>Max.</th>
<th>Skewness</th>
<th>Freq. of zero (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All crime</td>
<td>661</td>
<td>5.548</td>
<td>9.466</td>
<td>0</td>
<td>162</td>
<td>8.764</td>
<td>94 (14.14%)</td>
</tr>
<tr>
<td>Violent crime</td>
<td>661</td>
<td>1.307</td>
<td>3.011</td>
<td>0</td>
<td>36</td>
<td>6.159</td>
<td>346 (52.03%)</td>
</tr>
<tr>
<td>Property crime</td>
<td>661</td>
<td>4.241</td>
<td>7.014</td>
<td>0</td>
<td>129</td>
<td>9.739</td>
<td>116 (17.44%)</td>
</tr>
</tbody>
</table>
As the dependent variable $Y$ counting the number of events at the street segment level varies according to the length of street segment $l$, we set exposure variable $\ln l$

$$\ln \left( \frac{\mu}{l} \right) = \beta_0 + \beta_1 x_1$$

Which can be written as:

$$\ln \mu_c = \beta_0 + \beta_1 x_1 + \ln l$$

$\mu_c$: Number of crime incidents, $l$: Length of street segment
### 3. Results

### All segment within 1/4 buffer from school
(n==661)

<table>
<thead>
<tr>
<th>Group</th>
<th>All Crime</th>
<th>Violent Crime</th>
<th>Property Crime</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IRR</td>
<td>P-value</td>
<td>IRR</td>
</tr>
<tr>
<td>I. LAND USE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single family home</td>
<td>0.495**</td>
<td>0.001</td>
<td>0.347**</td>
</tr>
<tr>
<td>Multifamily housing</td>
<td>2.644**</td>
<td>0.000</td>
<td>4.324**</td>
</tr>
<tr>
<td>Vacant / abandoned building</td>
<td>1.528**</td>
<td>0.003</td>
<td>1.746*</td>
</tr>
<tr>
<td>II. STREET CHARACTERISTICS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School zone designated?</td>
<td>0.851</td>
<td>0.077</td>
<td>0.894</td>
</tr>
<tr>
<td>Street lane (0:1 or 2 lane vs. 1:3 lanes)</td>
<td>1.522**</td>
<td>0.002</td>
<td>2.526***</td>
</tr>
<tr>
<td>Street lane (0:1 or 2 lane, vs. 2:4+ lanes)</td>
<td>3.826***</td>
<td>&lt;0.001</td>
<td>6.940***</td>
</tr>
<tr>
<td>Number of driveways &amp; street intersections (mean±S.D)</td>
<td>0.944</td>
<td>0.267</td>
<td>0.768</td>
</tr>
<tr>
<td>Number of street lights (mean±S.D)</td>
<td>1.077***</td>
<td>&lt;0.001</td>
<td>1.081**</td>
</tr>
</tbody>
</table>

Note: N=661, Unit of Analysis is Street segment; ***p<0.001, **0.001<p<0.01, *0.01≤p<0.05; street length is an exposure variable
**Red**: positive association (x>1) **Blue**: negative association (x<1)
### 3. Results

#### All segment within 1/4 buffer from school (n=661)

<table>
<thead>
<tr>
<th>Group</th>
<th>All Crime</th>
<th>Violent Crime</th>
<th>Property Crime</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IRR</td>
<td>P-value</td>
<td>IRR</td>
</tr>
<tr>
<td>III. WAKING &amp; BIKING CONDITIONS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Signs Visible</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. No thru trucks</td>
<td><strong>3.309</strong>***</td>
<td>&lt;0.001</td>
<td><strong>6.401</strong>***</td>
</tr>
<tr>
<td>b. No parking / towing enforced</td>
<td><strong>1.539</strong>***</td>
<td>&lt;0.001</td>
<td><strong>2.277</strong>***</td>
</tr>
<tr>
<td>c. Child safety / pedestrian crossing sign</td>
<td>0.944</td>
<td>0.498</td>
<td>1.007</td>
</tr>
<tr>
<td>d. Bike route / bicyclist friendly sign</td>
<td>1.792**</td>
<td>&lt;0.001</td>
<td>2.474**</td>
</tr>
<tr>
<td>e. Community / cultural / religious / political / historical marker</td>
<td>1.342**</td>
<td>&lt;0.001</td>
<td>1.354*</td>
</tr>
<tr>
<td>f. Crime watch / surveillance warning / home security service</td>
<td>0.804*</td>
<td>0.015</td>
<td>0.550**</td>
</tr>
<tr>
<td>g. Beware of dog sign</td>
<td>0.816</td>
<td>0.052</td>
<td>0.669*</td>
</tr>
<tr>
<td>h. No trespassing</td>
<td>1.252*</td>
<td>0.019</td>
<td>1.605**</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bus stop</th>
<th>All Crime</th>
<th>Violent Crime</th>
<th>Property Crime</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IRR</td>
<td>P-value</td>
<td>IRR</td>
</tr>
<tr>
<td></td>
<td>2.208**</td>
<td>&lt;0.001</td>
<td>3.474**</td>
</tr>
</tbody>
</table>

Note: N=661, Unit of Analysis is Street segment; ***p<0.001, **0.001<p<0.01, *0.01≤p<0.05; street length is an exposure variable

Red: positive association (x>1) Blue: negative association (x<1)
## 3. Results

### All segment within 1/4 buffer from school (n=661)

<table>
<thead>
<tr>
<th>Group</th>
<th>All Crime</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IRR</td>
<td>P-value</td>
</tr>
<tr>
<td>All Crime</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Violent Crime</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Property Crime</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### III. WAKING & BIKING CONDITIONS

**Signs Visible**

- **a. No thru trucks**
  - IRR: 3.309***
  - P-value: <0.001

- **b. No parking / towing enforced**
  - IRR: 1.539***
  - P-value: <0.001

- **c. Child safety / pedestrian crossing sign**
  - IRR: 0.944
  - P-value: 0.498

- **d. Bike route / bicyclist friendly sign**
  - IRR: 1.792***
  - P-value: <0.001

- **e. Community / cultural / religious / political message or event / historical marker**
  - IRR: 1.342***
  - P-value: <0.001

- **f. Crime watch / surveillance warning / home security service**
  - IRR: 0.804*
  - P-value: 0.015

- **g. Beware of dog sign**
  - IRR: 0.816
  - P-value: 0.052

- **h. No trespassing**
  - IRR: 1.252*
  - P-value: 0.019

**Bus stop**

- IRR: 2.208***
  - P-value: <0.001

**Note:** N=661, Unit of Analysis is Street segment; ***p<0.001, **0.001<p<0.01, *0.01≤p<0.05; street length is an exposure variable

**Red:** positive association (x>1)  **Blue:** negative association (x<1)
## Results

### All segment within 1/4 buffer from school (n==661)

#### All Crime

<table>
<thead>
<tr>
<th>Group</th>
<th>IRR</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Violent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Property</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### IRR

<table>
<thead>
<tr>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.001</td>
</tr>
<tr>
<td>0.001</td>
</tr>
</tbody>
</table>

### III. WAKING & BIKING CONDITIONS

#### 4. Street trees

- **a. Tall deciduous trees (in PUBLIC right-of-way)**: 1.818***<0.001
- **b. Tall evergreen trees (in PUBLIC right-of-way)**: 0.925 0.353
- **c. Shrubs (in PUBLIC right-of-way)**: 0.925 0.353
- **d. Other (in PUBLIC right-of-way)**: 0.739 0.134
- **e. Tall deciduous trees (in PRIVATE property / yard)**: 0.731 0.303
- **f. Tall evergreen trees (in PRIVATE property / yard)**: 0.762* 0.013

#### 5. Unattractive items

- **a. Graffiti**: 1.451***<0.001
- **b. Whole or broken bottles / cans**: 1.412***<0.001
- **c. Cigarette / cigar butts or packages**: 1.706***<0.001
- **d. Abandoned cars**: 1.335 0.110
- **e. Buildings with broken / boarded windows or other vandalism**: 1.913** 0.002
- **f. Condoms, needles, syringes, or drug-related paraphernalia**: 1.089 0.811
- **g. Excessive power lines**: 1.223* 0.014
- **i. Unattended dogs in private property / yard**: 0.778 0.476
- **j. Other trash**: 0.964 0.835

---

*Note: N=661, Unit of Analysis is Street segment; ***p<0.001, **0.001<p<0.01, *0.01≤p<0.05; street length is an exposure variable.*
### 3. Results

#### Group

<table>
<thead>
<tr>
<th>All segment within 1/4 buffer from school (n==661)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All Crime</strong></td>
</tr>
<tr>
<td>IRR</td>
</tr>
</tbody>
</table>

#### IV. SIDEWALK

1. Sidewalk

   a. Sidewalk (0:no, 1:yes)  
      - IRR: 1.356** (P-value: 0.003)  
      - IRR: 1.963*** (P-value: <0.001)  
      - IRR: 1.231* (P-value: 0.038)

   b. Sidewalk Detail (Part of segment:11, Entire segment:12)  
      - IRR: 1.686*** (P-value: <0.001)  
      - IRR: 1.948** (P-value: 0.006)  
      - IRR: 1.637*** (P-value: <0.001)

3. Sidewalk obstruction (0:no, 1:yes)

   a. Poles or signs  
      - IRR: 1.746*** (P-value: <0.001)  
      - IRR: 2.201*** (P-value: <0.001)  
      - IRR: 1.590*** (P-value: <0.001)

4. Sidewalk characteristics

   a. Sidewalk complete? (0:absolutely no and partially yes 1: absolutely yes)  
      - IRR: 1.816*** (P-value: <0.001)  
      - IRR: 2.003** (P-value: 0.004)  
      - IRR: 1.778*** (P-value: <0.001)

   b. Sidewalk connected? (0:absolutely no and partially yes 1: absolutely yes)  
      - IRR: 1.982*** (P-value: <0.001)  
      - IRR: 2.113** (P-value: 0.003)  
      - IRR: 1.954*** (P-value: <0.001)

   d. Sidewalk slope (0: Flat or gentle, 1: moderate or steep)  
      - IRR: 0.799*** (P-value: <0.001)  
      - IRR: 0.809* (P-value: 0.029)  
      - IRR: 0.793*** (P-value: <0.001)

   e. Sidewalk width (0:<6, 1: 6+)  
      - IRR: 1.214  
      - P-value: 0.082  
      - IRR: 1.470  
      - P-value: 0.031  
      - IRR: 1.133  
      - P-value: 0.251

5. Sidewalk surface conditions (0:none, 1:a little or a lot)

   a. Weeds  
      - IRR: 1.008  
      - P-value: 0.930  
      - IRR: 0.920  
      - P-value: 0.584  
      - IRR: 1.045  
      - P-value: 0.630

   b. Litter  
      - IRR: 1.672*** (P-value: <0.001)  
      - IRR: 2.186*** (P-value: <0.001)  
      - IRR: 1.527*** (P-value: <0.001)

6. Buffer?

   - IRR: 1.062  
   - P-value: 0.769  
   - IRR: 1.001  
   - P-value: 0.997  
   - IRR: 1.083  
   - P-value: 0.697

Note: N=661, Unit of Analysis is Street segment; ***(p<0.001), **(0.001<p<0.01), *(0.01≤p<0.05); street length is an exposure variable. Red: positive association (x>1)  Blue: negative association (x<1)
### 3. Results

#### All segment within 1/4 buffer from school (n=661)

<table>
<thead>
<tr>
<th>Group</th>
<th>All Crime</th>
<th></th>
<th>Violent Crime</th>
<th></th>
<th>Property Crime</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IRR</td>
<td>P-value</td>
<td>IRR</td>
<td>P-value</td>
<td>IRR</td>
<td>P-value</td>
</tr>
<tr>
<td><strong>V. POLLUTION</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air Pollution (0:none, 1:a little or a lot)</td>
<td>1.700**</td>
<td>0.002</td>
<td>2.654***</td>
<td>&lt;0.001</td>
<td>1.414*</td>
<td>0.046</td>
</tr>
<tr>
<td>Noise from factories (0:none, 1:a little or a lot)</td>
<td>1.589***</td>
<td>&lt;0.001</td>
<td>2.398***</td>
<td>&lt;0.001</td>
<td>1.396***</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Noise from barking dogs (0:none, 1:a little or a lot)</td>
<td>0.795</td>
<td>0.051</td>
<td>0.619*</td>
<td>0.020</td>
<td>0.851</td>
<td>0.160</td>
</tr>
<tr>
<td><strong>PERCEPTIONS</strong> (11:poor, 12:fair, 13:good, 14:very good, 15:Excellent)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Street/sidewalk maintenance</td>
<td>0.998</td>
<td>0.975</td>
<td>0.953</td>
<td>0.632</td>
<td>1.012</td>
<td>0.845</td>
</tr>
<tr>
<td>Street/sidewalk cleanliness</td>
<td>0.750***</td>
<td>&lt;0.001</td>
<td>0.603***</td>
<td>&lt;0.001</td>
<td>0.802***</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Cleanliness and maintenance of buildings and gardens</td>
<td>0.839**</td>
<td>0.008</td>
<td>0.675**</td>
<td>0.001</td>
<td>0.897</td>
<td>0.087</td>
</tr>
<tr>
<td>Visual quality of street</td>
<td>0.856*</td>
<td>0.016</td>
<td>0.685**</td>
<td>0.001</td>
<td>0.917</td>
<td>0.167</td>
</tr>
<tr>
<td>Visual quality of buildings</td>
<td>0.835*</td>
<td>0.016</td>
<td>0.588***</td>
<td>&lt;0.001</td>
<td>0.933</td>
<td>0.345</td>
</tr>
<tr>
<td>Visual quality of trees/vegetation</td>
<td>0.829**</td>
<td>0.006</td>
<td>0.603***</td>
<td>&lt;0.001</td>
<td>0.912</td>
<td>0.170</td>
</tr>
<tr>
<td>Condition/health of trees/vegetation</td>
<td>0.914</td>
<td>0.163</td>
<td>0.787*</td>
<td>0.029</td>
<td>0.954</td>
<td>0.456</td>
</tr>
<tr>
<td>Attractiveness in walking</td>
<td>0.931</td>
<td>0.183</td>
<td>0.870</td>
<td>0.125</td>
<td>0.954</td>
<td>0.372</td>
</tr>
<tr>
<td>Comfort in walking</td>
<td>0.993</td>
<td>0.895</td>
<td>0.954</td>
<td>0.628</td>
<td>1.006</td>
<td>0.915</td>
</tr>
<tr>
<td>Safety in walking</td>
<td>0.987</td>
<td>0.792</td>
<td>0.932</td>
<td>0.427</td>
<td>1.003</td>
<td>0.957</td>
</tr>
</tbody>
</table>

Note: N=661, Unit of Analysis is Street segment; ***p<0.001, **0.001<p<0.01, *0.01≤p<0.05; street length is an exposure variable. **Red**: positive association (x>1)  **Blue**: negative association (x<1)
Current research has demonstrated that crime is associated with certain types of built environments at the street segment level.

The findings were consistent with previous studies that physical incivilities/disorders were associated with a higher number of reported crimes (Perkins, Wandersman, Rich, & Taylor, 1993).

Environmental interventions, such as limiting high-density housing, improving visual surveillance, and removing signs of social disorder, appear helpful to reduce crimes around elementary schools.
4. Discussions

**Limitations**

- **Cross-sectional Study**
  This study is based on a cross-sectional approach, limiting the ability to draw a causal inference between variables.

- **Aggregation of indoor and outdoor Crime**
  No information was available to distinguish indoor crimes from outdoor crimes.

- **Limited Control Variables**
  Further study needs to control for the number of housing units and household income along the street to better understand the relationship between crime and street characteristics.
Our study of the micro-level environmental factors linked with crime provides important insights into the potential environmental interventions around elementary schools, especially those with high % of low-income and minority student, that can improve safety and promote walking to school.
THANK YOU!

For more information, please contact:
Sungmin Lee
saint83@tamu.edu