A Preliminary Microspatial Analysis of Urban Intersections and Injury

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Injury is a major cause of death among adolescents in the United States.

Approx. 15,000 13-to-20 year olds die from injuries each year.

The injury death rate among these adolescents is at least eight times that of all other, non-traumatic causes of adolescent death combined. (i)

2007 Causes of Death for 13-20 year olds

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cause of Death</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Unintentional Injury</td>
<td>8,948</td>
</tr>
<tr>
<td>2</td>
<td>Homicide</td>
<td>3,040</td>
</tr>
<tr>
<td>3</td>
<td>Suicide</td>
<td>2,068</td>
</tr>
<tr>
<td>4</td>
<td>Malignant Neoplasms</td>
<td>1,060</td>
</tr>
<tr>
<td>5</td>
<td>Heart Disease</td>
<td>516</td>
</tr>
<tr>
<td>6</td>
<td>Congenital Anomalies</td>
<td>297</td>
</tr>
<tr>
<td>7</td>
<td>Cerebrovascular</td>
<td>106</td>
</tr>
<tr>
<td>8</td>
<td>Chronic Low. Respiratory Disease</td>
<td>101</td>
</tr>
<tr>
<td>9</td>
<td>Influenza &amp; Pneumonia</td>
<td>90</td>
</tr>
<tr>
<td>10</td>
<td>Diabetes Mellitus</td>
<td>86</td>
</tr>
</tbody>
</table>

Source: Center for Disease Control; http://webappa.cdc.gov/sasweb/ncipc/leadcaus10.html
Background (cont.)

• Adolescent injuries are the end-result of a "causative web" of contributing factors.
• These factors can be broadly measured at the neighborhood level.
• This measurement strategy may neglect many microspatial effects that are visible at the level of street configurations, buildings, and specific parcels of land.
• Analyzing the geometric structure of the environment might be used to identify these under-studied microspatial effects.
Background (cont.)

By exploring the geometric structure of injury sites to subjects through a case-control study design, we will be able to investigate the potential influence that these factors may have on the risk of adolescent injury.
Background (cont.)

• Previous research in motor vehicle accidents have led to an increased understanding of the effect of road geometry on fatal injury.

• Geometric features have an impact on:
  - Perception, decision, and reaction time.
  - People’s abilities to process safety.
  - Ability to respond to safety threats. (iii)
• Spatial processing that occurs during traffic accidents may generalize to other environmental injury threats.

• The road geometry of all injuries may provide important information about factors in the built environment.
Methods

• This study is an innovative use of existing data sources and telephone interviews to conduct a population-based case-control study of the relationship between fatal adolescent injury, the built environment, and other factors (such as alcohol).

• Each control:
  – Households are located within Philadelphia County
  – Physically located in Philadelphia at the time of their index case’s injury study
Methods (cont.)
Density Maps of Case/Control Locations

All subjects

Cases (red) Controls (blue)
Density Maps of Case/Control Locations
660ft buffer around Case-Control layer points. Buffered layer joined to closest street segment from Philadelphia street file, captures number of surrounding junctions (4 to 80) and street class. Intersection type (3-, 4-, 5-point, etc) determined visually.
## Results

<table>
<thead>
<tr>
<th></th>
<th>JUNCTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean (SD)</strong></td>
<td></td>
</tr>
<tr>
<td>Cases</td>
<td>40.0 (15.9)</td>
</tr>
<tr>
<td>Controls</td>
<td>31.1 (17.1)</td>
</tr>
</tbody>
</table>

\[ p = 0.002 \quad p = 0.007 \]

**Please note that this is all preliminary data!**
<table>
<thead>
<tr>
<th></th>
<th>JUNCTIONS</th>
<th>Median (p25, p75)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-intersections</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cases</td>
<td>21 (24, 48)</td>
<td></td>
<td>0.025</td>
</tr>
<tr>
<td>Controls</td>
<td>17 (8, 32)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-point intersections</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cases</td>
<td>36 (33, 51)</td>
<td></td>
<td>0.070</td>
</tr>
<tr>
<td>Controls</td>
<td>34 (20, 47)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Logistic regression modeling junctions (×10)

• Yielded an odds ratio of 1.39 (p=0.006, 95% CI 1.01, 1.75) comparing cases to controls.

• This held true when controlling for street class and intersection type: odds ratio=1.46 (p=0.003, 95% CI 1.14, 1.86).
Discussion

• Many spatial analyses focus on administratively defined geographic areas (ZIP codes and census tracts).
• This type of analysis does not lend itself to a microspatial examination and does not take into consideration the nuances of the built environment.
• Specifically, the geometry and orientation of roadways may influence fatal injury in adolescents.
• Analyzing and quantifying the geometric structure of the microspatial environment can be used to understand the built environment and its impact on adolescent injury.
From our preliminary data, we found:

- Cases are surrounded by more junctions than controls at the time of injury.
- While there is no significant difference in street class with respect to junctions, there was a significant difference in the number of junctions surrounding three and four point intersections, favoring the cases.

*These findings underscore the importance of a microspatial examination of where adolescent injury occurs.*
Discussion (cont.)

• This type of microspatial analysis is of particular importance in densely populated urban centers.
• ArcGIS allows us to create geospatial boundaries that are not administratively defined, and so examine the causative factors of injury at a microspatial level that may have greater relevance to public health.
References


