A Preliminary Microspatial Analysis of Urban Intersections and Injury

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Background

- 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

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

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)

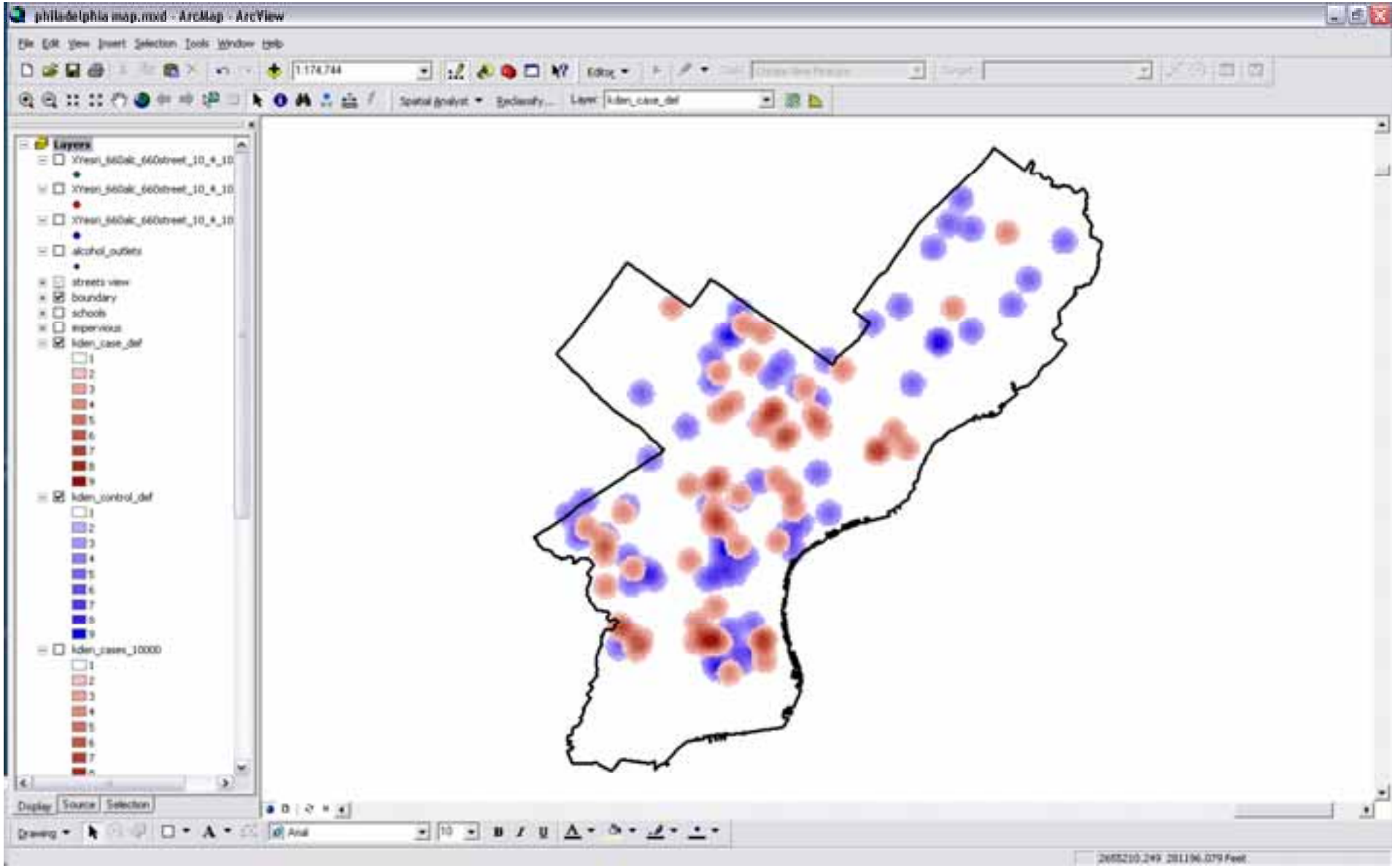
Background (cont.)

- 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.

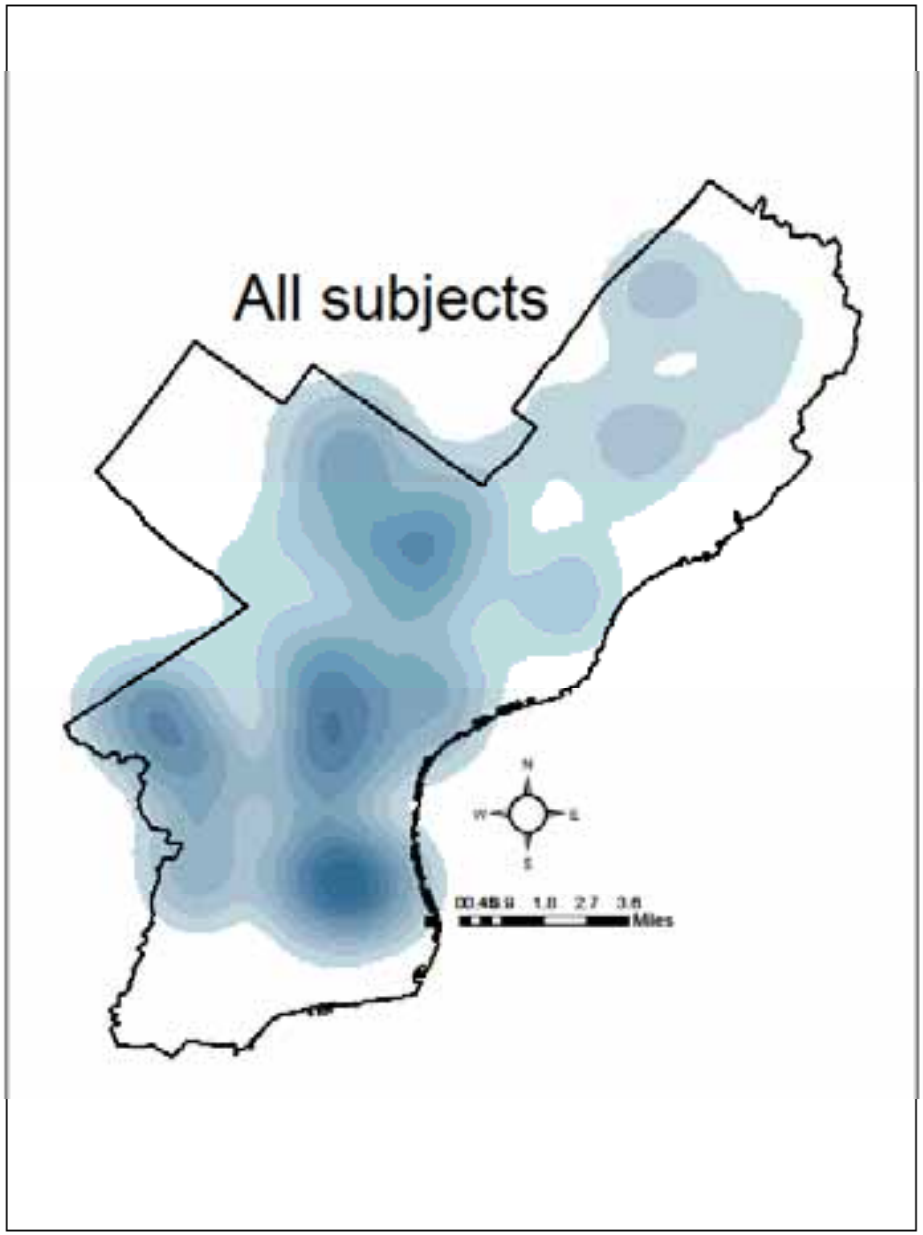
Methods

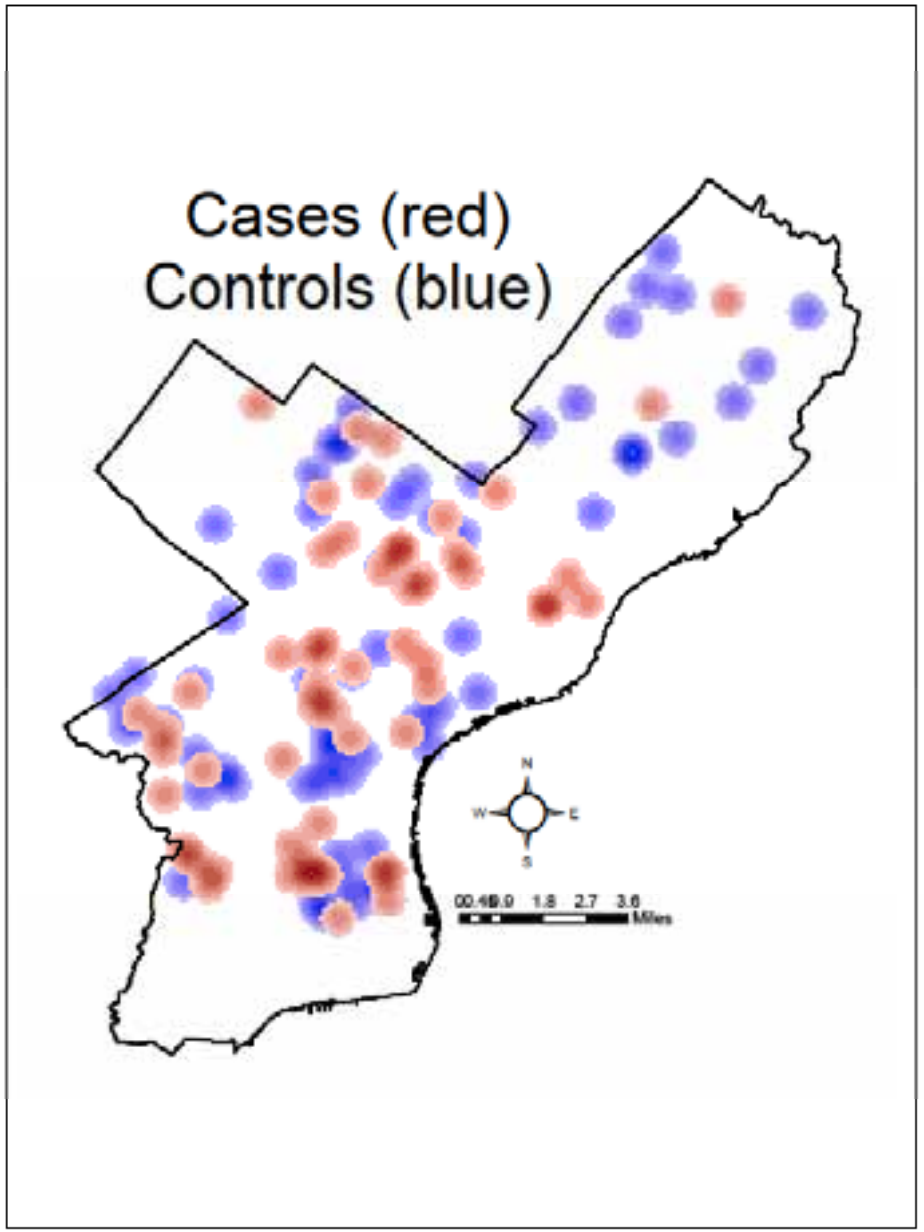
- This study is an innovative use of existing data sources and telephone interviews to conduct a population-based case-control study of the relationship between fatal adolescent injury, the built environment, and other factors (such as alcohol).
- Each control:
  - Households are located within Philadelphia County
  - Physically located in Philadelphia at the time of their index case's injury study

Methods (cont.)

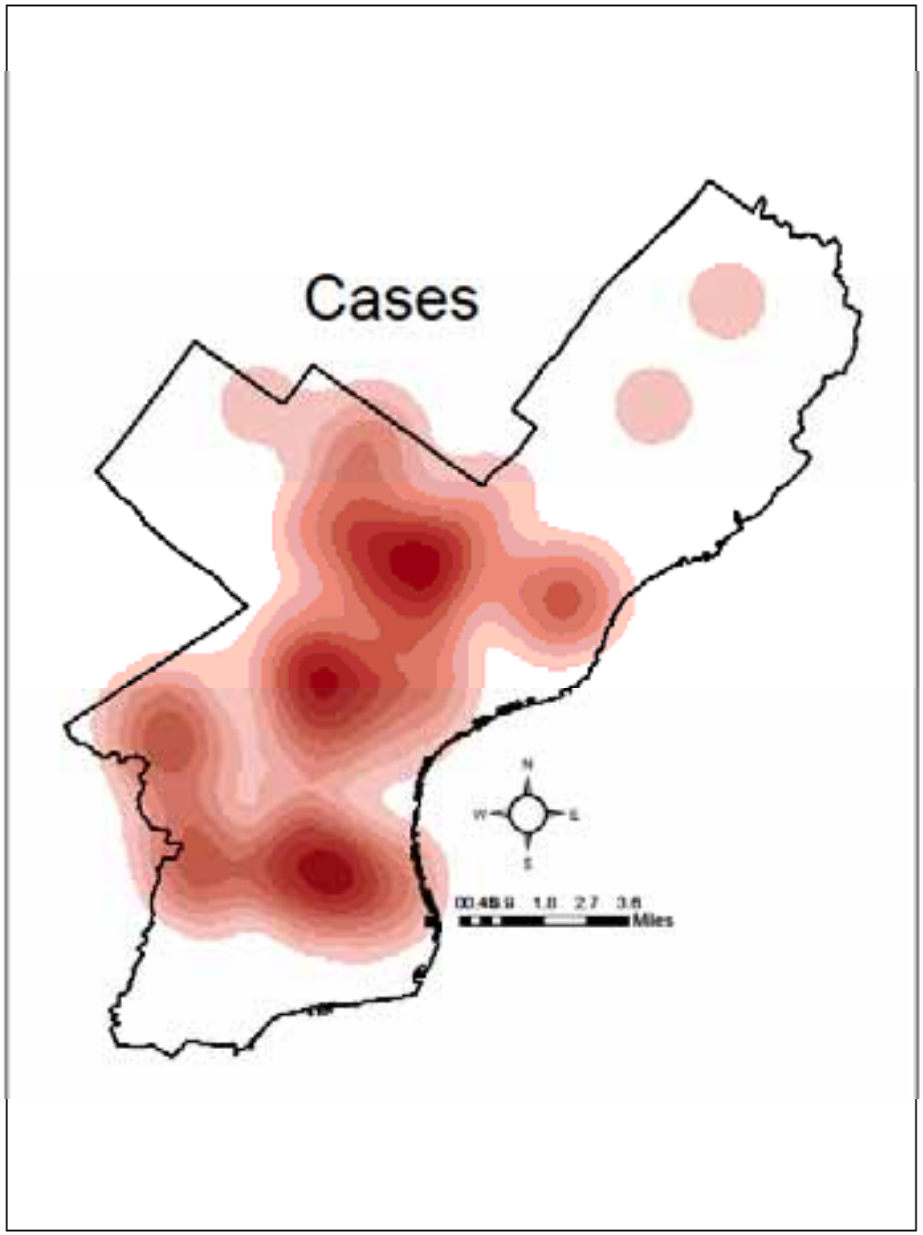


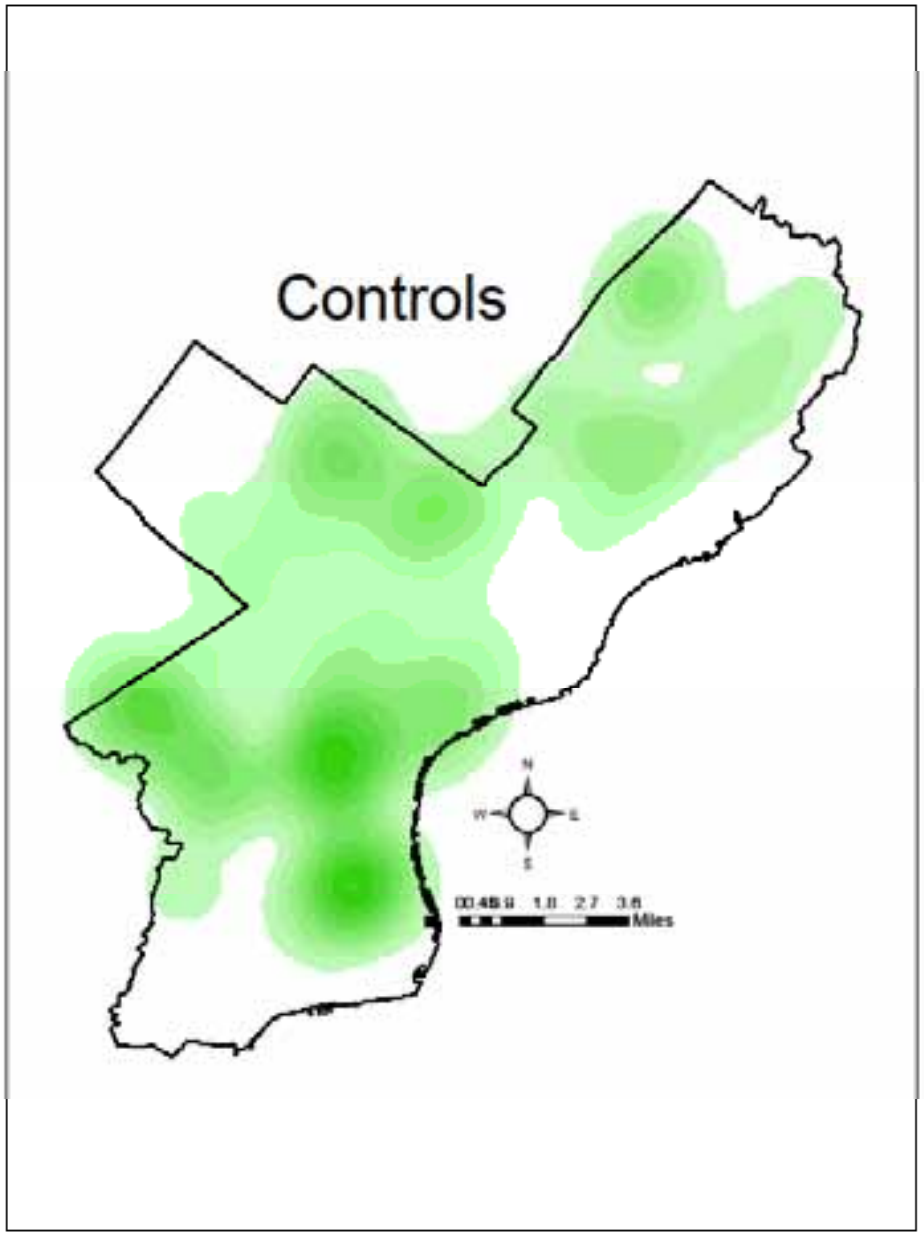
Density Maps of Case/Control Locations





Density Maps of Case/Control Locations

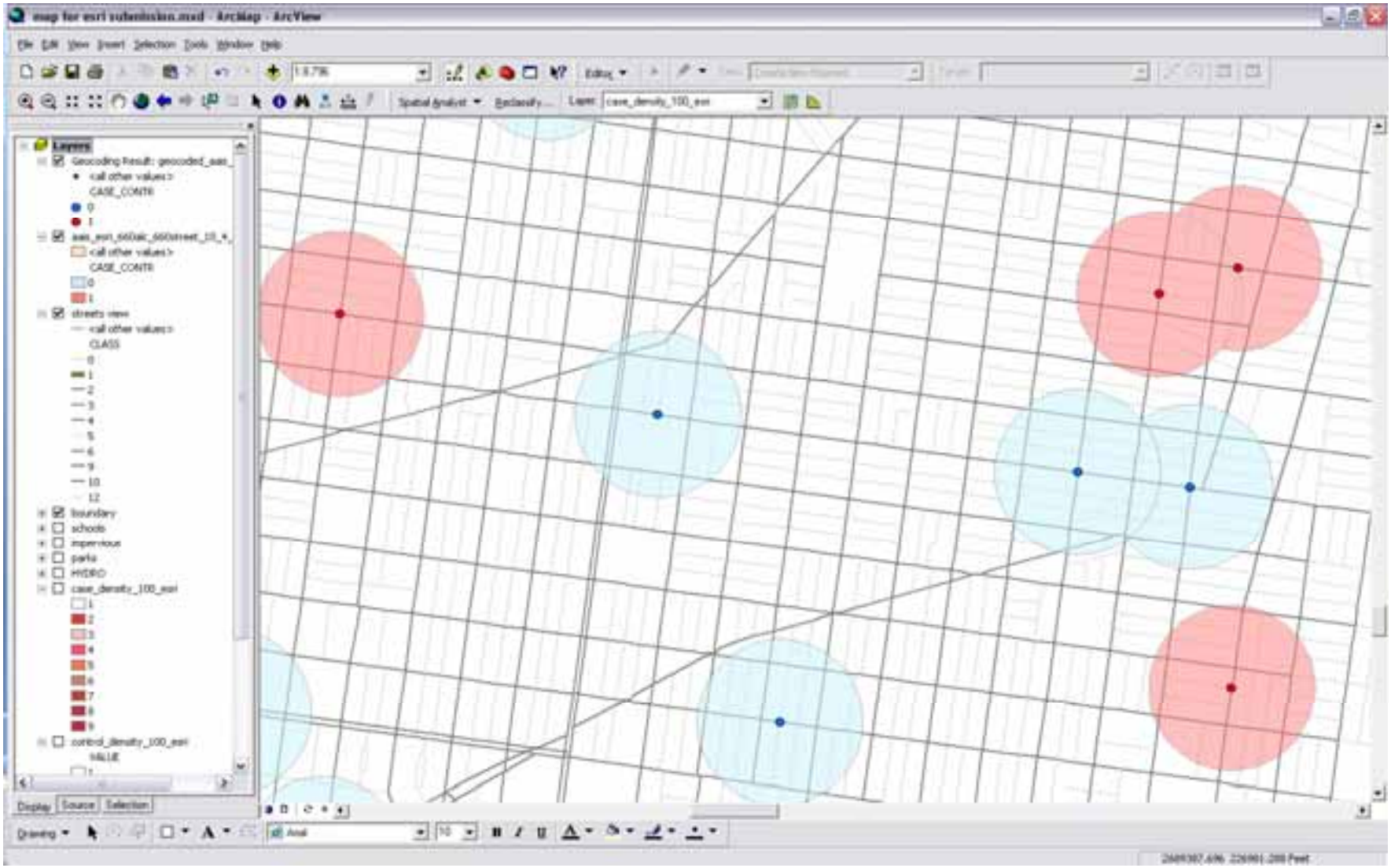




660ft buffer around Case-Control layer points.

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

	JUNCTIONS			
	Mean (SD)		Median (p25, p75)	
Cases	40.0 (15.9)	p=0.002	36 (29, 51)	p=0.007
Controls	31.1 (17.1)		30 (17, 44)	

**** Please note that this is all preliminary data! ****

	JUNCTIONS	
T-intersections	Median (p25, p75)	
Cases	21 (24, 48)	p=0.025
Controls	17 (8, 32)	
4-point intersections		
Cases	36 (33, 51)	p=0.070
Controls	34 (20, 47)	

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

i. Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. Web-based Injury Statistics Query and Reporting System, Leading Causes of Death Reports, 1999 – 2002. URL: http://webappa.cdc.gov/sasweb/ncipc/leadcaus10.html. Last accessed 5-27-2010.

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iii. Khorashadi A, Niemeir D. Shankar V, Mannering F. Differences in rural and urban driver-injury severities in accidents involving large-trucks: An exploratory analysis. Accident Analysis and Prevention 2005;37:910-921.

iv. Pennsylvania Spatial Data Access: The Pennsylvania Geospatial Data Clearinghouse. URL: http://pasda.psu.edu. Last accessed 7-23-2010.