THE RELATIONSHIP BETWEEN PHYSICAL AND SOCIAL ENVIRONMENTS AND VIOLENCE INVOLVEMENT AMONG YOUTH IN ALLEGHENY COUNTY, PA: A SPATIAL ANALYSIS

by

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ABSTRACT

Background: Violence disproportionately affects young people and impacts their health outcomes, highlighting the public health importance of youth violence. Features of built and social environments have been shown to be associated with violence risk, however these associations have not been studied in the context of a mid-size city.

Methods: We utilized data from two studies conducted among youth in Allegheny County, PA. Associations between physical environmental contexts and youth violence were studied using data from the Engendering Healthy Masculinities (EHM) study. To investigate associations between both social and environmental contexts and youth violence, we used data from the Healthy Allegheny Teens Survey (HATS). Exposure to built environmental features was defined using participants' neighborhood study site (EHM) or home address (HATS). In EHM, violence involvement was measured by three survey items: physical fighting, threatening someone with a weapon, and injuring someone with a weapon. The HATS study measured violence involvement by three survey items: being threatened or injured with a weapon, being involved in a physical fight, and getting injured or needing medical treatment from a fight. Logistic regression models separately examined associations between each environmental feature and the violence

involvement measures. Within the HATS dataset, additional models examined associations between the social environment, built environment, and violence involvement.

Results: Mean age for EHM was 15.5 years, 78% of participants were African American with 3.7% Caucasian. For HATS, mean age was 16.7 years, 72% were Caucasian with 15.5% African American. From EHM, better neighborhood walkability and higher density of bike lanes were associated with significantly lower odds of fighting (walkability adjusted odds ratio (AOR) 0.84, 95%CI 0.73-0.96; bike lane AOR 0.90, 95%CI 0.81-1.0). From HATS, higher density of bike lanes was associated with lower odds or being threatened or injured with a weapon (AOR 0.736, 95%CI 0.564-0.961), and increased green space quality was associated with lower odds of getting injured or needing medical treatment from a fight (AOR 0.990, 95%CI 0.980-0.9997).

Discussion: This work extends previous studies from large urban centers to a mid-sized city context and suggests that neighborhood contexts offer opportunities for the development of interventions that may aid in youth violence prevention.

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1.0 Introduction

1.1 Youth violence

Youth violence is the intentional use of physical force or power to threaten or harm others, includes witnessing, perpetrating, and being victimized by violence among those ages 10-24 years.[1] It is a significant public health problem. Homicide is the third leading cause of death among young people ages 10-24. Additionally, each day over 1,300 youth ages 10-24 are treated for nonfatal physical assault-related injuries in emergency departments.[2] In 2017, 30% of male high school students reported being in a physical fight in the past year and 24% reported carrying a weapon in the past month.[2] Youth who are victims of violence have a greater risk for other poor health outcomes. These include smoking, obesity, academic problems, and depression.[1] Youth violence also carries an economic cost. Each year an estimated $17.5 billion is lost in medical and lost productivity costs due to youth homicide and nonfatal assault injuries.[1] Youth in lower resource neighborhoods experience a disproportionate burden of perpetrating and being victimized by violence,[3-6] which negatively affects both mental and physical health outcomes and increases risk of injury and incarceration.[1,2] Violence during adolescence can lead to further violence involvement later in life.[7] Youth who experience physical abuse or neglect have an even greater risk for violence perpetration later in life.[8,9] The causes of youth violence are multifaceted, and while individuals in an adolescent's life can influence their behaviors and beliefs, neighborhood physical and social contexts also play a role in violence outcomes.[10]

1.2 Violence and the built environment

Emerging research suggests environmental contexts in large urban centers may shape violence risk. A body of evidence has demonstrated that features of the built environment – such as vacant properties, street lighting, pedestrian and transit infrastructure, and access to green space – may influence rates of crime and violence.[11-15] Alcohol and tobacco outlets have also been shown to be associated with a higher risk of violence and violent crimes.[16-19] One built environmental feature that may shape violence risk is neighborhood walkability, which is a term used to describe how physical environmental features influence the likelihood of walking being used as a mode of transport. Walkability ties together several aspects of the emerging research on the built environment. The Environmental Protection Agency's Walkability Index, a widely used metric for quantifying walkability, incorporates measures such as the proximity to public transit stops and the diversity of land uses.[20]

1.3 Violence and the social environment

The social environment encompasses relationships with individuals, groups, and larger communities. Three aspects of the social environment that may be particularly relevant to youth are social support, school connectedness, and social cohesion. Social supports measure a person's access to supportive others.[21] Measures of school connectedness assess students' sense of connection to their school and how much they feel cared for by other people at their school.[22] Lastly, one definition of social cohesion comes from Jeannotte, 2003, "the ongoing process of

developing a community of shared values, shared challenges, and equal opportunity…based on a sense of trust, hope and reciprocity."[23]

Previous work has shown associations between neighborhood social environment and violence and crime. Disordered environments may signal that an area is not maintained and criminal activity has little risk of detection. Conversely, ordered and clean environments indicate that crime is not tolerated. In this "broken windows" theory, neighborhoods with a strong sense of cohesion assert social responsibility on themselves, resulting in residents reporting higher rates of feeling safer in their neighborhood.[24] Also, neighborhood collective efficacy, a measure of the social environment, has been associated with lower rates of violence.[25] The vast majority of research on the social environment and violence focuses on neighborhood-level measures of social cohesion and adult populations, however there has been little research that examines support across multiple social contexts and how this support relates to violence involvement among adolescents.

1.4 Interconnections between the built environment and social environment

Social processes within a neighborhood can be influenced by the built environment. Designing a built environment that strengthens social interaction creates a positive social environment. This is accomplished through actively maintained public areas, mixed-use commercial-residential spaces, and visible social interactions. The hypothesis of "busy streets" maintains that features of the built environment encourage positive social interactions, which, in turn, promote social cohesion and collective efficacy.[26] Walkability provides a compelling example of this hypothesis. Previous work has demonstrated the positive impact of walkability,

including effects on improvements in social relations, health, and safety.[27] Walkability, along with other built environmental features, is associated with an increase in neighborly behaviors.[28]

1.5 Violence and the built and social environment – city contexts

To date, aside from a recent study in Youngstown, OH,[29] the majority of research on the built environment and youth violence has been undertaken in large urban centers.[11-15] Little is known about whether associations between the built environment and violence translate into mid-sized cities. Importantly, mid-sized cities tend to have less dense urban centers and differential distribution of residential and commercial spaces.[29] This means that where people spend time, how they move between places, and the landscapes in which people interact may differ fundamentally between dense urban centers and mid-sized cities. Additionally, there has been little research that jointly examines the built and social environment, and violence involvement, especially in mid-sized cities. Rather than extrapolate from findings in large cities, it is imperative to examine associations between the built environment, social environment, and violence across a range of city contexts to understand how the spatial distribution of built environmental features relates to youth violence.

1.6 Study aims

This study examined associations between the built environment, social environment and youth violence involvement using two datasets of youth in Allegheny County, Pennsylvania to understand how neighborhood physical and social contexts may be leveraged to reduce youth violence in mid-sized cities.

2.0 Methods

2.1 Participants

2.1.1 EHM

Engendering Healthy Masculinities (EHM), a cluster-randomized community-based sexual violence prevention trial, enrolled 866 male adolescents ages 13-19 years through youth-serving community agencies in 20 lower resource neighborhoods in Allegheny County, PA from August 2015 to June 2017. Participants completed anonymous, baseline surveys in-person on tablets (iPad Air; Apple) prior to the intervention program about violence involvement, school enrollment and demographic characteristics. Further details of the study protocol have been previously described in detail.[30] The study was approved by the Institutional Review Board of the University of Pittsburgh and was granted a waiver of parental permission and a waiver of documentation of written consent. Participants received $10 remuneration for completion of the baseline survey.

2.1.1.1 EHM Neighborhoods

The 20 lower resource neighborhoods from the EHM study were located throughout Allegheny County, with a large proportion located within the City of Pittsburgh. The neighborhoods within Pittsburgh were defined by the City, while the neighborhoods within Allegheny Count were municipalities defined by the County. The number of participants within each neighborhood ranged from 6 to 96.

2.1.2 HATS

The Healthy Allegheny Teen Survey (HATS) was a representative telephone survey conducted across Allegheny County, PA of youth ages 14-19 to assess health risk behaviors. Random-digit-dialing allowed for probability-based sampling and was accomplished using a dual frame design that included both landlines (33,400) and cellphones (25,700). A total of 1,813 interviews with youth were conducted for the survey from February 2014 to November 2014. Participants were surveyed on their violence experience, factors of their social environment, and demographics. A two-step weighting procedure incorporated and calibrated design weights to reflect selection probabilities of households and target population geodemographic characteristics. The survey was approved by the Institutional Review Board of the University of Pittsburgh and was granted a waiver of parental permission and a waiver of documentation of written consent.

2.2 Measures

2.2.1 Built environment

We collected data on six environmental variables retrieved from the U.S. Environmental Protection Agency (street intersection density and walkability (National Walkability Index scores); census block group), the Western Pennsylvania Regional Data Center (tobacco outlets and bike lanes; point and line location, respectively), the Pennsylvania Liquor Control Board (alcohol outlets; point location), and the U.S. Geological Survey (green space quality (median normalized difference vegetation index (NDVI) in 0.25-mile radius); Landsat satellite raster image). These

environmental variables were aligned with the time of baseline study participation for EHM, and with the time of survey completion for HATS. Each environmental variable was referenced with a pair of latitude and longitude coordinates, either explicitly for points or as a geographic centroid for the census block group polygons, which were then converted to raster map layers using kernel density (point-based data) and inverse distance weighting (polygon-based data) calculations, using the default bandwidths in ArcGIS (ArcMap 10.6). Kernel density and inverse distance weighting measures are continuous and boundary-free, which assists in avoiding inappropriate aggregation effects.[31] The method for ascribing individual participant exposures differed slightly across the two studies. The EHM study was designed such that youth attended study programming near their place of residence; therefore, the study sites were used to define an individual's exposure to built environmental features. Home address locations were collected for the HATS survey, and used to define exposure for those participants.

2.2.2 Social environment

Several questions in the HATS survey assessed participants' social environments. These included the constructs of social cohesion, social supports, and school connectedness.

2.2.2.1 Social supports

Social supports were measured using three modified items from Sarason, et al. on a 5-point Likert scale (all of the time (5) – none of the time(1)): 1) someone you really count on to be dependable when you need help, 2) someone you really count on to care about, and 3) someone you really count on to help you feel better when you are feeling generally down-in-the- dumps.[21] Participants' social supports scores were determined by computing the mean across the three items,

and then dichotomized as high or low for analyses. A score of 4 or higher was considered as high social supports, while a score below 4 was considered low social supports.

2.2.2.2 School connectedness

School connectedness was measured using five items from McNeely, et al. on a 5-point Likert scale (strongly agree (5) – strongly disagree (1)): 1) I feel close to people at this school, 2) I feel like I am part of this school, 3) I am happy to be at this school, 4) The teachers at this school treat students fairly, and 5) I feel safe in my school.[22] Participants' school connectedness scores were determined by computing the mean across the five items, and then dichotomized as high or low for analyses. A score of 4 or higher was considered as high school connectedness, while a score below 4 was considered low school connectedness.

2.2.2.3 Social cohesion

Social cohesion was measured using five items from Sampson, et al. on a 5-point Likert scale (strongly agree (5) – strongly disagree (1)): 1) people around here are willing to help their neighbors, 2) this is a close-knit neighborhood, 3) people in this neighborhood can be trusted, 4) people in this neighborhood generally don't get along with each other (reverse coded), and 5) people in this neighborhood do not share the same values (reverse coded).[25] Participants' social cohesion scores were determined by computing the mean across the five items, and then dichotomized as high or low for analyses. A score of 4 or higher was considered as high social cohesion, while a score below 4 was considered low social cohesion.

2.2.3 Violence involvement

2.2.3.1 EHM Measures

Violence involvement was measured on baseline EHM surveys by three validated Youth Risk Behavior Surveillance System items: 1) physical fighting, 2) threatening someone with a weapon, and 3) injuring someone with a weapon in the past nine months. Each item was dichotomized as any/none for analyses.[32]

2.2.3.2 HATS Measures

Violence involvement was measured on the HATS survey by three modified Youth Risk Behavior Surveillance System items: 1) being threatened or injured with a weapon, 2) being involved in a physical fight, and 3) getting injured or needing medical treatment from a fight in the past twelve months. These three items were also combined to create a summary violence involvement measure. A participant was considered to have experienced any violence involvement if they endorsed any of the three violence victimization measures. Each item was dichotomized as any/none for analyses.

2.3 Statistical Analysis

2.3.1 EHM

Multilevel logistic regression models separately examined associations between each neighborhood built environmental feature and the violence involvement measures. The models for

the EHM study accounted for individual-level confounders (age, race, ethnicity, caregiver education, school enrollment, and intervention group) and clustering of participants at the neighborhood level. Likelihood ratio tests comparing models that additionally accounted for clustering of sites (n=1-3) within neighborhoods were not significant, and thus final models only accounted for clustering at the neighborhood level. Statistical analyses were carried out using Stata SE 14 (StataCorp, TX).

2.3.2 HATS

Three sets of models were conducted for the HATS survey. First, logistic regression models were conducted to study the associations between each social environment measure and the violence involvement measures. Second, similar to the EHM models, logistic regression models separately examined associations between each neighborhood built environmental feature and the violence involvement measures. Finally, logistic regression models examined associations between any violence involvement and the neighborhood built environmental features, stratified by the social environment constructs. All three sets of models accounted for individual-level confounders (age, gender, race, ethnicity, caregiver education, and school enrollment) and survey weighting. Statistical analyses were carried out using Stata SE 14 (StataCorp, TX).

3.0 Results

3.1 Participant characteristics

3.1.1 EHM

There were 866 participants in the EHM study. The mean participant age was 15.5 years. Seventy-eight percent of participants were African American, 4% Caucasian, and 6% Hispanic (Table 1). The percent of households below the poverty line ranged from 5.1 to 65.8% across the twenty neighborhoods, whereas the national rate was 13.5% for 2015.[33] Walkability across the neighborhoods ranged from 11.9 to 18.6 (ideal walkability=20; Figure 1).

3.1.1.1 EHM Neighborhoods

The EHM study sites were located in 20 lower resource neighborhoods in Allegheny County, PA. They ranged from less than 1% to 90% African American. Residents with a college degree or higher varied from 2% to 30%. The population densities ranged from 3,382 people per square mile to 13,296 people per square mile, compared to the Allegheny County population density of 1,651. Also, the lowest median household income was $13,012, while the highest was $116,684 (Table 2).

3.1.2 HATS

For the HATS survey, there were 1,813 participants. The mean participant age was 16.7 years. Fifty-one percent of participants were male, and 49% were female. Seventy-two percent of participants were Caucasian, 15.5% African American, and 2% Hispanic (Table 3). The percent of households below the poverty line for Allegheny County was 9.0%.

3.2 Violence involvement

3.2.1 EHM

In EHM, in the past 9 months, 66.4% reported being in a fight, 28.6% reported threatening someone with a weapon, and 14.7% reported injuring someone with a weapon.[34]

3.2.2 HATS

Among HATS participants, in the past 12 months, 6% reported being threatened or injured with a weapon, 18% reported being involved in a fight, and 1.7% reported being injured and needing treatment.

3.3 EHM: Associations between built environment and violence involvement

Better neighborhood walkability was associated with significantly lower odds of fighting (adjusted odds ratio (AOR) 0.84, 95%CI 0.73-0.96) (Table 4). Higher density of bike lanes was also inversely associated with fighting (AOR 0.90, 95%CI 0.81-1.0). The density of alcohol and tobacco outlet retailers was inversely associated with fighting (alcohol AOR 0.98, 95%CI 0.96-0.99; tobacco AOR 0.91, 95%CI 0.87-0.96). Tobacco outlet density was also inversely associated with threatening someone with a weapon (AOR 0.96, 95%CI 0.92-0.995). Green space quality was associated with slightly increased odds of injuring someone with a weapon (AOR 1.003, 95%CI 1.001-1.005). There were no significant associations between street intersection density and violence perpetration.

3.4 HATS: Social environment and violence involvement

Social supports were associated with significantly lower odds of fighting (AOR 0.39, 95%CI 0.20-0.75) (Table 5). School connectedness was associated with significantly lower odds of being threatened or injured with a weapon (AOR 0.23, 95%CI 0.09-0.62) and fighting (AOR 0.45, 95%CI 0.28-0.72). Similarly, social cohesion was associated with lower odds of being threatened or injured with a weapon (AOR 0.34, 95%CI 0.15-0.77) as well as fighting (AOR 0.45, 95%CI 0.29-0.71). All three measures were associated with lower odds of any violence involvement (social supports AOR 0.47, 95%CI 0.25-0.86; school connectedness AOR 0.41, 95%CI 0.26-0.67; social cohesion AOR 0.46, 95%CI 0.31-0.70).

3.5 HATS: Built environment and violence involvement

Better neighborhood walkability was associated with higher odds of being threatened or injured with a weapon (AOR 1.29, 95%CI 1.04-1.61) and with higher odds of any violence involvement (AOR 1.11, 95%CI 1.03-1.19) (Table 6). Similarly, an increase in street intersection density was associated with slightly higher odds of both being threatened or injured with a weapon (AOR 1.01, 95%CI 1.00-1.01) and any violence involvement (AOR 1.003, 95%CI 1.001-1.005). Higher density of bike lanes was inversely associated with being threatened or injured with a weapon (AOR 0.74, 95%CI 0.56-0.96). The density of tobacco outlet retailers was associated with higher odds of being threatened or injured with a weapon (AOR 1.20, 95%CI 1.02-1.42). Tobacco outlet density was also associated with higher odds of any violence involvement (AOR 1.16, 95%CI 1.06-1.26) (Figure 2). Green space quality was associated with slightly lower odds of getting injured and needing treatment (AOR 0.99, 95%CI 0.98-0.9997). There were no significant associations between alcohol outlet retailer density and violence involvement.

3.6 HATS: Social and built environments and violence involvement

Stratifying the associations between neighborhood built environmental features and violence involvement by the social environment showed differences in the association patterns between those with high versus low social supports, school connectedness, and social cohesion. Among those participants with high social supports, there were slightly higher odds of violence involvement associated with higher walkability scores (AOR 1.19, 95%CI 1.05-1.36), street intersection density (AOR 1.003, 95%CI 1.00-1.01), alcohol outlet density (AOR 1.06, 95%CI

1.02-1.10), and tobacco outlet density (AOR 1.18, 95%CI 1.07-1.29) (Table 7). Among participants reporting low school connectedness, an increase in alcohol and tobacco outlet density was associated with higher odds of violence involvement (alcohol AOR 1.07, 95%CI 1.01-1.14; tobacco AOR 1.22, 95%CI 1.06-1.41). Higher odds of violence involvement were also associated with walkability (AOR 1.13, 95%CI 1.01-1.25) and tobacco outlet density (AOR 1.15, 95%CI 1.03-1.28) for participants with low social cohesion. Finally, among participants reporting high social cohesion, higher odds of violence involvement were associated with bike lane density (AOR 1.19, 95%CI 1.05-1.36).

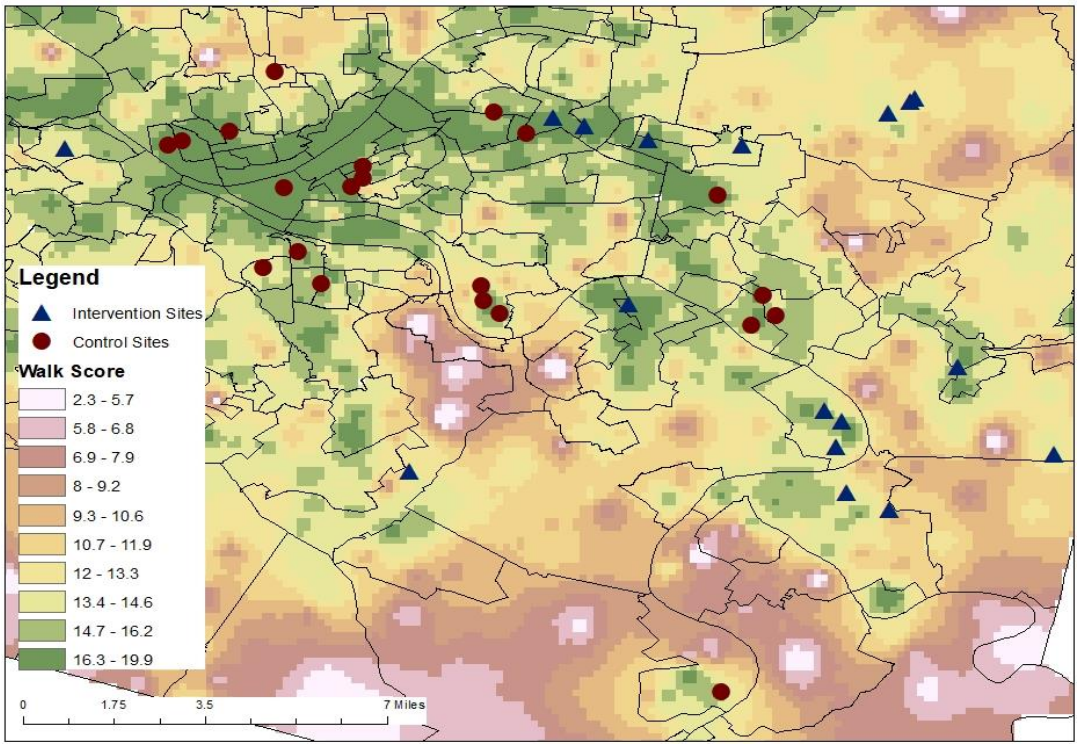

Figure 1 - Locations of EHM program sites overlaid on National Walkability Index scores

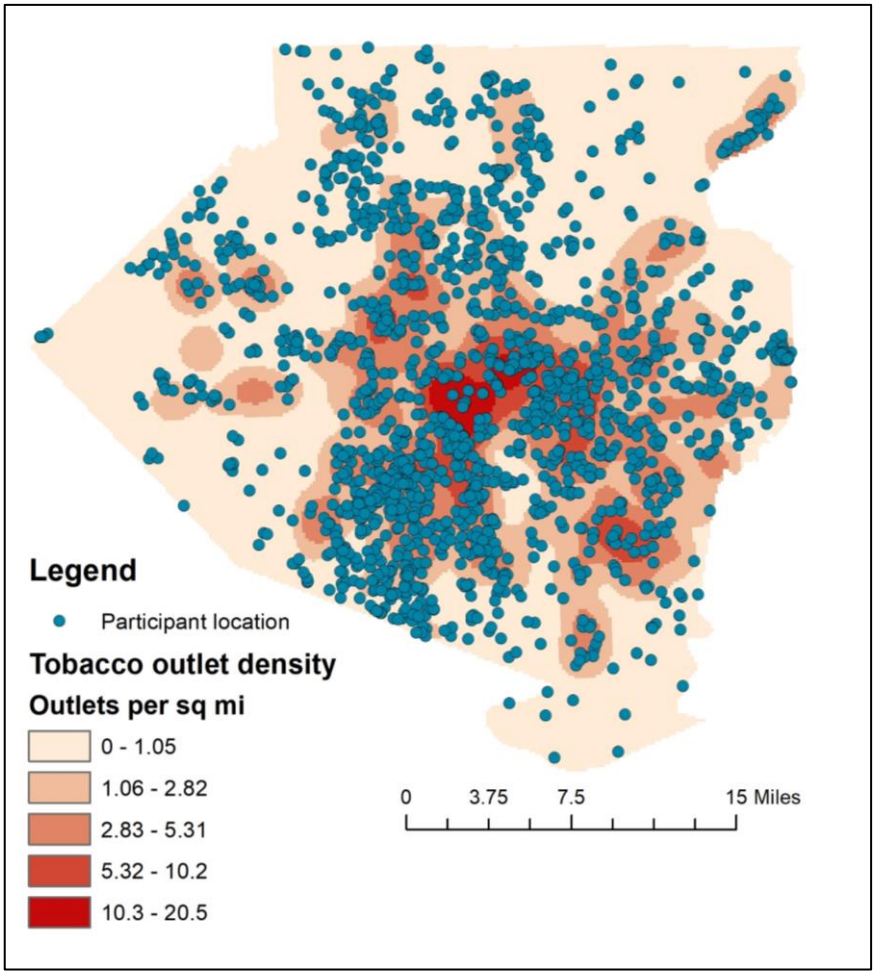

Figure 2 - Locations of HATS participants overlaid on tobacco outlet density (locations have been enlarged and randomly jittered to maintain participant confidentiality)

4.0 Discussion

Violence involvement was highly prevalent among EHM participants, with 66% reporting fighting in the past nine months. For HATS participants, violence involvement was less prevalent, with 18% reporting fighting in the past year. We identified significant associations between both the built and social environments and violence involvement. However, important differences emerged in the results across these two datasets. For EHM, walkability was associated with significantly lower odds of reporting fighting. Bike lanes as well as substance retailers were also inversely associated with violence risk. For HATS, walkability, street intersection density, and tobacco outlet density were associated with higher odds of any violence involvement.

The conflicting results across these two studies for associations between violence involvement and built environmental features, especially with walkability, may have multiple causes. First, the way exposure to the built environmental features was defined for participants differed between the two studies. Study site locations were utilized to define exposure for EHM participants since home addresses were not available. Conversely, home addresses were available for HATS participants, and so they were used to define exposure. Differences in exposure definition can alter the measured built environmental context, resulting in conflicting findings. Both of these measures act as proxies for where participants spend their time, although they are not directly measuring this. Also, it is possible that the relationships between violence involvement and features of the built environment are fundamentally different in the lower resource, all male population of the EHM study as compared to the general youth population across Allegheny County in the HATS study.

All three types of social environment measures, among participants from the HATS study, appeared to be protective in violence involvement. Social supports, school connectedness, and social cohesion were all associated with lower odds of reporting fighting and any violence involvement. School connectedness and social cohesion were also associated with lower odds of reporting being threatened or injured with a weapon.

The joint examination of the built and social environment found that the associations between violence involvement and the built environmental features did differ based on high and low social environment measures. Among those reporting high social supports, walkability, street intersection density, and alcohol and tobacco outlet density were associated with higher odds of violence involvement. Alcohol and tobacco outlet density were associated with higher odds of reporting violence involvement among those with low school connectedness. And for participants who reported low social cohesion, walkability and tobacco outlet density were associated with higher odds of violence involvement. These results differed slightly from the first model that assessed solely the associations between built environmental features and violence involvement across all HATS participants. These results suggest that the social environment influences violence risk, as well as demonstrate the interconnected nature of physical and social environments and their relationship with youth violence.

For several features of the built environment that we examined, we did not see significant associations with violence that have previously been found in large urban centers. One explanation for these null findings is that there may not be significant relationships between these features and violence outcomes in the context of mid-sized cities. However, there may be have been less variation in these across the EHM sites or HATS participants' homes. Without variation in

exposures it is much less likely that an effect would be detected, resulting in the model not showing a correlation between these features and violence outcomes.

This study has several limitations. As a cross-sectional survey, observed associations cannot be inferred as causal. The violence involvement measures from both studies used self-report, which can be subject to reporting bias. There is the potential for unmeasured confounding to be present. Some of the spatial data were only available at larger geographic scales, which may make it more difficult to decipher nuances in the environmental contexts between adjacent areas. Also, to protect participant confidentiality in the EHM study, we did not collect participants' home location or activity spaces, and instead used the site where participants attended programming as a proxy [35,36] Important strengths include two large samples of youth across Allegheny County, PA, multiple measures of violence outcomes, detailed assessment of multiple environmental features, and spatial analytic methods that maximize utility of the available data.

These findings contribute to the growing body of literature demonstrating the associations between positive neighborhood social environments and lower odds of experiencing violence. Future work should study the interconnections between built and social environments, and how they relate to youth violence. Also, this work should focus on where youth are spending time when defining exposures. Coupled with well-established individual, family, and school-based intervention approaches, reshaping the built environment may serve as an important part of a multifaceted strategy to affect the social environment of neighborhoods and reduce violence among youth.

Appendix – Supplemental Tables

Table 1 - Participant characteristics of EHM study

Participant Demographics	Total (%) n = 866
Age (years)	
13-14	280 (32.3)
15-16	338 (39.0)
17-19	246 (28.4)
Race	
Black/African-American	632 (77.5)
White	30 (3.7)
Other	125 (14.5)
Ethnicity	
Hispanic	53 (6.1)
Educational status	
In school	734 (84.8)
Not in school	
Completed high school degree	28 (3.2)
Did not complete high school degree	43 (5.0)
Highest educational level of parents/guardians	
Did not complete high school	378 (43.6)
Completed high school or received GED	149 (17.2)
College degree or higher	208 (24.0)
Violence perpetration (past nine months)	
Fighting	545 (66.4)
Threatening someone with a weapon	236 (28.6)
Injuring someone with a weapon	121 (14.7)
Neighborhood physical features	Mean (SD)
Walkability (National Walkability Index score)	14.9 (0.07)
Street intersection density (intersections per square mile)	180.7 (3.2)
Bike lane density (bike lanes per square mile)	2.5 (0.09)
Alcohol outlet density (alcohol outlets per square mile)	10.3 (0.52)
Tobacco outlet density (tobacco outlets per square mile)	6.5 (0.15)
Median NDVI score in 0.25-mile radius	327.5 (4.0)

Table 2 - Characteristics of neighborhoods in EHM study

Neighborhood Sites	Race (% African American)	Ethnicity (% Hispanic/ Latino)	Age (% 15 to 24 years old)	Population Density (people/ square mile)	Median Household Income (USD)	College Degree Attainment (% with college degree)
Allegheny County	12.9	2.0	13.0	1,651.1	53,040	37.8
Allentown/Beltzhoover/ Hill Top*	53.4	1.2	11.9	8,378.7	25,370	7.3
Clairton	56.9	0.94	8.8	3,382.3	25,268	9.9
Downtown	0.42	4.0	4.1	5,316.8	116,684	28.1
Duquesne*	55.7	0.72	13.1	3,250.3	24,281	6.1
East Hills	89.0	0.36	15.6	5,757.0	16,350	8.6
East Liberty	65.3	2.2	14.6	8,882.0	23,849	14.3
Garfield*	28.8	3.0	13.5	13,296	41,943	29.9
Hazelwood*	42.7	1.1	8.6	9,155.8	20,336	9.7
Hill District*	72.9	2.5	17.2	7,590.0	21,442	7.7
Homewood	85.3	1.1	10.8	7,244.0	23,299	9.1
Larimer	71.0	1.5	21.3	6,024.0	30,923	15.1
McKeesport*	25.1	2.4	11.0	4,739.3	35,152	10.8
Munhall	55.2	1.0	21.4	10,691.5	27,351	13.7
North Braddock*	59.3	8.1	9.7	3,390.2	25,239	6.8
Northside*	49.0	3.2	10.0	6,363.4	31,540	15.5
Northview	90.3	7.4	17.6	4,589.4	13,012	2.1
Penn Hills*	33.0	2.7	7.9	3,041.2	48,051	17.0
Sheraden	45.7	0.32	13.2	8,995.0	24,006	14.8
Whitehall	3.7	3.2	11.4	6,187.6	61,048	19.1
Wilkinsburg	81.0	2.2	14.5	8,361.5	28,512	5.7
Wilmerding	19.6	1.7	11.2	4,708.0	32,719	8.3

* = average values of sites reported in neighborhoods with multiple programming sites
data obtained from the American Community Survey, 2015 (U.S. Census Bureau)

Table 3 - Participant characteristics of HATS survey participants

Participant Demographics	Total % (n) n=1813
Age, years; mean (SE)	16.7 (0.065)
Gender	
Male	51.1 (899)
Female	49.0 (914)
School enrollment	91.2 (1728)
In school	91.2 (1728)
Not in school	8.9 (78)
Race	
White	71.8 (1450)
Black/African American	15.5 (184)
Other	10.7 (156)
Ethnicity	
Hispanic/Latino	2.28 (52)
Not Hispanic/Latino	97.7 (1740)
Highest educational level of parent/guardian	
Did not complete high school	25.4 (368)
Completed high school	35.5 (691)
Some high school	20.1 (412)
Not reported	19.0 (342)
Violence experience	
Threatened or injured with a weapon (past year)	5.7 (74)
Fighting (past year)	17.6 (247)
Injured and needed treatment (past year)	1.7 (27)
Any violence involvement*	17.6 (285)
Neighborhood physical features	Mean (SD)
Walkability	12.0 (0.28)
Street intersection density	101 (4.0)
Bike lane density	0.81 (0.06)
Alcohol outlet density	4.7 (0.28)
Tobacco outlet density	3.1 (0.12)
Median NDVI score in 0.25-mile radius	159 (2.6)
Demographics are reported in survey weighted percentages (unweighted n) *Any violence involvement indicates participant endorsed 1 or more of the violence experience questions	

Table 4 - Adjusted odds ratios for associations between neighborhood physical features and violence involvement (EHM)

	Fighting	Threatening someone with a weapon	Injuring someone with a weapon
	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)
Walkability	**0.836** (0.732, 0.955)	0.955 (0.865, 1.05)	0.932 (0.807, 1.08)
Street intersection density	0.9982 (0.9956, 1.007)	0.9992 (0.9974, 1.001)	0.9998 (0.9971, 1.002)
Bike lanes	**0.903** (0.813, 1.00)	0.956 (0.888, 1.03)	1.00 (0.896, 1.12)
Alcohol	**0.976** (0.962, 0.991)	0.995 (0.982, 1.01)	0.987 (0.966, 1.01)
Tobacco	**0.913** (0.872, 0.955)	**0.955** (0.917, 0.995)	0.950 (0.894, 1.01)
Green space	1.002 (0.9996, 1.004)	1.001 (0.9998, 1.003)	**1.003** (1.001, 1.005)

Bolded AORs indicate a p-value < 0.05
Models adjusted for age, race, ethnicity, caregiver education, school enrollment, and intervention group

Table 5 - Adjusted odds ratios for associations between social environment and violence involvement (HATS)

	Threatened or injured with a weapon	Fighting	Injured and needed treatment	Any violence involvement
	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)
Social supports	0.589 (0.220, 1.58)	**0.390** (0.202, 0.753)	0.568 (0.150, 2.15)	**0.467** (0.252, 0.864)
School connectedness	**0.232** (0.087, 0.624)	**0.447** (0.279, 0.715)	0.454 (0.151, 1.37)	**0.414** (0.255, 0.672)
Social cohesion	**0.338** (0.149, 0.765)	**0.450** (0.288, 0.705)	1.23 (0.404, 3.76)	**0.463** (0.308, 0.696)

Bolded AORs indicate a p-value < 0.05
Models adjusted for age, gender, race, ethnicity, caregiver education, school enrollment, and survey weighting

Table 6 - Adjusted odds ratios for associations between neighborhood physical features and violence involvement (HATS)

	Threatened or injured with a weapon	Fighting	Injured and needed treatment	Any violence involvement
	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)
Walkability	**1.29** (1.04, 1.61)	1.05 (0.980, 1.12)	1.03 (0.832, 1.27)	**1.11** (1.03, 1.19)
Street intersection density	**1.01** (1.00, 1.01)	1.002 (0.999, 1.004)	1.000 (0.993, 1.007)	**1.003** (1.001, 1.005)
Bike lanes	**0.736** (0.564, 0.961)	1.07 (0.947, 1.22)	0.908 (0.679, 1.21)	1.07 (0.946, 1.21)
Alcohol outlets	1.02 (0.955, 0.1.08)	1.02 (0.982, 1.06)	0.936 (0.844, 1.04)	1.04 (0.999, 1.07)
Tobacco outlets	**1.20** (1.02, 1.42)	1.07 (0.987, 1.16)	0.923 (0.731, 1.17)	**1.16** (1.06, 1.26)
Green space	0.999 (0.988, 1.01)	0.998 (0.993, 1.00)	**0.990** (0.980, 0.9997)	0.995 (0.990, 1.00)

Bolded AORs indicate a p-value < 0.05
Models adjusted for age, race, ethnicity, caregiver education, school enrollment, and survey weighting

Table 7 - Adjusted odds ratios for associations between neighborhood physical features and any violenceinvolvement, stratified by social environment (HATS)

	Any violence involvement					
	Social supports		School connectedness		Social cohesion	
	High social supports	Low social supports	High school connectedness	Low school connectedness	High social cohesion	Low social cohesion
	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)
Walkability	**1.10** (1.01, 1.19)	1.14 (0.957, 1.36)	1.06 (0.970, 1.15)	1.10 (0.967, 1.26)	1.03 (0.950, 1.13)	**1.13** (1.01, 1.25)
Street intersection density	**1.003** (1.00, 1.01)	1.00 (0.997, 1.01)	1.000 (0.997, 1.003)	1.002 (0.998, 1.01)	1.003 (0.999, 1.007)	1.00 (0.999, 1.005)
Bike lanes	1.08 (0.941, 1.23)	0.951 (0.718, 1.26)	1.14 (0.995, 1.30)	1.07 (0.901, 1.26)	**1.19** (1.05, 1.36)	0.981 (0.830, 1.16)
Alcohol outlets	**1.06** (1.02, 1.10)	0.916 (0.830, 1.01)	0.981 (0.931, 1.03)	**1.07** (1.01, 1.14)	1.03 (0.983, 1.08)	1.001 (0.935, 1.07)
Tobacco outlets	**1.18** (1.07, 1.29)	1.07 (0.902, 1.28)	1.04 (0.947, 1.15)	**1.22** (1.06, 1.41)	1.06 (0.967, 1.18)	**1.15** (1.03, 1.28)
Green space	0.995 (0.990, 1.00)	0.992 (0.980, 1.00)	0.996 (0.990, 1.00)	0.995 (0.977, 1.01)	1.00 (0.992, 1.01)	0.994 (0.989, 1.00)

Bolded AORs indicate a p-value < 0.05
Models adjusted for age, gender, race, ethnicity, caregiver education, school enrollment, and survey weighting

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