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# What neighborhood area captures built environment features related to adolescent physical activity?

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# Abstract

In research investigating built environment (BE) influences on physical activity (PA), inconsistent neighborhood definitions may contribute to inconsistent findings. Using data from the National Longitudinal Study of Adolescent Health (Wave I; 1994-95), we compared associations between moderate-vigorous PA (MVPA) and PA facility counts and street connectivity measures (intersection density and link:node ratio) within 1, 3, 5, and 8.05 kilometers (km) from each respondent's residence (Euclidean neighborhood buffers). BE-MVPA associations varied by BE characteristic, urbanicity, and sex. PA facilities within 3 km buffers and intersection density within 1k buffers exhibited the most consistent associations with MVPA. Policy recommendations and corresponding research should address potential differences in relevant neighborhood areas across environment feature and population subgroup.

#### Keywords (MeSH\*)

Environment design\*; physical activity\*; adolescent\*; epidemiology\*; modifiable areal unit problem; neighborhood definition; United States

# INTRODUCTION

Despite some evidence that built environment (BE) features (e.g., recreation facilities, street connectivity) may promote physical activity (PA), associations vary dramatically across studies (Saelens and Handy, 2008, Wendel-Vos et al., 2007). Inconsistent study findings could result, in part, from variation in neighborhood definitions, which may capture neighborhood features relevant to PA to varying degrees, depending on the type of BE feature and population subgroup (Colabianchi et al., 2007, Diez Roux, 2007, Soobader et al., 2006).

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Findings from the few empirical comparisons of objectively defined neighborhoods are mixed, showing dramatic (Zhang and Kukadia, 2005) or inconsequential (Lovasi et al., 2008, Berke et al., 2007, Diez Roux et al., 2007, Forsyth et al., 2008) differences in associations according to neighborhood size. However, these studies focus on adult, generally metropolitan samples and lack the size and diversity needed to evaluate subgroup differences.

Our objective was to determine the most salient circular neighborhood area for capturing BE features (PA facilities and street connectivity) most strongly associated with moderatevigorous PA (MVPA) in a nationally representative sample of adolescents. We considered areas within 1, 3, 5, and 8.05 kilometers (km) of each respondents' home (Euclidian neighborhood buffers) using a unique database which provided exceptional geographic variability.

#### METHODS

#### Study population and data sources

We used Wave I data (n=20,745; 11-22 years of age) from The National Longitudinal Study of Adolescent Health (Add Health), a prospective cohort study of adolescents representative of the U.S. school-based population in grades 7 to 12 in 1994-95. The survey design and sampling frame have been discussed elsewhere (Resnick et al., 1997).

Using complex Geographic Information System (GIS) techniques, we linked time-varying, community-level data to Add Health respondent residential locations determined from (of 18,924 adolescents in the probability sample) geocoded home addresses with street-segment matches (n=15,480), global positioning system (GPS) measurements (n=2,996), ZIP/ZIP+4/ZIP+2 centroid match (n=205), and respondent's geocoded school location (n=243) (Boone-Heinonen et al., 2010). Results were virtually identical after excluding respondents with ZIP- or school location-imputed locations. Attributes of the circular area within 1, 3, 5, and 8.05 km (8.05 km=5 miles) of each respondent residence and block group, tract, and county from U.S. Census and other federal sources were merged with individual-level Add Health interview responses.

The final sample included 17,659 adolescents for analysis. Exclusions included self-reported pregnancy (n=401) or mobility disability (n=122) and Native Americans due to sparse data (n=156); of the remaining sample, those with missing analytic variables were also excluded (n=589).

#### Study variables

**GIS-derived BE characteristics of interest (1, 3, 5, and 8.05 km buffers)**—*PA facility counts* were obtained from a historical dataset of U.S. businesses (1995) with high overall agreement between commercial and field data (Boone et al., 2008) and classified according to 8-digit Standard Industrial Classification codes. We also examined facility counts weighted by the inverse distance from each respondent (facilities between 1 and 8 km); facilities within 1 km received weights of 1.

Two measures of *street connectivity*, an indicator of the number and directness of route options (Saelens et al., 2003), were calculated from the ESRI StreetMap 2000 dataset. Link:node ratio represents the number of links (street segments) relative to the number of nodes (intersections); intersection density is the number of 3 or more-way intersections per square km. Higher values indicate higher connectivity.

**GIS-derived control variables**—U.S. Census-defined urbanized areas (UA) were used to classify residential locations as *non-urban* or urban. Urban locations were further categorized into "*low-urban*" and "*high-urban*" based on the area of developed land as a proportion of total area within 8 km after excluding water and ice [ $\leq$  or > 78% (75<sup>th</sup> percentile) developed landcover, respectively], calculated using Fragstats software (McGarigal et al., 2002) with U.S. Geologic Survey National Landcover Data (1992). This measure provided an indicator of urban development that is independent of population density and correctly classifies areas as within or outside of a UA (Receiver Operating Curve area=0.986).

Analyses controlled for percent of persons below poverty within census tracts. 1990 Census population counts weighted according to the proportion of the block-group area captured within the buffer were divided by the buffer area to obtain *population density* within each buffer. Population density was used to control for density-related characteristics and per capita availability of facilities. County-level *non-violent and violent crime rate* per 100,000 population was obtained from 1995 Uniform Crime Reporting data.

Self-reported behaviors and sociodemographics—Weekly frequency (bouts) of MVPA (skating & cycling, exercise, and active sports) was ascertained using a standard, interview administered activity recall based on questionnaires validated in other large-scale epidemiologic studies. Individual-level control variables included age at Wave I interview, self-identified race (white, black, Asian, Hispanic); parent-reported annual household income and highest level of education (<high school, high school or GED, some college, ≥college degree), and administratively determined U.S. region (West, Midwest, South, and Northeast).

#### **Statistical analysis**

**Sample characteristics**—We compared neighborhood-level characteristics across three levels of urbanicity and individual-level characteristics across sex and urbanicity using design-based F-tests and Wald tests for categorical and continuous characteristics, respectively, with Bonferroni correction for multiple comparisons. Descriptive analyses were weighted for national representation and adjusted for multiple stages of cluster sampling.

**Multivariable analysis**—Using negative binomial regression models, we examined the number of weekly MVPA bouts as a function of PA facilities count, intersection density, or link:node ratio within 1, 3, 5, or 8.05 Euclidean buffers. All models adjusted for individual-level (continuous age, race, household income tertile, highest parental education, region) and neighborhood-level (poverty and crime tertiles; urbanicity-specific population density tertile) covariates. Due to potential identification error (Oakes, 2004) posed by dramatic variation in BE measures across urbanicity, we stratified by urbanicity rather than testing for urbanicity interactions. We included statistically significant (p<0.10) sex-BE interactions.

Subsequently, we fit an analogous model with the most salient measures from the first set of models (PA facilities counts within 3 km and intersection density within 1 km); this model adjusted for population density within 1 km, but adjusting for population density within 3 km yielded similar estimates.

All models adjusted for clustering on our primary sampling unit (schools). Given that schools are not nested within census tracts and counties, we did not use multi-level analysis. Further, intraclass correlations for ln(MVPA) were minimal (0.03; ICC's are not definable for negative binomial distributed outcomes), and multi-level analysis of unbalanced, sparse

data (mean=8, range=1-275 respondents per census tract) within geographic units can result in biased estimates (Clarke, 2008).

To address non-linear relationships with MVPA, each model included statistically significant (Wald p<0.10) quadratic and cubic terms and, for PA facility counts, analyzed natural-log transformed variables (plus 1 to address zero counts). To stabilize estimates, extreme observations (<0.5<sup>th</sup> or >99.5<sup>th</sup> urbanicity-specific percentile) were dropped if their exclusion simplified the model (e.g., higher order term was no longer significant) or resulted in >10% change in the BE coefficient(s); in each model, no more than 1% of the sample was excluded.

We present exponentiated estimates comparing urbanicity-specific 90<sup>th</sup> and 10<sup>th</sup> percentiles (Diez-Roux et al., 1997) for the BE measure of interest, which reflect the proportional difference in MVPA bouts (e.g, 1.05 represents 5% greater MVPA bouts associated with the 90<sup>th</sup> versus 10<sup>th</sup> percentile of a given BE measure). Model coefficients are reported in the Appendix (Table A1).

### RESULTS

In general, we observed dramatic differences in most environmental characteristics among urbanicity levels (Table 1). Individual-level characteristics by sex and urbanicity are presented in the Appendix (Table A2).

The association between MVPA and facility count varied by buffer size and urbanicity (Table 2). The strongest associations were generally observed for 1-5 km buffers, most consistently for the 3 km buffer. Associations were strongest in the non- and low-urban strata and were similar by sex. Associations with weighted counts were similar to counts within 1-5 km. Intersection density within 1 km yielded the strongest associations; in several cases, associations were stronger in males, with the strongest association in high-urban males. Associations between link:node ratio and MVPA were generally positive in non-urban females and negative in high-urban females but otherwise not significant.

After including facilities count within 3k and intersection density within 1 km in the same models (Table 3), associations were similar to Table 2 except the MVPA-resource count association was no longer apparent in the non-urban stratum.

#### DISCUSSION

In our large, national sample of U.S. adolescents, we found particular relevance for PA facilities within a 3 km buffer and street connectivity within a 1 km buffer. Our joint model suggests that MVPA is independently associated with intersection density and, in low-urban adolescents, resource count. Our findings are consistent with prior work (Zhang and Kukadia, 2005) suggesting that behavior is influenced by different features within different neighborhood areas. That is, the relevant neighborhood area may be larger for PA facilities (due to higher incentive to travel) than for intersection density (which may encourage street-based activities such as skateboarding or jogging closer to home (Nelson et al., 2005)).

Observed variation in BE-MVPA associations by buffer size, type of BE characteristic, sex, and urbanicity could produce inconsistent BE-PA associations in existing research. Our link:node ratio findings suggest that while high street connectivity might encourage walking in adults (Ewing et al., 2003, Doyle et al., 2006, Frank et al., 2004), dead end streets or cul de sacs might encourage street-based PA in high-urban, adolescent females. This finding also suggests that our two street connectivity measures appear to capture different characteristics. More consistent BE-MVPA associations in males versus females could

reflect the stronger role of safety concerns (Roman and Chalfin, 2008) and sociodemographic characteristics (Frank et al., 2008) in females or higher male participation in organized PA (Vilhjalmsson and Kristjansdottir, 2003), which is more easily measured. Finally, while most studies, even those with national samples (Boer et al., 2007, Powell et al., 2007, Ewing et al., 2003), ignore urbanicity, we found urbanicity differences which may reflect differences in effect, omission of safety or complex social or physical factors represented by urbanicity (Vlahov and Galea, 2002), or dramatic differences in the range of BE measures captured across urbanicity.

Our study has several limitations. First, cross-sectional associations do not imply causality (Boone-Heinonen et al., 2009). Second, optimal buffer size may vary by type of PA facility and type of PA (Giles-Corti et al., 2005); however, our total leisure-time MVPA measure is a tradeoff for the size and scope of the Add Health study, and results were similar after excluding active sports, which may be performed farther from home. Third, we did not consider quality of facilities or moderation by perceived or objective safety. Fourth, selection bias (Hernan et al., 2004) resulting from urbanicity stratification is possible, as selection of non-, low-, or high-urban areas may be related to both neighborhood amenities and propensity for PA. Fifth, while we did not examine alternative neighborhood definitions such as buffers based on street network distances, administrative areas (e.g., census tracts), or other methods (Chaix et al., 2009), our comparison of circular buffers enabled explicit comparisons of various neighborhood sizes. Finally, while empirically comparing neighborhood definitions has limitations (Spielman and Yoo, 2009), our study contributes by estimating effects of objectively measured neighborhood characteristics within various areas for a geographically diverse, nationally representative sample population.

#### **Conclusion and implications**

In our cross-sectional study, higher MVPA was generally associated with resource counts and intersection density within 1-5 km and 1 km of respondents' homes, respectively. These findings suggest that recommendations should specify the relevant scale and setting. For example, guidelines for minimum intersection density based on research within a 1 km buffer in high-urban areas applied to larger scales or in suburban areas may not be valid. Until consensus on the most relevant scale is reached, reporting of associations within various neighborhood sizes is recommended. More research in diverse geographic areas which include currently understudied rural and suburban areas, as well as further examination of age and sex differences is needed.

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# APPENDIX

#### Table A1

Regression coefficients<sup>*a*</sup> for MVPA modeled as a function of  $ln(\underline{resource} counts)$ , <u>intersection density</u> and <u>link:node ratio</u> within 1, 3, 5, and 8.05k circular buffer, by urbanicity<sup>*b*</sup> level

			Resou	irces	Inte	ersection	Density	Ι	.ink:Nod	e Ratio
		coeff	sig	n, exclusions <sup>c</sup>	coeff	sig	n, exclusions <sup>c</sup>	coeff	sig	n, exclusions <sup>c</sup>
<u>Non-Urban</u> (n=6889)										
1 km	linear	0.036	0.012	6861, hi	0.054	0.005	6853, hi	-0.028	0.131	6882, hi
	squared	d			-0.005	0.082		d		
3 km	linear	0.027	0.024	6889	0.064	0.000	6855, hi	2.264	0.035	6855, hi
	linear*female	d			d			-1.662	0.191	
	squared	d			d			-0.803	0.029	
	squared*female	d			d			0.642	0.141	
5 km	linear	0.021	0.098	6889	0.045	0.092	6855, hi	3.953	0.000	6889
	linear*female	d			d			-5.127	0.000	
	squared	d			d			-1.440	0.000	
	squared*female	d			d			1.936	0.000	
8 km	linear	0.004	0.751	6855, hi	0.005	0.978	6825, hi/lo	3.517	0.062	6821, hi/lo
	linear*female	d			-0.334	0.061		-7.097	0.009	
	squared	d			-0.039	0.816		-1.270	0.060	
	squared*female	d			0.395	0.036		2.678	0.006	
	cubed	d			0.004	0.919		d		
	cubed*female	d			-0.097	0.056		d		
weighted	linear	0.031	0.018	6889	-NA-			-NA-		
Low-urban (n=6450)										
1 km	linear	0.022	0.025	6450	-0.053	0.127	6418, hi	0.073	0.257	6388, hi/lo
	linear*female	d			-0.003	0.958		d		
	squared	d			0.014	0.034		d		
	squared*female	d			-0.007	0.564		d		
	cubed	d			-0.001	0.039		d		
	cubed*female	d			0.001	0.436		d		
3 km	linear	0.020	0.016	6450	0.002	0.813	6418	0.139	0.095	6450
	linear*female	d			-0.022	0.038		d		
5 km	linear	-0.112	0.020	6433, lo	-0.001	0.964	6387, hi/lo	0.175	0.121	6450
	squared	0.024	0.002		d			d		
8 km	linear	-0.228	0.006	6382, hi/lo	-0.135	0.009	6450	0.101	0.438	6417, hi
	linear*female	d			0.130	0.030		d		

			Resou	irces	Inte	ersection	Density	L	ink:Nod	e Ratio
		coeff	sig	n, exclusions <sup>c</sup>	coeff	sig	n, exclusions <sup>c</sup>	coeff	sig	n, exclusions <sup>c</sup>
	squared	0.030	0.001		0.030	0.003		d		
	squared*female	d			-0.031	0.016		d		
weighted	linear	-0.152	0.016	6385, hi/lo	-NA-			-NA-		
	squared	0.033	0.001							
High Urban (n=4320)										
1 km	linear	-0.154	0.007	4299, hi	0.020	0.575	4277, hi/lo	13.671	0.014	4279, hi/lo
	linear*female	0.343	0.000		0.078	0.157		d		
	squared	0.045	0.024		0.002	0.428		-8.597	0.015	
	squared*female	-0.109	0.000		-0.011	0.029		d		
	cubed	d			d			1.757	0.016	
3 km	linear	-0.174	0.512	4307, lo	-0.035	0.356	4279, hi/lo	-0.021	0.905	4278, hi/lo
	linear*female	0.831	0.031		0.178	0.017		-0.297	0.035	
	squared	0.024	0.451		0.005	0.233		d		
	squared*female	-0.115	0.022		-0.026	0.004		d		
5 km	linear	-0.007	0.866	4277, hi/lo	-0.128	0.040	4299, hi	86.391	0.003	4300, hi
	linear*female	d			0.450	0.002		-73.983	0.143	
	squared	d			0.017	0.023		-56.140	0.003	
	squared*female	d			-0.063	0.000		46.521	0.154	
	cubed	d			d			12.082	0.002	
	cubed*female	d			d			-9.757	0.163	
8k	linear	-0.026	0.589	4282, hi/lo	-0.396	0.005	4278, hi/lo	-0.040	0.797	4320
	linear*female	d			0.712	0.004		-0.557	0.026	
	squared	d			0.055	0.003		d		
	squared*female	d			-0.107	0.002		d		
weighted	linear	-0.020	0.703	4278, hi/lo	-NA-			-NA-		

<sup>*a*</sup>Negative binomial regression results modeling MVPA bouts as a function of each built environment measure within each of 4 circular buffers (Euclidean distance). Adjusted for individual-level age and race, household-level income, parental education, census tract-level poverty, county level crime, and population density within corresponding neighborhood buffer size. Each model contains only one built environment variable of interest.

<sup>b</sup>Urbanicity based on U.S. Census-defined urbanized areas (UA; non-urban or urban); locations within a UA with  $\leq$ 78% (75th percentile) and >78% developed land cover were classified as "low-urban" and "high-urban," respectively.

 $^{c}$ hi: observations >99.5<sup>th</sup> percentile excluded; lo: observations <0.5<sup>th</sup> percentile excluded

 $^{d}$ Higher order term not statistically significant (p<0.10) and excluded from model MVPA: Moderate to vigorous physical activity

coeff: coefficient

#### Table A2

Individual-level characteristics by sex and urbanicity<sup>a</sup> level [mean /% (SE)]

		Males			Females	
	Non-Urban (n=3,506)	Low-Urban (n=3,196)	High-Urban (n=2,192)	Non-Urban (n=3,453)	Low-Urban (n=3,254)	High-Urban (n=2,128)
MVPA (mean # bouts)	4.1 (0.1)	4.1 (0.1)	7.4 (0.2)	3.4 (0.1)	3.3 (0.1)	5.2 (0.2)

		Males			Females	
	Non-Urban (n=3,506)	Low-Urban (n=3,196)	High-Urban (n=2,192)	Non-Urban (n=3,453)	Low-Urban (n=3,254)	High-Urban (n=2,128)
Age (mean)	15.4 (0.2)	15.5 (0.2)	15.7 (0.3)	15.2 (0.2)	15.3 (0.2)	15.5 (0.3)
Race*						
white	80.2 (3.7)	70.3 (2.8)	21.4 (4.0)	80.2 (3.8)	70.8 (2.8)	24.4 (4.9)
black	14.8 (3.4)	12.7 (2.2)	29.0 (6.4)	14.7 (3.5)	13.7 (2.2)	24.9 (5.5)
asian	1.9 (1.2)	4.0 (0.9)	10.2 (3.5)	1.9 (1.1)	3.8 (0.8)	9.8 (3.9)
hisp	3.1 (0.8)	13.0 (1.7)	39.4 (6.7)	3.1 (0.8)	11.8 (1.5)	41.0 (6.8)
Education*						
<hs< td=""><td>10.0 (1.1)</td><td>14.3 (1.7)</td><td>32.9 (4.0)</td><td>11.5 (1.2)</td><td>13.9 (1.5)</td><td>33.5 (4.4)</td></hs<>	10.0 (1.1)	14.3 (1.7)	32.9 (4.0)	11.5 (1.2)	13.9 (1.5)	33.5 (4.4)
HS/GED	34.6 (1.3)	31.8 (2.1)	26.6 (2.8)	36.4 (1.4)	31.6 (1.9)	27.9 (2.7)
Some college	31.5 (1.3)	27.0 (1.3)	22.9 (2.1)	28.9 (1.2)	27.4 (1.2)	21.0 (2.0)
College or greater	23.9 (1.3)	26.8 (3.0)	17.5 (2.6)	23.1 (1.4)	27.2 (3.0)	17.5 (3.3)
Income Tertile*						
1	28.6 (2.7)	28.7 (2.6)	49.2 (4.8)	30.9 (2.7)	28.9 (2.7)	47.2 (5.0)
2	41.6 (1.4)	37.2 (1.7)	32.8 (2.5)	38.8 (1.5)	33.3 (1.4)	34.1 (2.5)
3	29.8 (2.1)	34.1 (3.4)	18.0 (2.8)	30.2 (2.3)	37.8 (3.0)	18.7 (3.4)

<sup>*a*</sup>Urbanicity based on U.S. Census-defined urbanized areas (UA; non-urban or urban); locations within a UA with  $\leq$ 78% (75th percentile) and >78% developed land cover were classified as "low-urban" and "high-urban," respectively.

Significantly different across urbanicity levels, within sex (p<0.05), with Bonferroni correction for multiple comparisons

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Table 1

	Non-Urban	(n=6,889)	Low-Urban	(n=6,450)	High-Urban	(n=4,320)
	Mean/% (SE)	10 <sup>th</sup> , 90 <sup>th</sup> %ile	Mean/% (SE)	10 <sup>th</sup> , 90 <sup>th</sup> %ile	Mean/% (SE)	10 <sup>th</sup> , 90 <sup>th</sup> %ile
Resource Count <sup>d</sup> (mean)		-			- -	
lk	$1.09\ (0.11)\ ^{i}$	0, 4	3.04 (0.30) <sup>ii</sup>	0, 8	7.18 (1.07) <i>i</i> ii	1, 15
3k	4.82 (0.55) <sup>i</sup>	0, 12	$20.39~(1.77)~\ddot{u}$	2, 42	53.93 (8.43) <sup>iii</sup>	20, 104
5k	9.24 (1.06) <sup>i</sup>	0, 24	49.23 (4.12) <sup>ii</sup>	11, 98	137.57 (22.42) <sup>iii</sup>	58, 289
8k	17.30 (1.75) <sup>i</sup>	1, 42	114.42 (14.24) <sup>ii</sup>	27, 191	308.07 (52.69) <sup>iii</sup>	155, 645
weighted count	5.48 (0.52) <sup>i</sup>	0.2, 13.6	29.27 (3.00) <sup>ii</sup>	7.9, 52.1	78.24 (12.85) <sup>iii</sup>	36.0, 158.6
Intersection Density (mean, per km <sup>2</sup> )						
lk	13.06 (1.10) <sup>i</sup>	0.64, 35.33	37.44 (2.08) <sup>ii</sup>	14.32, 63.66	52.02 (2.38) <sup>iii</sup>	31.19, 76.39
3k	6.81 (0.65) <sup>i</sup>	0.74, 17.12	$28.05~(1.50)~\ddot{u}$	11.42, 47.46	44.86 (2.18) <i>iii</i>	27.45, 62.35
5k	4.89 (0.44) <sup>i</sup>	0.79, 11.60	23.19 (1.30) $\ddot{u}$	9.38, 40.50	40.89 (1.75) <i>iii</i>	27.68, 53.73
8k	3.74 (0.31) <sup>i</sup>	0.79, 7.40	$19.20\ (1.14)\ \ddot{u}$	7.76, 32.47	36.19 (1.25) <i>üi</i>	26.50, 45.89
Link:node ratio (mean)						
lk	$1.67~(0.02)^{i}$	1.31, 2.17	$1.54~(0.02)~\ddot{u}$	1.30, 1.77	$1.69~(0.04)^{i}$	1.39, 1.97
3k	$1.43~(0.01)^{i}$	1.26, 1.61	1.44 (0.02) <sup>i</sup>	1.27, 1.62	1.60 (0.04) <i>ii</i>	1.34, 1.81
5k	$1.40(0.01)^{i}$	1.25, 1.54	1.42 (0.01) <sup>i</sup>	1.26, 1.58	1.58~(0.03)~ii	1.36, 1.77
8k	$1.38\ (0.01)\ ^{i}$	1.25, 1.50	1.41 (0.01) <sup>i</sup>	1.28, 1.54	1.56 (0.03) <sup>ii</sup>	1.35, 1.74
Population Density (mean)						
Ik	248.4 (37.8) <sup>i</sup>	8.0, 719.7	$1,493.4\ (105.1)\ ii$	379.7, 2,893.8	4,510.6 (846.9) <i>iii</i>	1,563.0, 9,146.0
3k	159.7 (21.3) <sup>i</sup>	8.8, 427.4	$1,133.0~(78.6)^{ii}$	344.4, 1,954.1	3,787.2 (756.9) <sup>iii</sup>	1,378.9, 8,012.9
5k	120.6 (13.7) <sup>i</sup>	9.0, 289.0	982.9 (88.7) <sup>ii</sup>	297.2, 1,665.7	3,638.1 (797.7) iii	1,300.7, 7,951.6
8k	96.8 (9.9) <sup>i</sup>	9.7, 208.9	902.1 (136.8) <sup>ii</sup>	275.4, 1,366.3	3,309.3 (706.9) iii	1,142.8, 6,990.6
% Below Poverty (CT) (mean)	14.93 (1.22) <sup>i</sup>	4.34, 30.68	11.79 (1.04) <i>i</i> , <i>i</i>	2.68, 26.34	21.12 (2.20) i, iii	5.53, 40.74
Crime Rate/100k (mean)	4,313.5 (280.5) <sup>i</sup>	1,646, 7,679	5,906.8 (282.3) <sup>ii</sup>	2,702, 8,317	7,281.1 (540.1) <sup>ii</sup>	4,307, 12,342
Region (%)*						

	Non-Urbar	1 (n=6,889)	Low-Urban	(n=6,450)	High-Urba	n (n=4,320)
	Mean/% (SE)	10 <sup>th</sup> , 90 <sup>th</sup> %ile	Mean/% (SE)	10 <sup>th</sup> , 90 <sup>th</sup> %ile	Mean/% (SE)	10 <sup>th</sup> , 90 <sup>th</sup> %ile
West	12.1 (3.0)	;	17.5 (3.1)	1	24.8 (9.0)	:
Midwest	28.2 (6.6)	1	36.0 (5.2)	ł	27.3 (9.3)	:
South	49.8 (5.6)	1	29.5 (4.1)	ł	30.0 (9.4)	1
Northeast	9.9 (2.9)	1	17.0 (3.2)	1	17.9 (7.4)	;

<sup>d</sup> Urbanicity based on U.S. Census-defined urbanized areas (UA; non-urban or urban); locations within a UA with ≤78% (75th percentile) and >78% developed land cover were classified as "low-urban" and "high-urban," respectively.

 $b_{\mathrm{Tests}}$  by urbanicity calculated for ln(count)

i Roman numerals indicate significantly different groups determined from pairwise design-based Wald tests, with Bonferroni correction for multiple comparisons

ii Roman numerals indicate significantly different groups determined from pairwise design-based Wald tests, with Bonferroni correction for multiple comparisons

iii Roman numerals indicate significantly different groups determined from pairwise design-based Wald tests, with Bonferroni correction for multiple comparisons

<sup>\*</sup> Chi<sup>2</sup> not significant across urbanicity levels (p=0.26)

CT: Census Tract

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# Table 2

Proportional difference<sup>a</sup> in MVPA bouts for 90<sup>th</sup> versus 10<sup>th</sup> percentile of ln(resource count), intersection density, and link:node ratio within 1, 3, 5, and 8.05k circular buffer, by urbanicity<sup>b</sup> level and sex [exp(coeff) (95% CI)]

Non-urbanMaleséFemaleséMaleséFemaleséMaleséMaleséMaleséIk $1.06 (1.01, 1.11)$ $1.06 (1.01, 1.11)$ $0.09 (0.94, 0.93, 0.94) (0.94, 0.93, 0.94) (0.95, 0.99, 0.11)$ $0.99 (0.94, 0.93, 0.94) (0.95, 0.99, 0.11)$ $0.99 (0.94, 0.95, 0.93, 0.94) (0.95, 0.95) (0.95, 0.95, 0.11)$ Sk $1.07 (0.94, 1.09)$ $0.99 (0.94, 1.00)$ $0.94 (0.88, 1.01)$ $1.01 (0.95, 0.95, 0.11)$ Sk $1.01 (0.94, 1.09)$ $0.98 (0.90, 1.08)$ $0.94 (0.88, 1.01)$ $1.01 (0.95, 0.95, 0.95)$ Low-urban $1.06 (1.01, 1.10)$ $1.08 (1.01, 1.16)$ $0.94 (0.87, 1.01)$ $1.01 (0.95, 0.95)$ Ik $1.06 (1.01, 1.10)$ $1.01 (0.94, 1.08)$ $0.93 (0.85, 1.02)$ $1.10 (0.95, 0.95)$ Sk $1.06 (0.98, 1.12)$ $0.97 (0.88, 1.08)$ $0.93 (0.88, 1.11)$ $1.11 (0.94, 0.94)$ Weighted $1.01 (0.04, 1.10)$ $1.01 (0.94, 1.08)$ $0.93 (0.88, 1.11)$ $1.11 (0.94, 0.12)$ K $1.06 (0.98, 1.15)$ $0.97 (0.88, 1.06)$ $0.98 (0.88, 1.11)$ $1.11 (0.94, 0.94)$ K $1.00 (0.91, 1.10)$ $1.01 (0.94, 1.13)$ $0.97 (0.98, 1.10)$ $1.10 (0.91, 1.10)$ K $1.00 (0.91, 1.10)$ $0.97 (0.88, 1.06)$ $0.98 (0.79, 0.02)$ $0.99 (0.84, 0.99)$ K $1.00 (0.91, 1.10)$ $0.92 (0.92, 1.13)$ $0.99 (0.79, 1.00)$ $0.99 (0.79, 0.00)$ K $1.00 (0.91, 1.10)$ $0.99 (0.79, 1.00)$ $0.99 (0.79, 1.00)$ $0.99 (0.79, 0.00)$ K $1.00 (0.92, 1.13)$ $1.00 (0.91, 1.10)$ $0.98 (0.79, 1.00)$ $0.99 (0.79, 0.00)$ K $0.99 ($		Reso	urces	Intersectio	on Density	Link:No	ode Ratio
Ik $1.06 (1.01, 1.11)$ $1.13 (1.06, 1.16)$ 0.99 (0.94, 0.94, 0.93, 0.94, 0.88, 1.01)         0.99 (0.94, 0.93, 0.94, 0.93, 0.94, 0.93, 0.93, 0.93, 0.94, 0.95, 0.93, 0.94, 0.95, 0.93, 0.94, 0.95, 0.93, 0.94, 0.95, 0.93, 0.94, 0.95, 0.93, 0.94, 0.95, 0.95, 0.95, 0.95, 0.95, 0.95, 0.95, 0.95, 0.95, 0.95, 0.95, 0.95, 0.95, 0.95, 0.95, 0.95, 0.95, 0.95, 0.95, 0.05, 0.95, 0.05, 0.95, 0.05, 0.95, 0.05, 0.95, 0.0	Non-urban	Males <sup>c</sup>	${ m Females}^c$	Males <sup>c</sup>	Females <sup>c</sup>	Males <sup>c</sup>	Females <sup>c</sup>
3k $1.07 (1.01, 1.14)$ $1.11 (1.06, 1.16)$ $0.99 (0.94, 1.03)$ 5k $1.07 (0.94, 1.16)$ $1.05 (0.94, 1.11)$ $0.98 (0.93, 1.11)$ $0.98 (0.93, 1.11)$ 8k $1.01 (0.94, 1.09)$ $0.94 (0.88, 1.01)$ $1.01 (0.95, 1.02)$ weighted $1.08 (1.01, 1.15)$ $0.98 (0.90, 1.08)$ $0.94 (0.88, 1.01)$ 1.0w-urban $1.08 (1.01, 1.15)$ $1.08 (1.01, 1.16)$ $0.94 (0.88, 1.01)$ 1.1 $1.06 (1.01, 1.10)$ $1.08 (1.01, 1.16)$ $0.94 (0.87, 1.01)$ $1.01 (0.95, 1.02)$ 1.1 $1.06 (1.01, 1.10)$ $1.00 (1.01, 1.10)$ $1.00 (0.91, 1.10)$ $1.10 (0.94, 1.08)$ 3k $1.06 (1.01, 1.10)$ $1.00 (0.94, 1.08)$ $0.93 (0.85, 1.02)$ $1.10 (1.01, 1.01)$ 8k $1.06 (1.01, 1.10)$ $1.00 (0.91, 1.10)$ $1.10 (1.04, 1.17)$ $1.00 (0.91, 1.10)$ 1.1 $1.00 (0.98, 1.15)$ $0.94 (0.88, 1.11)$ $0.94 (0.84, 0.77, 0.96)$ $0.99 (0.84, 0.78, 0.99 (0.84, 0.78, 0.99 (0.84, 0.78, 0.99 (0.84, 0.78, 0.99 (0.84, 0.78, 0.99 (0.84, 0.78, 0.99 (0.84, 0.78, 0.99 (0.84, 0.98 (0.77, 0.96)$ $0.98 (0.78, 0.99 (0.84, 0.78, 0.99 (0.78, 0.98 (0.79, 0.99 (0.84, 0.78, 0.98 (0.78, 0.98 (0.79, 0.98 (0.79, 0.98 (0.79, 0.98 (0.79, 0.98 (0.79, 0.98 (0.79, 0.99 (0.84, 0.79, 0.99 (0.84, 0.79, 0.99 (0.84, 0.79, 0.99 (0.84, 0.79, 0.99 (0.84, 0.79, 0.99 (0.84, 0.79 (0.98,$	1k	1.06 (1.(	01, 1.11)	1.13 (1.(	06, 1.21)	0.98 (0.9	95, 1.01)
5k $1.07 (0.94, 1.16)$ $1.05 (0.94, 1.11)$ $0.98 (0.90, 1.08)$ $0.94 (0.88, 1.01)$ $1.01 (0.95, 1.01)$ 8k $1.01 (0.94, 1.09)$ $0.98 (0.90, 1.08)$ $0.94 (0.88, 1.01)$ $1.01 (0.95, 1.01)$ $veighted$ $1.08 (1.01, 1.15)$ $NA$ $NA$ Low-urban $1.06 (1.01, 1.10)$ $1.08 (1.01, 1.16)$ $0.94 (0.87, 1.01)$ $1.01 (0.95, 1.02)$ $1k$ $1.05 (1.01, 1.10)$ $1.01 (0.94, 1.08)$ $0.93 (0.87, 1.01)$ $1.10 (0.94, 1.08)$ $5k$ $1.13 (1.06, 1.21)$ $1.01 (0.94, 1.08)$ $0.93 (0.85, 1.02)$ $1.10 (0.94, 1.10)$ $8k$ $1.06 (1.01, 1.10)$ $1.01 (0.94, 1.08)$ $0.93 (0.88, 1.11)$ $1.10 (0.94, 1.13)$ $8k$ $1.10 (1.04, 1.17)$ $0.97 (0.88, 1.06)$ $0.98 (0.88, 1.11)$ $1.10 (0.91, 1.10)$ $8k$ $1.00 (0.91, 1.10)$ $1.00 (0.91, 1.10)$ $1.10 (0.91, 1.10)$ $1.10 (0.91, 1.10)$ $110 (1.04, 1.17)$ $0.94 (0.88, 1.05)$ $0.98 (0.77, 0.96)$ $0.99 (0.84, 0.77, 0.96)$ $8k$ $1.00 (0.92, 1.14)$ $0.94 (0.84, 1.05)$ $1.04 (0.96, 1.13)$ $0.86 (0.77, 0.96)$ $8k$ $0.99 (0.87, 1.13)$ $1.00 (0.93, 1.08)$ $0.99 (0.78, 1.02)$ $0.98 (0.78, 102)$	3k	1.07 (1.(	01, 1.14)	1.11 (1.(	<b>)6, 1.16</b> )	0.99 (0.94, 1.04)	1.05 (0.98, 1.13)
8k $1.01 (0.94, 1.0)$ $0.98 (0.90, 1.08)$ $0.94 (0.88, 1.01)$ $1.01 (0.95, 1.00)$ weighted $1.08 (1.01, 1.15)$ $NA$ $NA$ Low-urban $1.08 (1.01, 1.16)$ $1.08 (1.01, 1.16)$ $0.94 (0.88, 1.01)$ $1.01 (0.95, 1.02)$ 1k $1.06 (1.01, 1.10)$ $1.08 (1.01, 1.16)$ $0.94 (0.87, 1.01)$ $1.1$ 3k $1.06 (1.01, 1.10)$ $1.01 (0.94, 1.08)$ $0.93 (0.85, 1.02)$ $1.1$ 3k $1.10 (1.04, 1.21)$ $0.97 (0.88, 1.06)$ $0.98 (0.88, 1.11)$ $1.1$ weighted $1.13 (1.06, 1.21)$ $0.97 (0.88, 1.06)$ $0.98 (0.88, 1.11)$ $1.1$ 10 $0.94 (0.98, 1.15)$ $0.97 (0.88, 1.06)$ $0.98 (0.88, 1.11)$ $1.1$ weighted $1.10 (1.04, 1.17)$ $0.97 (0.88, 1.06)$ $0.98 (0.77, 0.96)$ $0.99 (0.84, 1.11)$ 1k $1.01 (0.91, 1.11)$ $0.94 (0.84, 1.05)$ $1.22 (1.13, 1.33)$ $1.00 (0.91, 1.10)$ $0.96 (0.77, 0.96)$ $0.99 (0.79, 1.00)$ 1k $1.01 (0.91, 1.11)$ $0.94 (0.84, 1.10)$ $1.04 (0.95, 1.13)$ $0.88 (0.77, 0.96)$ $0.99 (0.84, 0.76)$ <td>5k</td> <td>1.07 (0.5</td> <td>99, 1.16)</td> <td>1.05 (0.5</td> <td>99, 1.11)</td> <td>0.98 (0.93, 1.04)</td> <td>1.06 (0.99, 1.14)</td>	5k	1.07 (0.5	99, 1.16)	1.05 (0.5	99, 1.11)	0.98 (0.93, 1.04)	1.06 (0.99, 1.14)
weighted $1.08 (1.01, 1.15)$ $NA$ Low-urbanLow-urban $1.06 (1.01, 1.10)$ $1.08 (1.01, 1.16)$ $0.94 (0.87, 1.01)$ $1.13 (1.06, 1.01, 1.10)$ $1k$ $1.06 (1.01, 1.10)$ $1.01 (0.94, 1.08)$ $0.93 (0.85, 1.02)$ $1.13 (1.06, 1.21)$ $5k$ $1.13 (1.06, 1.21)$ $1.01 (0.94, 1.08)$ $0.93 (0.85, 1.02)$ $1.1 (0.94, 1.03)$ $8k$ $1.106 (0.98, 1.15)$ $0.97 (0.88, 1.06)$ $0.98 (0.88, 1.11)$ $1.1 (0.94, 1.13)$ $8k$ $1.106 (1.04, 1.17)$ $0.97 (0.88, 1.06)$ $0.98 (0.88, 1.11)$ $1.1 (0.94, 1.13)$ $110 (1.04, 1.17)$ $0.97 (0.88, 1.06)$ $0.98 (0.88, 1.11)$ $1.1 (0.94, 1.13)$ $110 (1.04, 1.17)$ $0.94 (0.88, 1.10)$ $0.94 (0.94, 1.10)$ $0.98 (0.77, 0.96)$ $110 (0.91, 1.11)$ $0.94 (0.84, 1.05)$ $1.04 (0.96, 1.13)$ $0.86 (0.77, 0.96)$ $0.99 (0.84, 1.03)$ $110 (0.92, 1.14)$ $0.94 (0.84, 1.05)$ $1.04 (0.96, 1.13)$ $0.89 (0.79, 1.00)$ $0.95 (0.79, 0.96)$ $110 (0.92, 1.14)$ $0.96 (0.84, 1.10)$ $1.00 (0.93, 1.08)$ $0.89 (0.78, 1.02)$ $0.98 (0.87, 0.96)$	8k	1.01 (0.5	94, 1.09)	$0.98\ (0.90,\ 1.08)$	$0.94\ (0.88,1.01)$	1.01 (0.95, 1.06)	1.07 (1.01, 1.14)
Low-urbanLow-urban1.05 (1.01, 1.10)1.08 (1.01, 1.16) $0.94 (0.87, 1.01)$ $1.1$ $3k$ $1.06 (1.01, 1.10)$ $1.01 (0.94, 1.08)$ $0.93 (0.87, 1.02)$ $1.1$ $5k$ $1.13 (1.06, 1.21)$ $1.01 (0.94, 1.08)$ $0.93 (0.85, 1.02)$ $1.1$ $8k$ $1.13 (1.06, 1.21)$ $1.01 (0.94, 1.08)$ $0.93 (0.85, 1.02)$ $1.1$ $8k$ $1.10 (1.04, 1.17)$ $0.97 (0.88, 1.06)$ $0.98 (0.88, 1.11)$ $1.1$ $1.10 (1.04, 1.17)$ $0.97 (0.88, 1.06)$ $0.98 (0.88, 1.11)$ $1.1$ $1.10 (1.04, 1.17)$ $0.94 (0.88, 1.06)$ $0.98 (0.88, 1.11)$ $1.1$ $1.10 (1.04, 1.17)$ $0.94 (0.88, 1.06)$ $0.98 (0.78, 0.96)$ $0.98 (0.88, 1.11)$ $1.10 (1.04, 1.17)$ $0.94 (0.88, 1.13)$ $1.00 (0.91, 1.10)$ $0.99 (0.84, 1.05)$ $1.10 (0.91, 1.11)$ $0.94 (0.84, 1.05)$ $1.04 (0.96, 1.13)$ $0.86 (0.77, 0.96)$ $0.99 (0.84, 1.03)$ $3k$ $0.99 (0.87, 1.13)$ $1.00 (0.93, 1.08)$ $0.89 (0.78, 1.02)$ $0.98 (0.79, 0.05)$ $8k$ $0.96 (0.84, 1.10)$ $1.00 (0.93, 1.08)$ $0.89 (0.78, 1.02)$ $0.98 (0.87, 1.02)$	weighted	1.08 (1.0	01, 1.15)	Z	A	Z	IA
Ik $1.05 (1.01, 1.10)$ $1.08 (1.01, 1.16)$ $0.94 (0.87, 1.01)$ I. $3k$ $1.06 (1.01, 1.10)$ $1.01 (0.94, 1.08)$ $0.93 (0.85, 1.02)$ $1.1$ $5k$ $1.13 (1.06, 1.21)$ $1.01 (0.94, 1.08)$ $0.93 (0.85, 1.02)$ $1.1$ $8k$ $1.06 (0.98, 1.15)$ $0.97 (0.88, 1.06)$ $0.98 (0.88, 1.11)$ $1.1$ $8k$ $1.06 (0.98, 1.15)$ $0.97 (0.88, 1.06)$ $0.98 (0.88, 1.11)$ $1.1$ $110 (1.04, 1.17)$ $0.97 (0.88, 1.06)$ $0.98 (0.88, 1.11)$ $1.1$ $110 (1.04, 1.17)$ $0.94 (0.88, 1.05)$ $0.98 (0.88, 1.11)$ $1.1$ $110 (1.04, 1.17)$ $0.94 (0.84, 1.13)$ $1.00 (0.91, 1.10)$ $0.98 (0.88, 1.11)$ $11k$ $1.01 (0.91, 1.11)$ $0.94 (0.84, 1.03)$ $1.22 (1.13, 1.33)$ $1.00 (0.91, 1.10)$ $0.96 (0.74, 0.96)$ $3k$ $1.02 (0.92, 1.14)$ $0.94 (0.84, 1.05)$ $1.04 (0.96, 1.13)$ $0.86 (0.77, 0.96)$ $0.99 (0.79, 1.00)$ $5k$ $0.99 (0.87, 1.13)$ $1.00 (0.93, 1.08)$ $0.89 (0.78, 1.02)$ $0.98 (0.87, 1.02)$	Low-urban						
$3k$ $\mathbf{I.06} (\mathbf{I.01, I.10})$ $1.01 (0.94, 1.08)$ $0.93 (0.85, 1.02)$ $\mathbf{I.1}$ $5k$ $\mathbf{I.13} (\mathbf{I.06, I.21})$ $\mathbf{I.00} (0.91, 1.10)$ $\mathbf{I.10}$ $8k$ $1.06 (0.98, 1.15)$ $0.97 (0.88, 1.06)$ $0.98 (0.88, 1.11)$ $\mathbf{I.1}$ $8k$ $1.06 (0.98, 1.15)$ $0.97 (0.88, 1.06)$ $0.98 (0.88, 1.11)$ $\mathbf{I.10}$ $weighted$ $\mathbf{I.10} (\mathbf{I.04, I.17})$ $0.97 (0.88, 1.06)$ $0.98 (0.88, 1.11)$ $\mathbf{I.10}$ $high-Urban$ $\mathbf{I.10} (\mathbf{I.04, I.17})$ $\mathbf{I.22} (\mathbf{I.13, I.33})$ $1.00 (0.91, 1.10)$ $0.3$ $1k$ $1.01 (0.91, 1.11)$ $0.94 (0.84, 1.05)$ $\mathbf{I.22} (\mathbf{I.13, I.33})$ $1.00 (0.91, 1.10)$ $0.3$ $3k$ $1.02 (0.92, 1.14)$ $0.94 (0.84, 1.05)$ $1.04 (0.96, 1.13)$ $0.86 (0.77, 0.96)$ $0.99 (0.84, 1.03)$ $5k$ $0.99 (0.87, 1.13)$ $1.00 (0.93, 1.08)$ $0.89 (0.78, 1.02)$ $0.98 (0.79, 1.00)$ $8k$ $0.96 (0.84, 1.10)$ $1.00 (0.93, 1.08)$ $0.89 (0.78, 1.02)$ $0.98 (0.87, 1.02)$	1k	1.05 (1.(	01, 1.10)	1.08 (1.0 1, 1.16)	0.94 (0.8 7, 1.01)	1.03 (0.9	98, 1.10)
5k1.13 (1.06, 1.21) $1.00 (0.91, 1.10)$ $1.$ 8k $1.06 (0.98, 1.15)$ $0.97 (0.88, 1.06)$ $0.98 (0.88, 1.11)$ $1.$ 8k $1.06 (1.04, 1.17)$ $0.97 (0.88, 1.06)$ $0.98 (0.88, 1.11)$ $1.$ High-Urban $1.10 (1.04, 1.17)$ $0.94 (0.85, 1.03)$ $1.22 (1.13, 1.33)$ $1.00 (0.91, 1.10)$ $0.$ 1k $1.01 (0.91, 1.11)$ $0.94 (0.84, 1.05)$ $1.22 (1.13, 1.33)$ $1.00 (0.91, 1.10)$ $0.$ 3k $1.02 (0.92, 1.14)$ $0.94 (0.84, 1.05)$ $1.04 (0.96, 1.13)$ $0.86 (0.77, 0.96)$ $0.99 (0.84, 1.03)$ 5k $0.99 (0.87, 1.13)$ $1.00 (0.93, 1.08)$ $0.89 (0.78, 1.02)$ $0.98 (0.78, 1.02)$ 8k $0.96 (0.84, 1.10)$ $1.00 (0.93, 1.08)$ $0.89 (0.78, 1.02)$ $0.98 (0.87, 1.02)$	3k	1.06 (1.(	01, 1.10)	1.01 (0.94, 1.08)	0.93 (0.85, 1.02)	1.05 (0.9	99, 1.11)
8k $1.06 (0.98, 1.15)$ $0.97 (0.88, 1.06)$ $0.98 (0.88, 1.11)$ $1.$ weighted $1.10 (1.04, 1.17)$ $0.97 (0.88, 1.06)$ $0.98 (0.88, 1.11)$ $1.$ High-Urban $NA$ 1k $1.01 (0.91, 1.11)$ $0.94 (0.85, 1.03)$ $1.22 (1.13, 1.33)$ $1.00 (0.91, 1.10)$ $0.$ $3k$ $1.01 (0.92, 1.14)$ $0.94 (0.84, 1.05)$ $1.04 (0.96, 1.13)$ $0.86 (0.77, 0.96)$ $0.99 (0.84, 1.03)$ $5k$ $0.99 (0.87, 1.13)$ $1.04 (0.97, 1.11)$ $0.89 (0.79, 1.00)$ $0.95 (0.79, 1.00)$ $8k$ $0.96 (0.84, 1.10)$ $1.00 (0.93, 1.08)$ $0.89 (0.78, 1.02)$ $0.98 (0.87, 1.03)$	5k	1.13 (1.(	06, 1.21)	1.00 (0.5	91, 1.10)	1.06 (0.9	99, 1.13)
weighted1.10 (1.04, 1.17)NAHigh-Urban11.01 (0.91, 1.11) $0.94 (0.85, 1.03)$ $1.22 (1.13, 1.33)$ $1.00 (0.91, 1.10)$ $0.$ 1k $1.01 (0.91, 1.11)$ $0.94 (0.84, 1.05)$ $1.04 (0.96, 1.13)$ $0.86 (0.77, 0.96)$ $0.99 (0.84, 0.84, 0.84, 0.97)$ 5k $0.99 (0.87, 1.13)$ $1.04 (0.97, 1.11)$ $0.89 (0.79, 1.00)$ $0.95 (0.79)$ 8k $0.96 (0.84, 1.10)$ $1.00 (0.93, 1.08)$ $0.89 (0.78, 1.02)$ $0.98 (0.87, 0.96)$	8k	1.06 (0.5	98, 1.15)	0.97 (0.88, 1.06)	0.98 (0.88, 1.11)	1.03 (0.9	96, 1.10)
High-Urban         1k       1.01 (0.9 1, 1.11)       0.94 (0.8 5, 1.03) <b>1.22 (1.13, 1.33)</b> 1.00 (0.9 1, 1.10) <b>0</b> .         3k       1.02 (0.92, 1.14)       0.94 (0.84, 1.05)       1.04 (0.96, 1.13) <b>0.86 (0.77, 0.96)</b> 0.99 (0.84, 1.05)         5k       0.99 (0.87, 1.13)       1.04 (0.97, 1.11)       0.89 (0.79, 1.00)       0.95 (0.79, 1.00)         8k       0.96 (0.84, 1.10)       1.00 (0.93, 1.08)       0.89 (0.78, 1.02)       0.98 (0.87, 1.02)	weighted	1.10 (1.(	04, 1.17)	Z	A	Z	IA
Ik         1.01 (0.9 1, 1.11)         0.94 (0.8 5, 1.03) <b>1.22 (1.1 3, 1.33)</b> 1.00 (0.9 1, 1.10)         0.           3k         1.02 (0.92, 1.14)         0.94 (0.84, 1.05)         1.04 (0.96, 1.13) <b>0.86 (0.77, 0.96)</b> 0.99 (0.84, 1.05)           5k         0.99 (0.87, 1.13)         1.04 (0.97, 1.11)         0.89 (0.79, 1.00)         0.95 (0.79, 1.00)           8k         0.96 (0.84, 1.10)         1.00 (0.93, 1.08)         0.89 (0.78, 1.02)         0.98 (0.87, 1.02)	High-Urban						
3k         1.02 (0.92, 1.14)         0.94 (0.84, 1.05)         1.04 (0.96, 1.13) <b>0.86 (0.77, 0.96)</b> 0.99 (0.84, 1.96)           5k         0.99 (0.87, 1.13)         1.04 (0.97, 1.11)         0.89 (0.79, 1.00)         0.95 (0.79, 1.00)           8k         0.96 (0.84, 1.10)         1.00 (0.93, 1.08)         0.89 (0.78, 1.02)         0.98 (0.87, 1.02)	1k	1.01 (0.9 1, 1.11)	0.94 (0.8 5, 1.03)	1.22 (1.1 3, 1.33)	1.00 (0.9 1, 1.10)	0.89 (0.3	80, 0.99)
5k         0.99 (0.87, 1.13)         1.04 (0.97, 1.11)         0.89 (0.79, 1.00)         0.95 (0.79, 1.00)           8k         0.96 (0.84, 1.10)         1.00 (0.93, 1.08)         0.89 (0.78, 1.02)         0.98 (0.87, 1.02)	3k	1.02 (0.92, 1.14)	$0.94\ (0.84,1.05)$	1.04 (0.96, 1.13)	0.86 (0.77, 0.96)	0.99 (0.84, 1.16)	0.86 (0.74, 1.00)
8k 0.96 (0.84, 1.10) 1.00 (0.93, 1.08) 0.89 (0.78, 1.02) 0.98 (0.87,	5k	3.0) 99.0	87, 1.13)	1.04 (0.97, 1.11)	$0.89\ (0.79,\ 1.00)$	0.95 (0.79, 1.14)	0.80 (0.66, 0.98)
	8k	0.96 (0.	84, 1.10)	$1.00\ (0.93,\ 1.08)$	0.89 (0.78, 1.02)	0.98 (0.87, 1.11)	0.79 (0.67, 0.94)
weighted 0.97 (0.83, 1.13) NA	weighted	3.0) 70.0	83, 1.13)	Z	A	Z	[A

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<sup>a</sup>Negative binomial regression results modeling counts of MVPA bouts as a function of each built environment measure within each of 4 circular buffers (Euclidean distance). Adjusted for individual-level age and race, household-level income, parental education, census tract-level poverty, county level crime, and population density within corresponding neighborhood buffer size. Each model contains only one built environment variable if interest. b Urbanicity based on U.S. Census-defined urbanized areas (UA; non-urban or urban); locations within a UA with  $\leq$ 78% (75th percentile) and >78% developed land cover were classified as "low-urban" and "high-urban," respectively.

<sup>c</sup> A single estimate for males and females indicates that sex-built environment interaction was not statistically significant (p>0.10) and thus excluded from the model

MVPA: Moderate to vigorous physical activity

NA: not applicable

Bold font indicates statistical significance

#### Table 3

Proportional difference<sup>*a*</sup> in MVPA bouts for 90<sup>th</sup> versus 10<sup>th</sup> percentile of <u>*ln(resource count)*</u> and <u>*connectivity*</u> <u>*combined*</u>, by urbanicity<sup>*b*</sup> [exp(coeff) (95% CI)]

	Males <sup>c</sup>	Females <sup>c</sup>	
Non-urban			
Resource count (weighted)	1.00 (0.9	94, 1.05)	
Intersection density (1k)	1.14 (1.06, 1.22)		
Low-urban			
Resource count (weighted)	1.07 (1.02, 1.13)		
Intersection density (1k)	1.06 (0.98, 1.14)	0.92 (0.85, 1.00)	
High-urban			
Resource count (weighted)	0.98 (0.8 7, 1.09)	1.00 (0.8 9, 1.12)	
Intersection density (1k)	1.26 (1.14, 1.38)	1.01 (0.90, 1.12)	

<sup>*a*</sup>Negative binomial regression results modeling MVPA bouts as a function of BE measure within each of 4 circular buffers. Adjusted for individual-level age and race, household-level income, parental education, census tract-level poverty, county level crime, and population density within 1k.

<sup>b</sup>Urbanicity based on U.S. Census-defined urbanized areas (UA; non-urban or urban); locations within a UA with  $\leq$ 78% (75th percentile) and >78% developed land cover were classified as "low-urban" and "high-urban," respectively.

 $^{C}$ A single estimate for males and females indicates that sex-built environment interaction was not statistically significant (p>0.10) and thus excluded from the model

MVPA, Moderate to vigorous physical activity

Bold font indicates statistical significance