Authors: Ming Wen & Xingyou Zhang

Contextual Effects of Built and Social Environment of Urban Neighborhoods on Physical Activity: A Multilevel Study in Chicago

BACKGROUND

In recent years, there has been a growing recognition that the impacts of the built environment on active living are important and hold the promise of creating long-term change in physical activity. Meanwhile, the interest and literature on neighborhood effects on health status and behavior has been rapidly growing. While the two lines—the impact of the built environment and the social environment on human behaviors—have been explored fruitfully, they seem to have developed in relative isolation from each other and a dialogue between the two has been weak. To tackle a multifactorial behavior like physical activity, we need to understand the relative influences of neighborhood physical design and other social-structural-ecological characteristics and among a myriad of theoretically relevant environmental correlates which ones are "high-powered leverage points."

OBJECTIVES

Our goal is to study the contextual effects of the built and the social environment of urban neighborhoods on physical activity, drawing upon theoretical and empirical development in urban sociology, social epidemiology, urban planning, transportation, and public health.

METHODS

Neighborhood-level data are constructed from the 1990 Census and the Project on Human Development in Chicago Neighborhoods-Neighborhood Survey (PHDCN-CS) conducted in 1995. Neighborhood-level built environment measures were from multiple sources, including the Metropolitan Chicago Information Center (MCIC), City of Chicago, and Northern Illinois Planning Commission (NIPC). Individual data are from the Metropolitan Chicago Information Center-Metro Survey (MCIC-MS) which is a repeated cross-sectional survey conducted annually. These data sets are linked using neighborhood identifiers following Sampson et al. (1997).

We use two measures of physical activity as the dependent variables. In the MCIC-CS, in 1996, respondents were asked "How often a week, on average, do you work out or exercise?" In 1995, 1996, 1997, 1999, respondents were asked "In the past year to stay healthy or improve your fitness did you exercise regularly?" Both are self-reported, the first measure captures more recent levels of physical activity and used a week as the time window, the second measure taps the regular levels of physical activity over a year time period. The two measures are highly correlated with each other and with having had a weight problem and self-rated health.

Measures of neighborhood deprivation are obtained or derived from the 1990 Census, including neighborhood-level affluence, poverty, education, percent of female-headed households, percent on public assistance, and combined into a composite index of concentrated disadvantage (α=0.92). Measures of neighborhood social capital are constructed from the PHDCN-CS, including neighborly trust, norms of reciprocity, perceived violence, and homicide rate, and combined into a composite index of social capital (α=0.83).

The built environment is measured by block density, distance to subway, distance to parks, land use mix, pedestrian injury rate, access to restaurants and bars, access to facilities, access to institutions, and access to health and human services to capture the features of the built environment. All these built environment variables are constructed within ArcGIS and SAS.

Control variables include individual-level age, gender, race/ethnicity, marital status, education, income, and a measure of neighborhood age structure.

To test our hypotheses, a series of random intercept logit models are fit for regular exercise over past year and random intercept OLS regression models are fit for frequency of weekly workout or exercise. The models of regular exercise over a year feature 907 individuals living in 242 neighborhoods. The models of weekly workout or exercise feature 3,530 individuals living in 266 neighborhoods. Neighborhood deprivation and social capital are separately modeled as the baseline models, and the built environment variables are added one by one to the two baseline models.

Moreover, in the final step, we will test spatial autocorrelation and heterogeneity and will fit Bayesian multilevel/hierarchical spatial models to examine the spill over effects of neighboring neighborhood contexts on physical activity

RESULTS

For regular exercise over last year, neighborhood deprivation (OR=0.70, 95% CI: 0.56-0.87) and social capital (OR=1.32, 95% CI: 1.08-1.61) are both significant correlates. Meanwhile, among the built environment factors, access to restaurants and bars (OR=1.24, 95% CI: 1.05-1.46), and access to art, culture, leisure, and entertainment facilities (OR=1.22, 95% CI: 1.03-1.45) are significant and promoting factors of regular exercise, net of effects of individual socio-demographic background and neighborhood structural and social factors.

For weekly workout or exercise, neighborhood deprivation and social capital are not significant. By contrast, nearly all the built environment variables are significant except for block density and distance to subway. The effect sizes are: distance to parks (b=-0.32, z=2.68), land use mix (0.32, z=2.33), pedestrian injury rate (b=0.036, z=1.79), access to restaurants and bars (0.06, z=2.82, access to facilities (b=0.05, z=2.34), access to institutions (b=0.04, z=2.06), and access to health and human services (b=0.05, z=2.27).

CONCLUSIONS

Both the social and the physical aspects of local neighborhoods are important and need to be better understood to illuminate environmental impacts on physical activity and to identify what aspects of neighborhood environment should be prioritized to promote physical activity.

Note: We have not finished the multilevel spatial analysis but will add them to the final paper.

REFERENCE:

Sampson RJ, Raudenbush SW & Felton E. 1997. "Neighborhoods and violent crime: a multilevel study of collective efficacy" Science 227:918-923

Table 1 Correlation Matrix of Neighborhood Environmental Factors

	1	2	3	4	5	6	7	8	9	10	11	12
Neighborhood deprivation[a]	1.00											
Neighborhood social capital[b]	-0.79	1.00										
Neighborhood age structure[c]	-0.40	0.54*	1.00									
Block density	0.18*	-0.16	-0.22	1.00								
Distance to subway	-0.17	0.24*	0.22*	-0.40	1.00							
Distance to parks	-0.14	0.20*	0.21*	-0.15	0.31*	1.00						
Land use pattern	0.19*	-0.24	-0.23	0.02	-0.32	-0.09	1.00					
Pedestrian injury rate	0.24*	-0.36	-0.34	0.37*	-0.41	-0.16	0.16*	1.00				
Access to restaurants and bars[d]	-0.41	0.38*	0.08	0.01	-0.19	-0.08	0.27*	-0.06	1.00			
Access to facilities[e]	-0.36	0.34*	0.02	-0.03	-0.21	-0.09	0.31*	-0.09	0.85*	1.00		
Access to institutions[f]	0.15*	0.07	0.12	-0.02	0.02	-0.06	0.21*	-0.24	0.40*	0.42*	1.00	
Access to services[g]	0.31*	-0.19	-0.24	0.14*	-0.31	-0.21	0.45*	0.01	0.43*	0.49*	0.75*	1

* significant at 5%

a. Neighborhood deprivation is indexed by a factor score based on neighborhood affluence, poverty, education, % of female-headed HHs, and % of HHs on public assistance.

b. Neighborhood social capital is indexed by a factor score based on neighborhood trust, norms of reciprocity, perceived violence, and homicide rate.

c. Percent of residents age 55 or over

d. Number of restaurants and bars in a 1-mile buffer

e. Number of art (art centers), culture (e.g., museums), leisure, and entertainment facilities in a 3-mile buffer

e. Number of library, houses of churches, and educational institutes in a 2-mile buffer

f. Number of health and human services in a 3-mile buffer

Table 2 Multilevel Logistic Model of Neighborhood SES and Built Environment on Regular Exercise

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Age	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.25)	(0.20)	(0.27)	(0.25)	(0.13)	(0.24)	(0.14)	(0.13)	(0.24)	(0.30)
Male	0.47***	0.47***	0.47***	0.48***	0.49***	0.47***	0.50***	0.48***	0.48***	0.49***
	(3.03)	(3.04)	(3.06)	(3.06)	(3.14)	(3.00)	(3.17)	(3.11)	(3.10)	(3.12)
Black	0.63***	0.61***	0.66***	0.62***	0.65***	0.62***	0.82***	0.81***	0.60***	0.63***
	(2.99)	(2.92)	(3.10)	(2.98)	(3.03)	(2.96)	(3.67)	(3.60)	(2.85)	(3.02)
Hispanic	0.36	0.35	0.37	0.38	0.40	0.36	0.45*	0.47*	0.38	0.38
	(1.44)	(1.38)	(1.47)	(1.52)	(1.60)	(1.44)	(1.77)	(1.82)	(1.50)	(1.52)
Married/Cohabitating	0.21	0.20	0.24	0.23	0.24	0.21	0.24	0.24	0.22	0.24
	(1.30)	(1.20)	(1.42)	(1.43)	(1.47)	(1.28)	(1.45)	(1.44)	(1.33)	(1.46)
Education	0.30***	0.30***	0.30***	0.29***	0.30***	0.30***	0.30***	0.30***	0.30***	0.30***
	(4.57)	(4.58)	(4.55)	(4.46)	(4.57)	(4.58)	(4.52)	(4.50)	(4.55)	(4.48)
Annual household income	0.08**	0.08**	0.08**	0.08**	0.08**	0.08**	0.08**	0.08**	0.08**	0.08**
	(2.34)	(2.35)	(2.35)	(2.38)	(2.39)	(2.36)	(2.31)	(2.26)	(2.29)	(2.27)
Neighborhood deprivation[a]	-0.36***	-0.37***	-0.37***	-0.36***	-0.37***	-0.37***	-0.31***	-0.33***	-0.38***	-0.39***
	(3.22)	(3.25)	(3.30)	(3.24)	(3.21)	(3.25)	(2.71)	(2.93)	(3.32)	(3.41)
Neighborhood age structure[b]	-1.79*	-2.03*	-1.63	-1.55	-1.55	-1.95*	-1.50	-1.42	-1.97*	-1.49
	(1.65)	(1.85)	(1.48)	(1.40)	(1.39)	(1.73)	(1.36)	(1.28)	(1.79)	(1.35)
Block density		-0.00								
		(1.42)								
Distance to subway			-0.06							
			(0.84)							
Distance to parks				-0.47						
				(1.06)						
Land use pattern					0.56					
					(1.09)					
Pedestrian injury rate						-0.00				
						(0.52)				
Access to restaurants and bars[c]							0.21**			
							(2.56)			
Access to facilities[d]								0.20**		
								(2.30)		
Access to institutions[e]									0.09	
									(1.06)	
Access to health and human services[f]										0.12
										(1.48)

N=907 individuals in 242 neighborhoods
Coefficients are presented
Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
a. Neighborhood deprivation is indexed by a factor score based on neighborhood affluence, poverty, education, % of female-headed HHs, and % of HHs on public assistance.
b. Percent of residents age 55 or over
c. Number of restaurants and bars in a 1-mile buffer
d. Number of art (art centers), culture (e.g., museums), leisure, and entertainment facilities in a 3-mile buffer.
e. Number of library, houses of churches, and educational institutes in a 2-mile buffer
f. Number of health and human services in a 3-mile buffer

Table 3 Multilevel Logistic Model of Neighborhood Social Capital and Built Environment on Regular Exercise

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Neighborhood social capital[a]	0.28***	0.28***	0.30***	0.29***	0.29***	0.28***	0.21**	0.22**	0.27***	0.27***
	(2.71)	(2.73)	(2.85)	(2.79)	(2.77)	(2.69)	(1.96)	(2.11)	(2.63)	(2.67)
Neighborhood age structure[b]	-2.23*	-2.47**	-2.12*	-2.00*	-2.07*	-2.21*	-1.71	-1.66	-2.24*	-2.01*
	(1.89)	(2.07)	(1.79)	(1.67)	(1.72)	(1.85)	(1.42)	(1.37)	(1.90)	(1.66)
Block density		-0.00								
		(1.39)								
Distance to subway			-0.07							
			(0.99)							
Distance to parks				-0.55						
				(1.23)						
Land use pattern					0.54					
					(1.06)					
Pedestrian injury rate						0.00				
						(0.16)				
Access to restaurants and bars[c]							0.21**			
							(2.49)			
Access to facilities[d]								0.18**		
								(2.07)		
Access to institutions[e]									0.01	
									(0.17)	
Access to health and human services[f]										0.07
										(0.81)

N=907 individuals in 242 neighborhoods
Coefficients are presented; all models controlled for age, gender, race/ethnicity, marital status, education, and annual household income.
Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
a. Neighborhood social capital is indexed by a factor score based on neighborhood trust, norms of reciprocity, perceived violence, and homicide rate.
b. Percent of residents age 55 or over
c. Number of restaurants and bars in a 1-mile buffer
d. Number of art (art centers), culture (e.g., museums), leisure, and entertainment facilities in a 3-mile buffer.
e. Number of library, houses of churches, and educational institutes in a 2-mile buffer
f. Number of health and human services in a 3-mile buffer

Table 4 Multilevel Logistic Model of Neighborhood SES and Built Environment on Weekly Workout

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Neighborhood deprivation[a]	-0.01	-0.01	-0.02	-0.02	-0.02	-0.01	0.00	-0.01	-0.02	-0.02
	(0.56)	(0.56)	(0.73)	(0.65)	(0.89)	(0.52)	(0.03)	(0.24)	(0.76)	(0.84)
Neighborhood age structure[b]	0.07	0.04	0.16	0.22	0.21	0.20	0.16	0.16	-0.01	0.19
	(0.27)	(0.15)	(0.58)	(0.81)	(0.74)	(0.73)	(0.59)	(0.60)	(0.03)	(0.70)
Block density		-0.00								
		(0.54)								
Distance to subway			-0.03							
			(1.51)							
Distance to parks				-0.32***						
				(2.68)						
Land use pattern					0.32**					
					(2.33)					
Pedestrian injury rate						0.00*				
						(1.79)				
Access to restaurants and bars[c]							0.06***			
							(2.82)			
Access to facilities[d]								0.05**		
								(2.34)		
Access to institutions[e]									0.04**	
									(2.06)	
Access to health and human services[f]										0.05**
										(2.27)

N=3,530 individuals in 266 neighborhoods
Coefficients are presented
Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
a. Neighborhood deprivation is indexed by a factor score based on neighborhood affluence, poverty, education, % of female-headed HHs, and % of HHs on public assistance.
b. Percent of residents age 55 or over
c. Number of restaurants and bars in a 1-mile buffer
d. Number of art (art centers), culture (e.g., museums), leisure, and entertainment facilities in a 3-mile buffer.
e. Number of library, houses of churches, and educational institutes in a 2-mile buffer
f. Number of health and human services in a 3-mile buffer

Table 5 Multilevel Logistic Model of Neighborhood Social Capital and Built Environment on Weekly Workout

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Neighborhood social capital[a]	0.00	0.00	0.01	0.01	0.01	0.01	-0.02	-0.01	-0.01	0.00
	(0.15)	(0.15)	(0.47)	(0.41)	(0.48)	(0.48)	(0.65)	(0.44)	(0.19)	(0.04)
Neighborhood age structure[b]	0.10	0.07	0.15	0.22	0.21	0.19	0.25	0.25	0.08	0.25
	(0.34)	(0.22)	(0.52)	(0.75)	(0.69)	(0.63)	(0.85)	(0.84)	(0.27)	(0.82)
Block density		-0.00								
		(0.53)								
Distance to subway			-0.03							
			(1.50)							
Distance to parks				-0.32***						
				(2.69)						
Land use pattern					0.31**					
					(2.27)					
Pedestrian injury rate						0.00*				
						(1.86)				
Access to restaurants and bars[c]							0.06***			
							(2.94)			
Access to facilities[d]								0.05**		
								(2.43)		
Access to institutions[e]									0.04**	
									(2.00)	
Access to health and human services[f]										0.05**
										(2.18)

N=3,530 individuals in 266 neighborhoods
Coefficients are presented; all models controlled for age, gender, race/ethnicity, marital status, education, and annual household income.
Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
a. Neighborhood social capital is indexed by a factor score based on neighborhood trust, norms of reciprocity, perceived violence, and homicide rate.
b. Percent of residents age 55 or over
c. Number of restaurants and bars in a 1-mile buffer
d. Number of art (art centers), culture (e.g., museums), leisure, and entertainment facilities in a 3-mile buffer.
e. Number of library, houses of churches, and educational institutes in a 2-mile buffer
f. Number of health and human services in a 3-mile buffer