The Relation of the Perceived Environment to Fear, Physical Activity, and Health in Public Housing Developments: Evidence from Chicago

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ABSTRACT

Within the realm of active living in urban neighborhoods in the United States, only a few studies have addressed the factors that promote or inhibit active living among residents in public housing. This paper examines the environmental and interpersonal factors associated with active living and health in public housing. We specifically examine the environmental predictors of fear of crime, and whether fear is related to moderate physical activity, and in turn, health and obesity. The analysis drew upon data from a sample of 328 African-American residents living in two severely distressed public housing developments in 2007. Structural equation modeling was used to calculate a path model of direct and indirect effects. Perceptions of violence were positively associated with fear, and both fear and physical activity predicted health. However, neither fear nor physical activity was associated with obesity. We discuss the implications of these findings for improving the quality of life of disadvantaged residents living in high-crime neighborhoods.

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INTRODUCTION

Over the last decade, researchers have been examining the relationships among the social and physical environment, active living, and health outcomes. Studies testing these relationships use a host of

independent variables, including social capital indicators such as neighborhood collective efficacy, and environmental variables such as crime and disorder. Great strides have been made in understanding the complex dynamics that contribute to active living and better health in urban neighborhoods. It is now widely recognized that both environmental and individual determinants of physical activity and health exist (1).

A growing number of studies includes both social and physical environmental variables, coupled with individual determinants, and assesses how these factors are interrelated to explain active living (2,3) and health (3,4). A few studies explicitly have examined whether the association between characteristics of the environment and health are mediated by an individual's health behaviors, such as physical activity (3,5,6). However, the findings in this area are mixed, with some studies finding mediating effects of physical activity and some not.

The current study examines the environmental and interpersonal factors associated with active living and health of public housing residents. We specifically examine the social and environmental predictors of fear of crime, and whether fear influences moderate activity, and in turn, health and obesity. We focus on residents living in two decaying and substandard public housing developments in Chicago, IL, USA, both of which are part of the US Housing and Urban Development's HOPE VI program, a program to remove or redevelop some of the poorest quality public housing in the country (7). Public housing developments that are demolished as part of HOPE VI are usually replaced with "mixed-income" housing developments – developments composed of housing units with differing levels of affordability, typically with some market-rate housing and some housing that is available to low-income occupants below market rate.

Within the realm of active living and health in urban neighborhoods, only a few studies (8–12) have addressed the factors that promote or inhibit active living among residents in public housing. Furthermore, the health of public housing residents, in general, has received little attention. Public housing households are some of the poorest in the United States, and the concentration of problems within housing developments – such as poor health, racial segregation, crime, disorder, and decay – further degrades the quality of life

among public housing residents. Research consistently has shown that minority inner-city residents and low-income individuals are more overweight, less physically active, and less healthy overall than the general population (13–15). Communities that are highly segregated by race – such as the two developments in this study – have increased exposure to violence (16). The health status of HOPE VI residents is decidedly worse than for others in federally subsidized housing and other poor people, despite their similarity in terms of economic deprivation (17). One recent study found the prevalence of obesity to be 48% among HOPE VI residents, compared to 39% in a national sample of black women (18).

The current study provides an opportunity to test a theoretically driven path model of the perceived environment, fear, activity, and health within the context of two severely impoverished and crime-ridden public housing neighborhoods. The bodies of literature on social capital, fear of crime, and active living guided the selection of all predictors as well as the causal direction of the hypothesized models in this study. Given that all residents in our sample live in either one of two small neighborhoods (i.e., public housing developments), variation in residents' built environments in the same development is virtually nonexistent. Hence, we do not include neighborhood-level physical environment variables, but instead focus on understanding how *perceptions* of the environment and interpersonal factors are related to fear, activity, and health. Within contained, high-poverty neighborhood environments, there is a great need to identify modifiable factors that may affect physical activity and health. Similarly, research examining the relationship between a person and his or her environment can shed light on how one's social and interpersonal attributes shape the person–environment interaction.

METHODS

Setting and Sample

The study's setting was two Chicago Housing Authority public housing developments in Chicago's mid-south neighborhoods. One of the developments – Madden/Wells (hereafter referred to as "Wells") – was built in 1941 exclusively for African Americans. At

the time data were collected for this study (March–September 2007), the majority of buildings and units that comprised Wells had been demolished or boarded up and an estimated 250 families remained as they awaited relocation. The other development – Dearborn Homes – consists of 16 six- and nine-story buildings, comprising 800 units, but housing only 260 families in early 2007. Since the beginning of the Chicago Housing Authority's HOPE VI program, Dearborn Homes has operated as a "relocation resource," providing capacity for residents who have moved from other developments undergoing redevelopment or rehabilitation.

Data for this study were drawn from a 2007 household survey conducted by the Urban Institute and the Survey Research Lab at the University of Illinois at Chicago to examine housing and quality of life indicators for the residents of the two housing developments (survey available from authors upon request), all of whom were offered an enhanced family case management demonstration program. The two housing developments were chosen for the demonstration, known as the "Chicago Family Case Management Demonstration," and for this study because the developments were known to house families with multiple barriers to relocation out of public housing – such as unemployment, histories of lease violations, substance abuse, and contact with the criminal justice system. The sample was composed of all heads of households living in the two developments in Chicago, IL, USA as of March 2007, 100% of whom were African Americans. The completed interview rate was 76.6% ($N = 360$).

Description of Proposed Models

Figure 1 represents the proposed conceptual path models. Similar path models were developed for two outcome variables: a self-reported health index and obesity. Individual-level covariates (age, gender, education) were chosen based on past literature. The physical and social environmental covariates (collective efficacy, disorder, violence) were operationalized as *perceptions* of neighborhood characteristics, which have been found to be related to fear (19–21), activity (22), and health (23,24). Past literature also suggests that fear has a direct relation to physical activity (25,26). Our models allow for both the direct and indirect (through activity) effects of fear

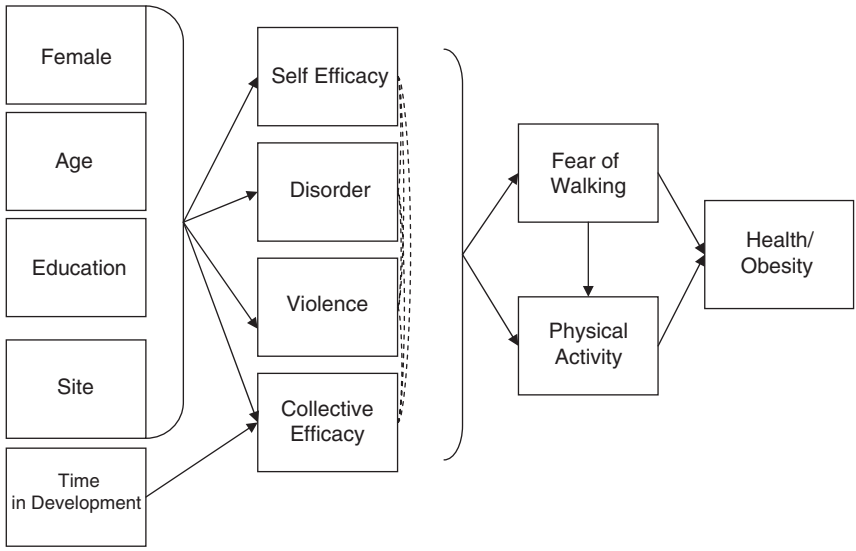


Figure 1
Proposed path model of influences of environment on fear, activity, and health (Model 1) and obesity (Model 2)

of walking outdoors on health and obesity. Our models test the following hypotheses, using "influence" to refer to significant associations in statistical models:

(1) Fear of walking negatively and directly influences health and obesity.
(2) Fear of walking directly influences physical activity and indirectly influences health and obesity through physical activity as a mediator.
(3) Physical activity positively and directly influences health and obesity.
(4) Perceptions of disorder and violence directly and positively influence fear of walking, and both directly and indirectly influence physical activity (through fear of walking).
(5) Collective efficacy has a direct negative influence on fear of walking and a direct positive influence on physical activity. Collective efficacy also indirectly influences health and obesity through fear and physical activity.

(6) General self-efficacy has a direct negative influence on fear of walking and a direct positive influence on physical activity. Self-efficacy also indirectly influences health and obesity through fear and physical activity.

The models control for age, gender, education, and time lived in that particular public housing development. The models also include a control variable for site, to distinguish between the two public housing developments: the two developments have different neighborhood characteristics, such as crime rates, physical disorder, and access to resources, and those variables were not available in this study.

Measures

Physical health

Following Ross and Mirowsky (24), physical health represents a composite index based upon physical functioning, self-rated health, and a lack of chronic conditions. Physical functioning was measured by asking respondents, on a 5-point scale, their difficulty in (a) walking a quarter of a mile, (b) walking up 10 steps, (c) standing on their feet for 2 hours, (d) sitting for 2 hours, (e) bending or kneeling, and (f) reaching over their head. Response options were: not at all difficult (coded 5), only a little difficult (coded 4), somewhat difficult (coded 3), very difficult (coded 2), and can not do at all (coded 1). Self-rated health was a respondent's assessment of his or her own health as excellent (coded 4), very good (coded 3), fair (coded 2), or poor (coded 1). Lack of chronic conditions was established from two bivariate variables asking respondents if they had (1) a recurring health condition that required regular, ongoing care and/or (2) hypertension. The six physical functioning questions, chronic health conditions, hypertension, and self-rated health all loaded onto a single factor at 0.84, 0.81, 0.82, 0.56, 0.67, 0.66, 0.64, 0.48, and 0.57, respectively.

Obesity

Body mass index (BMI) was calculated from self-reported height (in inches) and weight (in pounds). Respondents with a BMI $\geqslant 30$

were coded as 1 for obese and those with a BMI <30 were coded as 0 (27).

Physical activity

The variable "moderate physical activity" was created from two questions. The first asked respondents if, in a typical week, they engaged in activities that increase heart rate and breathing rate (such as bicycling or brisk walking) for at least 10 minutes at a time. Individuals who responded positively were then asked how many days per week (from 1 to 7) they performed those activities. We created a 3-point scale (0–2) for moderate physical activity, indicating whether the respondent never performed those activities (coded 0), performed between 1 and 4 days a week (coded 1), or performed more than 4 days a week (coded 2).

Fear of walking

Fear of walking was constructed as a 4-point scale that asked respondents how often fear of crime kept them from walking outdoors: never (coded 1), rarely (coded 2), sometimes (coded 3), or always (coded 4).

Self-efficacy

This construct was measured by using the New General Self Efficacy Scale (28). Respondents were asked to rate their agreement with a series of eight questions from 4 (strongly agree) to 1 (strongly disagree). Examples of questions are as follows: *I will be able to achieve most of the goals that I have set for myself; I believe I can succeed at most any endeavor to which I set my mind.* The eight questions loaded onto a single factor ($\alpha = 0.88$); scale score was the mean of the eight items.

Collective efficacy

Collective efficacy was a 10-item construct (29) representing individual-level perceptions of community cohesion and informal social control. Respondents were asked to indicate the extent of their agreement on a 4-point scale ranging from strongly disagree to strongly agree or very unlikely to very likely. The items included the

following: *This is a close-knit neighborhood; people around here are willing to help neighbors; people don't get along with each other; people do not share the same values; people in this neighborhood can be trusted; likelihood that neighbors would do something about kids hanging out; likelihood that neighbors would do something about kids painting graffiti; likelihood that neighbors would scold a child showing disrespect; likelihood that neighbors would break up fight in front of house; and likelihood that neighbors would do something if the local fire station closed.* The mean of the 10 items was used to form a single scale. Internal reliability was high ($\alpha = 0.88$).

Violence

Violence was measured as a composite of three questions that asked respondents to what degree they believed the following to be problems in their community: robberies/attacks, gangs, and shooting/general violence. Respondents indicated their responses on a 3-point scale (no problem to a big problem). The index was created by taking the mean of the three scores. Internal reliability was adequate ($\alpha = 0.71$).

Disorder

The disorder measure consisted of six questions regarding perceptions of social disorder and physical disorder in the neighborhood. Perceived social disorder was measured by four questions that asked respondents if they found the following to be a problem in their neighborhoods: *loitering, selling drugs, using drugs, and gang presence*. Perceived physical disorder was measured using two questions about the prevalence of graffiti and trash in the neighborhood. Participants were asked to rate the degree of the problem of each form of disorder on a 3-point scale from no problem (coded 1) to a large problem (coded 3). The disorder index was calculated by taking the mean of the responses. Reliability was high ($\alpha = 0.90$).

Individual-level socio-demographics

Individual-level socio-demographic characteristics included self-reported age (in years), gender (male/female), education (has a high school diploma or General Educational Development (GED)

diploma or above vs. having no high school diploma or GED diploma), and number of years the respondent had been living in the development.

Site

A binary variable was included to capture the public housing facility in which each respondent lived (1 = Wells; 0 = Dearborn).

Statistical Analysis Plan

We began with a sample of 360 observations and deleted observations for which any variable specified in our model was missing, yielding a sample size of 338. In addition, 10 entries had implausibly high or low BMIs. We deleted all observations that indicated a BMI <1 or a BMI >100, for a final sample size of 328.

Path analysis was conducted using version 8.54 of LISREL (30). Path analysis allows for the simultaneous testing of a system of equations in which each variable is regressed against those for which the hypothesized model indicates that a causal relationship exists. It determines path coefficients for each relationship, which can then be used to calculate direct and indirect effects, as well as mediating relationships, to the dependent variable (31). A formal chi-square test compares the observed correlation among measured variables to that which is predicted by the hypothesized model, allowing for an assessment of the "goodness of fit" of the hypothesized model.

In the path analysis, one assumes the data are continuous, multivariate, and normally distributed. Many of the data collected in our study were ordinal variables on 4-point scales and many were non-normally distributed. Given a small sample size ($N < 500$) and moderately sized models (items >8), we were unable to use the asymptotically distribution-free estimator that makes no assumption of normality (32). Instead we used the Satorra–Bentler Scales chi-square and standard errors, which adjust the chi-squared by the level of kurtosis of the variables (33). The polychoric correlation matrix and asymptotic covariance matrix were first estimated and maximum likelihood estimation was used to determine the Satorra–Bentler chi-square.

RESULTS

Descriptive Statistics

The majority of participants in the study (82%) were female, and their mean age was 47 years (see Table 1). Most (59%) had at least a high school diploma or GED diploma. The average respondent had lived in his or her development for 27 years, although on average individuals in Wells lived in that development slightly longer. Over half (55%) of respondents came from Wells. The majority of individuals reported very high levels of self-efficacy, with a mean of 3.68 on a scale of 1–4. Perceptions of collective efficacy were lower, with a mean of 2.33 on the same 1–4 scale. On average, individuals from Wells reported higher self-efficacy and slightly lower collective efficacy.

Perceived violence had a mean score of 1.92 on a scale of 1–3, with the majority of respondents indicating they found robberies,

Table 1: Descriptive statistics for study variables

	Full sample (N=328)			*Wells (n=180)*		*Dearborn (n=148)*	
Variable	*Mean*	*Min*	*Max*	*Mean*	*s.d.*	*Mean*	*s.d.*
Age	47.00	20.00	88.00	47.00	13.89	47.00	11.91
Gender	0.82	0.00	1.00	0.83	0.38	0.80	0.38
Education	0.59	0.00	1.00	0.60	0.49	0.60	0.49
Years lived in development	27.00	6.00	58.00	27.20	11.65	25.80	11.90
Site	0.55	0.00	1.00	—	—	—	—
Disorder scale	0.00	−2.70	1.01	0.21	0.94	−0.27	1.04
Violence scale	1.92	1.00	3.00	2.08	0.55	1.75	0.63
Collective efficacy scale	2.33	1.00	4.00	2.28	0.76	2.35	0.77
Self-efficacy scale	3.68	1.00	4.00	3.71	0.39	3.64	0.52
Fear of walking	2.20	1.00	4.00	2.34	1.03	2.04	1.07
Moderate activity	1.03	0.00	2.00	1.07	0.89	0.99	0.89
Physical health	0.02	−1.63	0.94	0.00	0.73	0.04	0.69
Obesity	0.47	0.00	1.00	0.47	0.50	0.49	0.50

s.d., standard deviation.

gangs, and shootings to be a problem in their neighborhood. Perceived violence was higher in Wells (2.08) than in Dearborn (1.75). Fear of walking had a mean score of 2.2 on a 4-point scale, with a higher average score in Wells compared to Dearborn. Although the mean activity score was 1.0 (minimal moderate physical activity), most respondents indicated either no daily moderate activity (37%) or less than 5 days of moderate physical activity per week (22%). Although almost half of the respondents (47%) were obese, roughly 60% of the sample self-reported better than average health.

The physical health and disorder variables were standardized with a mean of zero and a standard deviation of one.

Direct Effects

Table 2 presents direct effects of individual and perceived environmental characteristics on the hypothesized mediators, and on obesity and health. In the models, site predicted self-efficacy ($P<0.05$), disorder ($P<0.01$), and violence ($P<0.01$), indicating residents of Wells had higher levels on these measures. Of the environmental variables, perceptions of violence significantly predicted fear of walking outdoors ($P<0.01$). In addition, self-efficacy predicted physical activity ($P<0.01$). Fear of walking did not predict physical activity, suggesting that individuals with higher levels of fear of walking do not make changes in moderate activity due to that fear.

Neither fear of walking nor physical activity was significant in predicting our binary indicator of obesity. However, physical activity was significant ($P<0.01$) in predicting physical health, indicating that higher levels of activity were associated with greater self-reported health. As hypothesized, higher levels of fear were associated with lower scores on physical health, although the effect was only marginally significant ($P<0.10$).

Indirect Effects

Tables 3 and 4 show the results of tests for indirect effects. The site variable significantly and positively predicted fear of walking outdoors ($P<0.01$). Respondents living in Wells were more likely to fear walking outdoors. In addition, self-efficacy was significantly

Table 2: Direct effects on endogenous variables

	Collective efficacy[a] *(s.e.)*	*Perceived violence*[a] *(s.e.)*	*Physical and social disorder*[a] *(s.e.)*	*Self-efficacy*[a] *(s.e.)*	*Fear of walking outdoors*[a] *(s.e.)*	*Physical activity*[a] *(s.e.)*	*Physical health*[a] *(s.e.)*	*Obesity*[a] *(s.e.)*
Age	0.107	−0.024	0.164	−0.239	−0.024			
	(0.66)	(0.06)	(0.604)	(0.43)	(0.06)			
Gender (1=female)	−0.009	−0.095	−0.176	0.169	−0.095			
	(0.22)	(0.08)	(0.16)	(0.10)	(0.08)			
High school education	−0.039	−0.106	0.113	0.098	−0.106			
	(0.17)	(0.08)	(0.139)	(0.097)	(0.08)			
Years spent in development	0.071							
	(0.58)							
Site (1=Wells)	0.090	0.342***	0.312***	0.098*	0.342***			
	(0.05)	(0.07)	(0.05)	(0.05)	(0.07)			
Collective efficacy					−0.076	−0.008		
					(0.07)	(0.06)		
Perceived violence					0.378***	0.037		
					(0.10)	(0.10)		
Physical and social disorder					0.084	−0.033		
					(0.09)	(0.09)		
Self-efficacy					−0.046	0.211***		
					(0.05)	(0.05)		
Fear of walking						−0.104	−0.097[b]	−0.090
						(0.08)	(0.056)	(0.076)
Physical activity							0.140**	−0.055
							(0.050)	(0.081)

[a] Unstandardized regression coefficient.
[b] $P<0.10$.
*$P<0.05$, **$P<0.01$, ***$P<0.001$.
s.e., standard error.

Table 3: Total indirect effects of X (exogenous) on Y (endogenous), Model 1 and Model 2

	Outcome	*Model 1: Health*[a] *(s.e.)*	*Model 2: Obesity*[a] *(s.e.)*
Age	Fear of walking	−0.020	−0.020
		(0.105)	(0.105)
	Physical activity	−0.047	−0.047
		(0.097)	(0.097)
	Physical health/obesity	−0.005	0.004
		(0.021)	(0.097)
Gender (1=female)	Fear of walking	−0.058	−0.058
		(0.045)	(0.045)
	Physical activity	0.041	0.041
		(0.025)	(0.025)
	Physical health/obesity	0.011	0.003
		(0.007)	(0.007)
High school education	Fear of walking	−0.043	−0.043
		(0.043)	(0.043)
	Physical activity	0.020	0.020
		(0.026)	(0.026)
	Physical health/obesity	0.007	0.003
		(0.007)	(0.005)
Years spent in development	Fear of walking	−0.005	−0.005
		(0.045)	(0.045)
	Physical activity	<0.001	<0.001
		(0.006)	(0.006)
	Physical health/obesity	0.001	0.001
		(0.004)	(0.004)
Site (1=Wells)	Fear of walking	0.155*	0.155*
		(0.038)	(0.038)
	Physical activity	0.020	0.020
		(0.025)	(0.025)
	Physical health/obesity	−0.014	−0.015
		(0.010)	(0.013)

[a] Unstandardized regression coefficient.

*$P < 0.001$.

s.e., standard error.

Table 4: Total indirect effects of Y on Y[a], Model 1 (Physical health) and Model 2 (Obesity)

	Outcome	*Physical health*[b] *(s.e.)*	*Obesity*[b] *(s.e.)*
Collective efficacy	Physical activity	0.008 (0.009)	0.008 (0.009)
	Physical health/obesity	0.007 (0.011)	0.007 (0.009)
Perceived violence	Physical activity	−0.039 (0.033)	−0.039 (0.033)
	Physical health/obesity	−0.037 (0.027)	−0.034 (0.030)
Physical and social disorder	Physical activity	−0.009 (0.011)	−0.009 (0.011)
	Physical health/obesity	−0.012 (0.015)	−0.006 (0.012)
Self-efficacy	Physical activity	0.004 (0.007)	0.004 (0.007)
	Physical health/obesity	0.035* (0.016)	−0.008 (0.018)
Fear of walking	Physical health/obesity	−0.015 (0.012)	0.006 (0.010)

[a] Correlations between mediator variables (self-efficacy, collective efficacy, perceived violence, and disorder) are available upon request.
[b] Unstandardized regression coefficient.
*$P < 0.05$.

and positively associated with health through its effects on both fear of walking and moderate physical activity ($P < 0.05$). It is important to note that fear of walking was not significantly indirectly related to overall health through activity, indicating that the only effect of fear on health was direct. No indirect effects on obesity were found.

Model Fit

The chi-square test statistic for the physical health model was 17.64 ($P < 0.73$) with a root square mean error of approximation of < 0.01

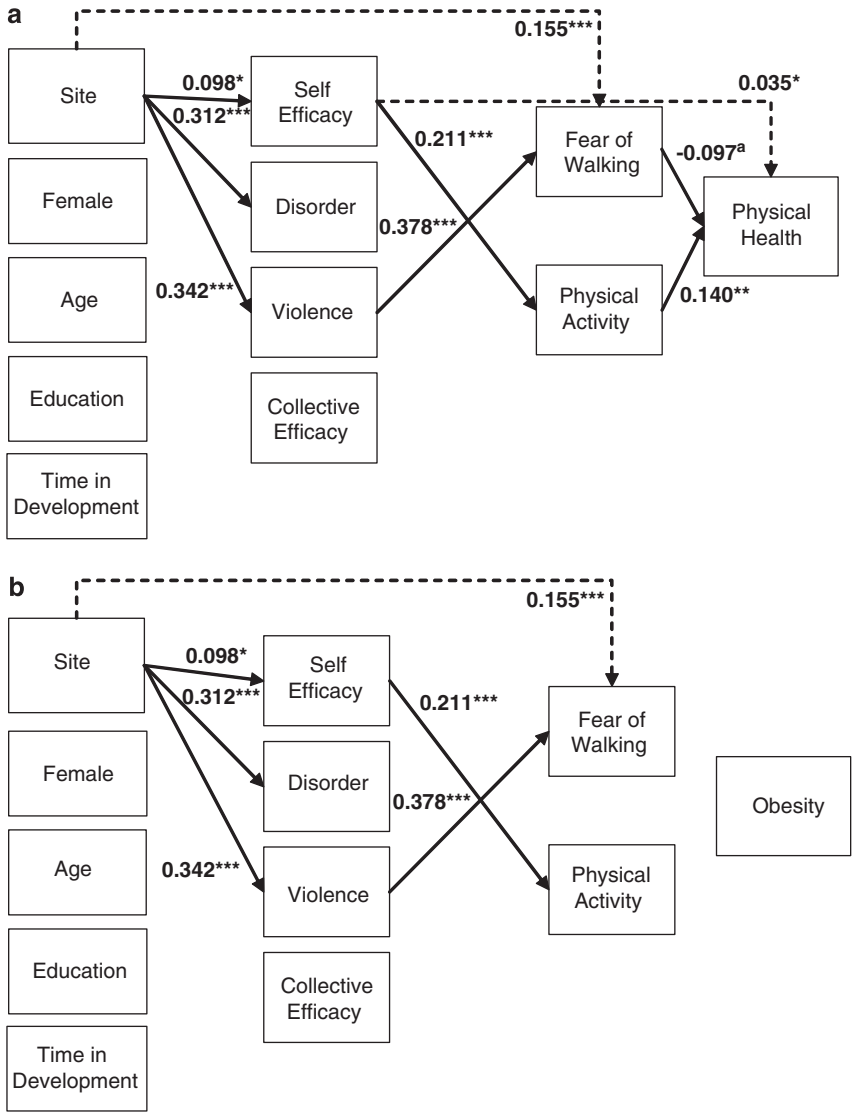
and a comparative fit index = 0.83. For the obesity model, the Satorra–Bentler scaled chi-square was 26.15 ($P < 0.25$) with a root mean square error of approximation of < 0.01 and a comparative fit index = 0.92. These statistics indicated good fit of the models. Significant direct and indirect effects of the models are summarized in Figure 2.

DISCUSSION

This study examined the associations of perceptions of the local social environment and interpersonal characteristics with health, obesity, fear, and physical activity. Our approach differs from previous investigations by explicitly considering the direct and indirect role that fear and physical activity play in explaining physical health and obesity. We also examined whether fear was directly associated with physical activity.

Our findings indicated that fear was directly related to reported health (Hypothesis 1). Although the relation of fear to health was only marginally significant, the findings nonetheless suggest the need to explore the mechanisms linking fear to health, perhaps via stress, within the larger social ecologic framework. That we did not find a hypothesized relationship between fear of walking outdoors and physical activity, coupled with the finding that physical activity did not act as a mediator of fear's associations with health or obesity (Hypothesis 2), provides more weight for the argument that some other mechanism might be at work. The fields of psychology and physiology have linked traumatic situations to poor health through high levels of the hormone cortisol (34). It is reasonable to expect that prolonged exposure to violence in a neighborhood environment may have a direct impact on the health of residents.

Although the path model had a good fit, neither fear nor physical activity was significantly related to obesity (Hypotheses 1 and 3). This is not necessarily surprising, given that the average age of sample respondents was close to 50 years; hence, lifelong patterns of health behaviors may have already been established, but not adequately captured by the available survey items. We did not have data on physical activity other than self-reported moderate activity, and the physical activity measure was not validated. We also did not have historical data on socio-economic or lifestyle factors, such as



[a]$P<0.10$, *$P<0.05$, **$P<0.01$, ***$P<0.001$ Direct effects are indicated with a solid line; indirect effects are indicated with a dotted line.

Figure 2
(a) Path model of the influences of environment on fear, activity, and health (Model 1).
(b) Path model of the influences of environment on fear, activity, and obesity (Model 2)

food consumption. Although the lack of association between physical activity and obesity could be mainly due to measurement limitations, if these findings can be replicated among African-American adults, this could suggest that obesity prevention among children may be a promising approach.

Perceived violence, but not disorder, was directly related to fear of walking, with no indirect associations found between violence and disorder and physical activity, through fear of walking (Hypothesis 4). With regard to violent environments, it is theoretically sensible that acts of violence would directly result in fear of walking, as opposed to less fear-provoking signs of disorder. However, this study's null findings on the relation of disorder to activity and health stand in contrast with recent studies that found perceived disorder related to activity and/or health (3,5). It is possible that residents of the developments in this study have become somewhat used to decaying and disorderly conditions, and were less likely mentally to associate disorder with fear or the possibility of getting hurt; hence, the presence of disorder may not be related to health behaviors in this population.

Collective efficacy also was not associated with lower fear or higher physical activity in our sample, nor was collective efficacy positively indirectly related to health or obesity (Hypothesis 5), as some studies have found (35). It is possible that our individual-level collective efficacy measure did not tap the neighborhood-level processes of social capital as defined in the sociological literature (29). In the majority of the extant English-language literature, collective efficacy and other social capital constructs were measured at the neighborhood level as a way to capture positive neighborhood processes beyond one individual's perspective. Although we could have aggregated the responses for the environmental variables to a unit of analysis (such as the neighborhood or portion of a street grid), we expected little meaningful variation given that residents resided in only two neighborhoods.

Another finding worth noting was self-efficacy's strong direct association with moderate physical activity and its indirect relation to physical health through both physical activity and fear (Hypothesis 6). These results indicate the importance of considering social cognitive factors within social ecologic models of health. Interestingly, our measure of self-efficacy, which did not incorporate efficacy

items directly referring to physical activity but instead relied on general self-efficacy items, still found strong associations with physical activity.

We acknowledge a number of study limitations. First, the cross-sectional nature of the study renders it impossible to establish causality. It is possible that study participants have long been obese or in ill health, and these poorer physical states could affect their trust in other people, leading to negative community perceptions. Second, fear of walking and physical activity were measured through invalidated self-reports; objective measures of walking and moderate activity were not available, nor was information provided to differentiate between non-walkers and those who must walk for transport. We also recognize that the construct validity of the fear measure might be low as a result of using only one item, therefore contributing to the non-significant relationship between fear and physical activity. Another limitation was that the measure for moderate activity did not expressly examine activity that takes places outdoors – to which fear would be most relevant. A measure of personal victimization in the past – found in some studies to be related to fear – was not available and, therefore, not used as an individual-level predictor. Finally, generalizability may be limited, as the study sites consisted of only two public housing developments, both situated within one urban area. This limitation extends more generally to studies that focus on specific populations. Although these studies can lead to targeted solutions for a particular sub-population, such studies may sacrifice variability across observed variables, reducing the capacity to make valid inferences about some underlying relationships.

Despite these limitations, this study provides a step forward in the search for a better understanding of the correlates of active living in public housing – and other severely disadvantaged urban neighborhoods. But unlike other poor residents of disadvantaged communities, public housing residents are more likely to remain in public housing and endure a range of social problems. Many of these residents are not likely to qualify for a new mixed-income housing and may not even qualify for other support options, leaving them without viable opportunities for improving their quality of life through relocation. The concentration of residents in a centralized physical location, such as public housing, provides a unique

opportunity for policymakers and practitioners to experiment with options that change physical features and/or support the social aspects of these communities, in hope of reducing fear and increasing physical activity. In many jurisdictions in the United States, public housing program expenditures for comprehensive resident services do exist, but priorities dictate that case management and supportive services focus on building residents' income and assets, as well as education and tenancy record. Our analyses demonstrate that efforts spent on increasing physical activity, as well as reducing fear, might be worthwhile investments in the health of residents and communities. Given the findings that fear was higher in Wells than Dearborn, and physical conditions appeared to be decidedly worse in Wells, if we can make the assumption that these conditions are related to the lengthy process of demolishing buildings and relocating residents of Wells (roughly 7 years), future efforts to replace large multi-building developments should consider having fewer phases of relocation and/or ensuring a safe environment for residents who remain among vacant and distressed units for *any* period of time.

Research that provides a better understanding of local residents' perspectives about perceived risk of crime and levels of fear, coupled with details on physical activity habits and motivation (or lack of motivation) to walk for transport or exercise, could facilitate a more thorough understanding of the mechanisms that ultimately influence health behaviors in high-risk urban settings. As studies of social capital, crime, and health conducted within a social ecologic framework continue to multiply, it becomes important to remember that tremendous variation can exist within one microenvironment. We recognize the public health literature's general agreement across North America that many individual-level determinants, such as exercise preferences, may be shaped by fundamental social factors and neighborhood processes (2). However, we suggest that *longitudinal* research, which follows children through adulthood, may be best suited to answering complex questions about the interactions of the social and physical environment, interpersonal factors, health behaviors, and health. Furthermore, the high levels of obesity, low levels of even moderate exercise, and high perceptions of violence among this study's participants points to the importance of advocating for public health and violence-reduction programs and

policies that specifically can reach the most vulnerable populations – including those who may be left behind even in the face of large-scale policy and program levers.

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REFERENCES

1. Jackson R, Kochtitzky C. *Creating a Healthy Environment: The Impact of the Built Environment on Public Health*. Washington, DC: Sprawl Watch Clearinghouse; 2002.
2. McNeill LH, Wyrwich KW, Brownson RC, Clark EM, Kreuter MW. Individual, social environmental, and physical environmental influences on physical activity among black and white adults: a structural equation analysis. *Ann Behav Med*. 2006;31(1):36–44.
3. Franzini L, Caughy M, Spears W, Esquer M. Neighborhood economic conditions, social processes, and self-rated health in low-income neighborhoods in Texas: a multilevel latent variables model. *Soc Sci Med*. 2006;61:1135–50.
4. Guite HF, Clark C, Ackrill G. The impact of the physical and urban environment on mental well-being. *Public Health*. 2006;120(12): 1117–1126.
5. Poortinga W. Perceptions of the environment, physical activity, and obesity. *Soc Sci Med*. 2006;63:2835–46.

6. Mohan J, Twigg L, Barnard S, Jones K. Social capital, geography and health: a small area analysis for England. *Soc Sci Med*. 2005;60(6): 1267–83.
7. US Department of Housing and Urban Development. *HOPE VI*. Available at http://www.hud.gov/offices/pih/programs/ph/hope6/, accessed 3 November 2008.
8. Bennett GG, McNeill LH, Wolin KY, Duncan DT, Puleo E, Emmons KM. Safe to walk? Neighborhood safety and physical activity among public housing residents. *PloS Med*. 2007;4(10):1599–607.
9. Heinrich KM, Lee RE, Suminski RR, Regan FR, Reese-Smith JY, Howard HH, *et al*. Association between the built environment and physical activity in public housing residents. *Int J Behav Nutr Phys Act*. 2007;4(56):1479–88.
10. Regan G, Lee RE, Booth K, Resse-Smith J. Obesogenic influences in public housing: a mixed-method analysis. *Am J Health Promot*. 2006; 20(4):282–90.
11. Taylor AF, Wiley A, Kuo FE, Sullivan SC. Growing up in the inner city: green spaces as places to grow. *Environ Behav*. 1998;20(1): 3–27.
12. Lewis CE, Raczynski JM, Heath GW, Levinson R, Cutter GR. Physical activity of public housing residents in Birmingham, Alabama. *Am J Public Health*. 1993;83(7):1016–23.
13. Popkin SJ, Cunningham MK, Burt M. Public housing transformation and the hard to house. *Housing Policy Debate*. 2005;16(1):1–24.
14. Keberhaht M, Pamuk E. The importance of place of residence: examining health in rural and nonrural areas. *Am J Public Health*. 2004;94(10):1682–6.
15. Parks S, Housemann R, Brownson R. Differential correlates of physical activity in urban and rural adults of various socioeconomic backgrounds in the United States. *J Epidemiol Commun Health*. 2003; 57(1):29–35.
16. Massey DS. Segregation and stratification: a biosocial perspective. *Du Bois Rev*. 2004;1:7–25.
17. Howell E, Harris LE, Popkin S. The health status of HOPE VI public housing residents. *J Health Care Poor Underserved*. 2005;16(2): 273–285.
18. Manjarrez CA, Popkin SJ, Guernsey E. Poor health: adding insult to injury for HOPE VI families. Metropolitan Housing and Communities, Brief No. 5. Washington, DC: The Urban Institute; 2007.
19. Markowitz FE, Bellair PE, Liska AE, Liu J. Extending social disorganization theory: modeling the relationship between cohesion, disorder and fear. *Criminology*. 2001;39(2):293–320.

20. LaGrange RL, Ferraro KF, Supancic M. Perceived risk and fear of crime: role of social and physical incivilities. *J Res Crime Delinquency*. 1992;29:311–34.
21. Taylor RB, Hale M. Testing alternative models of fear of crime. *J Crim Law Criminol*. 1986;77:151–89.
22. Handy S. Critical assessment of the literature on the relationships among transportation, land use, and physical activity. *Resource paper for TRB Special Report 282: Does the built environment influence physical activity? Examining the evidence*. Washington, DC: Transportation Research Board and Institute of Medicine Committee on Physical Activity, Health, Transportation, and Land Use; 2005.
23. Cohen DA, Mason K, Bedimo A, Scribner R, Basolo V, Farley TA. Neighborhood physical conditions and health. *Am J Public Health*. 2003;93(3):467–71.
24. Ross CE, Mirowsky J. Neighborhood disadvantage, disorder, and health. *J Health Soc Behav*. 2001;42(3):258–76.
25. Chandola T. The fear of crime and area differences in health. *Health Place*. 2001;7:105–16.
26. Ross CE. Fear of victimization and health. *J Quant Criminol*. 1993; 9(2):59–75.
27. Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion. *Defining Overweight and Obesity*. 2008, Available at http://www.cdc.gov/nccdphp/dnpa/obesity/defining.htm, accessed 3 November 2008.
28. Chen G, Gully SM, Eden D. Validation of a new general self efficacy scale. *Organizational Research Methods*. 2001;4(1):62–83.
29. Sampson RJ, Raudenbush S, Earls F. Neighborhoods and violent crime: a multi-level study of collective efficacy. *Science*. 1997;277: 918–924.
30. Jöreskog KG, Sörbom D. *LISREL for Windows [Computer Software]*. Lincolnwood, IL: Scientific Software International, Inc; 2006.
31. Jöreskog KG, Sörbom D, Du Toit S, Du Toit M. *LISREL 8: New Statistical Features. Third Printing with Revisions*. Chicago: Scientific Software International; 2001.
32. Finney SJ, DiStefano C. Non-normal and categorical data in structural equation modeling. In: Hancock GR, Mueller RO, editors. *Structural Equation Modeling: A Second Course*. Greenwood, CT: Information Age Publishing, Inc; 2006, pp. 269–314.
33. Satorra A, Bentler PM. Corrections to test statistics and standard errors in covariance structure analysis. In: von Eye A, Clogg CC, editors. *Latent Variables Analysis: Applications for Developmental Research*. Thousand Oaks, CA: Sage; 1994, pp. 399–419.

34. Ohlin B, Nilsson PM, Nilsson JA, Berglund G. Chronic psychosocial stress predicts long-term cardiovascular morbidity and mortality in middle-aged men. *Eur Heart J*. 2004;25(10):867–73.
35. Kawachi I, Berkman LF. Social cohesion, social capital, and health. In: Berkman LF, Kawachi I, editors. *Social Epidemiology*. New York: Oxford University Press; 2000, pp. 174–90.