

Neighborhood Physical Conditions and Health

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We give shape to our buildings, and they in turn shape us.

Winston Churchill, in a 1943 speech
to the House of Commons

In a substantial body of work, Wallace and colleagues have identified the deterioration of inner cities as contributing to the spread of HIV and tuberculosis, violence, and a variety of health disparities.^{1–4} These studies highlight the potential importance of the physical environment in influencing health. The physical aspects of a neighborhood create opportunities for people to interact and to informally monitor one another's behavior. Neighborhoods are where people exercise and purchase their foodstuffs and other consumer products (including illegal substances). Local neighborhood resources are likely to be more important for persons of lower income, because more affluent people have greater mobility, allowing them to travel farther to obtain healthful products as well as social support.

Causal relationships are believed to exist between crime and the appearance and design of buildings and streets.^{5–7} Physical structures apparently provide cues to potential criminals as to whether they can behave criminally without being apprehended. Cues from the physical environment that influence criminal behavior come from entire neighborhoods, city blocks, buildings, and portions of buildings. For example, high-rise housing projects experience more crime than low-rise housing projects in a linear fashion—the higher the building, the higher the crime rate.⁸

When buildings have more than 50 apartments, residents often treat each other as strangers. This makes them more vulnerable to crime, as residents are less likely to challenge criminals when they enter the building.⁹ Houses are more likely to be burglarized if they are in areas with higher speed limits and have fewer fences or other barriers, fewer signs of being occupied, and less visual access to neighboring homes.⁸ Although no random-

Objectives. We explored the relationship between boarded-up housing and rates of gonorrhea and premature mortality.

Methods. In this ecological study of 107 US cities, we developed several models predicting rates of gonorrhea and premature death before age 65 from all causes and from specific causes. We controlled for race, poverty, education, population change, and health insurance coverage.

Results. Boarded-up housing remained a predictor of gonorrhea rates, all-cause premature mortality, and premature mortality due to malignant neoplasms, diabetes, homicide, and suicide after control for sociodemographic factors.

Conclusions. Boarded-up housing may be related to mortality risk because of its potential adverse impact on social relationships and opportunities to engage in healthful behaviors. Neighborhood physical conditions deserve further consideration as a potential global factor influencing health and well-being. (*Am J Public Health.* 2003;93:467–471)

ized controlled studies have irrefutably proven a link between crime and the condition of the environment, the possibility of such a link has spawned a movement to prevent crime through environmental controls, such as removing graffiti, trash on the street, and abandoned cars—the so-called broken windows approach to crime prevention.

There is some evidence that the physical environment has other effects on health and well-being, including effects on mental health and child development. A study examining the emotional adjustment of children aged 9 to 11 years indicated that children living on commercial streets in inner-city neighborhoods were more lonely, fearful, and unhappy than their counterparts in strictly residential neighborhoods, after family composition and social class were controlled.¹⁰ In another study, adolescents who lived in neighborhoods that were considered dangerous and were marked by graffiti, low residential stability, and low socioeconomic status had higher levels of depression, anxiety, and conduct disorders than those from more ordered neighborhoods, even after controlling for socioeconomic status.¹¹ Opportunities for social interaction and physical activity, as well as cues from the environment, may trigger a variety of emotional responses and either facilitate or reduce health-related behaviors such as exercising, indulging in substance use, and maintaining a healthy diet.

Architectural design is also known to affect the type and number of social networks a person might have through the opportunities it affords (or fails to afford) to interact with others. One study comparing dormitory designs showed that students living in a building with a central access area developed more extensive social networks than students living in dormitories with more isolated entryways.¹² A study of residents in the Washington Heights section of New York indicated that a deteriorated neighborhood interfered with the community's ability to organize and form relationships.¹³

Maintaining social relationships (including social and support networks) and a sense of social trust is believed to significantly influence health outcomes.^{14,15} It is certainly plausible that if physical structures increase criminal behavior either directly by increasing opportunities to commit crime or indirectly by limiting informal social controls, physical structures may also influence social controls and social relationships related to health behaviors. Figure 1 illustrates how the relationship between the social and physical environments may affect health by inhibiting or facilitating risk-taking behavior, by influencing social relationships, and by exposing residents to visual cues that can arouse fear, anxiety, and depression.

In an earlier study in New Orleans, we found that gonorrhea rates were associated with degree of neighborhood deterioration at

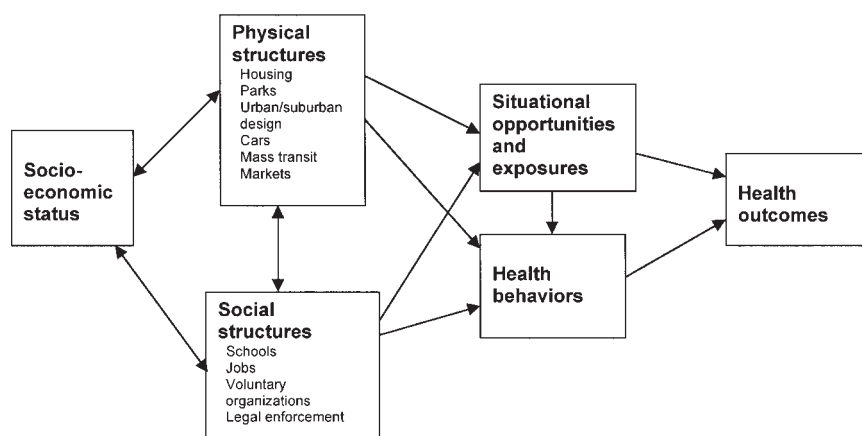


FIGURE 1—Environmental influences on health.

the level of the census block group.¹⁶ To further investigate the generalizability of the relationship between the physical environment and health, we conducted an ecological study of the relationship between neighborhood deterioration and health in 107 US cities.

METHODS

In its decennial census, the US Census Bureau categorizes the status of houses that are vacant.¹⁷ A vacant house was considered “boarded-up” if there were physical signs that the house was not habitable, such as boards secured over doors and windows. In most cases, such housing units were visibly deteriorated. In a 1997 study, we documented neighborhood deterioration with a “broken windows index,” which scored the appearance of homes and quantified the presence of graffiti, trash, and abandoned cars in block groups.¹⁶ The 1990 US census measure of boarded-up units per square mile in New Orleans was highly correlated with our broken windows index.¹⁸ Therefore, we consider the US census measure of boarded-up houses to be a relatively good proxy for neighborhood deterioration.

The sample population and units of analysis used for this study were all 107 US cities with populations over 150 000. All predictor variables, except for the percentage of the population that was uninsured, were obtained from the 1990 US census.¹⁷ We obtained the percentage uninsured from the 1990 US Current Population Survey, which provides data on the

metropolitan statistical areas.¹⁹ We obtained gonorrhea rates for 63 cities from the Centers for Disease Control and Prevention²⁰ and mortality data from the National Center for Health Statistics. We included only premature deaths, defined as deaths before the age of 65.

We calculated mortality rates with 1990 census population denominators. Mortality rates were adjusted for age with the direct method. We studied total premature deaths, as well as those due to the following specific causes: cardiovascular disease, malignant neoplasms, diabetes, homicide, suicide, asthma, pneumonia/influenza, and injuries (excluding motor vehicle fatalities). In our cause-specific analyses, we included only the cause of death listed as being primary.

The predictor variables and covariates included were (1) percentage Black, (2) percentage of persons older than 15 years who were

married, (3) percentage of persons aged 18 years or older with less than a high school education, (4) percentage of housing units that were boarded up, (5) percentage population change from 1980 to 1990, (6) percentage of persons with no health insurance, and (7) a poverty index assessing percentage in poverty and percentage unemployed (of those in the labor force). The 2 measures of poverty, percentage in poverty and percentage unemployed, were combined into a single index, because they had a high degree of correlation (.885).

Before performing regression analyses, we examined bivariate correlations and checked the variables for linearity and normality. We transformed all variables to reduce problems that might arise due to skewness or to differences in units of the variables. For all models, we obtained collinearity diagnostics. Despite relatively high bivariate correlations, tolerance estimates for all predictors were less than 0.10, and condition indexes were less than 30, indicating no serious collinearity problems.

RESULTS

Table 1 describes the demographic characteristics of the 107 US cities with populations over 150 000 in 1990. Among the cities, a mean of .709 per 1000 units were “boarded up,” with a range from less than .02 per 1000 to 3.61 per 1000.

Table 2 lists correlations between city-level variables and 2 health outcomes: all-cause age-adjusted premature mortality and gonorrhea. All predictors were strongly correlated with age-adjusted premature mortality, and all

TABLE 1—Demographic Data on 107 US Cities

	Mean	SD	Minimum	Maximum
1990 population	493 476	812 742	143 485	7 322 564
Percentage Black	23.14	17.78	1.32	75.67
Percentage married	50.13	6.40	35.00	63.77
Percentage in poverty	17.56	5.69	4.25	32.41
Percentage with less than high school education	9.14	4.97	2.35	31.92
Percentage unemployed	7.45	2.52	2.80	19.67
Boarded-up units per 1000	0.709	0.657	0.02	3.61
Percentage population change from 1980 to 1990	11.00	19.72	-16.41	89.53
Percentage uninsured	14.33	5.64	5.00	29.70

Note. Data are from the 1990 US Census.¹⁷

TABLE 2—Correlations Between Demographics, Gonorrhea, and Age-Adjusted Premature Mortality Rate, 1990^a

	1990 Gonorrhea Rate (P)	1990 Premature Mortality Rate (P)
Percentage Black	.87 (.000)	.68 (.000)
Percentage married	-.64 (.000)	-.63 (.000)
Percentage in poverty	.43 (.000)	.70 (.000)
Percentage with less than high school education	.03 (.841)	.56 (.000)
Percentage unemployed	.39 (.002)	.63 (.000)
Boarded-up units per 1000	.65 (.000)	.63 (.000)
Percentage population change from 1980 to 1990	-.61 (.000)	-.56 (.000)
Percentage uninsured	-.24 (.063)	.005 (.961)

^aCorrelations refer to the transformed variables used in the regression analysis. Most variables were log-transformed to reduce skewness.

TABLE 3—Predictors of Age-Adjusted Premature Death Rate by City, 1990

Variables	Model 1 (P)	Model 2 (P)	Model 3 (P)	Model 4 (P)
Percentage Black	.381 (.000)	.308 (.000)	.331 (.000)	.349 (.000)
Percentage married	-.224 (.002)	-.228 (.001)	-.265 (.001)	-.208 (.009)
Percentage with less than high school education	.291 (.000)	.325 (.000)	.318 (.000)	.395 (.000)
Percentage in poverty/unemployed	.190 (.036)	.084 (.394)	.108 (.278)	.113 (.262)
Boarded-up units per 1000	...	.190 (.018)	.204 (.012)	.221 (.007)
Percentage population change from 1980 to 1990	...	...	.102 (.223)	.143 (.123)
Percentage uninsured	...	...	...	-.139 (.048)
N	107	107	107	105
R ²	.698	.715	.719	.729

except education were strongly correlated with gonorrhea in expected directions.

Table 3 shows a series of linear regression models predicting age-adjusted premature mortality. Model 1 examined the independent

associations of percentage Black, the poverty index, percentage married, and percentage with less than a high school education. In model 2, number of boarded-up housing units per 1000 was added. Because of the possibility

that boarded-up housing is simply a marker for an exodus of healthy people, model 3 included population change between 1980 and 1990. To address the possibility that access to medical care contributed to premature mortality, we added percentage of persons without medical insurance in model 4. In all models, boarded-up housing remained a significant predictor of all-cause premature mortality.

We constructed similar models for gonorrhea rates and 8 cause-specific premature mortality outcomes (Table 4). For all outcomes, models including all the predictors explained more variance than any of the models with fewer predictors; thus, only these full models are shown.

For gonorrhea rates, the only statistically significant predictors were percentage Black, number of boarded-up housing units, and percentage married. Percentage Black was consistently associated with most mortality outcomes (the exceptions were asthma and injuries), whereas percentage married had only inconsistent associations with mortality outcomes. The percentage of the population with less than a high school education was positively associated with higher premature mortality due to chronic diseases, homicide, and pneumonia/influenza, but was not positively associated with higher premature mortality due to injuries. Interestingly, poverty was independently associated with premature mortality from asthma, but not with death from any other cause. The percentage population change was positively associated with homi-

TABLE 4—Predictors of Gonorrhea and Cause-Specific Age-Adjusted Premature Mortality, 1990

Variables	Gonorrhea (P)	Cardiovascular Disease (P)	Malignant Neoplasms (P)	Diabetes (P)	Homicide (P)	Suicide (P)	Pneumonia/Influenza (P)	Asthma (P)	Injuries (P)
Percentage Black	.742 (.000)	.483 (.000)	.277 (.011)	.368 (.001)	.504 (.000)	-.413 (.004)	.247 (.040)	.215 (.123)	.043 (.752)
Percentage married	-.180 (.031)	.142 (.094)	.084 (.430)	.227 (.032)	-.172 (.010)	-.018 (.898)	-.103 (.385)	-.014 (.921)	-.086 (.520)
Percentage with less than high school education	-.134 (.093)	.416 (.000)	.313 (.005)	.180 (.092)	.410 (.000)	-.169 (.238)	.344 (.005)	-.061 (.662)	.087 (.521)
Percentage in poverty/unemployed	-.181 (.086)	-.004 (.968)	-.033 (.808)	.091 (.496)	-.011 (.900)	.036 (.843)	.101 (.502)	.490 (.006)	.310 (.070)
Boarded-up units per 1000	.239 (.007)	.162 (.063)	.280 (.011)	.257 (.018)	.327 (.000)	.354 (.015)	.114 (.346)	-.177 (.210)	.131 (.336)
Percentage population change from 1980 to 1990	.021 (.838)	-.157 (.115)	-.165 (.187)	-.190 (.123)	.274 (.001)	.029 (.862)	.073 (.599)	.125 (.436)	.089 (.570)
Percentage uninsured	-.062 (.450)	-.215 (.005)	-.211 (.026)	-.085 (.360)	.076 (.196)	-.073 (.557)	-.093 (.371)	-.029 (.809)	-.078 (.508)
N	62	105	105	105	105	105	105	105	105
R ²	.841	.689	.505	.523	.809	.137	.392	.178	.227 (.309 ^b)

^bR² if outliers (Bakersfield and San Francisco, Calif) are omitted.

cide; that is, higher rates of homicide occurred in cities that grew the most. Otherwise, percentage population change was not associated with premature mortality. The number of boarded-up units was positively associated with gonorrhea and premature mortality due to malignant neoplasms, diabetes, homicide, and suicide. The association with cardiovascular diseases did not quite reach statistical significance ($P=.063$). Boarded-up housing was not associated with premature mortality due to pneumonia/influenza, asthma, or injuries. Models predicting suicide and these latter outcomes did not fit the data well and explained less than 40% of the variance.

CONCLUSIONS

We found that neighborhood physical deterioration, as measured by the presence of boarded-up vacant housing units, was associated with premature mortality from all causes and from several specific causes and with morbidity from sexually transmitted diseases after control for other known socioeconomic correlates of these outcomes. It is possible that in our data, boarded-up housing served merely as a proxy measure for neighborhood socioeconomic status and that its association with mortality was capturing only the recognized relationship between disease and socioeconomic status. However, the relationship between boarded-up housing and health outcomes remained quite strong even in a regression model that included measures of socioeconomic status (income, education, and employment) as well as a measure of racial/ethnic minority status. It is therefore worth considering whether boarded-up housing (or perhaps neighborhood deterioration in general) may in fact be causally related to health.

Areas with boarded-up housing are usually considered dangerous and thus generate fear among residents and outsiders alike, thus contributing to social isolation.²¹ Fewer commercial businesses may be conveniently accessible, either as a result of lower demand or because fearful business owners would prefer to locate elsewhere. Consequently, the residents of these neighborhoods may not adopt healthful behaviors that could otherwise protect them against heart disease, cancer, and diabetes, simply because they do not have access to nutritious

foods or opportunities to exercise.²² In areas with boarded-up housing, fresh fruits and vegetables may be less available because of lower density of markets per household. In addition, low-fat foods may be more expensive in deteriorated neighborhoods.²³ Exercise may not be feasible, given ambient dangers. The association between abandoned housing and homicide is not surprising, given that areas with abandoned housing are likely to be subject to less frequent natural surveillance by residents and to contain fewer legitimate street activities, both of which might otherwise constrain antisocial behaviors.^{5,6,24}

African American race was independently associated with most cause-specific premature mortality outcomes, even after adjustment for poverty, education, employment, and abandoned housing. The subject of racial disparities in health has been studied extensively; the causes are complex and incompletely understood.^{25,26} In our analysis, it is likely that there are unmeasured variables that account for this association. Studies have documented that neighborhoods with a high percentage of African Americans have an overconcentration of alcohol outlets,²⁷ fewer institutional resources,²⁸ and lower levels of social capital^{29,30} and collective efficacy,³¹ factors that are not directly measured in this study. All of these factors are associated with violence and poor health outcomes.^{11,12,29,32}

The relationship between the physical conditions in which people live and the maintenance of social connections and social controls has also been noted in other areas, such as criminal justice. Kawachi and colleagues suggested that crime and population health share the same social origins.³² A significant portion of serious crime is considered adventitious—that is, dependent on the opportunity provided by surroundings—rather than the result of social forces or personal failings.^{5,32} So, too, are many health behaviors adventitious. Whether one contracts a communicable disease is more related to the infection rate in the community than to any individual behavior.^{33,34} Whether a person eats healthful food often depends on convenience and price³⁵ (consider, for example, the popularity of fast food). Whether children exercise may depend on how close they live to a playground.³⁶ And whether teens engage in sex or substance use may depend on

the amount of unsupervised time.³⁷ Physical conditions are not merely a consequence of social structures³⁸; rather, they are likely to be in dynamic relationship with social structures and may facilitate or constrain cooperation, supervision, and feedback, all of which are critical to the adoption of low-risk health behaviors.

An alternative explanation for the association between boarded-up housing and premature mortality is that perhaps the healthiest people have moved out of the neighborhood, leaving a concentration of the sickest individuals. Although we tried to control for this possibility by including the change in population over the previous 10-year period in the multivariate analysis, it might not have been entirely addressed by this procedure. Similar concerns have arisen in the area of crime; some claim that environmentally focused crime control measures merely displace crime to another area. Yet theorists have suggested that crime is not fully displaced. When a gang is broken up, its members commit fewer crimes on their own than in a group. For other types of crime, such as drug dealing, the infrastructure that supports crime in one neighborhood often cannot be easily transferred to another.²⁴

Other limitations of our data are the use of metropolitan statistical area-level insurance data to substitute for city-level data, the collinear nature of the predictor variables, and the relatively small number of cities in the analyses.

We chose a parsimonious model primarily to determine whether a measure of the physical environment had an independent effect on premature mortality. Because the models that included boarded-up housing appeared to have an independent contribution to the outcomes and explained a large amount of the variance in the outcomes, we are confident that the association is not spurious. The city-level unit of analysis restricts the sample size; thus, future studies should explore these associations at the census tract level, at which the larger number of units will provide greater power.

Historically, housing conditions have been associated with health outcomes; yet, research in this area declined after the major problems associated with poor housing—such as crowding, poor ventilation, and lack of plumbing, sewage controls, and clean water—were addressed through slum clearance and the development of housing projects. In 1 recent study,

however, homeownership was negatively associated with mortality, whereas the presence of plumbing and heating were not associated with mortality.³⁹ Homeownership is likely to contribute to neighborhood stability and stronger social controls.

Wilson and Kelling,²⁴ proponents of the broken windows approach to crime prevention, posited that the principal threats to public order and safety come from collective sources and generalized problems, not from specific incidents. Accordingly, they advocated a community-oriented approach to policing rather than an individual approach of responding to crimes as they occur. Similarly, the growing public health movement to examine community and environmental determinants of health may be exactly what is needed to improve health and well-being at the population level. Our study suggests that 1 of the factors that should be considered in attempting to improve the health of communities is the level of physical deterioration of neighborhood buildings. ■

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Contributors

D.A. Cohen, R. Scribner, and T.A. Farley contributed to the study design, data interpretation, and article preparation. K. Mason contributed to the study design and article preparation and performed the data analysis. V. Basolo and A. Bedimo contributed to the data interpretation and article preparation.

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Human Participant Protection

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