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Explaining variation in health status across space and time: implications for racial and ethnic disparities in self-rated health

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Abstract

We use the Metropolitan Community Information Center-Metro Survey—a serial cross section of adults residing in the City of Chicago, USA, conducted from 1991 through 1999—in combination with 1990 census data to simultaneously examine the extent to which self-rated health varies across Chicago neighborhoods and across time. Three-level hierarchical logit models are employed to decompose individual, spatial, and temporal variance in self-rated health. Results indicate that variation in self-rated health across neighborhoods is explained, in part, by variation in the level of neighborhood affluence. Neighborhood level poverty, however, is not a significant predictor of self-rated health. Community level affluence, moreover, accounts for a substantial proportion of the residual health deficit experienced by African-Americans when compared with Whites (after controlling for individual level SES). The effects of affluence hold when controlling for spatial autocorrelation and when considered in primarily African-American neighborhoods. Findings also indicate that individuals living in the City of Chicago became significantly healthier over the decade of the 1990s, and that this improvement in health is explained largely by the increasing education and income levels of Chicago residents.

Keywords: Self-rated health; Neighborhood effects; USA

Research on the relationship between neighborhood context and health outcomes has added important insight into the origins of racial disparities in health and well-being. Recent evidence suggests that persistent racial differences in health outcomes (e.g., heart disease (Leclere, Rogers, & Peters, 1998)) may be explained, in part, by disparities in socioeconomic context (Robert, 1999). These findings draw attention to the importance of health-relevant resources in the environment in redressing persistent gaps in health outcomes across social groups. To date, however, most research on community context and health has examined the effect of poverty concentration without considering the role of affluence or other potentially relevant structural dimensions of the neighborhood. Moreover, investigation of the social and behavioral determinants of health outcomes tends to ignore the spatial and temporal context of urban neighborhoods.

Drawing on recent neighborhood theory to identify potentially health-relevant dimensions of community context, we test a number of hypotheses regarding the distribution of health across urban neighborhoods. Rooted in Wilson's theory of neighborhood decline (Wilson, 1987; Wilson, 1996) and collective efficacy theory (Sampson, Raudenbush, & Earls, 1997), our approach emphasizes aspects of neighborhood structure that contribute to the social organizational and mobilization capacity of urban residents (Browning & Cagney, 2002). Specifically, we suggest that the health-relevant resource potential of a community is captured by the presence of affluent residents as well as the degree of residential stability and ethnic homogeneity characterizing the neighborhood. In contrast to "epidemic" or "contagion" models of neighborhood influence that

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focus on the transmission of detrimental health behaviors in contexts where *poverty is prevalent*,[1] our approach emphasizes the consequences of critical economic and social resource deficits at the community level when *affluence is scarce*. These resources may be used to provide informal health-related social support, promote community attachment and solidarity, and draw effective health-related services—such as high quality local clinics, parks and recreational spaces, and municipal attention to local hazards—to urban neighborhoods. Cagney, et al. (Cagney, Browning, & Wen, 2002) for instance, found that neighborhood affluence was significantly associated with the health of older urban residents and explained, in part, the disparity in health between African-Americans and Whites. We build on this research by considering the role of neighborhood affluence in explaining racial and ethnic health disparities for the urban adult population as a whole.

We further extend existing neighborhood effects research on health by considering the spatial and temporal context of health in urban neighborhoods. The theoretical model we develop highlights the potential consequences of the spatial clustering of urban neighborhoods with respect to key structural characteristics for the well-being of residents. Resource-poor neighborhoods surrounded by similarly disadvantaged communities may experience an exacerbating spatial penalty with respect to health outcomes. Moreover, neighborhood effects models based on contiguous area data that do not account for spatial clustering risk biased or overly precise parameter estimates. Finally, we also explore the pattern and correlates of change in neighborhood level health status during the decade of the 1990s.

We employ data from the 1990 Decennial Census in combination with serial cross-sectional data from the Metropolitan Chicago Information Center-Metro Survey to examine the structural determinants of self-rated health in an urban American context. In order of presentation, we consider (1) the extent to which self-rated health within urban neighborhoods changed over the 1990s, in what direction, and the factors that account for this change, (2) the neighborhood structural determinants of health—including poverty, affluence, residential stability, and ethnic heterogeneity—that may explain variation in health status across neighborhoods and account for racial disparities in self-rated health at the individual level, and (3) the degree to which spatial proximity to unhealthy and structurally disadvantaged neighborhoods independently affects health status. Our analysis of spatial proximity also assesses the robustness of the structural effects we observe when accounting for spatial autocorrelation both generally and in predominantly African-American neighborhoods.

Theoretical background

Neighborhood structural context and health

In what follows, we develop a theoretical model that articulates the role of neighborhood socioeconomic resources in contributing to the health of urban residents above and beyond individual socioeconomic status. As noted, we emphasize the macro-level presence of resources as the critical structural antecedent in the link between neighborhood context and health. This theoretical focus is distinguished from the typical emphasis on the prevalence of disadvantage. We root this focus in Wilson's conceptual model of urban change during the last several decades and his discussion of the consequences of these processes for urban residents in the United States—particularly African-Americans. We then describe the relevance of Wilson's insights to health, and suggest that attention to neighborhood resources may add insight into persistent racial and ethnic gaps in health.

Changes in the spatial concentration and severity of poverty over the last four decades have been tracked with growing concern among sociologists and policy-makers. Research interest in this trend was given impetus by the agenda developed in William Julius Wilson's *The Truly Disadvantaged* (1987) and the ongoing debate regarding the causes and consequences of urban poverty (Massey & Denton, 1993). In Wilson's view, the origins of the increasingly concentrated poverty and dislocation observed in many major urban centers during the 1970s and 1980s can be traced to a number of broader sociodemographic and economic shifts. Fundamentally, the transformation of the US economy from a primarily manufacturing to a service-oriented economy has adversely affected the life chances of inner-city residents. The diminished availability of lower-skilled, blue-collar jobs, the increasing educational requirements for employment in the fastest growing sectors of the economy, and the suburbanization of employment opportunities have contributed to a decline in both the real wages of inner-city residents and their rates of labor force participation.

The changing demographic composition of inner-city neighborhoods has aggravated the conditions induced by broader economic shifts. The mobility of middle and working class African-American families and older residents out of inner-city neighborhoods has left an increasingly poor, jobless, and young population in their wake. In the face of declining resources, opportunities, and the decreasing availability of conventional role models, residents of disadvantaged communities have

[1] See Fitzpatrick and LaGory (2000) for a discussion of subcultural approaches to health.

found the task of sustaining foundational social and cultural institutions (e.g., churches, voluntary organizations, and the family) progressively more difficult. Indeed, by 1980, the downward spiral of poor African American neighborhoods led to such glaring discrepancies in ecological contexts by race that the most disadvantaged white neighborhoods were significantly better off with respect to poverty and family disruption than the average African-American context (Sampson & Wilson, 1995).

Wilson's emphasis on the presence of relatively affluent residents in urban neighborhoods is an important feature of his theoretical framework. In this view, the absence of a stabilizing middle-class population is one of the critical factors contributing to decline in the economic, institutional, and social infrastructure of inner-city neighborhoods. Not only are schools, churches, and voluntary organizations at risk, but informal friendship and acquaintanceship networks are threatened as well, weakening the community's capacity to mobilize on its own behalf to achieve valued collective goals. Consonant with Wilson's emphasis on the benefits of economic heterogeneity for urban communities, recent contributions to neighborhood theory and research have stressed the critical role of neighborhood affluence in generating the social conditions that support community social organization and mobilization capacity—described by Sampson and colleagues as ''collective efficacy'' (Sampson, Morenoff, & Earls, 1999).

The specific mechanisms through which collective efficacy may contribute to health include the social control of health-related behaviors, access to services and amenities, the management of neighborhood physical hazards, and psychosocial processes (Kawachi & Berkman, 2000). First, collective efficacy contributes to the regulation of local violence (Sampson et al., 1997) and may help limit problem behaviors more generally, including illicit substance use, alcohol abuse, child and elder neglect/abuse, and reckless behavior. Second, communities with more economic resources and higher levels of collective efficacy are potentially more effective at drawing and maintaining health-relevant services such as recreational space and community health clinics. Third, neighborhoods are the potential source of a number of physical hazards including decaying infrastructure (e.g., poorly maintained sidewalks and streets) and housing stock (e.g., dilapidated or abandoned buildings). These problems may be addressed more effectively in neighborhoods with high levels of affluence and social organization through the solicitation of external resources to correct potentially risky conditions and through rigorous monitoring of neighborhood hazards and vulnerable residents (e.g., the elderly). Finally, psychosocial processes such as the effect of a trusting and trustworthy environment on factors such as fear and self-respect may improve the health and well-being of residents in affluent and socially organized neighborhoods (Kawachi & Berkman, 2000).

In an attempt to capture the effects of neighborhood context on health, however, most research has focused on the concentration or prevalence of disadvantage. Findings from this line of research are mixed. A number of studies have found significant effects of poverty/disadvantage measures on health outcomes apart from the contribution of individual level SES (Davey Smith et al., 1998; Diez-Roux et al., 1997; Haan, Kaplan, & Camacho, 1987; Humphreys & Carr-Hill, 1991; Jones & Duncan, 1995; Krieger, 1992; LeClere et al., 1997; Waitzman & Smith, 1998; Yen & Kaplan, 1999). Some studies, however, have found negligible or insignificant effects of disadvantage-prevalence measures. Sloggett and Joshi (1994) found that the excess mortality associated with residence in areas designated as deprived by census-based indicators is wholly explained by the concentration in those areas of poor people. Duncan et al., found little unique impact of area level deprivation on health-related behavior (Duncan, Jones, & Moon, 1993) or psychiatric morbidity (Duncan, Jones, & Moon, 1995). Browning and Cagney (2002) found no direct effect of concentrated disadvantage on self-rated physical health after controlling individual level SES. Inconsistency in the effect of neighborhood poverty/disadvantage measures on health may be due, in part, to variation in the outcomes considered (e.g, morbidity vs. mortality). Nevertheless, the relatively exclusive focus on poverty/disadvantage may not be theoretically justified.

In contrast, relatively little attention has been paid to the effects of affluence in the literature on neighborhood and health. Cagney et al. (2002) found that a measure of the proportion of households with incomes $50,000 or greater was positively associated with self-rated health and significantly attenuated the race difference in self-rated health in a sample of elderly residents in Chicago. Neighborhood poverty, however, was not a significant predictor of health in their analyses. Robert (1998) found that the percentage of families earning $30,000 or more was a significant predictor of chronic conditions after accounting for individual- and family level socioeconomic status (1998). These findings call into question the dominant focus on the prevalence of poverty and disadvantage in neighborhood effects research on health. Recent investigations of outcomes such as violence (Morenoff, Sampson, & Raudenbush, 2001) and early child development (Chase-Lansdale, Gordon, Brooks-Gunn, & Klebanov, 1997) have also highlighted the importance of the presence of affluent residents at the neighborhood level, suggesting that the benefits of affluence may generalize to outcomes beyond traditional measures of health. While the empirical investigation of variation in the availability of resources among neighborhood residents (as opposed to the severity of their absence) is relatively new, this line of research is arguably more reflective of Wilson's original theoretical model.

Other structural characteristics of communities may also be relevant in generating the conditions under which neighborhoods maximize mobilization capacity. The stability of neighborhood residents in the community has been hypothesized to be an important determinant of neighborhood social network formation and organizational participation (Kasarda & Janowitz, 1974). Similarly, the degree of ethnic and racial heterogeneity has been identified as potentially inhibiting communication across social groups—resulting in lower levels of commitment to the neighborhood and a diminished capacity for recognition and mobilization on behalf of shared neighborhood goals (Sampson et al., 1997; Shaw & McKay, 1969). In analyses below, we examine the extent to which these neighborhood structural characteristics—poverty, affluence, residential stability, and ethnic heterogeneity—contribute to our understanding of spatial variations in the health of urban adults.

The spatial clustering of urban neighborhoods

Wilson's emphasis on the potential benefits of economic heterogeneity also highlights the role of proximate neighborhoods in contributing to individual well-being. Specifically, the concept of *social isolation* captures the implications of economic and social resource-absence in both the immediate neighborhood environment and the larger context of adjoining neighborhoods. With respect to health outcomes, the detrimental impact of internal resource deficits may be compounded by spatial proximity to comparable neighborhoods. Similarly, the negative impact of poor health services and health-relevant amenities within one's own neighborhood may be partially offset by the advantages provided by a nearby resource-endowed neighborhood.

These observations suggest that neighborhoods, like individuals, should not be considered in isolation from their larger context. Both Wilson (1987, 1996) and Massey and Denton (1993) have observed the spatial clustering of neighborhoods characterized by limited access to resources and conventional institutions, suggesting the potential for spatial dependencies in the effects of neighborhoods on well-being. In analyses of violence in Chicago, for instance, Morenoff et al. (2001) found that levels of homicide in contiguous neighborhoods independently contributed to homicide rates in the focal neighborhood, above and beyond internal community characteristics. A similarly robust spatial dependency was found in analyses of neighborhood collective efficacy.

Failure to account for the spatial clustering of neighborhoods may also have serious statistical implications for models of neighborhood effects on health. Recent evidence suggests that a number of health outcomes in contiguous small areas may be spatially autocorrelated (see Analytic Strategy below for a more extensive discussion of the consequences of spatial autocorrelation for statistical models of area effects). Studies of specific health outcomes have observed spatial autocorrelation in analyses of mortality (Lorant, Thomas, Deliége, & Tonglet, 2001), cancer incidence (Stam-Moraga et al., 1998; Thouez, Emard, Beaupre, Latreille, & Ghadirian, 1997; Walter et al., 1994), lead poisoning (Griffith, Doyle, Wheeler, & Johnson, 1998), and asthma (Hsiao, 2000). Thus theoretical developments in urban research and accumulating empirical evidence suggest the importance of considering context beyond neighborhood boundaries in affecting health outcomes.

Research on race, SES, and health status

Wilson's conceptualization of neighborhood structural heterogeneity has important implications for individual health and well-being. While racial differences in health may be a function of the association between race and individual level SES, neighborhood environment may uniquely contribute to racial disparities. At the individual level, research exploring racial and socioeconomic disparities in health is voluminous and documents consistent and quite striking differences across social class and race/ethnic groupings. In short, African-Americans and Latinos experience substantial health deficits when compared with their White counterparts—disparities that have not yet been fully explained (House & Williams, 2000; Williams & Collins, 1995). The well-established SES gradient in health—an empirical regularity of remarkable consistency—has been advanced as an explanation for persisting race/ethnic health gaps (Robert, 1999). Individual level SES consistently explains a significant proportion of the association between race/ethnicity and health status, including all-cause mortality (Menchik, 1993) and general health and functional status (Kington & Smith, 1997; Schoenbaum & Waidman, 1997; Smith & Kington, 1997). However, many studies report an unexplained health differential between African Americans and Whites (the most commonly explored racial/ethnic gap), net of SES (House & Williams, 2000; Lillie-Blanton, Parsons, Gayle, & Dievler, 1996; Williams & Collins, 1995). These studies highlight the limitations of exclusively individual level models in accounting for racial disparities in health.

In sum, neighborhood effects research on health outcomes has emphasized the detrimental effects of concentrated disadvantage to the exclusion of other potentially relevant structural characteristics of urban neighborhoods. Most notably, variation in the presence of middle and upper-middle class residents may have important implications for the capacity of urban neighborhoods to promote health. Below, we examine the impact of structural factors on self-rated health in a large sample of urban residents, simultaneously exploring change in neighborhood health status over time and the implications of structural context for racial disparities in health. Finally, we consider the potential for spatial dependence in health outcomes among proximate neighborhoods.

Data and methods

We use two data sources in this analysis: the 1990 Decennial Census and the 1991–1999 Metropolitan Chicago Information Center Metro Survey (MCIC-MS). Neighborhood structural characteristics are constructed from census data and include measures of poverty, affluence, residential stability, and immigrant concentration (described below). Neighborhood measures are constructed for 342 "Neighborhood clusters" (NCs)—aggregations of two to three census tracts designed to more accurately represent the practical and ecological boundaries of Chicago neighborhoods. NCs were designed to maintain relative population homogeneity with respect to racial/ethnic, socioeconomic, housing, and family structure characteristics (NCs average roughly 8000 people). NCs were also defined on the basis of ecologically meaningful boundaries such as railroad tracks and freeways (Earls & Buka, 1997).

MCIC-MS

The dependent variable and individual level predictors are drawn from the MCIC-MS. The MCIC-MS is a serial cross-section of adults (ages $\geqslant 18$) who reside in the six county metropolitan Chicago area (we focus on the City of Chicago sample only—$N = 8706$ pooling the nine waves used in the analysis).[2] The MCIC-MS contains demographic background, health, and well-being assessments, including a measure of self-rated health. The self-rated health question was administered every year from 1991 to 1999 providing an opportunity to assess changes in the overall health status of Chicago neighborhoods over the decade of the 1990s. The MCIC-MS sample represents the racial and ethnic composition of the City of Chicago population relatively closely when compared with data from the 1990 census. The proportions of Whites (including "other" racial categories), African-Americans, and Latinos (18 or over) living in the city in 1990 based on census data (0.434, 0.387, and 0.179, respectively) were only nominally different from data taken from the MCIC-MS for 1991-95 (0.431, 0.403, and 0.157, respectively).

Dependent measure

Our dependent variable is a measure of self-rated health, considered a robust assessment of general health status (Goldstein, Siegel, & Boyer, 1984; Wilson & Kaplan, 1995). The validity of self-rated health as a predictor of mortality (Benyamini & Idler, 1999; Idler & Benyamini, 1997; Idler & Angel, 1990; Kaplan et al., 1988), morbidity (Ferraro, Farmer, & Wybraniec, 1997), and subsequent disability (Idler & Kasl, 1995; Kaplan & Keil, 1993) and health care utilization (Malmstrom, Sundquist, & Johansson, 1999) has been widely documented. Although validity assessments of the self-rated health measure across dimensions such as gender, race and ethnicity still merit further exploration (Idler & Benyamini, 1997), initial investigations indicate that its predictive capacity is comparable for Latinos, African Americans and Whites (Finch, Hummer, Reindel, & Vega, 2002; Gibson, 1991; Johnson & Wolinsky, 1994). The MCIC-MS asks "In general, would you say your health is: excellent, good, fair or poor?" We treat self-rated health as a dichotomous indicator (1 = "fair" or "poor" self-rated health; 0 = "excellent" or "good" self-rated health).[3] Of whites, 16.0% reported fair or poor health compared with 26.8% of African-Americans and 28.9% of Latinos.

Independent measures

We constructed measures of neighborhood level social composition from the 1990 decennial census. In operationalizing economic structure, we chose to focus on the prevalence of lower and middle/upper middle class residents as defined by income. For the purposes of a comparative analysis, this approach allows for an assessment of concentrations in the upper and lower tails of a single dimension.[4] *Poverty* was operationalized as the proportion of neighborhood residents with incomes below the poverty line in 1990 (mean = 0.227,

[2] The response rate for the MCIC-MS was approximately 55 percent across the nine cross-sectional samples.

[3] We also refer to "fair or poor" health as "poor" health in the discussion to follow.

[4] The well-known problem of collinearity among macro-level indicators of socioeconomic status, including income, education, and occupation status, renders their unique effects difficult to assess in multivariate models. This problem has led some to argue for the use of factor analytic approaches—a strategy we employ for the measurement of residential stability and ethnic heterogeneity. Because we are concerned with the comparative effects of poverty and affluence, however, we chose to focus on single item measures of economic status in order to avoid complicating interpretation of their relative effects on health.

standard deviation = 0.170). *Affluence* captured the percentage of households with incomes $50,000 or over (mean = 0.179, standard deviation = 0.106). A *residential stability* scale was constructed based on scores from a factor analysis of measures of housing tenure (percent living in the same house since at least 1985 [mean = 0.258, standard deviation = 0.250]) and the percent of housing occupied by owners (mean = 0.515, standard deviation = 0.119). Tapping ethnic heterogeneity in the context of Chicago, a second factor—*immigrant concentration*—was marked by high factor loadings for percent Latino (mean = 0.079, standard deviation = 0.089) and percent foreign born (mean = 0.166, standard deviation = 0.156).[5] Factor loadings exceeded 0.70 for all variables.[6] Bivariate correlations among neighborhood level variables are reported in Appendix A. As expected, the correlation between neighborhood affluence and poverty is quite high (−0.77).

Individual level variables are taken from the 1991 through 1999 waves of the MCIC-MS. Demographic background characteristics include measures of age, gender, race/ethnicity (African-American, Latino, versus White/other), marital status (married versus single or cohabiting), education level, income (in ten categories),[7] and homeownership. Means and standard deviations are reported in Table 1.

Table 1
Descriptive statistics for variables in the analysis (MCIC-MS: 1991–1999)

Variables	Mean	Standard dev.
I. *Dependent variable*		
Self-rated health		
Excellent	0.35	0.48
Good	0.43	0.49
Fair	0.18	0.38
Poor	0.05	0.21
II. *Socio-demographic background*		
Male	0.09	0.49
Age	43.13	16.16
Race		
White	0.43	0.50
African-American	0.38	0.49
Latino	0.18	0.39
Married	0.41	0.49
Income		
⩽$10,000	0.10	0.30
>$10,000-$15,000	0.08	0.27
>$15,000-$20,000	0.08	0.27
>$20,000-$25,000	0.09	0.29
>$25,000-$30,000	0.11	0.31
>$30,000-$40,000	0.18	0.38
>$40,000-$50,000	0.13	0.34
>$50,000-$70,000	0.10	0.30
>$70,000-$90,000	0.06	0.24
>$90,000	0.07	0.25
Education		
8th grade or less	0.08	0.27
9–12th grade, no diploma	0.12	0.33
High school graduate	0.17	0.38
Some college	0.33	0.47
College graduate	0.16	0.37
Graduate study or degree	0.14	0.34
Own home	0.43	0.49

Note: $N = 8706$.

Analytic strategy

We use three-level hierarchical logit models (Raudenbush & Bryk, 2002; Snijders & Bosker, 1999) in order to decompose the variance in self-rated health into individual, temporal, and spatial components. This strategy allows us to simultaneously assess the extent to which health varies across individuals (within neighborhoods and time points), time (within neighborhoods), and neighborhoods (across space). By employing a three-level approach, we also ensure that conclusions regarding neighborhood differences remain stable across time—that is, we check for variation in latent health trajectories across neighborhoods. The model can be described as follows:

$$\ln\left(\frac{\mu_{itj}}{1-\mu_{itj}}\right) = \pi_{0tj} + \sum_{p=1}^{P} \pi_p X_{pitj}$$

$$\pi_{tj0} = \beta_{00j} + \beta_{01j}(\mathrm{YEAR})_{tj} + \beta_{02j}(\mathrm{YEAR}^2)_{tj} + r_{tj}$$

$$\beta_{00j} = \delta_{000} + \sum_{q=1}^{Q} \delta_q Z_{qj} + u_{00j}$$

$$\beta_{01j} = \delta_{010} + u_{01j}$$

$$\beta_{02j} = \delta_{020} + u_{02j}$$

where μ_{itj} is the probability of fair or poor health of person i at interview year t in neighborhood j, π_{0tj} is the intercept, X_{pitj} is the value of person-level predictor p for individual i at time point t in neighborhood j, and π_p is

[5] Eigenvalues for the two factors exceeded 1.

[6] The analysis employed alpha-scoring factor analysis with an oblique rotation. Scores from principal components analyses yielded the same pattern of effects in multivariate analyses of health.

[7] Missing values for income were imputed with a multivariate prediction model. Results from models with only nonmissing data on the income variable produced the same pattern of results.

the effect of person level predictor p on individual i's expected log odds of self-rated fair or poor health. At level one, we include demographic background characteristics as described above (age, gender, race/ethnicity, marital status, education, income, and homeownership).

At level two, interview year-specific neighborhood intercepts π_{0tj} are modeled as a function of an overall neighborhood intercept β_{00j} and the linear (β_{01j}) and quadratic (β_{02j}) effects of interview year with an independently, normally distributed error term r_{tj}. Significant coefficients for interview year variables capture any linear or quadratic time trend in neighborhood health status. Identification and explanation of the time trend in health sheds light on the health dynamics of a major urban center during the 1990s and contextualizes the analyses in time (in addition to space).

At level three, neighborhood intercepts β_{00j} are modeled as a function of a grand mean δ_{000}, the effects δ_q of a series of neighborhood level predictors Z_{qj} and a neighborhood level error term u_{00j}. We also allow the neighborhood-specific linear and quadratic time trends β_{01j} and β_{02j} to vary randomly across neighborhoods. Likelihood ratio chi-square tests on the variance components for these randomly varying slopes offered no evidence of significant variation in neighborhood health trajectories suggesting that the time trend estimated at level two (reported below) effectively characterizes the rate of change in health across neighborhoods. In contrast, we did find evidence of significant variation in neighborhood health intercepts β_{00j} ($p<0.001$). These intercepts represent spatial variation in health assessed in 1995 (due to the centering of the interview year variable). The lack of variability in neighborhood health trajectories across time suggests that β_{0j} characterizes the relative health of neighborhoods across the 1990s.[8]

Spatial analyses

An often-overlooked consideration in analyses of neighborhood or community phenomena is the spatial context of the study area. The data used in the analyses to follow are drawn from 342 contiguous neighborhood clusters based on ecologically meaningful but nevertheless artificially imposed boundaries. Moreover, neighborhoods with similar characteristics tend to cluster together—a phenomenon that may indicate spatially based dependencies.

Among causes of spatial dependency are incorrect specification of the boundaries of areal units and, perhaps more importantly, the presence of spill-over effects or spatial externalities between jurisdictions (Anselin, 1988). As an example, consider two areal units with identical independent variable characteristics. The dependent variable is some socioeconomic phenomenon. The realized value of this socioeconomic variable is a function of its neighboring jurisdictions' outcomes. Thus depending on the location of the two areal units, the values of the dependent variable may be quite different, yet OLS estimation of the independent variables will not account for this difference. Cross-sectional OLS estimation that ignores the presence of true spatial dependence risks biased estimation of standard errors *as well as* regression parameters.

To test for the presence of residual spatial autocorrelation, we calculated Moran's I on the empirical bayes (EB) neighborhood level residuals from hierarchical logit models of self-rated fair or poor health fully specified at the individual level (model 4 from Table 2).[9] The test employed a first-order contiguity weight matrix.[10] The Moran I-statistic was only marginally significant ($p<0.10$), suggesting minimal spatial autocorrelation among neighborhoods with respect to self-rated health. Nevertheless, we employ a conservative strategy, assessing the robustness of the neighborhood structural effects observed in nonspatial hierarchical models in the context of controls for spatial dependence. Specifically, we estimate a mixed regressive–spatial autoregressive model of the neighborhood level

[8] Though we cannot determine whether structural characteristics of urban neighborhoods changed over the 1990s (e.g., affluence, poverty) using census data, we did examine the effects of structural characteristics on health for combined data from early (1991–1994) and later (1995–1999) years of the MCIC-MS. The effects of structural characteristics (including affluence) on health were comparable across these samples, enhancing our confidence in the results reported here.

[9] Empirical bayes residuals take into account differences in the reliability of neighborhood intercepts by regressing these intercepts toward the neighborhood grand mean by a factor proportional to the unreliability with which they have been estimated (Raudenbush & Bryk, 2002).

[10] The first stage of the spatial statistical analysis is to specify the spatial weight matrix. This matrix defines the nature of the spatial lag, or the mechanism by which phenomena are related in space. A common weight matrix definition for studies of jurisdictional data is a binary, or first-order contiguity matrix. First employed by Moran (1948), this matrix consists only of zeroes and ones. Let w_{ij} be the weight assigned to the spatial interaction between areal units i and j. Element w_{ij} of the spatial weight matrix $\mathbf{W}$ is assigned a one if and only if areal unit i and j share a common border, otherwise element w_{ij} is assigned a zero. The decision to employ a first-order contiguity weight matrix is theoretically justified to the extent that health-related aspects of adjoining neighborhoods (e.g., clinics/services, parks, informal social processes) are most likely to impact individual well-being. Nevertheless, the "spatial multiplier" process implied by the spatial autoregressive model described below incorporates progressively diminishing effects of the characteristics of neighbors' neighbors as well (Anselin, 1988).

Table 2
Three level logit models of fair/poor self-rated health on individual background, time, and neighborhood characteristics (1991–99 MCIC-MS samples)

Independent variables	Fair/poor self-rated health					
	1	2	3	4	5	6
Demographic background						
Age	—	—	0.040**	0.032**	0.032**	0.032**
			(0.002)	(0.002)	(0.002)	(0.002)
Male	—	—	−.171**	−0.096	−0.093	−0.092
			(0.054)	(0.057)	(0.057)	(0.057)
African-American	—	—	0.656	0.343**	0.299**	0.174
			(0.071)	(0.069)	(0.088)	(0.092)
Latino	—	—	1.209**	0.550**	0.562**	0.517**
			(0.074)	(0.090)	(0.090)	(0.090)
Married	—	—	−0.101	0.109	0.105	0.105
			(0.055)	(0.063)	(0.064)	(0.064)
Education	—	—	—	−0.321**	−0.318**	−0.305**
				(0.024)	(0.025)	(0.025)
Income	—	—	—	−0.113**	−0.112**	−0.106*
				(0.015)	(0.015)	(0.015)
Homeownership	—	—	—	−0.097	−0.128	−0.119
				(0.067)	(0.071)	(0.071)
Neighborhoods across time						
Year	—	−0.039**	−0.049**	−0.022	−0.022	−0.022
		(0.012)	(0.013)	(0.014)	(0.014)	(0.014)
Year squared	—	−0.020**	−0.021**	−0.015*	−0.015*	0.015*
		(0.006)	(0.006)	(0.007)	(0.007)	(0.007)
Neighborhood across space						
Poverty	—	—	—	—	0.070	—
					(0.191)	
Affluence	—	—	—	—	—	−0.011**
						(0.004)
Residential stability	—	—	—	—	0.047	0.082
					(0.034)	(0.034)
Immigrant concentration	—	—	—	—	0.019	0.050
					(0.045)	(0.047)
Intercept	−1.178**	−1.053**	−1.588**	−1.567**	−1.536**	−1.463**
	(0.035)	(0.047)	(0.067)	(0.074)	(0.079)	(0.080)
Variance across time	0.057	0.040	0.023	0.056	0.057	0.062
Variance between neighborhoods	0.198	0.201	0.105	0.021	0.021	0.011

Note: Neighborhood level $N = 342$; interview year $N = 2353$; individual level $N = 8706$.
* $p<0.05$, ** $p<.01$ (two-tailed tests). Standard errors in parantheses.

empirical bayes residuals from hierarchical logit models of self-rated health,[11] given by

$$\mathbf{y} = \rho\mathbf{W}\mathbf{y} + \beta\mathbf{X} + \varepsilon, \quad \varepsilon \sim N(0, \sigma^2),$$

where $\mathbf{y}$ is an $N \times 1$ vector of observations on the outcome measure, $\mathbf{W}$ is a first order contiguity weight matrix, $\mathbf{X}$ is an $N \times K$ matrix of independent variables, β is an $K \times 1$ vector of regression coefficients, ρ is the spatial lag operator, and ε is a vector of independent and normally distributed error terms with 0 means and constant variances. The results presented in Table 3 below employ the spatial lag specification described to regress the adjusted EB neighborhood intercepts on census based structural indicators.

[11] Lagrange multiplier tests, though not significant, suggest the appropriateness of the spatial lag model over an alternative spatial error model (Anselin, 1988).

Results

Table 2 reports the results of three-level hierarchical logit models of self-rated health. Model 1 reports the

Table 3
Spatial lag regressions of EB fair/poor self-rated health on neighborhood structural characteristics ($N = 342$)

Indeqpendent	Global	Regimes			
Variables	Model 1	Model 2		Model 3	
		⩾75% African-American	<75% African-American	⩾75% African-American	<75% African-American
Neighborhood structure					
Spatial lag parameter	0.077 (0.087)	0.119 (0.086)		0.072 (0.087)	
Poverty	—	0.001 (0.006)	−0.001 (0.007)	—	—
Affluence	−0.013* (0.005)	—	—	−0.032* (0.016)	−0.013* (0.007)
Residential stability	0.111 (0.059)	0.085 (0.121)	0.041 (0.078)	0.311* (0.151)	0.104 (0.074)
Immigrant concentration	−0.016 (0.056)	—	—	—	—
Intercept	0.231* (0.111)	−0.023 (0.241)	0.004 (0.124)	0.366 (0.196)	0.271 (0.159)
R^2	0.025	0.008		0.032	

$*p<0.05$, $**p<.01$ (two-tailed tests). Standard errors in parantheses.

results of the unconditional three-level model.[12] Model 2 adds linear and quadratic time trends at level two. The coefficients for linear and quadratic year effects are negative and significant, suggesting that the health of Chicago residents significantly *improved* across the decade of the 1990s and the speed with which improvement occurred accelerated toward the end of the decade. Model 3 adds individual level demographic predictors including age, male gender, African-American and Latino race/ethnicity (by comparison with White), and marital status. All demographic predictors achieve significance in model 3 with the exception of marital status. African-American and Latino race/ethnicity are both positively associated with poor health in Model 3. Latino ethnicity has a larger positive association with poor health, though both coefficients are relatively substantial in magnitude.

As individual level predictors are entered into the model, we track changes in the coefficients for interview year at level two in order to determine the extent to which the improved health of Chicago neighborhoods is due to changes in social composition. In model 3, the linear effect of time actually increases modestly, suggesting that population selection on the basis of age, gender, and race/ethnicity does not account for health improvement over time. It is important to recognize the possibility that the health status of the Chicago population may have changed due to the arrival of new residents with better average health, the departure of less healthy residents, or improvements in the health of existing Chicago residents. To the extent that time-invariant characteristics such as gender, age, and race/ethnicity account for the effect of interview year, we may assume that selection is accounting for health improvement. However, as indicated in Model 3, these time-invariant characteristics do not explain the time trend in health.

Model 4 adds individual level educational achievement, income, and home ownership to the model. Consistent with previous research, the effects of education and income on poor health are quite pronounced and negative. Adding income and education at the individual level accounts for over half of the linear time effect and renders it insignificant at the conventional level (0.05) (again, through selection of higher income and more educated residents into the city, the selection of lower income/education residents out of the city, or the increasing income and education of existing residents). These findings suggest that changes in the socioeconomic status of Chicago residents account, in

[12] Examining variance components from the unconditional model indicates that level 3 variation (neighborhoods across space) accounts for about 6% of the variance in self-rated health. While relatively small, this proportion is nevertheless comparable in magnitude to results from individual and neighborhood level variance decompositions performed for other outcomes and does not rule out substantial effect *sizes* for neighborhood characteristics (Duncan & Raudenbush, 1999). Variance at the temporal level accounted for about 2% of the total variance. Likelihood ratio chi-square tests for both variance components were significant ($p<0.001$).

part, for improvements in overall health over the decade of the 1990s (though the quadratic effect of time remains marginally significant).

The inclusion of individual level SES measures in Model 4 also allows us to assess the extent to which the pronounced race/ethnicity effects on health are a function of differences in SES across Whites, African-Americans, and Latinos. Income and education level account for a large proportion of the effects of African-American and Latino race/ethnicity—though these coefficients remain substantial in magnitude and significant in Model 4 ($p<0.01$). Individual SES measures introduced in Model 4 reduce the magnitude of the African-American coefficient by 48% and the Latino coefficient by 55%. This result is consistent with previous research finding negative effects of race/ethnicity on health independent of individual level SES (House & Williams, 2000).[13]

Turning to the central theoretically motivated component of the analysis, Model 5 adds neighborhood level poverty, residential stability, and immigrant concentration to assess the extent to which these neighborhood level structural factors explain variations in neighborhood health status across space. In contrast to recent research suggesting the importance of neighborhood poverty in accounting for spatial variation in health, we find no evidence of an effect of poverty above and beyond individual demographic characteristics.[14] Similarly, measures of residential stability and immigrant concentration are not significantly related to self-rated health. Model 6, however, includes our measure of neighborhood affluence in place of neighborhood poverty (to avoid potential collinearity problems). Consistent with the expectations of Wilson's model of neighborhood disadvantage, affluence is protective against poor health and is powerfully associated with this outcome above and beyond individual level characteristics. A 10% increase in neighborhood affluence decreases the odds of fair or poor health at the individual level by about 10%. The effect of residential stability becomes significant and positive in Model 6, contrary to expectations.

Model 6 allows us to track the residual effects of race/ethnicity after controlling for neighborhood level structural characteristics. The coefficient for African-American race in Model 6 is reduced by an additional 25% to 0.174 (compared with the baseline effect in Model 3[15]). Moreover, the coefficient for African-American race is no longer significant at the 0.05 level in Model 6. Thus, after controlling for both individual level SES and neighborhood affluence, there is no evidence to suggest that the self-rated health of African-Americans is significantly worse than that of whites. This finding provides evidence that the level of affluence characterizing urban communities accounts for a significant proportion of the residual disparity in health status between African-Americans and Whites independent of individual level SES. In contrast, the coefficient for Latinos is reduced by an additional 3% in Model 6 (compared with the baseline effect in Model 3). Latinos remain at significantly increased risk of fair or poor health even after controlling for individual SES and neighborhood level structural factors (the odds of fair or poor health are 68% greater for Latinos by comparison with Whites).

Finally, Table 3 reports the results of spatial lag regressions of aggregated, standardized EB self-rated health on key structural characteristics. In addition to exploring the possibility of spatial autocorrelation in neighborhood health status, these models assess the robustness of the affluence effect observed in hierarchical models and the extent to which this pattern of association holds for predominantly African-American neighborhoods in Chicago. Column 1 of Table 3 reports coefficients from the global spatial lag model for all neighborhoods in Chicago. The spatial lag parameter does not achieve significance, suggesting that self-reported health status in Chicago neighborhoods is not spatially dependent. The effect of affluence remains significant, however, in this more conservative model specification.

The spatial regimes models reported in subsequent columns of Table 3 fit the two neighborhood structural effects models reported in Table 2 (with poverty and affluence in separate models). The spatial regimes model essentially interacts measures of structural characteristics with an indicator of neighborhood racial composition (i.e., whether the neighborhood was 75% or more African-American in 1990) to assess the comparability of findings from the global model to those for predominantly African-American contexts. The regimes model includes a shared spatial lag parameter allowing, again, for a conservative estimate of structural associations with health status in the two contexts. The first regimes model includes measures of poverty and

[13] Some recent studies (e.g., Veugelers, Yip, & Kephart, 2001; Yen & Kaplan, 1999) have demonstrated that the effects of income on health vary by neighborhood SES. We investigated whether the effects of race/ethnicity or SES varied across neighborhoods or time points. Tests of significance on variance components from random coefficient models offered no evidence of significant variability in the effects of individual level covariates across neighborhoods or time.

[14] A composite disadvantage index including the percent below the poverty line, on public assistance, unemployed, and in female-headed households was also not associated with self-rated health. Separate models including the effects of percent African-American also indicated no significant effect of this variable above and beyond individual level characteristics.

[15] The effects of race/ethnicity are comparable in models with and without the control for marital status.

stability to assess the effect of the former in African-American neighborhoods.[16] Consistent with the findings from hierarchical logit models presented in Table 2, poverty is not a significant predictor in either neighborhood type. A second regimes model substitutes affluence for poverty in the same model context. Affluence has a significant protective effect on health in contexts characterized by higher and lower levels of African-American concentration, indicating that the benefit of middle and upper-middle class residents for health is not conditioned by the racial composition of the neighborhood.[17]

Of note in the final regimes model are the coefficients for residential stability in the two neighborhood types. Residential stability in predominantly African-American contexts is positively associated with aggregated fair/poor health while the effect of stability in neighborhoods with lower concentrations of African-Americans is not significant. This finding suggests that stability not only does not exert protective effects on health but that it may actually be detrimental *in some contexts*. While unexpected from the standpoint of traditional models of neighborhood social organization, the effect of residential stability is arguably consistent with Wilson's emphasis on the negative consequences of *stable disadvantage*—a contributing factor in the emergence of socially isolated communities (Wilson, 1987; Wilson, 1996).

In sum, findings from multivariate hierarchical logit and spatial lag models indicate, first, that fair or poor health status in Chicago neighborhoods declined in prevalence over the decade of the 1990s, and that this change was partially due to improvements in the socioeconomic condition of Chicago residents. Second, the prevalence of neighborhood affluence is protective against poor health status, controlling for a range of individual level demographic and SES covariates. We find no evidence, however, that neighborhood poverty is associated with health status. Moreover, accounting for neighborhood affluence substantially attenuates the disparity in health status between African-Americans and Whites. Finally, spatial regression models of aggregated health status show little evidence of dependency among neighborhoods. The effects of affluence, however, are robust in the context of models controlling for spatial dependence and when considered for neighborhoods with higher and lower concentrations of African-American residents.

[16] We exclude ethnic heterogeneity from the model due to the relative lack of variability in Latino prevalence within predominantly African-American neighborhoods.

[17] We also investigated the impact of neighborhood affluence on health among African-American respondents from the MCIC-MS at the individual level, finding a similar pattern of association.

Discussion

Race and ethnic differences in health status have occupied considerable research attention in recent decades. While the hypothesis that discrepancies in socioeconomic resources at the individual level has helped explain a proportion of the race/ethnic health gap, evidence suggests that individual level SES alone cannot fully account for the persistent disparities in health between Whites and African American and Latino minorities. Extending the work of Cagney et al. (2002) on elderly urban residents, our findings contribute to research on race/ethnicity and health by highlighting the importance of the *presence of neighborhood resources*—specifically, the proportion of residents with relatively high incomes—in accounting for the residual difference in health between African Americans and Whites. Our analyses demonstrate the specific importance of affluent residents in contributing to the health of urban residents, as distinct from the hypothesized opposite effect of the prevalence of poor residents.

Conclusions drawn from prior research indicating that the prevalence of poverty or disadvantage in urban neighborhoods is the key neighborhood level factor generating contextual effects on health should be questioned to the extent that affluence is not also considered. Despite the generally high correlation between poverty and affluence, neighborhood models of their impact on health have emphasized distinct causal processes. For instance, Fitzpatrick and LaGory (2000) discuss subculturally based models of neighborhood disadvantage that stress the role of concentrated poverty in contributing to health-compromising attitudes and behaviors. These subcultural orientations are hypothesized to increase the likelihood of poor dietary habits, lack of exercise, the rapid resort to violence in situations of conflict, alcohol and substance use, and so on.

While theories of social organization have also stressed the role of widespread poverty, our approach draws on Wilson's theory of neighborhood well-being in emphasizing the absence of middle-class or more affluent residents as the underlying precipitant of compromised community social organization, mobilization capacity, and institutional infrastructure. In this sense, measures of the concentration of poverty may be functioning as proxies for the absence of stabilizing middle class residents with higher levels of access to potentially health-relevant social and economic resources.[18]

[18] It is possible, however, that poverty works through other mechanisms such as the direct impact of exposure to toxins in the environment (e.g., lead exposure (Elreedy et al., 1999)).

Our analyses also assessed the extent to which health status is a function not only of internal characteristics of urban neighborhoods but characteristics of adjacent neighborhoods as well. Access to resource endowed neighborhoods characterized by higher quality health services, recreational opportunities, and extensive informal social networks may offset the negative consequences of living in a resource poor environment. Similarly, residence in a neighborhood with limited resources surrounded by neighborhoods with similar deficits may further compromise health status. While our analyses did not support this conclusion in models of self-rated health, we nevertheless view the assessment of spatial dependencies as an important potential future direction for neighborhood effects research on health outcomes generally. Spatial dependencies, for instance, may be manifest only for specific types of health conditions.

The spatial models we considered did offer a conservative model context in which to assess the effects of affluence on aggregated fair or poor health status. The effects of affluence appeared remarkably robust in these models. Controlling for spatial dependence, affluence continued to exert a significant protective effect on health in Chicago neighborhoods generally as well as predominantly African-American neighborhoods in the city. Thus middle and upper middle class residents, as Wilson suggests, are equally important in African-American neighborhoods and may provide significant social and economic resources with which to achieve shared goals—including enhanced health.

Finally, our results also indicate that the decade of the 1990s saw significant improvement in the health of Chicago residents due, in part, to improvements in the individual level socioeconomic resources of these residents. Though we cannot determine whether this health improvement was due to the selection of higher SES residents into (or lower SES residents out of) Chicago or improvements in the educational levels and income of existing Chicago residents, this finding nevertheless underscores the centrality of socioeconomic resources in promoting health.

As others have recommended (Robert, 1999), we encourage research on the mechanisms linking neighborhood structural characteristics with health. Careful assessment of intervening processes at the neighborhood level will illuminate the pathways through which neighborhood structure works to influence health status. Future research will also, hopefully, unpack the powerful association between Latino ethnicity and self-rated health. Our analyses did not account for the substantial negative effect of Latino ethnicity on self-rated health, pointing to an important area for future research—particularly given the rapid increase in the urban Latino population both in Chicago and nationally in the United States. The circumstances facing immigrant populations generally may be unique, calling for specific models that address the impact of migrant population dynamics on health. Though evidence suggests that self-rated health is a valid measure of general health status for Latinos (Finch et al., 2002), continuing investigation into the meaning of self-ratings of health for Latinos, particularly less acculturated immigrants (Shetterly, Baxter, Mason, & Hamman, 1996), may provide a more nuanced understanding of the associations we observe in the current paper.

Though robust predictors of subsequent morbidity and mortality (Idler & Benyamini, 1997; Idler & Kasl, 1995), self-ratings of health are inevitably less precise indicators of health status (Patrick & Erickson, 1993). Consequently, research on specific, objective health outcomes will also aid in understanding the extent to which the beneficial effects of neighborhood resources generalize to a broad range of specific health conditions and, potentially, their severity.

Our future efforts will assess the extent to which income inequality at the neighborhood level independently affects health status. Income inequality has been the focus of a host of recent studies examining macro-level effects on health status (Kawachi & Kennedy, 1999; Kawachi, Kennedy, Lochner, & Prothrow-Stith, 1997; Lochner, Pamuk, Makuc, Kennedy, & Kawachi, 2001; Lynch, Due, Muntaner, & Davey Smith, 2000; Ross et al., 2000). Our findings regarding the beneficial effects of the presence of affluent residents (both generally and for typically less advantaged African-American communities), however, would appear to challenge the hypothesis that economic heterogeneity is detrimental to health—at least at the neighborhood level. Attention to the potentially distinct role of economic structure at different levels of aggregation is an important direction for theoretical development and empirical research in the area of contextual effects on health. In general, however, the findings reported here reinforce the importance of broader social context in improving our understanding of health inequalities—particularly, persistent racial and ethnic differences in health status.

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Appendix A

See Table 4.

Table 4
Correlations among neighborhood characteristics

Neighborhood characteristics	1	2	3	4
1. Affluence	—			
2. Poverty	−0.77	—		
3. Residential stability	0.37	−0.30	—	
4. Immigrant concentration	−0.12	−0.11	−0.21	—

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