Neighborhood Socioeconomic Disadvantage and Access to Health Care*

JAMES B. KIRBY

Agency for Healthcare Research and Quality

TOSHIKO KANEDA

Population Reference Bureau

Journal of Health and Social Behavior 2005, Vol 46 (March): 15–31

Most research on access to health care focuses on individual-level determinants such as income and insurance coverage. The role of community-level factors in helping or hindering individuals in obtaining needed care, however, has not received much attention. We address this gap in the literature by examining how neighborhood socioeconomic disadvantage is associated with access to health care. We find that living in disadvantaged neighborhoods reduces the likelihood of having a usual source of care and of obtaining recommended preventive services, while it increases the likelihood of having unmet medical need. These associations are not explained by the supply of health care providers. Furthermore, though controlling for individual-level characteristics reduces the association between neighborhood disadvantage and access to health care, a significant association remains. This suggests that when individuals who are disadvantaged are concentrated into specific areas, disadvantage becomes an "emergent characteristic" of those areas that predicts the ability of residents to obtain health care.

Disparities in access to quality health care services are of growing concern to policy makers (Institute of Medicine 2001; U.S. Department of Health and Human Services 2000). Identifying and understanding factors that help individuals obtain needed medical care or that hinder them from doing so is therefore an important goal for researchers interested in the U.S. health care system and, ultimately, population health. To date, most research on access to health care has focused on individual-level determinants such as race, income, education, insurance status, and disability (Andersen and Davidson 2001; Andersen, Rice, and Kominski 1996; Berk, Shur, and Cantor 1995). The role of community-level factors in helping or hindering individuals in obtaining needed care, however, has not received much attention. Yet community-level characteristics have been recognized as potentially important determinants of access (Andersen and Davidson 2001; Andersen et al. 2002; Donaldson et al. 1996; Phillips et al. 1998). We address this gap in the literature by investigating whether neighborhood socioeconomic disadvantage is associated with access to health care net of individual-level characteristics.

Though research on community-level correlates of access to health care is scarce, some research has shown that the utilization of health care services varies across communities. In

 While working on this article, Toshiko Kaneda was supported by a Bernard Berelson Fellowship from the Population Council. An earlier version of the article was presented at the annual meeting of the Population Association of America, Boston, Massachusetts, April 1–3, 2004. Address correspondence to James B. Kirby, Agency for Healthcare Research and Quality, 540 Gaither Road, Fifth Floor, Rockville, MD 20850.

particular, hospital utilization rates differ across communities with different levels of health care supply (Bindman et al. 1995; Roderick et al. 1999) and with different socioeconomic characteristics (Carlisle et al. 1995; Komaromy et al. 1996). Community-level variation in the use of general ambulatory care and cancer screenings has also been found (Cunningham and Kemper 1998; Wells and Horm 1998). These studies, however, take an ecological approach and do not control for individual-level characteristics in their analyses. Their findings thus may be a reflection of the composition of communities, rather than an indication that community characteristics themselves influence health care utilization. For example, because the U.S. population is highly segregated by income (Massey 1996), there may be lower levels of health care utilization in impoverished communities simply because such communities are composed of poor individuals who cannot afford care, regardless of the characteristics of the communities in which they live. To distinguish between associations that are due to community composition and those that are due to community-level factors, studies that examine individual- and community-level characteristics simultaneously are needed. To date, only a few studies have done this.

One such study found that, among a sample of low income individuals living in the 100 largest metropolitan statistical areas (MSAs), those living in areas with high rates of poverty and unemployment were less likely to have seen a doctor in the previous year than those living in other areas (Andersen et al. 2002). The study also found that those living in areas with more federally funded health centers were more likely to have seen a doctor (Andersen et al. 2002). Similar findings were reported for a sample of Nova Scotians (Yip, Kephart, and Veugelers 2002). Another study found that women living in Kansas counties with high median incomes had higher rates of breast and cervical cancer screenings than those living in counties with lower median incomes (Engelman et al. 2002). As these studies controlled for several individual-level characteristics, their results suggest that there may be a relationship between community-level characteristics and health care utilization.

Though these studies make a valuable contribution by investigating the possibility of a relationship between community-level characteristics and health care use, they are limited in several ways. The studies use health care utilization as an indicator of access. If access to health care is conceptualized as the ability to obtain needed care, health care utilization alone is not a sufficient measure. For example, healthy individuals with generous health insurance plans and high incomes could have excellent access to health care but little or no utilization. In contrast, unhealthy individuals with no insurance and low incomes might have substantial health care utilization out of necessity, but still not be obtaining all the care they need. Other limitations of previous research pertain to the data used. Previous studies on the community-level correlates of access to and use of health care services use data from specific geographic areas or populations, and thus it is not clear whether their findings apply to the U.S. population at large. Furthermore, community-level variables are measured at relatively high levels of aggregation (the county or MSA) and thus encompass very heterogeneous areas. Communities are likely to be approximated more accurately with smaller geographic areas. Finally, previous studies use data in which there is a time lag between individual-level characteristics and community-level social and economic data.

In this study, we contribute to the line of research described above in several important ways. First, we examine the effects of both community- and individual-level factors on access to health care simultaneously to distinguish between associations that are "compositional" in nature, versus "contextual." Second, we use several variables designed to measure access to health care explicitly, rather than making inferences about access from utilization patterns. Third, we use data on a nationally representative sample of individuals from a large household survey. Fourth, we use individual- and community-level data that were measured in the same year, ensuring that information obtained regarding individuals' experiences with the health care system coincide with information on their communities. Finally, we use community-level data measured at the block group-level, the smallest geographic area for which social statistics are available from the 2000 U.S. Census. This enables us to assess more accurately the extent to which socioeconomic disadvantage is geographically concentrated.

BACKGROUND AND THEORY

As a theoretical base, this study uses the behavioral model of health care utilization developed by Andersen, Aday, and others (Aday and Andersen 1975; Aday, Flemming, and Andersen 1984; Andersen 1968, 1995; Andersen and Newman 1973; Millman 1993). This framework takes a systems approach to understanding the determinants of health care utilization. It posits that the determinants of health care use can be grouped into three broad categories: factors that predispose individuals to use health care (e.g., demographic characteristics and health-related beliefs), factors that enable or impede the use of health care (e.g., health insurance and affordability), and factors related to the need for health care (e.g., health status and disability). Though neighborhood-level characteristics were not explicitly included in the earliest formulation of the behavioral model of health care utilization (Andersen 1968), later refinements did suggest a role for contextual-level factors (Andersen and Davidson 2001; Andersen and Newman 1973; Andersen et al. 2002). Recent work from the Institute of Medicine (Donaldson et al. 1996) also recognizes neighborhood characteristics as potentially important in explaining health care use and access. Despite this, little research is available that considers contextual variables as potential determinants of access to health care (Andersen and Davidson 2001). One of the challenges of this study is to extend the behavioral model of health services use and access to include community-level determinants. To this end, we draw on ideas from research that investigates the relationship between neighborhood-level socioeconomic disadvantage and health.

A substantial amount of research suggests that neighborhood socioeconomic disadvantage is associated with a variety of health outcomes, net of individual characteristics, including self-rated health (Katz, Kling, and Liebman 2001; Malmstrom, Sundquist, and Johansson 1999; Ross and Mirowsky 2001), functional disability (Ross and Mirowsky 2001), mental health (Aneshensel and Sucoff 1996; Latkin and Curry 2003; Ross 2000; Ross, Reynolds, and Geis 2000; Schultz et al. 2000), and mortality (Huie, Hummer, and Rogers 2002; LeClere, Rogers, and Peters 1997, 1998). This research offers several explanations for the association between neighborhood disadvantage and health, and these explanations can be extended to link community-level characteristics and access to health care.

One explanation offered for the relationship between neighborhood disadvantage and health is that disadvantaged neighborhoods suffer from unhealthy physical environments. Neighborhood resources, or lack thereof, impact characteristics of the physical environment such as quality of air and water and the prevalence of toxic waste (Bullard 1990; General Accounting Office of the United States 1983), and these constitute direct threats to health. The provision of municipal services such as policing, fire, and sanitation may also be lacking in many disadvantaged neighborhoods (Wallace and Wallace 1990). Some researchers argue that, as a result of these environmental and service-related factors, living in disadvantaged neighborhoods is less conducive to health (Roberts 1998). We contend that some of the same environmental factors may also be considered factors in the "enabling/impeding" domain of the behavioral model of health care use, thus affecting one's ability to access the health care system. For example, if a neighborhood has poorly maintained sidewalks and streets and poor public transit, traveling to obtain needed health care may be inconvenient and costly. If policing is inadequate in disadvantaged neighborhoods, fear of crime victimization may prevent residents from seeking the care they need, again operating in the "enabling/impeding" domain of the behavioral model. Fear of victimization may also make obtaining care seem less important relative to other things and thus might be considered part of the "predisposing" domain of the behavioral model. Finally, neighborhoods with poor physical environments may be less attractive to health care providers, making health care more difficult to find and afford.

Along with physical and service environments, the social environments of neighborhoods may influence factors in the "enabling/impeding" domain of the behavioral model of health care utilization. Concentrated socioeconomic disadvantage may diminish resources necessary to maintain organizations such as churches, schools, and voluntary organizations (Browning and Cagney 2002). These institutions act as nodes in social networks through which information and social support, including that related to obtaining health care, may be obtained. Information such as the location of facilities providing affordable or free health care services, the safest and most convenient means of getting

to such facilities, the quality of care provided, and whether providers can communicate in a particular language may therefore be less widely available in disadvantaged neighborhoods than in other neighborhoods. If so, residents of disadvantaged neighborhoods may be less able to obtain needed health care.

In summary, we hypothesize that neighborhood socioeconomic disadvantage may create physical, service, and social environments that impede the ability of individuals to obtain health care. Consequently, we expect that any association between neighborhood socioeconomic disadvantage and access to care will persist even after controlling for the composition of individuals in neighborhoods. In other words, neighborhood disadvantage and access to health care are associated not simply because disadvantaged neighborhoods are composed of disadvantaged individuals, but because the characteristics of disadvantaged neighborhoods affect the ability of residents to obtain health care services, regardless of whether they themselves are disadvantaged.

DATA AND METHODS

Sources of Data

Data for this study come from four sources. Individual-level data come from one year of the Medical Expenditure Panel Surveys (MEPS). MEPS is a series of longitudinal surveys based on clustered and stratified samples of households that provide nationally representative estimates of health care use, insurance coverage, and sociodemographic characteristics for the U.S. noninstitutionalized population (Cohen 1996, 1997). We link individuals in the 2000 MEPS to information regarding the supply of health care providers and facilities from two sources: the Area Resource File, published by the Bureau of Health Professionals (Bureau of Health Professionals 2001), and the Primary Care Service Area Files available from the Health Resources and Services Administration. Finally, to obtain neighborhood-level characteristics, we attached longitude and latitude figures to addresses in the 2000 MEPS sample (often referred to as "geocoding"), which enabled us to link individuals to information from the 2000 decennial Census regarding the block groups in which they live. Block groups are the smallest geographic area for which social statistics are available. They generally contain between 600 and 3,000 people and can be considered approximations of neighborhoods (Auchincloss, Van Nostrand, and Ronsaville 2001).

The 2000 MEPS data contain 25,096 individuals, 91 percent of whom were successfully linked to census block groups, primary care service areas, and counties. Though differences between individuals with and without contextual information were modest, individuals missing contextual data were more often nonwhite, less educated, and poor. To minimize sample selection bias, our analyses initially contained imputed values for those with missing block group information and dichotomous variables to identify them. Imputation was done by replacing missing values with means conditional on race, Hispanic ethnicity, education, and income. However, the dichotomous variables identifying the cases with imputed block group information were never significant in our analysis, nor did our substantive findings change when such cases were removed (available from authors upon request). We therefore exclude from our analysis individuals without block group information, yielding a total sample size of 22,890. Some individual-level variables contain missing data, and these were deleted listwise, reducing the sample slightly (see Tables 2 and 3). We conducted sensitivity analyses, and our findings are not sensitive to the way we treat missing data.

Access to Health Care

We conceptualize access to health care as the ability to obtain needed health-related services. Central to our conceptualization, services are "needed" not just when one becomes ill but also to detect conditions before illness becomes apparent or to prevent illness altogether. We use three types of measures to gauge access to health care. The first measure is dichotomous and indicates whether an individual has a provider from whom they usually obtain medical care, often referred to as a "usual source of care provider" (USC). Having a USC is an important gauge of access because it indicates whether an individual has a specific entry point into the health care system if some event necessitates it. Previous studies use this measure as a standard benchmark for whether an individual has

access to ambulatory care (Zuvekas and Taliaferro 2003).

The second measure is a subjective assessment of access to health care. Individuals were asked whether they were unable to obtain health care in the previous year when they or a doctor thought it was necessary. A dichotomous variable indicates whether an individual answers in the affirmative to this question, and we refer to it as "unmet need." Measures of access similar to this have been used widely in previous research (Cunningham and Kemper 1998; Hendryx et al. 2002).

Finally, we use two measures based on adherence to United States Preventive Task Force (USPTF) guidelines. Two dichotomous variables indicate whether an individual complied with the USPTF guidelines for blood pressure screening (received within the past two years for all individuals) and cholesterol screening (received within the past five years for those 35 and over). We examined a number of preventive care guidelines in addition to those listed above, including recommendations for influenza vaccines, and those for bowel, breast, and cervical cancer screenings. Results from the analyses on these measures are consistent with those presented in this paper. The results for blood pressure and cholesterol screenings can therefore serve as examples of a more general finding on preventive care use. Reducing the number of dependent variables in this way enables us to present a more complete set of results for each dependent variable.

Neighborhood Disadvantage

Our main independent variable is neighborhood socioeconomic disadvantage. Disadvantaged neighborhoods are those with a shortage of resources, either in the form of economic or human capital. Our measure is a scale consisting of three items: the percent of residents in a block group under 125 percent of the federal poverty line, the percent of residents over 16 who are unemployed, and the percent of residents over 18 with no high school diploma or GED. We standardize these variables to a mean of zero and a standard deviation of one and sum them to form a scale (alpha = .78). One unit therefore corresponds to a standard deviation shift in any of the underlying indicators. While this scale is similar to measures used in previous research on neighborhood disadvantage and health (Ross 2000; Ross and Mirowsky 2001), we do not include measures of residential instability or the prevalence of single-parent families as they do. Though such variables may capture interesting neighborhood-level characteristics, they are not good indicators of neighborhood socioeconomic disadvantage; several different measurement models based on confirmatory factor analysis demonstrated very poor model fit when one or both were added as indicators of neighborhood socioeconomic disadvantage. While residential instability and the prevalence of single-parent families are interesting contextual variables in their own right and should be investigated in future research, we focus here on neighborhood socioeconomic disadvantage.

The Supply of Health Care

As suggested previously, an association between neighborhood socioeconomic disadvantage and access to health care could be in part due to differences in the supply of health care providers available to residents of different neighborhoods. Unlike information on neighborhood socioeconomic disadvantage, information on the supply of health care is not available at the block group-level. Moreover, it is probably better to measure supply characteristics at higher levels of aggregation because health service providers and facilities serve geographic areas that are generally larger than block groups. To measure the supply of health care in an area, we include the number of active general practice or family practice physicians per 1,000 people in a "primary care service area" (PCSA) and the number of hospitals beds available per 1,000 county residents in our analysis. A PCSA is a standardized area developed by the Health Resources and Services Administration to represent market areas for primary care services. They consist of one or more zip codes. Hospital beds per capita is not available at the PCSA level, so the county level is used instead. Finally, we include a variable that indicates whether individuals live in a metropolitan statistical area (MSA). This is a general proxy for the geographic density of health care providers and facilities.

Individual-Level Control Variables

In order to distinguish the "compositional" effect of neighborhood disadvantage from its "contextual" effect, it is important to control for individual characteristics that might be associated both with obtaining needed medical care and with the likelihood of residing in a disadvantaged neighborhood. Among the most important individual-level characteristics with respect to access to health care is socioeconomic status (SES). An association between neighborhood disadvantage and access to health care may exist simply because low SES individuals are likely to live in disadvantaged neighborhoods and, at the same time, likely to be unable to afford health care. We measure individual-level SES using dichotomous variables on household income relative to the federal poverty line (less than 125%, 125%–200%, 200%–400%, or 400% or more) and educational attainment (no high school degree or GED, a high school degree only, a college degree, a graduate or professional degree, or under the age of 25 with no degree). The "under 25" category is a proxy for individuals who may not have completed their education.

Health status is another important predictor of access that may be related to the likelihood of living in a disadvantaged neighborhood and to the ability to obtain needed health care. Because health and income are positively related, poor health may be positively associated with the likelihood of living in a disadvantaged neighborhood. The effect of health on the likelihood of receiving needed care is, however, more complex. On the one hand, those who have chronic conditions or disabilities are likely to maintain close contact with the health care system out of necessity. They therefore may be more likely to have a USC and more likely to obtain preventive services. On the other hand, individuals in poor health may be more likely to report unmet need because their needs are great. We measure health status using the following three variables: subjective health status, the presence of chronic conditions, and the presence of functional limitations. Subjective health status is captured with a battery of dichotomous variables indicating whether individuals rate their health as excellent, very good, good, fair, or poor. The variable on chronic conditions indicates the number of diagnosed conditions a person has out of the following: angina, asthma, coronary heart disease, diabetes, emphysema, hypertension, heart attack, and stroke. Disability is measured with a variable that indicates whether individuals need help or supervision with personal care such as bathing, dressing, or getting around the house.

Insurance status is another individual-level variable that is important to control for in our models. Compared to individuals with private health insurance, those with public health insurance or no insurance coverage are more likely to live in disadvantaged neighborhoods. Because insurance status is also related to the ability of persons to obtain needed care, any association between neighborhood disadvantage and access may simply be a reflection of a neighborhood's composition with respect to health insurance status. As nearly all persons over age 65 in our sample are insured publicly through Medicare, our measure of insurance status is age-specific. We measure insurance status using five dichotomous variables to indicate whether individuals are: age 65 or above and insured exclusively by Medicare; age 65 or above and insured by Medicare plus some private supplemental insurance plan; under age 65 and uninsured; under age 65 and insured by a public plan; or under age 65 and insured by a private plan. Those who had both public and private insurance during the year were grouped with individuals having private insurance.

Finally, we control for other basic demographic characteristics, namely, gender, age, marital status, and race/ethnicity (Hispanic of any race, non-Hispanic white, non-Hispanic black, non-Hispanic Asian, or non-Hispanic some other race). All of these characteristics are associated with access to health care and may also be associated with the type of neighborhoods in which individuals live. Table 1 displays descriptive statistics for all the variables included in the analysis.

Analytical Approach

The primary methodological challenge in this study is the hierarchical structure of the data; individuals are nested within block groups, which are nested within PCSAs, which are nested within counties. In addition, MEPS is a stratified and clustered sample, so clustering at the primary sampling unit (PSU) must also be considered. If clustering in the sample is ignored, the standard errors of our estimates will be biased downward, increasing the chances of

TABLE 1. Sample Characteristics and Descriptive Statistics for All Variables

	Mean/ Proportion	Minimum	Maximum
Basic sample characteristics			
Number of people per county	41.24	1	1,044
Number of block groups per county	6.44	1	116
Number of people per block group	6.39	1	94
Number of people per PCSA	22.73	1	323
Access variables			
Has a USC	.82	0	1
Has unmet need	.07	0	1
Adheres to USPTF guidelines for			
Blood pressure screening	.88	0	1
Cholesterol screening	.67	0	1
Contextual-level variables			
Neighborhood socioeconomic disadvantage scale, SD = .83	0	0	1
Scale components (in original metrics)			
16 and older and unemployed, SD = .04	.04	0	1
18 and older with no high school diploma or GED, SD = .17	.20	0	.92
Below the federal poverty line, SD = .13	.14	0	.77
Number of family practitioners per 1,000 PCSA residents	.32	0	2.35
Number of hospital beds per 1,000 county residents	3.52	0	22.64
Resides in an MSA	.84	0	1
Individual-level independent variables			
Gender			
Male	.49	0	1
Female	.51	0	1
Age in years	35.80	0	90
Marital status			
Married	.41	0	1
Not married	.59	0	1
Race/ethnicity			
Non-Hispanic white	.71	0	1
Non-Hispanic black	.13	0	1
Hispanic/Latino	.12	0	1
Non-Hispanic Asian	.03	0	1
Non-Hispanic other race/ethnicity	.01	0	1
Educational attainment			
No high school diploma or GED	.10	0	1
High school diploma or GED	.37	0	1
College degree	.11	0	1
Graduate/professional degree	.05	0	1
Under 25 with no degree	.36	0	1
Income relative to the federal poverty line			
Less than 125%	.16	0	1
125%–200%	.13	0	1
200%–400%	.32	0	1
More than 400%	.39	0	1
Self-rated health			
Excellent	.32	0	1
Very good	.34	0	1
Good	.24	0	1
Fair	.07	0	1
Poor	.03	0	1
Needs help with at least one ADL	.01	0	1
Number of chronic conditions	.44	0	8
Insurance status			
Under 65, insured by a private plan	.67	0	1
Under 65, insured by a public plan	.10	0	1
Under 65, no insurance	.11	0	1
Over 65, Medicare only	.05	0	1
Over 65, Medicare plus private	.07	0	1

Note: PCSA = primary care service area; USC = usual source of care; USPTF = United States Preventive Task Force; SD = standard deviation; ADL = activities of daily living. Total number of counties = 555; total number of PCSAs = 1,007; total number of block groups = 3,577; total number of observations = 22,890.

Type I errors (i.e., finding statistically significant results when there are none). We have chosen to deal with this problem by calculating standard errors using a first-order Taylor series linear approximation method available in Stata, which adjusts for clustering at the PSU level (Levy and Lemeshow 1999; Statacorp 2001). Because block groups, PCSAs, and counties are all contained entirely within single PSUs, this approach provides accurate variance estimates (Goldstein 1999). All point estimates are calculated using sample weights.

We use this approach instead of hierarchical linear modeling (HLM) for several reasons. First, though HLM provides valuable information that our approach does not, such as estimates of error variances for all levels, it is very demanding of the data. The multilevel error variance estimates rely on not only total sample size, but also the number of people in each block group, PCSA, and county, as well as the number of block groups per PCSA, and so on. Table 1 shows that the average number of individuals per block group is 6.4. Unfortunately, over 22 percent of the sample has only one individual per block group, making HLM estimation impossible. We could collapse such block groups into others, but this is not only arbitrary, it results in a sample with 38 percent of block groups having only two individuals. Another disadvantage of HLM is that there is no software package that allows us to use sample weights with dichotomous dependent variables and, therefore, point estimates derived from the HLM approach may be biased. Finally, a four-level HLM seemed to us excessively complex to interpret. Though we recognize the many strengths of HLM, in this study we favor the Taylor series approach because it provides results that are easy to interpret, consistent point estimates and standard errors, and because it relies only on the number of PSUs and the number of individuals per PSU for its statistical power.

Our analysis consists of four binomial logistic regression models for each of the four dichotomous dependent variables. In the first models, we include only the variable on neighborhood disadvantage, thereby investigating the bivariate association between neighborhood disadvantage and access to care. In the second models, we include only the individual-level variables. These models provide a set of results that serve as a baseline for individual-level effects, enabling us to ascertain the extent to which the associations between individual-level factors and access are explained by neighborhood-level characteristics. In the third models, we add the variables measuring the supply of health care to the first models. These results give a sense of how much of the crude association between neighborhood disadvantage and access is driven by the supply of health care. In the final models, we control for all individual-, neighborhood-, PCSA-, and county-level variables.

RESULTS

In Tables 2 and 3, we present odds ratios and t-statistics from 16 logistic regression models, four for each dependent variable. More specifically, Table 2 shows results for the models pertaining to the likelihood that individuals have a USC and experience unmet need. Table 3 shows results for the models pertaining to adherence to USPTF guidelines on blood pressure and cholesterol screenings.

The results from the first model for each dependent variable provide a description of the crude association between neighborhood disadvantage and the access measures. Consistent with our expectations, the results indicate that residents of disadvantaged neighborhoods are significantly less likely to have a USC, more likely to experience unmet need, and less likely to comply with USPTF guidelines, compared to those in other neighborhoods. Specifically, the odds ratios from model 1 shown in Table 2 indicate that an increase of one standard deviation in neighborhood disadvantage (corresponding to a 4 percentage point increase in the unemployment rate, a 13 percentage point increase in the prevalence of poverty, or a 17 percentage point increase in the high school dropout rate) is associated with a decrease of 24 percent in the odds of having a USC (odds ratio = .76), and an increase of 70 percent in the odds of experiencing unmet need (odds ratio = 1.70). The results from model 1 shown in Table 3 indicate that an increase of one standard deviation in neighborhood disadvantage is associated with a 28 percent decline in the odds of adherence to USPTF guidelines for blood pressure screenings and a 19 percent decline in the odds of adherence for cholesterol screenings.

Our second models contain only individual-level predictors. The results from these models are generally consistent with previous research. Being female or married is associated with better access to health care, while being poor or

TABLE 2. Odds Ratios and t-statistics from Logistic Regressions on General Access Measures

	Has Usual Source of Care (Yes = 1, No = 0)				Has Unmet Need (Yes = 1, No = 0)			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Contextual-level variables								
Neighborhood socioeconomic disadvantage (standardized with mean = 0 and SD = 1)	.76		.75	.87	1.70		1.72	1.23
	(6.90)**		(7.23)**	(3.46)**	(8.48)**		(8.11)**	(2.26)*
General practitioners per 1,000 PCSA residents			1.91	1.63			1.04	1.16
			(2.82)**	(2.07)*			(.11)	(.40)
Hospital beds per 1,000 county residents			1.04	1.04			.97	.98
			(2.65)**	(2.67)**			(1.41)	(1.32)
Resides in an MSA			.68	.78			.93	.99
			(3.78)**	(2.32)*			(.45)	(.09)
Individual-level variables								
Gender (male = 1, female = 0)		.61		.62		1.03		1.02
		(10.02)**		(10.00)**		(.41)		(.38)
Marital status (married = 1, unmarried = 0)		1.45		1.44		.88		.87
		(6.35)**		(6.26)**		(.99)		(1.10)
Age in years		.99		.99		.99		.99
		(.63)		(.73)		(1.49)		(1.62)
Race and ethnicity (non-Hispanic white = reference)								
Non-Hispanic black		.72		.78		.60		.55
		(3.68)**		(2.52)*		(3.27)**		(3.43)**
Hispanic		.56		.65		.86		.75
		(6.76)**		(4.94)**		(1.11)		(1.81)
Non-Hispanic Asian		.61		.68		.82		.77
		(2.95)**		(2.33)*		(.57)		(.76)
Other non-Hispanic		1.07		1.04		1.14		1.14
		(.15)		(.10)		(.30)		(.30)
Education (high school only = reference)								
No high school diploma/GED		.94		.97		1.29		1.25
		(.76)		(.34)		(2.41)*		(2.09)*
College graduate		.88		.87		.96		.99
		(1.88)		(1.97)*		(.24)		(.04)
Professional/graduate degree		1.05		1.03		.92		.97
		(.40)		(.26)		(.38)		(.15)
Highest degree inapplicable, under 25		2.23		2.23		1.02		1.00
		(6.78)**		(6.67)**		(.15)		(.02)
Income relative to federal poverty line (over 400% = reference)								
Under 125%		.90		.91		3.80		3.62
		(1.05)		(.89)		(6.23)**		(5.66)**

(Continued on next page)

TABLE 2. ***(Continued)***

	Has Usual Source of Care (Yes = 1, No = 0)				Has Unmet Need (Yes = 1, No = 0)			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
125%–200%		.63		.63		4.67		4.50
		(4.52)**		(4.43)**		(8.07)**		(7.66)**
200%–400%		.87		.86		3.29		3.25
		(1.66)		(1.82)		(7.37)**		(7.37)**
Subjective health (excellent = reference)								
Very good		1.20		1.21		1.09		1.08
		(2.44)*		(2.60)*		(.74)		(.69)
Good		1.23		1.23		1.46		1.43
		(2.67)**		(2.73)**		(3.10)**		(2.91)**
Fair		1.62		1.67		2.22		2.16
		(4.05)**		(4.24)**		(5.62)**		(5.17)**
Poor		1.91		1.95		3.75		3.67
		(3.08)**		(3.21)**		(7.37)**		(7.08)**
Help with ADL ("no" = reference)		2.55		2.55		1.26		1.25
		(2.31)*		(2.33)*		(.63)		(.60)
Number of serious conditions		1.74		1.75		1.11		1.11
		(10.22)**		(10.44)**		(2.04)*		(2.06)*
Insurance status (under 65, private insurance = reference)								
Under 65, public insurance		1.10		1.17		2.75		2.60
		(.76)		(1.31)		(6.60)**		(6.13)**
Under 65, uninsured		.26		.27		3.66		3.57
		(16.53)**		(16.20)**		(10.39)**		(10.26)**
65 or over, Medicare only		2.83		2.81		.37		.38
		(6.01)**		(5.98)**		(3.88)**		(3.76)**
65 or over, Medicare plus private		1.78		1.79		.81		.82
		(3.11)**		(3.16)**		(.80)		(.77)
Observations	22,890	22,724	22,836	22,682	22,890	22,843	22,890	22,801

*$p < .05$; **$p < .01$

Note: SD = standard deviation; PCSA = primary care service area; MSA = metropolitan statistical area; ADL = activities of daily living; t-statistics are in parentheses.

TABLE 3. Odds Ratios and t-statistics from Logistic Regression Models on Adherence to United States Preventive Task Force Guidelines

	Blood Pressure Checked in Last 2 Years (Yes = 1, No = 0)				Cholesterol Checked within Last 5 Years, 35+ (Yes = 1, No = 0)			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Contextual-level variables								
Neighborhood socioeconomic disadvantage (standardized with mean = 0 and SD = 1)	.72 (8.16)**		.72 (8.74)**	.91 (2.20)*	.81 (5.39)**		.82 (4.91)**	.90 (1.95)
General practitioners per 1,000 PCSA residents		(2.47)*	1.78 (1.49)	1.39		(.31)	.93 (.13)	.97
Hospital beds per 1,000 county residents		(1.87)	1.03 (1.25)	1.02		(.14)	1.00 (.31)	1.00
Resides in an MSA			.82 (2.51)*	.98 (.28)			1.12 (1.62)	1.19 (2.02)*
Individual-level variables								
Gender (male = 1, female = 0)		.36 (16.01)**		.36 (15.87)**		.71 (6.07)**		.71 (6.05)**
Marital status (married = 1, unmarried = 0)		1.54 (6.13)**		1.54 (6.17)**		1.24 (3.40)**		1.23 (3.23)**
Age in years		1.01 (1.57)		1.01 (1.51)		1.04 (8.81)**		1.04 (8.64)**
Race and ethnicity (non-Hispanic white = reference)								
Non-Hispanic black		.84 (1.66)		.90 (.98)		1.67 (5.04)**		1.75 (5.08)**
Hispanic		.69 (4.33)**		.74 (3.08)**		1.65 (5.09)**		1.68 (4.57)**
Non-Hispanic Asian		.45 (4.13)**		.47 (3.77)**		.76 (1.58)		.74 (1.64)
Other non-Hispanic		.90 (.31)		.90 (.34)		67 (12)		.70 (.99)
Education (high school only = reference)								
No high school diploma/GED		.64 (4.35)**		.66 (4.07)**		.67 (4.94)**		.69 (4.42)**
College graduate		1.50 (3.77)**		1.48 (3.58)**		1.40 (3.51)**		1.36 (3.12)**
Professional/graduate degree		1.89 (3.94)**		1.83 (3.71)**		1.40 (3.08)**		1.36 (2.79)**
Highest degree inapplicable, under 25		1.03 (.28)		1.04 (.34)				

(Continued on next page)

TABLE 3. ***(Continued)***

	Blood Pressure Checked in Last 2 Years (Yes = 1, No = 0)				Cholesterol Checked within Last 5 Years, 35+ (Yes = 1, No = 0)			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Income relative to federal poverty line (over 400% = reference)								
Under 125%		.75		.77		.56		.58
		(2.39)*		(2.21)*		(5.09)**		(4.74)**
125%–200%		.80		.81		.62		.64
		(2.00)*		(1.87)		(4.76)**		(4.41)**
200%–400%		.81		.82		.73		.75
		(3.06)**		(2.89)**		(4.40)**		(4.12)**
Subjective health (excellent = reference)								
Very good		1.43		1.43		1.21		1.21
		(5.32)**		(5.29)**		(2.51)*		(2.56)*
Good		1.52		1.52		1.16		1.16
		(4.99)**		(4.94)**		(1.76)		(1.84)
Fair		1.93		1.96		1.23		1.24
		(4.39)**		(4.39)**		(1.84)		(1.91)
Poor		2.30		2.29		1.43		1.46
		(3.56)**		(3.56)**		(2.12)*		(2.22)*
Help with ADL ("no" = reference)		1.98		2.00		.72		.72
		(1.60)		(1.62)		(1.23)		(1.19)
Number of serious conditions		2.49		2.50		1.83		1.84
		(11.81)**		(11.85)**		(11.49)**		(11.58)**
Insurance status (under 65, private insurance = reference)								
Under 65, public insurance		.88		.92		.86		.88
		(.97)		(.63)		(.94)		(.80)
Under 65, uninsured		.43		.44		.55		.56
		(10.08)**		(9.72)**		(6.21)**		(6.13)**
65 or over, Medicare only		1.21		1.21		.95		.95
		(.97)		(.96)		(.30)		(.31)
65 or over, Medicare plus private		.95		.96		.71		.72
		(.26)		(.21)		(2.00)*		(1.91)
N	16,348	16,247	16,308	16,209	11,248	11,178	11,218	11,150

*$p < .05$; **$p < .01$

Note: SD = standard deviation; PCSA = primary care service area; MSA = metropolitan statistical area; ADL = activities of daily living; t-statistics are in parentheses.

uninsured is associated with worse access. Though educational attainment is not related to the likelihood of having a USC or to experiencing unmet need (Table 2), it is positively related to USPTF adherence (Table 3). Healthy individuals score lower on all measures of access because their need for health care is not great, and therefore they are unlikely to seek out a doctor, receive preventive care, or report unmet need. It is noteworthy that non-Hispanic blacks report unmet need less frequently than non-Hispanic whites and that both non-Hispanic blacks and Hispanics actually report higher screening rates for cholesterol compared to non-Hispanic whites. Although these findings run counter to common expectations, they are consistent with some previous research that finds a positive relationship between being black and the use of preventive screening services (Hewitt, Devesa, and Breen 2002; National Cancer Institute Cancer Screening Consortium for Underserved Women 1995).

In our third models, we include neighborhood socioeconomic disadvantage and the health care supply variables as regressors. The associations between neighborhood socioeconomic disadvantage and the access variables observed in model 1 remain statistically significant across all of our dependent variables, and the magnitudes of the odds ratios change very little. These results imply that virtually none of the association between neighborhood disadvantage and access to health care is attributable to differences in the supply of health care providers across PCSAs or counties.

In our final models, we control for all individual-level variables and the supply variables. The results suggest that, despite the inclusion of individual-level variables, neighborhood disadvantage remains significantly associated with all measures of access to health care. Odds ratios from model 4 in Table 2 indicate that, net of individual-level variables, a standard deviation increase in neighborhood disadvantage is associated with a 13 percent decrease in the odds of having a USC and a 23 percent increase in the odds of experiencing unmet need. Odds ratios from model 4 in Table 3 indicate that a standard deviation increase in neighborhood disadvantage is associated with a decrease of 9 percent in the odds of adhering to USPTF recommendations regarding blood pressure screenings and a 10 percent decrease in the odds of adhering to recommendations for cholesterol screenings. Though the magnitude of these results are relatively modest, neighborhood socioeconomic disadvantage is consistently related to access across a variety of measures, including all four variables used in the analyses in this article. These results indicate that the associations observed between neighborhood socioeconomic disadvantage and access to health care go beyond what would be expected given the composition of individuals in neighborhoods; neighborhood socioeconomic disadvantage itself seems to have an effect.

Odds ratios for the individual-level control variables from model 4 show the same general pattern of results as those observed in model 2, though the magnitude of some of the effects are slightly reduced. For example, the results from model 2 indicate that, compared to non-Hispanic whites, the odds of having a USC are 28 percent lower for non-Hispanic blacks and 44 percent lower for Hispanics. These figures are reduced to 22 percent and 35 percent, respectively, when neighborhood socioeconomic disadvantage is held constant. Not all differences across racial and ethnic groups are, however, attenuated by the inclusion of neighborhood socioeconomic disadvantage. For example, non-Hispanic blacks are less likely to report unmet need and more likely to get cholesterol screenings than non-Hispanic whites, and these differences actually increase when neighborhood socioeconomic disadvantage is included. Overall, these results suggest that, though neighborhood socioeconomic disadvantage may affect the ability of residents to obtain health care, it is not a major factor in explaining disparities in access across individual-level characteristics such as race and ethnicity.

It is possible that the association between neighborhood socioeconomic disadvantage and access to care is not the same across all individuals. To address this possibility, we estimated models with terms for a neighborhood disadvantage by income interaction, and a neighborhood disadvantage by education interaction. The resulting point estimates were inconsistent and had large standard errors. We therefore hesitate to draw conclusions from them. The cross-level interactions may be capturing very complex effects. For example, the interaction between individual-level income and neighborhood socioeconomic disadvantage might be a reflection of two underlying mechanisms. On the one hand, personal income may enable some individuals to overcome neighborhood-level barriers to obtaining health care. If so, we would

expect any deleterious neighborhood effect to be greater for the poor compared to the affluent. On the other hand, the health care system that poor and near-poor individuals use is probably very different from that of wealthier individuals, and it may require specific knowledge and skills. Thus, if poor people live among other poor people, they may benefit from the knowledge and skills of those in their neighborhood. If so, the deleterious effect of neighborhood socioeconomic disadvantage may be smaller, or even nonexistent, for poor individuals. Though we believe strongly that the mechanisms underlying these cross-level interactions deserve further investigation, a thorough analysis of them is beyond the scope of this paper.

DISCUSSION

This study investigated the association between neighborhood socioeconomic disadvantage and access to health care. We found that living in a disadvantaged neighborhood is associated with (1) a decreased likelihood of having a USC, (2) an increased likelihood of experiencing unmet need, and (3) a decreased likelihood of obtaining recommended preventive care. Furthermore, these associations are reduced but not eliminated when the composition of individuals within neighborhoods is held constant. Though the effects of neighborhood socioeconomic disadvantage are modest, especially relative to individual-level characteristics such as health insurance status, neighborhood-level socioeconomic disadvantage is consistently related to a variety of different measures of access. Little of the economic or racial disparities in access to health care are, however, explained by neighborhood socioeconomic disadvantage.

A limitation of this study is that we are not able to directly test the mechanisms by which neighborhood socioeconomic disadvantage is related to access to health care. We suggest that the associations exist because socioeconomic disadvantage at the neighborhood level gives rise to physical, service, and social environments that impede residents from finding, traveling to, and affording health care services. While our findings are consistent with these ideas, future research is needed to investigate them empirically. For this to happen, more detailed data on neighborhood environments are required, along with information on how residents perceive and respond to their environments. For example, information on the availability, convenience, and cost of public transportation and other travel-related variables would be useful for testing the mechanisms outlined in our study. Variables that measure social disorder, such as neighborhood crime rates and residents' perceptions of crime, the scope and density of networks in neighborhoods, and the type of information residents obtain from their networks would also be helpful. Though some of this information is available in other data sets (Ross and Mirowsky 2001; Ross et al. 2000), it is not yet available together with detailed individual-level information on health care access and utilization.

Another limitation of this study has to do with the possibility of omitted variables and measurement error. There may be variables at the individual level that are not included in our study or that are not measured adequately. If such variables are associated with both neighborhood disadvantage and access to health care, our findings could be a reflection of the composition of individuals in a neighborhood, rather than an actual neighborhood-level effect. For example, income is measured imperfectly, and no measures of assets or permanent income are available. It is possible that the association between neighborhood socioeconomic disadvantage and access to care is simply a reflection of personal socioeconomic disadvantage not measured by our variables. Important neighborhood-level variables may also be omitted or measured inadequately. If important neighborhood-level variables are omitted or poorly measured, the associations we observe could be due to some neighborhood characteristic other than neighborhood-level socioeconomic disadvantage. For example, while our measures of health care supply are the best available, they may not fully capture local variation in the extent to which health care services are easily available to individuals. If so, the association between neighborhood socioeconomic disadvantage and access may simply be a function of supply. Because we have included most individual-level and neighborhood-level variables identified by previous research as being important to health care access, we believe that any bias due to unobserved or poorly measured variables in our study is minimal. Nevertheless, the possibilities described above should be considered when interpreting our results.

Despite the limitations discussed above, this

study contributes to knowledge on access to health care by identifying neighborhood socioeconomic disadvantage as a possible determinant. Our findings suggest that when individuals who are disadvantaged are concentrated into specific areas, disadvantage becomes an "emergent characteristic" of those areas that affects the ability of residents to obtain needed health care. Given that a major goal of U.S. health policy is to ensure adequate access to health care for everyone (Institute of Medicine 2001; U.S. Department of Health and Human Services 2000), and given that the United States is highly segregated by a number of social and economic characteristics, more research is needed on how community-level characteristics affect the ability to obtain needed medical care.

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James B. Kirby is a service fellow at the Agency for Healthcare Research and Quality. He holds a doctorate in sociology from the University of North Carolina at Chapel Hill. His current research focuses on family and neighborhood influences on health, health behaviors, and access to health care.

Toshiko Kaneda is a policy analyst at the Population Reference Bureau in Washington, D.C. Her research focuses on socioeconomic inequalities in health, mortality, and access to health care among older populations. She is currently involved in projects examining community-level socioeconomic effects on health and mortality among older adults in mainland China.