Phantom of the Area: Poverty-Area Residence and Mortality in the United States

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ABSTRACT

Objectives. The purpose of the study was to conduct a national multivariate analysis on poverty-area residence and mortality in the United States.

Methods. Proportional hazards analyses were performed of the effect of poverty-area residence on the risk of mortality among adult examinees in the 1971 through 1974 National Health and Nutrition Examination Survey who were followed through 1987.

Results. Poverty-area residence was associated with significantly elevated risk of all-cause mortality (rate ratio = 1.78, 95% confidence interval = 1.33, 2.38) and some cause-specific mortality among those aged 25 through 54 years, but not among those aged 55 through 74 years, at baseline after adjustment for several individual and household characteristics.

Conclusions. Residence in poverty areas contributes to socioeconomic gradients in mortality among nonelderly adults in the United States. (*Am J Public Health.* 1998;88:973–976)

Introduction

The inverse gradient between individual and household socioeconomic status and mortality is well established.[1–3] Recent work has suggested that this gradient may be partly attributable to areal characteristics.[4–6] A study of 1811 Oakland, Calif, residents aged 35 years and older who were followed up from 1965 to 1974 found that residence in a federally designated poverty area had a significant association with all-cause mortality, even after selective adjustments for age, race, baseline measures of individual health behaviors, certain physiological measures, and individual and household socioeconomic and demographic characteristics.[4] Contradictory evidence, however, surfaced from a study in 1981 of residents aged 16 through 65 years in poorer wards in England who were followed up through 1989.[7]

To date, no national-level analysis has been performed of poverty-area residence and mortality in the United States, nor have national-level analyses addressed a period of growing socioeconomic disparities in mortality[3] or in specific causes of death. Such extensions would determine whether the association uncovered in Oakland applies nationally in similarly designated locales; these refinements might also provide insight as to the differences in findings between the English study and the US studies. We performed such an analysis, using a nationally representative sample of civilian, noninstitutionalized adults in the United States examined in the early 1970s and followed through 1987.

Methods

The data for our analysis were taken from the first National Health and Nutrition Examination Survey (NHANES I), conducted between 1971 and 1975, and the 1987 NHANES I Epidemiologic Follow-Up Survey. The NHANES I was the second in a series of surveys that constitute the largest nationally representative surveys to include both a medical exam by a physician and an extensive interview. The follow-up survey is the second and latest available follow-up survey of adults aged 25 through 74 years who completed the NHANES I medical examination (n=14407). The first-stage survey design of the NHANES I (1971–1974) included an oversampling of respondents in poverty areas (n=11348). Our study sample included only adult respondents from this sample who were either White or Black and for whom there were complete covariate data and information on vital status after the baseline interview (n=10161).

We performed Cox proportional hazards analyses to measure the effect of poverty-area residence separately on all-cause mortality and mortality due to cardiovascular disease, cancers, external causes, and all other causes. The proportional hazards assumption was found to be consistent with the data. Given the well-documented diminution of the effect of socioeconomic status on mortality with age,[8] we included an interaction term between age and poverty-area indicators. The results shown in Table 1 are from the interaction models, based on the significance of the age–poverty-area interaction. The age split (25–54 years or 55+ years at baseline) was based on an earlier analysis of the data that resulted in a division of the sample into 3 age cohorts[9] and on our determination that the middle age interval could be broken evenly between the younger and older cohorts without substantive changes to the results. The regression results (Tables 1 [last column] and 2) and crude rate ratios (Table 3) reflect both the incorporation of sample weights and the adjustment for the complex, multistage design effect of the NHANES survey, which was performed with SUDAAN, Version 6.4 (Research Triangle Institute, Research Triangle Park, NC).

The fully adjusted model (Table 1) included as covariates baseline measures of household income as a percentage of the

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TABLE 1—Effects of Poverty-Area Residence on Mortality, by Cause of Death

	All Causes	Cardiovascular Disease	Cancers	External Causes	Other Causes
	RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95%CI)	RR (95%CI)
Age/sex/race-adjusted model					
Age 25–54 y	2.01** (1.50, 2.69)	1.88** (1.23, 2.88)	1.97** (1.29, 3.00)	1.65 (0.64, 4.28)	1.45 (0.73, 2.88)
Age 55–74 y	1.02 (0.88, 1.18)	0.99 (0.81, 1.21)	1.01 (0.80, 1.28)	1.54 (0.68, 3.47)	0.99 (0.75, 1.33)
Fully adjusted model					
Age 25–54 y	1.78** (1.33, 2.38)	1.90** (1.24, 2.90)	1.95** (1.28, 2.95)	1.63 (0.61, 4.35)	1.41 (0.69, 2.85)
Age 55–74 y	0.87* (0.74, 1.01)	0.83* (0.66, 1.03)	0.94 (0.73, 1.20)	1.25 (0.54, 2.89)	0.83 (0.62, 1.10)

Note. RR = rate ratio; CI = confidence interval. Rate ratios are derived from age interval–poverty area interaction terms in Cox proportional hazards models. The fully adjusted model included, in addition to age, race, and sex, measures of the following covariates: marital status, household income as a percentage of the poverty line, formal education, alcohol consumption, body mass index, smoking, exercise frequency, baseline health status, hypertension, and cholesterol level. The variances on which the rate ratios are based incorporate the sampling weights and the complex sample design of NHANES, using SUDAAN, version 6.4.
*$P < .10$; **$P < .01$.

federally designated poverty line (<125%, 125%–249%, ≥250%), years of formal education completed, race (Black or White), marital status (married, divorced, widowed, or never married), smoking behavior (ever or never smoked 100 cigarettes), alcohol consumption (estimated average number of ounces of ethanol consumed daily), exercise (physically active or not), baseline health status, cholesterol level, hypertension (does not have or has systolic pressure ≥140 mm Hg or diastolic pressure ≥90 mm Hg, or takes blood pressure medication), and body mass index. These covariates were included because of their well-documented relationship to mortality in the literature on socioeconomic status and health.[4,7]

Federally designated poverty areas were initially defined as contiguous census tracts in the 100 largest metropolitan areas (according to the 1960 census) that ranked in the bottom quartile based on a weighting of several areal factors, including the proportions of families with low income, substandard housing, children in single-headed households, unskilled males in the labor force, and adults with low educational attainment. Area designations on the NHANES I were extended to all metropolitan tracts as well as nonmetropolitan census areas on the basis of 1970 census data and additional criteria established by the Census Bureau.[10]

Results

Age-specific mortality rates and rate ratios (RRs) by poverty-area residence and cause of death are given in Table 3. The difference between poverty-area and non–poverty-area residence is statistically greater for younger than for older individuals for all-cause, cardiovascular, and cancer mortality. In the younger group, the mortality rate among those residing in poverty areas was about twice that of non–poverty-area residents, regardless of cause of death. Among older residents, the poverty-area–nonpoverty-area mortality rate ratio, although markedly higher for external causes than for other causes of death, did not achieve statistical significance for any cause-of-death category, as in an earlier all-cause-of-death analysis of White men and women aged 70 years and older.[9]

Covariate means (Table 2) show that several demographic and socioeconomic risk factors—including having fewer years of formal education; having higher rates of household poverty; being divorced, separated, or never married (younger cohort); and being widowed—were significantly higher in poverty areas, as were such physiological and behavioral risk factors as hypertension and higher levels of body mass and alcohol consumption. To what extent are the patterns exhibited by the morality rate ratios by poverty area shown in Table 1 confounded by these characteristics? Results from the multivariate analyses (Table 1) indicate a robust effect of poverty-area residence on all-cause mortality in the younger cohort (RR = 1.78, 95% confidence interval [CI] = 1.33, 2.38) even after adjustment for all behavioral, physiological, and socioeconomic and demographic covariates, and despite the fact that these covariates generally had significant effects on mortality in the expected direction (Table 2, last column). Furthermore, the magnitude of the relative risk associated with poverty-area residence for this cohort was fairly stable across causes of death, except for distinctly lower risks of death from external and "other" causes, for which there were fewer sample deaths.

In the older cohort, poverty-area residence was not associated with a higher risk of mortality. Indeed, a suggestive protective effect surfaced in the fully adjusted all-cause and cardiovascular disease mortality models. Analyses stratified by sex (not shown) demonstrated that this result was driven by a marginally protective effect among older women. The rate ratio for deaths from external causes in the older group, while not statistically significant, was also distinctly higher than the rate ratio for any other cause.

Discussion

This analysis, using a considerably larger sample and a more recent and extended period of analysis, confirms for a US cohort aged 25 through 54 years what was previously demonstrated for a cohort aged 35 years and older in one urban area[4]: that residence in a poverty area is associated with a significantly elevated risk of mortality, even after multivariate adjustment for relevant individual and household demographic and socioeconomic characteristics, behavioral characteristics, and physiological measures. Why does poverty-area residence pose a risk for survival, particularly among those at younger to middle ages?

Although the crude rate ratios in particular showed elevated risks of death from external causes in poverty areas (Table 3), giving credence to a popular perception that higher levels of physical violence are responsible for increased risk of mortality there, such causes represent a small proportion of the overall excess mortality risk of residence in such areas. The elevated risk associated with poverty-area residence instead persisted across several causes, lending support to the hypothesis that a more general susceptibility arises in such contexts. Some researchers have maintained that the general susceptibility associated with lower individual or

TABLE 2—Weighted Sample Means of Covariates at Baseline, by Age Group and Poverty-Area Residence

Variable	Aged 25 through 54 y			Aged 55 through 74 y			
	All Respondents	Non–Poverty Area	Poverty Area	All Respondents	Non–Poverty Area	Poverty Area	Rate Ratio[a]
Age, y	38.9	38.8	39.6**	63.7	63.6	63.6	. . .
% Female	53.7	53.6	54.2	54.2	53.8	55.6	0.56**
% Black	11.3	7.8	26.6**	9.5	5.5	24.3**	1.01
Alcohol consumption, avg oz ethanol/day	1.19	1.17	1.26*	1.37	1.34	1.47**	1.16*
Cholesterol, mg/dL	212.9	213.5	210.1	238.0	237.7	239.2	1.00
% Hypertensive	34.2	32.9	39.7**	67.9	66.5	72.9**	1.60**
Body mass index, kg/m^2	29.14	29.00	29.75**	29.88	29.70	30.52*	0.98**
% With health problem	34.4	34.6	33.6	57.0	57.1	56.8	1.58**
Education, y	11.8	12.1	10.6**	9.9	10.3	8.4**	0.95**
% Ever smoked	63.6	64.4	60.2*	51.8	52.3	49.9	1.46**
% Never married	6.3	5.5	10.0**	4.6	4.5	5.2	1.30*
% Widowed	2.4	2.0	4.2**	19.6	18.9	22.2**	1.42**
% Divorced/separated	7.3	6.4	11.4**	5.8	5.4	7.0	1.47**
% Do not exercise	6.5	6.4	7.0	10.2	9.7	11.8	2.16**
% With income < 125% of poverty level	13.3	9.6	30.3**	21.9	17.5	37.8**	1.27*
% With income 125%–250% of poverty level	31.1	30.2	35.0*	29.3	28.9	30.5	1.09
% Residing in poverty area	18.3	. . .	. . .	21.6	. . .	. . .	. . .[b]

Note. *P* values of means are based on a simple *t*-test comparison of nonpoor and poor areas within age group. Rate ratios and associated *P* values are derived from the coefficients on the fully adjusted all-cause model reported in column 1 of Table 3. Variances from this model on which the *t* tests and rate ratios are based incorporate the complex sample design of the NHANES. Where mean values are reported as percentages, the rate ratio is from an indicator variable representing the presence or absence of the characteristic.

[a]With respect to all-cause mortality.

[b]Results on age–poverty area interactions are reported in Table 3.

*$P < .05$, **$P < .01$.

household socioeconomic status is partly due to greater psychosocial stress experienced by those of lower socioeconomic standing.[11] Our findings suggest that a component of such stress may be situated at the neighborhood level.

The absence of a significantly elevated risk associated with poverty-area residence among older residents (aged 55–74) is consistent with some "crossover" in which elderly survivors residing in poverty areas at baseline were relatively hardier than their counterparts in nonpoverty areas. Our control for baseline health status and physiological measures may not have captured such differences in hardiness. The fact that we have data on poverty-area residence at just one point in time may also be relevant to the differences uncovered in results by age. This single measure of residence reflects less information about residential history for the older cohort than for the younger cohort. The timing of moves into or out of poverty areas may mask the impact of the long-term effects of poverty-area residence in the older cohort in particular. Indeed, such moves could occur even if the elderly had stable residences, as the areas of residence themselves could change with respect to poverty-area designation.

The dynamic changes in the urban and industrial landscape in recent decades may also be relevant with respect to differential effects of poverty area on mortality by age. The late 1970s and the 1980s have been characterized as a period of increasing inequality in the United States[12] and of greater intensity of poverty in the inner cities.[13] To the extent that there may be threshold effects associated with recent changes in the socioeconomic environment of poverty areas, younger people may have been more affected because early exposures may have a more lasting impact on health, and because various characteristics of neighborhoods and area-level resources have been posited to be more important to human development at younger than at older ages.[14]

The difference between the results of this study and those from a study of an English sample[7] may be partly due to the absence of age interaction terms in that analysis. Indeed, in the fully adjusted models that we estimated without age interactions (not shown), the poverty-area effect was weak. On the other hand, as Sloggett and Joshi[7] emphasize in contrasting their results with those of Haan et al.,[4] the measure of area deprivation that they used is a continuous one rather than a threshold-type measure. They posit that the results from Haan and colleagues' study on Oakland may be partly due to especially severe deprivation experienced in that particular area. Our research demonstrates that this association between poverty area and mortality is not confined to one urban center, but this does not negate the possibility that threshold effects associated with area characteristics impinge on the health of residents in such areas.

Additional research should focus on the joint effects of poverty-area residence and such well-established social risk factors as marital status and race on the risk of mortality. Marital status interactions could provide insight into the extent to which the absence of informal social support is more or less lethal in a disadvantaged environment, while race interactions could shed light on whether poverty-area residence is more intense and devastating among Blacks than among Whites, as some have maintained with respect to the inner cities.[13]

Areal characteristics should be measured at more refined geographic levels than were available to us on this data set,[5] and at more than one point in time. Our incorporation of baseline health measures reduces potential bias in the effects of poverty area on mortality related to selection of less healthy people into such areas. More comprehensive data on residence over time, however, would help to clarify the extent of such bias.[15] Finally, in future analyses the incorporation of characteristics of the area itself—such as intensity of poverty, degree of racial segregation, unemployment rates, levels of environmental pollutants, and

TABLE 3—Mortality Rates, by Age Cohort, Poverty-Area Residence, and Cause of Death

			Cause of Death									
			All Causes		Cardiovascular Disease		Cancers		External Causes		Other Causes	
	n	Person-Years	No. Deaths	Mortality Rate[a]	No. Deaths	Mortality Rate[a]	No. Deaths	Mortality Rate[a]	No. Deaths	Mortality Rate[a]	No. Deaths	Mortality Rate[a]
Age 25–54 y	5830	83052	433	505	161	199	136	161	47	51	73	81
Poverty area (P)	2416	33630	259	872	97	364	78	273	28	89	46	120
Non–poverty area (NP)	3414	49422	174	428	64	164	58	138	19	43	27	73
Rate ratio, P/NP (95% CI)			2.04 (1.68, 2.46)		2.22 (1.62, 3.02)		1.98 (1.40, 2.77)		2.06 (1.15, 3.69)		1.65 (1.03, 2.65)	
Age 55–74 y	4331	49081	2183	3429	1162	1808	437	710	40	64	463	732
Poverty area (P)	2164	23984	1135	3521	587	1845	214	705	25	83	259	728
Non–poverty area (NP)	2167	25097	1048	3405	575	1798	223	711	15	59	204	733
Rate ratio, P/NP (95% CI)			1.03 (0.95, 1.12)		1.03 (0.92, 1.16)		0.99 (0.82, 1.19)		1.41 (0.74, 2.67)		0.99 (0.82, 1.19)	

Source. Data are from the first National Health and Nutrition Examination Survey (NHANES I, 1971–1975) and the NHANES I Epidemiologic Follow-Up Survey (1987).

Note. Sample size, person-years, and deaths are raw counts from the data. Sample weights are used to calculate the mortality rate on the basis of person-years and number of deaths. The row sums of cause-specific deaths do not equal the totals of all-cause deaths because of missing data on cause of death for some respondents. CI = confidence interval.

[a]Per 100 000 population.

availability of medical care, none of which were available for this analysis—will be fundamental to unraveling further the phantom-like qualities responsible for the elevated mortality risk experienced by nonelderly adult residents of poverty areas in the United States. □

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