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POVERTY AND HEALTH

PROSPECTIVE EVIDENCE FROM THE ALAMEDA COUNTY STUDY[1]

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To examine the reasons for the association between socioeconomic status and poor health, the authors examined the nine-year mortality experience of a random sample of residents aged 35 and over in Oakland, California. Residents of a federally designated poverty area experienced higher age-, race-, and sex-adjusted mortality over the follow-up period compared with residents of nonpoverty areas (relative risk = 1.71, 95 per cent confidence interval 1.20–2.44). This increased risk of death persisted when there was multivariate adjustment for baseline health status, race, income, employment status, access to medical care, health insurance coverage, smoking, alcohol consumption, physical activity, body mass index, sleep patterns, social isolation, marital status, depression, and personal uncertainty. These results support the hypothesis that properties of the sociophysical environment may be important contributors to the association between low socioeconomic status and excess mortality, and that this contribution is independent of individual behaviors.

mortality; poverty; prospective studies; socioeconomic factors

Socioeconomic position is one of the most persistent and ubiquitous risk factors known. Members of lower socioeconomic groups experience higher incidence and mortality rates and poorer survival rates for most major chronic diseases (1–3). Moreover, the risk of morbidity and mortality consistently declines as socioeconomic position improves. This gradient persists across a variety of diseases and for diverse populations in many different countries (3–14).

Despite the pervasive effect of socioeconomic position on health, the reasons for such differences have not been accounted for by existing research. The three major approaches to investigating the association between socioeconomic position and health have examined individual behavioral risk factors such as smoking and social connections, socioeconomic factors such as access to medical care and health insurance coverage, and socioenvironmental risk factors such as dilapidated housing and area rates of crimes and fires.

Studies investigating the association between socioeconomic position and disease have suggested that differences in behavioral risk factors such as smoking, cholesterol, physical activity, or relative weight do not account for much of the association between socioeconomic status and disease. For example, Salonen (15) reported a significant association between ischemic heart disease mortality and low education (relative risk = 2.1, $p < 0.05$) and low income

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(relative risk = 1.7, $p < 0.05$). These associations persisted after adjustment for age, serum cholesterol, smoking, and blood pressure.

Similarly, Rose and Marmot (16) compared coronary heart disease mortality among manual workers and low-skilled white-collar workers with mortality among administrative workers. Adjustment for cholesterol, smoking, blood pressure, body mass index, blood glucose, physical activity, and height accounted for less than 53 per cent of the increased risk of coronary heart disease mortality among manual workers and less than 62 per cent of the increased risk among low-skilled white-collar workers.

Studies on medical care and socioeconomic position have tended to focus upon the lack of medical care as an explanatory variable. Lack of access to medical care undoubtedly results in increased severity and poorer survival for many diseases (17–21). It seems unlikely, however, that lack of access can explain the higher incidence of disease among those in the middle to upper-middle socioeconomic position when compared with those in the highest socioeconomic position. In addition, the differential in health associated with socioeconomic position is still quite high in countries such as Finland or Sweden (22) where access by people of low socioeconomic position is not limited.

Studies focusing on area characteristics have suggested that certain socioenvironmental characteristics might be related to increased risk of disease (23). For example, Jenkins et al. (24), in a cross-sectional analysis, found that residential areas with higher proportions of people of low occupational status, substandard housing, and low median education experienced increased mortality from hypertensive diseases. They found similar significant associations for mortality due to all respiratory diseases, cerebrovascular disease (excluding hypertension), and ischemic heart disease. Similarly, Jenkins (25) reported an association between residence in low socioeconomic neighborhoods and mortality from all cancers. Dayal et al. (26–28) reported that residence in low socioeconomic position neighborhoods is associated with poorer survival from breast and prostatic cancers, even with adjustment for diagnostic stage and race.

Finally, in a 1965 cross-sectional analysis of a representative cohort of Alameda County, California, adult residents, Hochstim et al. (29) found a higher prevalence of health problems in residents of poverty areas compared with residents of nonpoverty areas, even when stratifying on income and race. They also found that, even within the same income level and race category, poverty area residents had more health problems. They concluded that residence in a poverty area was in itself a major health disadvantage.

These latter studies suggest that the social and physical environment to which many people of low socioeconomic position are exposed may be associated with increased risk of disease. Most of these studies, however, are cross-sectional and cannot specify whether residence in such environments is prospectively associated with mortality. Since chronic illness and disability often result in a decline in income, this methodological issue has substantive importance as well. Fox et al. (30) reported that the decline in income associated with poor health does not account for the association between socioeconomic position and mortality. In addition, individual-level data on behavioral and socioeconomic risk factors such as smoking, social connections, medical care access, or income were not always available in these studies. Thus, the influence of the social and physical environment on the health of people of low socioeconomic position has not been examined independently of established individual-level behavioral and socioeconomic risk factors.

The present research investigates the hypothesis that residence in areas characterized by a broad range of social and environmental deprivations, i.e., poverty areas, is

prospectively associated with increased risk for all-cause mortality, even after adjustment for potential confounders.

Materials and methods

Study population

Data for this study were collected by the Human Population Laboratory as part of a 19-year epidemiologic study of Alameda County, California, residents. In 1965, a cohort was assembled based on a random sample of noninstitutionalized adult residents of the county. Details on study procedures can be found in other publications (31–38). Mortality information is obtained via computerized death clearance matched against state mortality tapes and extensive in-state and out-of-state tracing procedures (39).

The present analysis is restricted to the 1,811 adults aged 35 and over who in 1965 were residents of Oakland, California, the largest city within Alameda County. The analyses compare the 1965–1974 mortality experience of those Oakland residents who lived in a federally designated "poverty" target area with the mortality experience of those who lived elsewhere in Oakland. The poverty area in Oakland occupies an approximately 10-mile-long strip on the western edge of Oakland. The area is divided by an interstate freeway, and residential areas exist side by side with warehouses, manufacturing industries, and railways.

The 1965 federal criteria (40) for "poverty area" designations included the proportion of families with low income, the proportion of substandard housing, the contiguity of census tracts (to form an "area"), the proportion of adults with low educational attainment, the proportion of unemployed, the proportion of unskilled male laborers, and the proportion of children in homes with a single parent. Thus, poverty area residence is a measure of socioeconomic position which incorporates a number of social and physical environmental factors, including area income, employment status, education, race, and dilapidated housing.

Thirty-seven of 102 census tracts in Oakland were included in the poverty area. Approximately 151,000 persons resided in this area in 1965, representing 41 per cent of Oakland's 1965 population (40).

Table 1 shows some of the characteristics of the poverty area taken from census data and other governmental sources (40). The poverty area exhibits disproportionately higher levels of unemployment for both men and women, higher police workload, poorer quality of housing, and a higher proportion of tuberculosis cases, often an indicator of poor living conditions and crowding, than exists in the nonpoverty area.

Table 2 compares the percentages of residents of the poverty and nonpoverty areas who were respondents in the survey for a number of socioeconomic and behavioral characteristics. There are disproportionately more people in the poverty area who are black, unemployed, poorly educated, and have low income. A higher proportion of residents of the poverty area also lacked health insurance coverage. Table 2 also shows that the proportion of divorced and widowed persons is higher in the poverty area, as is the proportion of those reporting fair or poor health. Current smoking differs

TABLE 1

Percentage of selected socioeconomic and health characteristics of the Oakland, CA, poverty area, 1965 (40)

Area characteristic	%
Population	41
Unemployed males ≥14 years	66
Unemployed females ≥14 years	61
General assistance recipients	94
Aid to families with dependent children recipients	85
Aid to disabled	73
Blind receiving aid	63
Police workload	65
Active tuberculosis cases	68
Dilapidated housing units	69
Renter-occupied units	75
Housing units with shared or no bathroom	89

TABLE 2

Proportion of adults aged 35 and over, by area residence, for selected demographic, socioeconomic, and behavioral characteristics, Oakland, CA, 1965

Characteristic	Area	
	Poverty (%)	Nonpoverty (%)
Black	66.8	13.5
Unemployed	4.7	1.6
Education (≤8th grade)	51.5	22.3
Inadequate income	30.4	12.9
Not covered by health insurance	30.0	12.4
Divorced or widowed	32.4	22.5
Fair or poor health	39.3	19.7
Current smokers	37.8	43.3
Heavy alcohol consumption (highest consumption category)	23.5	14.8*
Body mass index (first or fourth quartile)	52.8	48.4*
No.	615	1,196

* $p > 0.05$; all other comparisons are significant at $p < 0.0025$.

significantly by area of residence, but heavy alcohol consumption and body mass index, although both slightly higher in the poverty area, are not significantly different.

The prevalence of these socioeconomic and behavioral factors varies by area. There is, however, a sufficient distribution of these factors in both areas to allow examination of the association between poverty area residence and mortality, with adjustment for behavioral and socioeconomic factors commonly thought to account for the link between socioeconomic position and disease.

Measures

Table 3 lists and describes the coding for each of the independent variables included in this analysis. They are grouped into six conceptual domains as shown. These variables have been used and described in previous analyses by the Human Population Laboratory (31, 34–38), and their selection is based on their potential importance as explanatory variables.

Statistical methods

The analyses reported here compare the nine-year mortality experience of residents of the poverty area with that of residents of the nonpoverty area. In these calculations, attention is restricted to the 351 deaths that occurred during the nine-year follow-up period among the 1,811 residents who were 35 years of age or more in 1965.

Data analyses were performed using Statistical Analysis System (SAS) statistical programs (41, 42). As a first step, differences in age-, race-, and sex-specific all-cause mortality rates by poverty area residence were calculated. Area differences in age- and sex-adjusted rates were calculated, using the direct method of age adjustment which standardized rates to the age distribution of the sample. Finally, a series of logistic regression models were employed to examine the association between area residence and mortality, with simultaneous adjustment for other covariates.

The crude association between poverty area residence and all-cause mortality was first examined in a logistic model. Adjustments for age and sex were added in a second step, and adjustment for race was added in a third step. Four measures of baseline physical health status were then added to the model. The covariates included in this second model were included in all subsequent models.

Further models examined the association between poverty area residence and mortality, with adjustment for each of the four remaining domains: socioeconomic factors, health practices, social networks, and psychologic impairment.

TABLE 3

Variables used in logistic regression analyses of 1965–1974 all-cause mortality associated with area residence in adults aged 35 and over, Oakland, CA

Variable	Measurement
Demographic factors	
Sex	Female/male
Age	Years
Race	Nonwhite/white
Baseline physical health status	
Heart trouble	Present/absent
High blood pressure	Present/absent
Trouble breathing	Present/absent
Diabetes	Present/absent
Socioeconomic factors	
Income	Inadequate/marginal/adequate/very adequate*
Education	Years
Employment status	Part-time/other/full*
Regular physician	Yes/no
Health insurance	Yes/no
Health practices	
Smoking	Pack-years
Body mass index	Quartiles of body mass index with second quartile as reference
Alcohol consumption	Abstain/1–16*/17–30/31–60/61+ drinks per week
Sleep patterns	7–8 hours per night/other
Physical activity	Sedentary/medium/active* (based on questions concerning the type and strenuous nature of leisure time activity)
Social networks	
Marital status	Separated or divorced/widowed/single/currently married*
Close friends	No. and frequency of contacts
Relatives	No. and frequency of contacts
Group membership	Yes/no
Church group membership	Yes/no
Psychologic factors	
Depression	Present/absent
Personal uncertainty	Low/high

* Reference category.

RESULTS

Mortality rates

During the first nine years of follow-up, there were 351 deaths, of which 214 occurred in the nonpoverty area and 137 in the poverty area. Seventy-nine per cent of these deaths were due to either cancer or heart disease, and 3.5 per cent were due to accidents, suicide, or violence. There were no substantial differences by area in the proportion of deaths due to any specific cause.

The age-adjusted mortality rates shown in table 4 are higher in the poverty area for all sex and race group strata. The highest age-adjusted mortality rate occurs among white males residing in the poverty area and is 44 per cent higher than among white males residing in the nonpoverty area. Substantial area differentials also occur for females in both racial groups. Among white females, the age-adjusted mortality rate is 36 per cent higher in the poverty area; among nonwhite females, the age-adjusted mortality rate is 29 per cent higher. Virtually no poverty area differential in age-adjusted rates exists for nonwhite males.

Examination of the age-, race-, and sex-specific rates in table 4 shows that an age-related differential exists such that white males in the poverty area at all ages have higher rates than white males in the nonpoverty area. Among nonwhite males, the age-specific rates are higher in the poverty area, except at ages 45–54. Among white females, the poverty area differential persists until after age 65 when the rates become essentially equal. Among nonwhite females, the poverty area differential reverses after age 65.

The number of deaths at younger ages and among nonwhites in the nonpoverty area is small, and caution in interpretation of these rates is advisable. The health disadvantage associated with poverty area residence, however, is consistent for 13 out of 16 age-, race-, and sex-specific strata.

Multivariate analyses

Results of the logistic analyses are presented in table 5, which shows the effect of adjustment for a new covariable or set of covariables on the association between poverty area residence and all-cause mortality. Shown is the approximate relative risk of mortality associated with poverty area residence. Table 5 presents the crude associa-

TABLE 4

Age-, sex-, and race-specific mortality rates per 1,000, by area residence, Oakland, CA, 1965–1974

Age (years)	Whites		Nonwhites	
	Poverty	Nonpoverty	Poverty	Nonpoverty
		Males		
35–44	12.5 (16)*	3.9 (128)	6.4 (47)	4.4 (23)
45–54	32.1 (28)	9.3 (113)	10.2 (59)	14.3 (14)
55–64	29.6 (27)	23.0 (81)	15.6 (32)	0.0 (6)
≥65	58.3 (48)	57.5 (111)	60.9 (23)	50.0 (2)
Total no. at risk	(119)	(433)	(161)	(45)
Age-adjusted rates per 1,000	32.6	22.6	20.04	19.7
		Females		
35–44	9.5 (21)	5.2 (154)	7.8 (64)	6.7 (30)
45–54	6.3 (32)	6.0 (149)	10.4 (67)	0.0 (11)
55–64	27.0 (37)	8.6 (152)	22.5 (40)	0.0 (5)
≥65	38.3 (47)	39.1 (144)	33.3 (27)	50.0 (4)
Total no. at risk	(137)	(599)	(198)	(50)
Age-adjusted rates per 1,000	19.7	14.53	17.99	13.9

* Numbers in parentheses represent numbers of subjects.

TABLE 5

Estimated relative risk and 95% confidence intervals for association between area residence and all-cause mortality, Oakland, CA, 1965–1974

Adjustment variable	Approximate relative risk*	95% confidence interval
None	1.28	1.00–1.63
Age, sex	1.45	1.10–1.92
Demographic and health factors		
Age, sex, race	1.71	1.20–2.44
Age, sex, race, baseline health	1.55	1.07–2.23
Socioeconomic factors		
Income	1.50	1.03–2.19
Access to medical care	1.49	1.03–2.16
Employment status	1.46	1.01–2.12
Education	1.53	1.06–2.21
Health practices		
Smoking	1.54	1.07–2.23
Alcohol consumption	1.52	1.05–2.20
Physical activity	1.47	1.01–2.12
Sleep patterns	1.53	1.06–2.22
Body mass index	1.60	1.11–2.32
All health practices	1.49	1.02–2.18
Social networks		
Marital status	1.52	1.05–2.20
Close friends	1.51	1.05–2.20
Relatives	1.49	1.03–2.15
See close friends and relatives once per month	1.51	1.04–2.18
Group membership	1.47	1.02–2.13
Church group membership	1.57	1.09–2.27
All social networks items	1.47	1.01–2.16
Psychologic factors		
Personal uncertainty	1.50	1.03–2.16
Depression	1.52	1.05–2.20

* Multiple logistic regression model with adjustment for age, sex, race, baseline presence/absence of high blood pressure, heart trouble, trouble breathing, and diabetes.

tion between poverty area residence and all-cause mortality and this association adjusted for age and sex. Also shown are adjustments for individual covariates or sets of covariates as indicated, added to the basic model which includes age, sex, race, and four baseline health conditions.

Baseline health, age, race

Table 5 shows the association between poverty area residence and all-cause mortality, with adjustment for age, sex, and race, and with added adjustment for the presence of baseline heart trouble, high blood pressure, trouble breathing, and diabetes. All subsequent models are adjusted for these seven risk factors. There is a significant association between poverty area residence and all-cause mortality when there is adjustment for age, sex, and race. The strength of this association is not markedly reduced when there is simultaneous adjustment for four measures of baseline health status.

Socioeconomic variables

Table 5 also shows the association between mortality and residence in the poverty area when adjustments are made separately for income, access to medical care, employment status, and education. When income is entered into the model, there is essentially no change in the increased risk of mortality associated with residence in the poverty area. Similarly, simultaneous adjustment for the two medical care access variables, measured by having a regular physician and health insurance coverage, does not have any influence on this relation.

Adjustment for employment status of the respondents results in a very slight change in the relative risk. Finally, adjustment for education has virtually no effect on the strength or significance of the association.

Health practices

The influence of adjustment for each individual health practice measure on the association between mortality and poverty area residence is depicted in table 5. These results suggest that the increased risk associated with residence in the poverty area persists when there are separate adjustments for smoking, alcohol consumption, physical activity, body mass index, and sleep patterns. Each of the relative risks remains relatively constant, with less than a 6 per cent change with adjustment for these health practices variables compared with the model with adjustments for age, sex, race, and baseline health. The results of simultaneous adjustment for all five health practices at once is also shown. There is very little change in the poverty coefficient or the significance level.

Social networks

When adjustment is made for each individual measure of social connections, there is virtually no change in the mortality relative risk associated with residence in the poverty area (table 5). Simultaneous adjustment for all measures of social connections reduces the mortality relative risk associated with area residence by less than 6 per cent and has little effect on the precision of the estimate compared with the model with adjustments for age, sex, race, and baseline health.

Depression and personal uncertainty

Two models relating to psychologic factors are shown in table 5: one that includes adjustment for personal uncertainty and one that includes adjustment for psychologic depression. Adjustment for these risk factors has no influence on the relative risk associated with area residence.

Discussion

The initial hypothesis that residence in the poverty area is associated with increased risk of death has been supported by these analyses. The increased risk of mortality associated with residence in a poverty area was not affected by adjustment for age, sex, race, baseline physical health status, low income, lack of medical care, unemployment, education, health practices, social isolation, or psychologic uncertainty or depression.

It should be noted that many of these adjustment variables are associated with all-cause mortality and with lower socioeconomic status. As such, these covariates may be potential confounders of the association between poverty area residence and all-cause mortality. That adjustment for these risk factors does not substantially affect the association between poverty area residence and all-cause mortality suggests that this association may be due to other socioenvironmental factors present in the poverty area.

Collinearity between race and poverty area residence could be considered a problem in these analyses. Race was significantly associated with mortality in a logistic model which included age, sex, and baseline health. When poverty area residence was added to the model, the association between race and mortality was reduced by 26 per cent (relative risk for race = 0.98, $p = 0.103$). A similar reduction was not observed in the mortality relative risk for area residence, suggesting that poverty area residence could account for the association between race and mortality.

Inaccurate measurement may result in misclassification of covariates which may, in turn, result in incomplete adjustment for confounding (43). Of the health practices measures, heavy alcohol consumption, smoking, extreme over- and underweight, and physical activity were significantly associated with mortality. Of the social networks measures, lack of friends, lack of relatives, church group membership, and widowed status were significantly associated with mortality. Other Human Population Laboratory analyses (31–38) have reported similar associations for these risk factors. The findings in this study are also consistent with research reports from other data bases. That the covariates used for adjustment were associated with mortality in this and other research suggests that misclassification due to poor measurement is unlikely to explain these findings.

Since this study focuses upon the association between poverty area residence and mortality, it is important to examine whether differences in residential mobility might account for the observed association. In the present analysis, it is not possible to ascertain the length of residence of respondents in either area. Inspection of 1970 census data for Oakland, however, shows that approximately the same proportion of residents of the poverty area as of the nonpoverty area reported living at the same address five years previously. This suggests that residential mobility is similar in the two areas. Even if residential mobility out of the poverty area was higher than mobility into the poverty area, the effect of such misclassification would result in an underestimate of the association because exposed persons would in fact not be exposed, presumably leading to lower mortality in this group and a lower relative risk.

Differential mobility related to health status could also occur such that sicker persons (presumably with less income) might move into the poverty area in greater proportions. If downward mobility related to differential health status were the reason for these findings, adjustment for baseline health status would have substantially reduced the association between poverty area residence and all-cause mortality. Adjustment for presence of heart trouble, high blood pressure, trouble breathing, and diabetes at baseline reduces the relative risk by only 10 per cent (table 5).

These results suggest that poverty area residence is associated with all-cause mortality and that this association is not confounded by behavioral or socioeconomic factors commonly thought to account for the link between socioeconomic position and disease.

Unlike other studies that have examined the association between area characteristics of low socioeconomic position neighborhoods and disease, in the present study, it has been possible to adjust for many important risk factors measured on the individual level such as smoking, income, medical care access, and baseline physical health status. The present findings are con-

sistent with these other studies and suggest a role for sociophysical environmental characteristics in explaining the association between socioeconomic position and disease. Furthermore, this role appears to be independent of individual-level risk factors.

Overall, these research results, supported by similar findings elsewhere (17–19, 23–29), suggest that the search for new evidence to account for the persistent and pervasive link between socioeconomic position and disease should include assessment of the social and physical environmental demands to which persons of lower socioeconomic position are exposed. Residents of poverty areas may be exposed to higher crime rates, poorer housing, lack of transportation, and higher levels of environmental contaminants. These factors may be responsible for the gradients of health associated with socioeconomic position. Current research in the Alameda County Study is examining these environmental risk factors in further detail.

References

1. Kitagawa EM, Hauser PM. Differential mortality in the United States: a study in socioeconomic epidemiology. Cambridge, MA: Harvard University Press, 1973.
2. Syme SL, Berkman LF. Social class, susceptibility and sickness. Am J Epidemiol 1976;104:1–8.
3. Antonovsky A. Social class, life expectancy, and overall mortality. Milbank Mem Fund Q 1967;45:31–73.
4. Yeracaris CA, Kim JH. Socioeconomic differentials in selected causes of death. Am J Public Health 1978;68:432–51.
5. Morris JN. Social inequalities undiminished. Lancet 1979;1:87–90.
6. Black D, Morris JN, Smith C, et al. Inequalities in health: the Black report. Middlesex, UK: Penguin Books, 1982.
7. Pearce NE, Davis PB, Smith AH, et al. Mortality and social class in New Zealand. II. Male mortality by major disease groupings. NZ Med J 1983;96:711–16.
8. Holme I, Helgeland A, Hermann I, et al. Four-year mortality by some socioeconomic indicators: the Oslo Study. J Epidemiol Community Health 1980;34:48–52.
9. Logan WPD. Cancer mortality by occupation and social class, 1851–1971. Office of Population Censuses and Surveys—Studies on Medical and Population Subjects, 1982:44:1–253.
10. Devesa SS, Diamond EL. Socioeconomic and racial differences in lung cancer incidence. Am J Epidemiol 1983;118:818–31.
11. Syme SL, Oakes TW, Friedman GD, et al. Social class and racial differences in blood pressure. Am J Public Health 1974;64:619–20.
12. Marmot MG. Socioeconomic and cultural factors in ischemic heart disease. Adv Cardiol 1982;29:68–76.
13. Bright M. A follow-up study of the Commission on Cultural Illness Morbidity Survey in Baltimore. II. Race and sex differences in mortality. J Chronic Dis 1967;20:717–29.
14. Frey RS. The socioeconomic distribution of mortality rates in Des Moines, Iowa. Public Health Rep 1982;97:545–9.
15. Salonen JT. Socioeconomic status and risk of cancer, cerebral stroke, and death due to coronary heart disease and any disease: a longitudinal study in eastern Finland. J Epidemiol Community Health 1982;36:294–7.
16. Rose G, Marmot MG. Social class and coronary heart disease. Br Heart J 1981;45:13–19.
17. Hart JT. The Black report: a challenge to politicians. Lancet 1982;1:35–7.
18. Graham S. Socioeconomic status, illness and the use of medical services. Milbank Mem Fund Q 1957;35:59–66.
19. Freeborn DK, Pope CR, Davis MA, et al. Health status, socioeconomic status and utilization of outpatient services for members of a prepaid group practice. Med Care 1977;15:115–28.
20. Berg JW, Ross R, Latourette HB. Economic status and survival of cancer patients. Cancer 1977;39:467–77.
21. Linden G. The influence of social class in the survival of cancer patients. Am J Public Health 1969;59:267–74.
22. Nayha S. Social group and mortality in Finland. Br J Prev Soc Med 1977;31:231–7.
23. Harburg E, Erfurt JC, Chape C, et al. Socioecological stressor areas and black-white blood pressure: Detroit. J Chronic Dis 1973;26:595–611.
24. Jenkins CD, Tuthill RW, Tannenbaum SI, et al. Social stressors and excess mortality from hypertensive diseases. J Human Stress 1979;5:29–40.
25. Jenkins CD. Zones of excess mortality in Massachusetts. N Engl J Med 1977;296:1354–6.
26. Dayal HH, Power RN, Chiu C. Race and socioeconomic status in survival from breast cancer. J Chronic Dis 1982;35:675–83.
27. Dayal HH, Chiu C. Factors associated with racial differences in survival for prostatic carcinoma. J Chronic Dis 1982;35:553–60.
28. Dayal H, Chiu CY, Sharrar R, et al. Ecologic correlates of cancer mortality patterns in an industrialized urban population. JNCI 1984;73:565–74.
29. Hochstim JR, Athanasopoulos A, Larkins JH. Poverty area under the microscope. Am J Public Health 1968;58:1815–27.
30. Fox AJ, Goldblatt PO, Jones DR. Social class mortality differentials: artefact, selection or life circumstances? J Epidemiol Community Health 1985;39:1–8.
31. Berkman LF, Breslow L, eds. Health and ways of living: the Alameda County Study. New York:

Oxford University Press, 1983.
32. Belloc NB, Arellano MG. Computer record linkage on a survey population. Health Serv Rep 1973;88:344–50.
33. Belloc NB. Relationship of health practices and mortality. Prev Med 1973;3:67–81.
34. Wiley JA, Camacho TC. Life-style and future health: evidence from the Alameda County Study. Prev Med 1980;9:1–21.
35. Wingard DL, Berkman LF, Brand RJ. A multivariate analysis of health-related practices: a nine-year mortality follow-up of the Alameda County Study. Am J Epidemiol 1982;116:765–75.
36. Kaplan GA. Psychosocial aspects of chronic illness: direct and indirect associations with ischemic heart disease mortality. In: Kaplan RM, Criqui MH, eds. Behavioral epidemiology and disease prevention. New York: Plenum, 1985:237–69.
37. Kaplan GA, Camacho T. Perceived health and mortality: a nine-year follow-up of the Human Population Laboratory cohort. Am J Epidemiol 1983;117:292–304.
38. Berkman LF, Syme SL. Social networks, host resistance, and mortality: a nine-year follow-up study of Alameda County residents. Am J Epidemiol 1979;109:186–204.
39. Arellano MG, Petersen GR, Petitti DB, et al. The California Automated Mortality Linkage System (CAMLIS). Am J Public Health 1984;74:1324–30.
40. City of Oakland. Profile of target areas for economic opportunity programs. October 9, 1966.
41. SAS Institute, Inc. SAS user's guide: statistics. Cary, NC: SAS Institute, Inc, 1982.
42. SAS Institute, Inc. SAS supplemental library user's guide. Cary, NC: SAS Institute, Inc, 1980.
43. Greenland S. The effect of misclassification in the presence of covariates. Am J Epidemiol 1980;112:564–9.