OPTIMAL INDICATORS OF SOCIOECONOMIC STATUS FOR HEALTH RESEARCH

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ABSTRACT

Objectives: This paper examines the relationship between various measures of SES and mortality for a representative sample of individuals.

Methods: Data are from the Panel Study of Income Dynamics. The sample includes 3,734 individuals aged 45 and above who participated in the 1984 interview. Mortality was tracked between 1984 and 1994 and is related to SES indicators of education, occupation, income and wealth using Poisson regression models.

Results: Wealth and recent family income have the strongest associations with subsequent mortality. These associations persist after controlling for educational attainment and occupation and generally are stronger for women than for men and for the younger (age 45-64 in 1984) than for the older (age 65+ in 1984) cohort.

Conclusions: By and large the economic components of SES have associations with mortality that are at least as strong as, and often stronger than, the more conventional components of completed schooling and occupation.

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INTRODUCTION

Although numerous studies have documented the associations between socioeconomic status (SES) measures and a variety of health outcomes,[1-6] comprehensive measures of SES are not routinely collected in the United States. In addition, most SES data that are obtained are not reported.[7-9] This data deficiency was highlighted at a recent federally sponsored health conference on SES[1,10] and has been noted by the National Committee on Vital and Health Statistics (NCVHS).[11] In both cases, the recommendation was for regular collection of SES data and for the use of SES variables in studies of differential health outcomes.

Despite growing awareness of the need for regular collection of SES measures, there remains little agreement on which SES measures should be gathered.[12] One problem is that numerous measures of SES, including occupation,[13] education,[14,3] and household income,[4,5,15,16] have been shown to affect health outcomes, but these measures are not interchangeable.[12,17-19] Moreover, the impact of any particular SES measure on health varies across different population sub-groups, such as those based on gender and age.[3,20-22] The fact that various measures of SES may summarize different components of overall health risk suggests that a systematic evaluation of the explanatory power of various SES measures is required before an optimal set of indicators can be recommended.

This paper contributes to this examination by evaluating the empirical relationship between a set of SES measures, available from both administrative and survey data sources, and mortality for a nationally representative sample of individuals. The analysis takes advantage of a unique data set, the Panel Study of Income Dynamics (PSID), to examine the predictive power of a variety of SES measures. Although it includes the traditional SES measures of education and occupation, the analysis focuses on

the relatively neglected economic components of SES.

Our evaluation of "optimal" SES indicators is decidedly empirical and based on their sensitivity to mortality risk. We find considerably greater sensitivity for the economic components and suggest that they should be a standard feature of our measurement system for monitoring links between SES and health.

MEASURES OF SES

In general, measures of socioeconomic position are meant to provide information about an individual's access to social and economic resources. As such, they are markers of social relationships and command over resources and skills that vary over time.[23-24] Among the most frequently used indicators are education and occupation. Less common, but potentially as important, are economic measures such as household income and wealth. The following section describes the benefits and drawbacks of each of these measures.

Education is an important determinant of individuals' work and economic circumstances[25] that are themselves linked to health through specific work conditions and levels of consumption. Education also may be associated with health through its connection to health behaviors. The higher the level of education, the more likely one is to engage in a range of health-enhancing self-maintenance activities.[26,27] Years of completed schooling are reported with reasonable ease and reliability and are a meaningful indicator of SES for virtually all adults. Because education is typically completed early in adulthood, it serves as a marker of early life circumstances[28] and there are no reverse causation problems in linking education with health outcomes in older ages. These considerations led to the selection of education for the death certificate in 1989,[7] and the preliminary assessment of the National Committee of Vital and Health Statistics that education may be the most feasible SES indicator for administrative databases.[11] On the other hand, education captures neither differential on-the-job training and other career investments made by individuals with similar levels of formal schooling, nor the volatility in economic status during

adulthood that recently has been shown to have adverse implications for health.[16]

Usual or most recent occupation has long been employed as an indicator of SES for persons with labor force attachments and can have direct and indirect effects on health. For example, it represents exposure to the psychosocial and physical dimensions of work arrangements,[29,30] as well as a range of expected earnings and social capital in the form of relative standing or prestige. Measures of occupational class are widely used in other industrialized countries and have been found robust in predicting variations in health status.[17] The National Institute of Health (NIH) conference called for occupation to be included as a core SES variable in the United States.[1] Still, occupation is problematic for subgroups of the population, such as teen mothers and others with little labor market experience. Moreover, later-career occupations, unlike education, are more subject to reverse causation problems if poor health leads to declines in occupational status.

Household income has been used more widely as a measure of SES in studies undertaken in the United States than elsewhere. While education and occupation capture individually-based dimensions of social position, household income is more indicative of a standard of living and life chances experienced by household members through the sharing of goods and services. The most typical income-based measure is a household's total cash income, measured over the month, calendar year, or 12-month period prior to the point of health measurement.[5,15,22] Measures of disposable household income, obtained by subtracting the taxes paid by households from total cash income, better approximate a household's flow of resources, although they obviously require difficult-to-obtain tax data.

One problem with the use of household income to examine relationships between socioeconomic position and health is that members may have unequal access to household income. Specifically, research points to a female disadvantage in resource sharing in households.[31,32] A second problem is that current household income may be an inadequate representation of the standard of living of retired persons because it may not reflect available financial resources and it disregards the cumulative effects of a

lifetime of deprivation or privilege.[33] Moreover, since current income may be a product of recent health, associations between income and health are subject to reverse causation problems.

In contrast to income, which consists of a flow of resources over some time period, wealth captures the accumulated stock of assets or economic reserves at a given point in time. Income and wealth are positively correlated. For example, wealth is higher for families with histories of higher earnings, lower consumption, more savings and, in some cases, fewer expenditures on health care. But wealth and income also are distinct. For example, elderly individuals frequently have little cash income but substantial wealth. For most of the United States' population, wealth is tied up in cars and homes, items for which survey non-response bias can be minimized. Several studies in both the United States and the United Kingdom find that indicators of wealth are related to health, independent of the more traditional indicators of SES.[33-36] Concurrent associations between wealth and health are subject to problems of reverse causation, although perhaps less so than with income and health, since the wealth accumulation process is typically a lengthy one.

Most health inequalities research in the United States relies on socioeconomic position ascertained at one point in time. While this provides some indication of a relative pattern of health differentials, the cumulative and dynamic nature of socioeconomic structures and experiences is rarely considered. Persistent low income and income volatility may be especially problematic for health,[16] and vulnerability to socioeconomic conditions may vary across the life course.[37] Thus, in assessing their relevance for public policy regarding data collection and reporting, it is important to evaluate the relative utility of cross-sectional and longitudinal measures of socioeconomic position.

Finally, while cumulative research points to a robust association between socioeconomic position and health, the size of its effect may vary across social groups. For example, a weaker socioeconomic gradient in mortality has been observed for retired persons[21,38] and women.[24,39,40] The survival of those with lower levels of health risk, the postponement of morbidity among the socioeconomically advantaged,

the universality of certain social programs, such as Medicare, and the inadequacy of commonly used measures of socioeconomic position to capture the experiences of diverse groups may account for the differential effects of socioeconomic position by age,[20,41] race,[42,43] and gender.[44]

With a view to making a concrete contribution to policy decisions that would routinize the gathering of socioeconomic information in various data collection modes, the following analysis examines the relationship between socioeconomic position and mortality using data from the Panel Study of Income Dynamics. We consider both individual and household measures of such positions, as well as the relative merit of short-term versus long-term appraisal of selected indicators. All analyses are stratified by age and sex. Insufficient case counts precluded an additional level of stratification by race.

DATA

The PSID is an ongoing longitudinal study of a representative sample of individuals living in the United States and of the family units in which they reside. The survey began in 1968 with mortality follow-up through 1994. The emphasis of the survey is on dynamic aspects of household economic and demographic behavior, and considerable attention has been paid by study staff to edit and code occupation, earnings and family income data consistently across waves. Starting with a representative national sample of households and individuals in 1968, the PSID has collected data on individuals from those households on an annual basis. The initial-wave response rate among sampled dwellings in 1968 was 76 percent. Attrition was 11 percent between 1968 and 1969 and has remained between 2 and 3 percent each year since 1969. Approximately 55 percent of the still-living original sample of individuals continued to participate in the study in the interviewing year 1995. Studies evaluating the national representativeness of the surviving PSID sample at various points (including the 1984 point used to define our sample) have found no significant problems.[45] Probability-of-selection weights are available to adjust for differential non-response not related to mortality, as well as the design-driven unequal selection probabilities of the original sample. These make it possible to generate estimates that are representative

of the U.S. population, with the exception of some immigrants to the U.S. since 1968.

Death is recorded in the PSID as a reason for attrition from the sample. In the majority of instances, deaths are reported in the next annual interview by a surviving household member. For persons who were living alone when last interviewed, information about death comes from a variety of sources, including a surviving contact person, the administrator of the deceased person's estate, or the post office via returned mail. Comparisons of the PSID and vital statistics mortality data from the National Center for Health Statistics generally show close agreement.

Sample and methods. The analysis of PSID data is based on 3,734 individuals age 45 and above who were present at the time of the 1984 interview. The possible mortality of these individuals is tracked between 1984 and 1994. Over this period there were 298 deaths (11.8 percent) recorded for the nonelderly (ages 45-64 comprising 67.8 percent of the sample) and 535 deaths (44.3%) recorded for the elderly sample. Mortality is related to SES indicators using Poisson regression models that include additive controls for age in 1984, race (black or all other), and sex.

Although the relatively small sample available in the PSID precluded estimation of separate models for most demographic subgroups, we did estimate a complete set of models separately for non-elderly males and females (under age 65 in 1984; n=1,091 and 1,435, respectively). In all cases, we calculate Huber-White robust standard errors using STATA that account for the geographically-clustered nature of the sample (STATA Version 6).[46]

We distinguish three kinds of SES indicators: 1) "administrative data" indicators that can be collected in most health data, including death and birth certificates; 2) "survey" indicators that can be collected in a household survey; and 3) "exogenous" indicators measured a decade or more prior to the measurement of the health outcome and likely free from the serious bias caused by health status affecting SES.

Administrative data indicators. Included in our set of readily collected SES measures are years of completed schooling, most recent occupation and total family income. A direct question about completed schooling was asked in several of the PSID's interviewing waves; we took the most recent report prior to the 1984 interview. Descriptive information about this and all other measures are given in Table 1.

Information about occupation was asked in the PSID whenever a respondent reported working at the time of the interview or in the calendar year preceding the interview; again, we took the most recent report prior to the 1984 interview. Questions used to determine occupation are identical to those asked in Census Bureau surveys, and responses are coded to the 1970 U.S. Census Occupational Classifications. The ordinal scale used in the inequality index method (discussed below) was based on the following ranking of occupations: professional, managerial, clerical, sales, crafts, operatives, laborers, service, and farmer. This ordering follows the pattern of mortality risk across occupations reported by Moore and Hayward.[47] We also examined occupation-mortality associations using a prestige scale, which, relative to the Moore and Hayward method, gives service occupations a higher ranking. Our results were not sensitive to this reordering.

Total household income comes from a series of questions asked in the 1984 interview about components of income received by all family members during the calendar year 1983. The detailed nature of the questions is likely to lead to more reliable measurement of income than would be obtained from a single question. In contrast to other income-based indicators described below, we do not subtract taxes from household income since the data required for this adjustment are not likely to be available in administrative data sources. Similarly, it may not be feasible to collect sufficiently high-quality income information on death certificates.

Survey-based indicators. Our list of survey-based indicators consists of measures of SES that can be collected in a cross-sectional or short-run longitudinal household survey. Our household-income measure averages reports of household income over the five calendar years between 1979 and 1983. All

dollar-based measures in our analysis were inflated to 1984 price levels using the CPI-UX1 component of the Consumer Price Index. To approximate disposable household income, we subtracted Federal income taxes and Social Security taxes from the household's total cash income.

We obtained a household size-adjusted measure of household income by dividing an individual's household income by a Census Bureau-based poverty threshold that accounts for family size. For example, in 1999, the poverty threshold for a family of four—two adults and two children—was $16,895; an individual with that level of household income would have an "income-to-needs" ratio of 1.0; an income of $33,790 would produce a ratio of 2.0. We constructed a measure of household wealth at the time of the 1984 interview from a sequence of questions designed to gather comprehensive information about the assets and liabilities of the household.

Exogenous indicators from long-term prospective studies. That SES may reflect rather than cause health status is a bedeviling problem for studies of SES-health linkages. The PSID data span a long period, dating back to 1968, and thus provide the opportunity for SES measurement a decade or more prior to the period over which mortality is measured. Our strategy for compiling a set of exogenous indicators of SES is to measure everything prior to the 1976 interview and to adjust our regression estimates to reflect whether individuals reported health limitations in the 1976 interview. Our two exogenous indicators are household income and family-size-adjusted household income, both averaged over the years between 1967 and 1975. To minimize the possible effects of health selection in the analysis, we also control for disability, as defined by a 1976 self-reported response to the question: "Do you have any physical or nervous condition that limits the type of work or the amount of work that you can do?"

We relate SES measures to mortality by creating indices of inequality based on each of our socioeconomic indicators[28,48] and estimate the relationship between these indices and mortality using Poisson regression. In analyses not included in the paper, we also use Cox regression models to estimate

the relative mortality risk of individuals in the bottom versus the top deciles of the income of wealth distributions. Results are quite similar to those reported here.

Following Pamuk,[49] Kunst and Mackenback,[48] and Smith et al.,[28] we create indices for each of our SES indicators by assuming that the socioeconomic status of a group (e.g., those who did not complete high school) is determined by the group's relative position in the indicator's hierarchy (e.g., education). As such, the socioeconomic position of each group is assigned a value between 0 and 1 based on the proportion of the population with a higher position than the midpoint of each group within this hierarchy.

The numerical indicators of socioeconomic position are related to mortality using Poisson (log-linear) regression. Coefficients transformed by (expβ -1) show proportional increase in mortality moving from the top (=0) to the bottom (=1) of the social hierarchy. Following Smith et al.,[28] we refer to the relative inequality index as RII.

RESULTS

Table 2 presents Poisson regression-based risk estimates and 95 percent confidence intervals for our various indicators of SES. Estimates in each cell in Table 2 are obtained from regressions containing age, race, and the indicated SES measure only. In cases where the male and female samples are combined, the regressions also control additively for sex.

The first three rows of Table 2 show that the inequality index method produces a significant mortality association for occupation and family income, but not education, for the combined sample of 45-64 year olds. (Since all SES contrasts are reverse scaled, a risk estimate that exceeds 1.0 indicates higher mortality associated with lower levels of SES.) Breaking the age 45-64 sample down by sex produces somewhat higher SES-related mortality risks for women than for men (the exception being occupation), but only in the case of women's 1983 pre-tax family income is the risk estimate statistically significant at conventional levels. Only the family income administrative-data indicator had significant mortality impacts among individuals in the older cohorts.

Results for the survey-based indicators of SES (all of which measure economic resources) are presented in the fourth through sixth rows of Table 2. For the younger cohort, all SES indicators have significant associations with mortality, with relative rates of mortality of about 3.0. In all cases, these rates are higher for women than for men. As a final generalization, the rates are universally smaller for the older (age 65+) than for the younger cohort. Comparing income measures in the administrative and survey categories shows that the relative mortality rates are not affected much either by lengthening the accounting period from one year to five years or by adjusting family income for family size.

Results for the final, exogenous set of indicators are drawn a decade or more prior to the beginning of the interval over which mortality is assessed (final two rows of Table 2). To enhance our efforts to assess the exogenous effects of these SES components, we introduced an additive control for 1976 self-reported work limitations into all of the regressions. By and large, measuring the economic component of SES in the late 1960s and early 1970s reproduces the patterns found with the economic components measured in the late 1970s and early 1980s. Household income, in this case averaged over the 1967-1975 interval, continues to have stronger associations with subsequent mortality for women than for men and for younger than for older cohorts.

Risk ratios for the older cohorts are evident for both the more distant and the more recent SES measures, suggesting that economic status before and during retirement are important determinants of post-retirement health. The fact that the risk ratios are never as strong for the older as for the younger cohorts suggests that some of the health effects of SES may take the form of survival until age 65.

To assess which SES indicators retain their explanatory power in the presence of controls for other SES indicators we undertook the series of regressions summarized in Table 3. In all cases we used the inequality index method and controlled for sex, age and race. The first row shows the relative risk (1.59) associated with education for the sample of 45-64 year olds, including our demographic controls but no other SES indicators. By design, this estimate is identical to the one presented in the first row and

column of Table 2. In contrast, the relative risk shown in the second row (.56) includes controls for occupation and 1979-1983 post-tax family income. In neither case are these estimates significantly different from 1.0 at conventional levels. The occupation effect is also reduced in the presence of economic controls, but the associations of income and wealth with mortality are not diminished after controlling for occupation and education. A qualitatively similar story holds for the older cohort, although the absolute levels of the risk ratios are considerably lower than those for the younger cohort.

DISCUSSION

In this paper, we sought to enumerate alternative measures of SES and to assess their associations to mortality using prospective data from a nationally representative survey. Although we find some SES-mortality gradients for education and occupation, the most powerful associations are found for the economic measures—wealth and family income. These associations are generally stronger for women than men and for the younger (age 45-64 at baseline) cohort. They diminish little when measured nine to fifteen years prior to the mortality observation window or in the presence of adjustments for education and occupation.

One of our most striking results is the high mortality risk for women with low family incomes during their pre-retirement years. This finding is in stark contrast to those of other studies reporting a weaker socioeconomic gradient in mortality for women, particularly when education and occupational class are considered,[24] and buttresses the argument that these latter indicators may not adequately capture women's SES. For example, women receive lower income returns from education than men and occupational classification systems based on the characteristics of male-dominated occupations do not capture the hierarchy of women's jobs.[39] Further research is needed to understand the very different ways in which the material and symbolic dimensions of socioeconomic position affect the health of men and women.

Although our analysis distinguished SES-mortality associations between pre- and post-retirement cohorts and was able to measure some components of SES more than a decade prior to its morality observation window, we only began to exploit the potential of a life-course analysis perspective on links between SES and mortality. A more complete analysis would better address the process of acquiring SES positions and resources, including those resulting from economic and occupational changes caused by failing health.

Our results suggest that economic components of SES should be a standard feature of the measurement system for monitoring links between SES and health. It is feasible to gather reasonably valid information about income and wealth in surveys without compromising response rates.[50] Efforts to do so as part of collecting administrative data may be more difficult. However, the much greater explanatory power of income and wealth-based measures of SES as compared with the more conventional measures of education and occupation suggests the value of methodological efforts to support the collection of economic measures as part of administrative data systems.

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Table 1. Descriptive Statistics for Analysis Variables[a]

	Age 45-64			Age 65+
	Total	Men	Women	Total
Administrative Data Indicators				
Education				
N[b]	2526	1091	1435	1208
<=8 years	0.21 (0.411)	0.24 (0.425)	0.20 (0.399)	0.41 (0.493)
9-11 years	0.21 (0.409)	0.19 (0.395)	0.23 (0.418)	0.16 (0.371)
12 years	0.35 (0.478)	0.28 (0.451)	0.41 (0.491)	0.26 (0.439)
13+ years	0.21 (0.410)	0.28 (0.449)	0.16 (0.370)	0.15 (0.358)
Last Occupation				
N[b]	2369	1075	1294	919
Laborer	0.03 (0.176)	0.06 (0.244)	0.01 (0.091)	0.02 (0.151)
Operative	0.17 (0.378)	0.16 (0.370)	0.18 (0.384)	0.23 (0.422)
Crafts	0.09 (0.292)	0.21 (0.405)	0.01 (0.087)	0.05 (0.227)
Clerical	0.13 (0.338)	0.05 (0.217)	0.19 (0.395)	0.09 (0.289)
Service	0.15 (0.359)	0.07 (0.258)	0.21 (0.410)	0.05 (0.209)
Manager	0.10 (0.303)	0.16 (0.368)	0.06 (0.232)	0.04 (0.185)
Professional	0.09 (0.293)	0.12 (0.328)	0.07 (0.261)	0.06 (0.243)
1983 Pre-Tax Family Income				
N[b]	2526	1091	1435	1208
Overall Mean	34233 (32467)	39715 (34337)	30065 (30327)	19252 (18242)
Survey-Based Indicators				
Total Wealth				
N[b]	2526	1091	1435	1208
Overall Mean	118356 (345277)	135801 (369394)	105093 (325254)	114855 (424458)
1979-1983 Post-Tax Family Income				
N[b]	2526	1091	1435	1208
Overall Mean	29040 (21338)	32644 (21825)	26301 (20549)	19289 (29755)
1979-1983 Family Income-to-Needs				
N[b]	2526	1091	1435	1208
Overall Mean	3.7 (3.4)	4.2 (3.5)	3.4 (3.3)	3.0 (4.9)
"Exogenous" Indicators				
1969-1975 Post-Tax Family Income				
N[b]	2526	1091	1435	1208
Overall Mean	26433 (14480)	28064 (14177)	25193 (14590)	20110 (14181)
1969-1975 Family Income-to-Needs				
N[b]	2526	1091	1435	1208
Overall Mean	2.7 (1.9)	2.9 (1.9)	2.6 (2.0)	3.0 (2.5)

[a]Unweighted mean (standard deviation).
[b]Number of nonmissing observations on analysis variable.
Source: Authors' calculations based on the PSID.

Table 2. Age, Gender, and Race Adjusted Relative Rates of Mortality (and 95% confidence intervals) According to Administrative, Survey, and Exogenous Data Indicators

	Age 45-64			Age 65+
	Total	Men	Women	Total
Administrative Data Indicators				
Education RII	1.59 (0.96, 2.64)	1.67 (0.89, 3.10)	2.04 (0.83, 5.02)	1.48 (0.95, 2.31)
Occupation RII	2.34 (1.19, 4.57)*	2.37 (1.00, 5.63)*	2.01 (0.71, 5.70)	0.73 (0.38, 1.39)
1983 Pre-Tax Family Income RII	3.46 (2.07, 5.77)*	1.64 (0.77, 3.50)	3.87 (1.89, 7.93)*	1.58 (1.17, 2.14)*
Survey Data Indicators				
Wealth RII	2.86 (1.50, 5.45)*	2.51 (1.15, 5.44)*	4.51 (1.84, 11.0)*	2.05 (1.48, 2.85)*
1979-1983 Post-Tax Family Income RII	2.95 (1.67, 5.20)*	1.68 (0.82, 3.44)	4.60 (2.20, 9.64)*	1.50 (1.12, 2.00)*
1979-1983 Family Income-to-Needs RII	3.04 (1.63, 5.68)*	1.74 (0.73, 4.16)	3.68 (1.54, 8.78)*	2.06 (1.34, 3.19)*
Exogenous Indicators				
1969-1975 Post-Tax Family Income RII	1.94 (0.93, 4.08)	1.26 (0.62, 2.54)	3.97 (1.61, 9.79)*	1.38 (1.04, 1.85)*
1969-1975 Family Income-to-Needs RII	1.95 (1.01,3.75)*	1.49 (0.72,3.06)	2.31 (0.96, 5.53)	1.47 (1.06, 2.03)*

[a]Top decile contained fewer than 25 observations.
*Significant at the 5 percent level.

Source: Authors' calculations based on the PSID.