

Socioeconomic Status and Racial and Ethnic Differences in Functional Status Associated with Chronic Diseases

ABSTRACT

Objectives. This study examined the relationships between wealth and income and selected racial and ethnic differences in health.

Methods. Cross-sectional data on a national sample of 9744 men and women aged 51 through 61 from the 1992 Health and Retirement Survey were analyzed to examine the association between socioeconomic status and racial and ethnic differences in functional status among those with hypertension, diabetes, a heart condition, and arthritis.

Results. Compared with Whites, African Americans report higher rates of hypertension, diabetes, and arthritis, while Hispanics report higher rates of hypertension and diabetes and a lower rate of heart conditions. Accounting for differences in education, income, and wealth had little effect on these prevalence differences. In general, among those with chronic diseases, African Americans and Hispanics reported worse function than Whites. This disadvantage was eliminated in every case by controlling for socioeconomic status.

Conclusions. While socioeconomic status, including wealth, accounts for much of the difference in functional status associated with these chronic diseases, it plays a relatively small role in explaining differences in the prevalence of chronic disease, possibly reflecting different causal pathways. (*Am J Public Health.* 1997;87:805-810)

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Introduction

Numerous studies have documented differences in health status among racial and ethnic groups across the life cycle in the United States, and the disparities during middle and later life cut across a range of dimensions of health status.¹⁻⁸ By most measures, African Americans have worse health status than Whites, but the patterns are more complex among Hispanics. For example, the health status of some Hispanic populations is not consistently worse than that of Whites, a phenomenon sometimes labeled the Hispanic epidemiological paradox.⁹⁻¹⁴

Although the precise causal pathways producing racial and ethnic differences in health status have not been clearly delineated, racial and ethnic groups that experience worse health generally have a lower socioeconomic status (SES), which may be the primary underlying cause of the differences in health.^{1,15-19} Lower SES may lead to higher prevalence rates for many common chronic conditions via complex pathways linking behavioral and psychological, social, biological, and genetic factors.²⁰⁻²² For example, low SES may be associated with higher cumulative levels of stress, and biological reactants to this stress may contribute to the development of hypertension.²⁰ Once a person develops a disease, however, there may be wide variation in its impact on functional status. This variation may be especially important in chronic diseases for which treatment is known to affect clinical outcomes, such as hypertension and diabetes. Lower SES may lead to poorer outcomes once a disease develops because of such factors as reduced access to health care services,²³ lower quality of medical care,²⁴ and later diagnosis and greater severity of illness. Although this is outside the scope of this study, it is im-

portant to recognize that poor health may also affect SES, possibly reducing a person's capacity to work and earn income.

Using cross-sectional data on a national middle-aged population aged 51 through 61, this study describes the relationship between SES and racial and ethnic differences in the prevalence of four common chronic medical illnesses and in functional status among those with these illnesses. This paper also addresses two important methodological issues in the measurement of economic status that may be especially important in scientifically understanding racial and ethnic differences in health. First, financial resources are measured through both total household income and wealth, each of which may have a distinct relationship with health. Second, we address how variation across economic strata in the relationships between the income and wealth and the two dimensions of health (chronic disease prevalence and functional status) might affect conclusions about the role SES plays in explaining differences in health.

Methods

Data Overview

This study uses data from Wave I (1992) of the Health and Retirement Survey (HRS), funded by the National Institute on Aging.²⁵ The HRS is a national probability sample of 12 654 men

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TABLE 1—Demographic Characteristics and Disease Prevalence Rates (Weighted Means and Prevalence Rates)^a for Study Population (n = 9744), by Race/Ethnicity and Gender: 1992 Health and Retirement Survey

	Total Sample		White/Other		African American		Hispanic	
	Male	Female	Male	Female	Male	Female	Male	Female
No.	4583	5161	3473	3712	702	957	408	492
Demographic characteristics								
Age, y (SD)	55.9 (2.8)	55.9 (2.8)	56.0 (2.9)	55.9 (3.0)	55.9 (2.3)	56.0 (2.3)	55.7 (2.4)	55.8 (2.3)
Education, y (SD)	12.4 (3.1)	12.1 (2.6)	12.8 (2.9)	12.5 (2.3)	11.0 (2.5)	11.5 (2.2)	8.9 (3.5)	8.4 (3.2)
Married, %	82	69	85	74	64	42	79	64
Prevalence of chronic conditions ^b								
Hypertension	.39	.37	.38	.33	.52***	.60***	.34	.43***
Diabetes	.10	.10	.10	.08	.16***	.19***	.13	.17***
Heart condition	.15	.11	.16	.10	.14	.14**	.10*	.09
Arthritis	.31	.44	.31	.44	.31	.48*	.28	.44

^aWeighted to compensate for higher selection probabilities for households in Florida and in areas with high density of African Americans and Hispanics.

^bSignificance based on *t* tests for race and ethnicity variable coefficients in same-gender Probit estimations with no other explanatory variables.

**P* ≤ .05 for difference in prevalence compared with White/other of same gender.

***P* ≤ .01 for difference in prevalence compared with White/other of same gender.

****P* ≤ .001 for difference in prevalence compared with White/other of same gender.

and women ages 51 through 61 in 1992 and their spouses in 7700 households with a 2:1 oversampling of African-American and Hispanic persons and an oversampling of residents of Florida. The overall response rate was 81%. Our analyses were restricted to the 9744 respondents and spouses from ages 51 through 61. Approximately 2804 spouses whose ages were outside the specified range were eliminated. In addition, 11 persons with missing data on race/ethnicity and 95 persons with insufficient data on either income or wealth were dropped. These data were obtained by in-person home interviews of respondents and spouses. Substantially improved wealth data were obtained through bracketing techniques in which individuals who did not know, or were not willing to reveal, specific dollar amounts in response to financial questions were prompted to provide upper and/or lower bounds on the amounts; this resulted in a 25% reduction in nonresponse among wealth holders.²⁶

Variable Definitions

Outcome Variables

Prevalence rates for chronic conditions were estimated from self-reports of ever having been informed by a doctor of a diagnosis of hypertension, diabetes, or a heart condition. For arthritis, respondents reported ever having or ever being told by a doctor that they had arthritis. A functional status score was created based on

the answers to 17 questions about the ability to perform a series of functional activities. (A list of specific activities is available by request from the author.) Respondents could answer one of the following options: (1) not at all difficult, (2) a little difficult, (3) somewhat difficult, (4) very difficult/can't do, and (5) don't do. A functional status index was created by summing responses to all who answered 1 through 4 and rescaling to a 0-through-100 scale, with a value of zero implying no limitation in any activity and a higher score indicating worse function.

Following the creation of other similar indices in the published literature,^{27,28} we created a global functional index in which each activity is given equal weight. The mean score on the functional status index was 13.1; the standard deviation was 15.4. The Cronbach alpha²⁹ for this index was 0.89 in this sample.

Explanatory Variables

All multivariate analyses controlled for gender and age cohort (birth years 1931 through 1934, 1935 through 1937, and after 1937). Race was defined by the following categories: non-Hispanic African American, Hispanic of any race, and White/other. (In this category, 97% of persons were White; the rest were all persons who did not fall into the previous two categories.) Within the Hispanic subgroup, the majority (approximately 60%) were Mexican American. Marital status was measured by a series of dummy

variables indicating each of the following categories: currently married, living with a partner, never married, separated, divorced, and widowed. Educational attainment was defined by dummy variables indicating self-reports of 12 years or fewer of education, some college, college graduate, and advanced professional education (physicians, lawyers, PhDs).

Measurement of household financial resources was improved in two ways in this study. First, a broader concept was employed by measuring both total household yearly income and wealth, and second, we permitted a nonlinear relationship with health. The data permit a comprehensive definition of household wealth that includes net equity in home, business, and real estate as well as a complete list of financial assets.²⁶ We created two variants of income and wealth variables. The first involved a simple sum of total household income and wealth (linear variant). In the second version, we created a piecewise linear spline function, which permits estimation of different slopes over different ranges of the variable (nonlinear variant).³⁰ For wealth, different slopes were estimated within each of the following terciles: \$0 to \$50 000; \$50 000 to \$164 100; and \$164 100 and above. For household income, we estimated slopes for the following terciles: \$0 to \$25 656; \$25 656 to \$50 000; and \$50 000 and above. For heuristic purposes, we can think of these terciles as dividing the population into the poor, the middle class,

TABLE 2—Median Income and Wealth (1992 \$) for Total Sample and Subsamples with and without Hypertension, by Race/Ethnicity and Gender (Weighted)^a

	Total Sample		White/Other		African American		Hispanic	
	Male	Female	Male	Female	Male	Female	Male	Female
Income	43 946	34 248	47 000	38 200	31 000	20 000	23 328	16 200
Wealth	115 950	104 800	136 000	130 100	39 000	26 300	39 000	35 500
With hypertension								
Income	42 000	28 000	45 063	34 000	30 050	16 397	22 000	12 840
Wealth	107 700	72 000	132 000	100 500	36 430	18 000	37 000	22 000
Without hypertension								
Income	45 000	37 916	48 000	40 000	31 764	25 500	25 000	19 449
Wealth	120 000	124 850	138 100	146 900	42 000	41 500	42 000	40 875

^aSubsample numbers are as in Table 1. Weighted to compensate for higher selection probabilities for households in Florida and in areas with high density of African Americans and Hispanics.

and the affluent, with the estimated slopes telling us the relationships between the economic and health variables over each of these segments. A lowering of the slope as one proceeds to a higher tercile suggests a stronger relationship between economic status and health in lower economic strata.

Statistical Analysis

The probability of reporting a chronic condition was estimated by maximum likelihood probit regressions. Because the distribution of the functional status score was bounded by 0 and 100 with a large percentage of observations at 0 (13.7%), functional status scores were estimated by a two-limit Tobit regression model.³¹ For all models estimated in this paper, the *P* value associated with each equation's chi-square value was less than .0001.

Adjusted prevalence rates and functional status scores are presented. For White/other respondents, rates and scores were predicted by taking the White/other sample and estimating the mean prevalence rate and functional index score on the basis of their actual characteristics. For both African-American and Hispanic subsamples, adjusted scores were calculated by assigning each White/other observation its actual socioeconomic characteristics but reassigning the race/ethnicity for each observation first to African American and then to Hispanic. Rates and scores were then estimated for each newly created observation with its assigned race/ethnicity and its original socioeconomic characteristics. Through this procedure, African-American and Hispanic sample rates and scores were standardized on the basis of the socioeconomic and demographic characteristics of the White/

other sample. All regressions were weighted to reflect the sampling frame of the survey.

Results

SES and Prevalence of Common Chronic Conditions

Table 1 presents basic demographic characteristics of the study population and prevalence rates by race and gender for the chronic conditions. While age differences in our sample are small by design, African Americans and Hispanics trail their White counterparts substantially in schooling and are less likely to be married. For both hypertension and diabetes, African-American men and women had substantially higher prevalence rates than their White counterparts, while only African-American women had higher rates than White women for both heart conditions and arthritis. Hispanic women reported higher prevalence of diabetes and hypertension compared with Whites, and Hispanic men reported lower prevalence of heart conditions.

Table 2 presents median household income and wealth by race, ethnicity, and gender for the total sample and for one illustrative chronic condition—hypertension. There are large populationwide disparities in income and wealth across racial and ethnic groups, with disparities in wealth far exceeding those in income. For example, while incomes of African-American men are about two thirds of White men, their wealth is only 28% of White men. Within conditions, individuals reporting a chronic condition have lower incomes and, especially, wealth compared with those who do not so report. Wealth and income disparities

associated with the presence of chronic condition are much larger among women than among men and also appear to be larger among African Americans than among Whites.

To what extent are the SES disparities illustrated in Tables 1 and 2 associated with the racial and ethnic differences in the prevalence rates of common chronic conditions? To answer this question, we first estimated the probability of reporting each of the four common chronic conditions controlling only for race, ethnicity, age cohort, and gender (Model A). We then estimated the probability of having each of the chronic conditions controlling for SES in two ways. Both models included variables measuring marital status and educational attainment. In the first specification, total household income and wealth were entered linearly (Model B), while the alternative specification allowed for nonlinear effects of both income and wealth by use of the piecewise linear spline functions explained earlier (Model C).

We first summarize our estimates about the way income and wealth influence health. No matter which model is used, both income and wealth are significant and independent predictors of the probability of having a chronic condition. Even after all income differences are held constant, wealth variation in the sample is significantly associated with the probability of having any of these chronic conditions. Second, in all cases, the data strongly support models allowing for nonlinear effects of income and wealth. The effects of SES on health are generally much stronger for those at the bottom of our economic strata than for those at the top. For example, in predictions of func-

TABLE 3—Chronic Disease Prevalence Rates and Functional Status Scores by Race/Ethnicity, with and without Adjustments for Socioeconomic Status (Weighted)^a

	Adjusted Prevalence of Chronic Conditions by Race/Ethnicity (Probit Model)			Adjusted Functional Status Score ^b of Chronic Conditions by Race/Ethnicity (Tobit Model)		
	Model A ^c	Model B ^d	Model C ^e	Model A ^c	Model B ^d	Model C ^e
Hypertension						
White/other	.36	.36	.36	16.6	16.6	16.6
African American	.57***	.54***	.53***	19.1***	15.7	14.2**
Hispanic	.39	.36	.34	19.8**	15.9	14.2***
Diabetes						
White/other	.09	.09	.09	21.0	21.0	21.0
African American	.18***	.15***	.14***	24.5**	21.3	20.3
Hispanic	.15***	.12**	.11*	23.4	19.7	18.3
Heart condition						
White/other	.13	.13	.13	22.2	22.2	22.1
African American	.15	.13	.11	29.1***	24.4	21.9
Hispanic	.10*	.08***	.07***	28.9**	22.9	20.5
Arthritis						
White/other	.38	.38	.38	19.5	19.5	19.5
African American	.40*	.36	.34*	24.7***	21.2*	19.2
Hispanic	.37	.31***	.30***	25.0***	20.8	18.4

Note. For prevalence: significance based on *t* tests for race and ethnicity variable coefficients in Probit estimations. For functional status: Significance based on *t* tests for race and ethnicity variable coefficients in Tobit estimations.

^aWeighted to compensate for higher selection probabilities for households in Florida and in areas with high density of African Americans and Hispanics.

^bIndex range 0–100; higher score = worse function.

^cModel A: Controlling for age, gender.

^dModel B: Controlling for age, gender, education, marital status, linear income, and wealth.

^eModel C: Controlling for age, gender, education, marital status, nonlinear income, and wealth.

**P* ≤ .05 compared with White/other.

***P* ≤ .01 compared with White/other.

****P* ≤ .001 compared with White/other.

tional status scores among those with hypertension, the effect of a dollar of income is almost 40 times larger among the poor (the bottom tercile) than among the affluent (the top tercile). Similarly, a dollar of wealth has an impact almost 80 times larger in the lower tier of the wealth distribution than in the top tier.

The first three columns of Table 3 present predicted prevalence rates by race and ethnicity for each model. In the simplest model (Model A), African Americans were significantly more likely to report ever having hypertension and diabetes, as to a lesser degree were Hispanics. With marital status, education, and income and wealth controlled for, the predicted prevalence rates for the two minority groups fell. This decline in predicted minority prevalence was somewhat larger (and the remaining gap with Whites corresponding smaller) when our preferred nonlinear specification of income and wealth was used (Model C). However, even after we fully controlled for SES, African-American prevalence rates for both hypertension and diabetes remained significantly higher than those of

Whites. SES has somewhat more explanatory power for Hispanics, in part owing to their smaller initial difference compared with Whites.

There were smaller baseline differences for the other two conditions, heart conditions and arthritis. Hispanics had significantly lower rates of ever having a heart condition, a difference in their favor that expanded with SES controls. With demographic controls only (Model A), African Americans were more likely to report arthritis, but Hispanics were not. When SES was added to the models, both African Americans and Hispanics had a significantly lower probability of arthritis.

Socioeconomic Status and Functional Status by Chronic Condition

Our next analysis examines racial and ethnic differences in the ability to function among those with each of the four conditions. In Table 4, unadjusted functional status scores are arrayed by the presence of each condition (higher scores mean worse function). On the extremes, individuals with a heart condition have the most severe functional limitations while

those suffering from hypertension experience the least inability to function. In general, African Americans and Hispanics have worse functional ability than Whites. These racial and ethnic disparities are generally larger among those with a specific condition than in the population as a whole. Finally, in this age group, women have significantly higher scores (worse function) than men, and racial and ethnic disparities are larger among women. For example, Hispanic and African-American women with a heart condition have mean functional scores of about 35, more than three times the overall score among all White men.

The relationship between economic resources and prevalence of chronic conditions varied between those in the bottom and top segments of the economic strata. When mean index scores of functional status were compared by ordered quintiles of income and wealth for each of our demographic groups, lower income and wealth were associated with worse functional status. Functional status improved as one moved up the economic strata (in either income or wealth), but the biggest

TABLE 4—Unadjusted Mean Functional Status Scores,^a by Race/Ethnicity, Sex, and Chronic Conditions (Weighted)^b

Total Sample	Total Sample		White/Other		African American		Hispanic	
	Male	Female	Male	Female	Male	Female	Male	Female
Total score (SD)	10.7 (12.8)	14.8 (13.7)	10.4 (12.7)	13.9 (13.5)	12.7 (13.2)	18.4*** (13.9)	12.5 (12.6)	18.2*** (13.6)
Hypertension score (SD)	13.6 (14.4)	19.0 (14.8)	12.9 (14.4)	17.9 (14.9)	15.5 (14.0)	21.6*** (14.8)	17.8 (14.7)	22.3** (13.8)
Diabetes score (SD)	18.7 (16.6)	23.5 (16.2)	18.2 (16.7)	21.6 (16.2)	19.3 (15.9)	28.1*** (16.7)	22.2 (17.5)	24.4 (14.0)
Heart condition score (SD)	19.2 (16.6)	27.0 (17.8)	18.4 (16.8)	24.6 (17.5)	23.6 (16.0)	35.8*** (17.8)	25.2 (13.8)	34.0* (14.4)
Arthritis score (SD)	17.4 (16.3)	20.9 (15.9)	16.5 (16.2)	19.5 (15.8)	22.1** (16.3)	26.0*** (15.7)	22.1* (16.4)	26.8*** (14.3)

Note. Significance based on *t* tests for race and ethnicity variable coefficients in same gender Tobit estimations with no other explanatory variables for total sample and by subsamples with each chronic condition.

^aIndex range 0–100; higher score = worse function.

^bWeighted to compensate for higher selection probabilities for households in Florida and in areas with high density of African Americans and Hispanics.

**P* ≤ .05 compared with White/other of same gender with same condition.

***P* ≤ .01 compared with White/other of same gender with same condition.

****P* ≤ .001 compared with White/other of same gender with same condition.

absolute improvements occurred in the lowest quintiles. For example, among African-American men, the difference in the score between those in the first and the second income quintiles was 9.3 points, while the difference between those in the fourth and fifth quintiles was only 1.7 points.

Using an identical set of covariates, we repeated the same sequence of models to predict racial and ethnic differences in functional status scores. Among each group of respondents reporting the four chronic conditions, we first estimated adjusted scores controlling only for race and ethnicity, age cohort, and gender (Model A). We then estimated two additional models that differed only in the form of the income and wealth variables, a version with linear income and wealth (Model B) and a version with nonlinear income and wealth (Model C). For each condition, income and wealth were once again significant independent determinants of the ability to function, but the impact was highly nonlinear. For example, among respondents with hypertension, the effect of income on functional scores was 30 times larger among the poor than among the affluent, and the differences in wealth were even greater. In general, we find that the influence of SES on the ability to function persists only through the bottom two thirds of our economic strata with no statistically significant effects within the highest terciles of either income or wealth.

The last three columns of Table 3 summarize our Tobit model results concerning racial and ethnic disparities by each of the four chronic medical conditions. With only one exception (Hispanics with diabetes), both African Americans and Hispanics had significantly worse scores on the functional status index than Whites when only gender, age and race, and ethnicity were adjusted for. However, these minority deficits are completely eliminated when our full set of SES covariates is included in the model. Moreover, adjusted minority functional scores are systematically lower in the model that allows for nonlinear effects of income and wealth. In the case of hypertension, African Americans and Hispanics had better scores than those in the White/other category once nonlinearities in income and wealth were accounted for, a difference that would not have been detected if only linear specifications had been used.

Discussion

Our research suggests that SES plays a much greater role in explaining racial and ethnic differences in the ability to function once a person has a chronic illness than in explaining who has chronic illnesses. SES appears to explain almost all of the racial and ethnic differences in ability to function but only moderate amounts of the differences in disease prevalence.

This paper also makes two fundamental points about how household economic resources should be measured to capture their impact on health outcomes correctly. First, household income and *household wealth* have sizable independent relationships with both the likelihood of experiencing a chronic condition and the number of functional limitations for those with these conditions. Second, the relationships between income and wealth and both health outcomes examined in this research are highly nonlinear. The influences of income and wealth are quite strong within the poverty and near-poverty population; they persist but are smaller within the economic middle-class population and are quite weak among the more affluent. Although the SES-health gradient continues well outside the poverty population, it is at maximum strength among the poor.

What causal pathways could plausibly account for the pattern associations of SES with racial and ethnic differences in our two different dimensions of health? The presence of chronic conditions may reflect the cumulative impact of past behaviors, exposures, and constraints. Consequently, measurement of current resources available to the household—this year's income and even current wealth—may not adequately capture the complete set of lifetime resource constraints that led to illness in middle age.

In addition to possible genetic differences, racial and ethnic differences in diet and other risk factors (such as smoking,

drinking, and exercise) could play a role. However, when these behavioral risk factors were controlled in our analysis, the excess racial prevalence rates for these chronic conditions did not change very much (results not presented). Key dimensions of the macro-environment may be a more promising area to explore.³² Stress may well intensify when people live in crowded low-income neighborhoods frequently characterized by high rates of violence, crime, and drugs, offering little reason for hope.

What are the probable causal pathways that so effectively link lower SES and poor function? Lower SES is an important determinant of access to health care, and inadequate treatment for some chronic conditions will increase the risk of complications. People with few economic resources may also be less able to alter their environment to reduce the impact of changes in physical functioning. SES is also associated with health behaviors, such as smoking, that may increase the risk of complications from chronic conditions or increase the risk of developing other medical conditions that affect function.

Our results must be interpreted in the light of limitations of our data. First, our population is confined to a sample of middle-aged men and women, who may have already experienced a complex and unrecorded sequence of economic and health events prior to the onset of the survey. Second, our data are now cross-sectional, limiting our ability to draw strong conclusions about causation. Most importantly, we have not addressed the strong possibility of feedback effects where deterioration in health status lowers respondents' measured SES.³³ Until the relative causal links can be disentangled, we should exercise caution in how we interpret the links between SES and health. Fortunately, future waves of the HRS and other longitudinal data sets currently fielded may provide information about the relative timing of transitions in disease prevalence, the onset of functional limitations, and changes in economic status that may help us unravel the underlying causal mechanisms. □

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