

Predictive Strength of Self-Rated Health on Mortality Risk among Older Adults in the US:  
Does It Differ by Race and Ethnicity?\*

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## Abstract

Self-rated health (SRH) has been widely used as a measure of population health. In order to accurately measure trends and differentials across subpopulations, it is critical to understand the predictive validity of SRH for subsequent mortality. We address a gap in the literature by examining race/ethnic differences in the predictive strength of SRH on mortality, an important dimension of health inequalities. Cox proportional hazard models are used to analyze data from the National Health Interview Study Linked Mortality Files (1989-2006). Our results confirm that SRH serves as a reliable predictor of subsequent mortality. We also find significant race/ethnic variation: black and Hispanic adults have a weaker link between SRH and mortality. Three potential explanations for these patterns --different cause-of-death patterns, socioeconomic status, and acculturation-- explain only a portion of the overall differences. The findings indicate caution in using SRH for measuring race/ethnic health disparities.

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## INTRODUCTION

Accurate measurement of population health is crucial for designing and implementing social policies to reduce health disparities in the US. One of the most commonly used health indicator is self-rated health (SRH). This commonplace survey question is typically recorded on a five-point scale with respondents answering the simple question, “How would you rate your health?” Respondents, leaning on their own contextual framework, choose one from the following responses: excellent, very good, good, fair, or poor. SRH has consistently been shown as a powerful predictor of subsequent health outcomes including mortality even after adjusting for demographic factors and various health related indicators (Benjamins, Hummer, Eberstein & Nam, 2004; Idler, 1997, 2004).

While the pervasiveness of SRH in the population-health literature dates back several decades, the measure has recently attracted increasing scholarly attention for the differences of its predictive strength across different population subgroups. Variations in the predictive strength of SRH have been reported in socioeconomic strata (Zajacova & Dowd, 2011), by gender (Dowd & Todd, 2011), by age (Helweg-Larsen, 2003), or by ethnicity (Finch, 2002; Bzostek, 2007). These variations in the predictive power of SRH can lead to biased estimates (i.e. over or underestimates) that misrepresent the overall health as well as health disparities across various subgroups (Zajacova & Dowd, 2011: 982).

Using data from the National Health Interview Surveys (NHIS) linked to mortality information from the National Death Index, we revisit the association between SRH and mortality risk among older adults (55+) in the US to investigate possible heterogeneity across racial and ethnic groups including non-Hispanic whites, non-Hispanic blacks, Hispanics, and Asian Americans. We examine three possible explanations for the differences in the predictive power of SRH for mortality outcomes across racial and ethnic groups. Our results may provide useful insight into racial and

ethnic differences in the concepts of health and illness and will in turn enhance the design of health care programs that better fit for the various racial and ethnic groups who might be exposed to different social and cultural contexts.

## SELF-RATED HEALTH, MORTALITY RISK AND RACE/ETHNICITY

Previous studies consistently report that SRH is significantly associated with mortality risk even after controlling for various sociodemographic characteristics and baseline health condition (Benyamini & Idler 1999; DeSalvo, Bloser, Reynolds, He & Muntner 2006; Jylhä 2009). While the association between SRH and mortality has been confirmed in a number of studies spanning decades, only recently has research begun addressing differences across various subgroups in the SRH-mortality association. In general, the predictive ability of SRH on subsequent mortality risk appears to be stronger for younger respondents, men, and those with higher socioeconomic status compared to older adults, women and those with lower socioeconomic status, respectively (Benyamini, Blumstein, Lusky, & Modan 2003; Dowd & Zajacova 2007).

Given the large and persistent race/ethnic disparities in health among US adults, and the importance of capturing them using simple indicators like SRH in population studies, it is surprising that only few studies examined race and ethnic variations in the association between SRH and mortality. For example, Lee and colleagues found that SRH is a stronger predictor of mortality outcome among older whites compared to blacks (Lee et al. 2007). An analysis of NHIS data from 1986 to 1994 by McGee and colleagues (1999) showed that SRH is a strong prognostic indicator for subsequent mortality outcome for all racial and ethnic groups. The predictive strength was greater for white and Asian/Pacific Islander groups compared to black and Hispanic respondents, but the authors did not test for the statistical significance of the differences (McGee, Liao, Cao, & Cooper.

1999). A few additional existing studies focused more specifically on Latinos. Finch and colleagues (2007), for example, found that poor SRH appears to be a weaker predictor of subsequent mortality risk among relatively recent immigrants. However, as immigrants have stayed in the US for a longer time period, the predictive strength of SRH on mortality risk has increased (Finch, Hummer, Reindl & Vega 2007).

### Three Possible Explanations

Based on existing literature, several explanations can be suggested for racial and ethnic differentials in the association between SRH and subsequent mortality outcome. First, socioeconomic status (SES) may influence the predictive strength of SRH on mortality. SRH is a subjective measure, which relies on not only information (both scope and quality) that a respondent gathers but also evaluation of the information on her/his own. Respondents with lower socioeconomic status may (either intentionally or unintentionally) overlook existing health conditions or may incorporate their physical conditions into the health judgment to a lesser degree than higher-SES respondents. Then it is possible that those with lower socioeconomic status may over-rate their SRH relative to their actual underlying health status. On the other hand, research also suggests that those with lower socioeconomic status may under-rate their SRH. Socially disadvantaged group often reveals higher levels of psychological distress, which could lead to lower ratings of SRH. Conversely, socially advantaged group with higher levels of psychological well-being may over-rate their SRH given their higher expectations for their health (Down & Todd 2011; Iburg, Salomon, Tandon & Murray 2001).

Empirical findings seem to favor the former argument indicating that lower SES is associated with a weaker predictive strength of SRH (Dowd & Zajacova, 2007; van Doorslaer & Gerdtham, 2003). For example, a recent study found that the predictive strength of SRH on mortality is weaker

for those with lower SES (Dowd & Todd 2011) suggesting that those with lower SES may be relatively more optimistic and thus tend to rate their health higher than is warranted. As for race and ethnic differentials, given the lower socioeconomic status among racial and ethnic minorities, it is expected that socioeconomic status suppresses the race and ethnic differentials in the association between SRH and mortality risk.

Second explanation for the race and ethnic differentials is related to immigration status and language use. Some minorities, particularly Hispanics and Asian Americans, comprise a sizeable proportion of first-generation immigrants. As suggested in some studies, more traditionally-oriented Hispanics may be somewhat pessimistic about their health (Shetterly et al., 1996). Thus the lower levels of SRH among immigrants, especially the recent ones, might in part reflect cultural influences. In other words, it is expected that the longer immigrants have stayed in the US, the more similar they will be in terms of evaluating their own health to non-immigrants. Another argument related to immigration status is that immigrants, especially whose primary language is not English might evaluate their health poorer partly due to different connotations of SRH response categories while translating English into another language (Angel & Guarnaccia 1989; Franzini & Fernandez-Esquer 2004; Phillips, Hammock & Blanton 2005). In fact, Spanish language of interview is significantly associated with worse SRH (Bzostek, Goldman & Pebley 2007) and after adjusting for language of interview, the gap in SRH between whites and Latinos was substantially reduced (Viruell-Fuentes, Morenoff, Williams & House 2011).

The third explanation involves a differential prevalence of selected chronic conditions by race/ethnicity. Some researchers suggested that race and ethnic variations in the predictive strength of SRH on mortality might also be attributed to specific chronic conditions. For example, a study by Benjamins and colleagues (2004) found that the predictive strength of SRH on mortality is strong

among those with serious chronic diseases including diabetes, infectious and respiratory diseases. Additionally, they also found that SRH is not associated with mortality caused by social pathologies, such as accidents, homicide and suicide (Benjamins, Hummer, Eberstein, & Nam 2004). With respect to racial and ethnic variations in the predictive strength of SRH, it is well known that racial and ethnic minorities have higher prevalence of many chronic health conditions compared to non-Hispanic whites (Albano et al., 2007; Hayward et al., 2000; Jemal et al., 2008; Williams, 1999). In fact, if racial and ethnic differences in the association between SRH and mortality are found, it could be an indication that a stronger association for racial and ethnic minorities might be a reflection of a higher prevalence of chronic health conditions among the minorities. However, there are few studies attempting to examine the relative differences in the association between SRH and mortality among race and ethnic groups. The few existing studies look at either Hispanic vs. non-Hispanic, or whites vs. blacks (Ferraro & Kelley-Moore, 2001; Lee et al., 2007).

The purpose of this study is to explore racial and ethnic differentials in the association between SRH and mortality outcome. We describe the overall patterns for the older U.S. population. Then, we examine the role of the three mechanisms outlined above on the gross differences. Building on the previous literature, we test the following three specific hypotheses: (1) SRH is a weaker predictor of mortality for race and ethnic minorities compared to non-Hispanic whites even after controlling for socio-economic conditions. (2) The race and ethnic differentials in the predictive strength of SRH on mortality risk are at least partly explained by immigration status especially for Hispanics. (3) The race and ethnic differentials in the predictive strength of SRH on mortality risk are at least partly explained by chronic health conditions particularly for non-Hispanic blacks.

## METHODS

## Data

We use data from the National Health Interview Surveys Linked Mortality Files (NHIS-LMF). The NHIS is an annual cross-sectional survey that collects a wide range of information about health, demographics and socio-economic attainment among non-institutionalized population in the United States. The NHIS-LMF links adult respondents in the 1986-2004 NHIS to death records in the National Death Index through December 31, 2006 using a probabilistic matching algorithm (Lochner et al. 2008; National Center for Health Statistics 2009). We include matched NHIS surveys from 1989 to 2004 because information about immigration status is not available prior to the 1989 survey. We define our analytic sample to adult respondents who were 18 to 84 years old at the time of the interview as the NHIS top-coded age at 85 from the 1997 survey. We exclude a small proportion of those with missing or ‘other’ race/ethnicity status, those who were not eligible for the matching to the NDI due to insufficient information or other causes, and those who had missing values on the covariates (about 9.4% of the total). Our analytical sample includes 289,432 cases.

## Measures

The dependent variable is all-cause and cause-specific mortality. The vital status was determined by NCHS based on probabilistic matches of survey participants’ NHIS records to the National Death Index (NDI) records. For cause-specific mortality, we focus on five underlying causes of death categories including heart disease, cancer, respiratory disease, stroke, and diabetes among other leading causes of death. These causes are more likely to be developed by chronic health conditions over time. Additionally, our preliminary analysis reveals that there are only a few respondents died from other causes of death among Hispanic and non-Hispanic Asians (results of the preliminary analysis not shown), which are problematic to produce reliable estimates. Self-rated



health and race/ethnicity are key predictors. SRH is used with the original 5 response categories: excellent (reference), very good, good, fair, and poor. Race/ethnicity is coded into the following categories: non-Hispanic white (reference), non-Hispanic black, Hispanic, and non-Hispanic Asian.

We also include the following sociodemographic information as control variables in the analysis: age, sex, marital status, region, educational attainment, poverty status, and employment status. Age is measured in years ranging 55 to 84. Sex is dichotomously coded (female is reference). Marital status is specified as ‘married,’ ‘widowed,’ ‘divorced or separated,’ and ‘never married.’ Region is coded into ‘North,’ ‘Midwest,’ ‘West,’ and ‘South.’ Educational attainment has four categories: ‘less than high school,’ ‘high school,’ ‘some college,’ and ‘college or more.’ Poverty status indicates whether respondents were below the poverty threshold at the time of the survey (i.e. ‘0’ for those who are above the poverty threshold and ‘1’ for those who are below the poverty threshold). Employment status is dichotomized into either ‘employed’ or ‘not employed,’ with the latter category including respondents who were retired, unemployed, or not in the labor force. To account for to what extent racial and ethnic differentials in the association between SRH and mortality outcome may be explained by cultural orientation and language use, we incorporate immigration status in to the analysis. Information on immigration status and duration of time spent in the US is used as a proxy to control for different ratings of SRH at least partly due to language use and acculturation since the NHIS does not consistently collect that information directly. We create three categories: non-immigrants (reference); immigrants who have stayed in the US less than 10 years; and immigrants who have stayed in the US for 10 years or more.

## Analytical Models

We estimate a series of nested Cox proportional hazard models to evaluate the association between SRH and mortality risk across race and ethnic groups. First, we examine racial and ethnic differentials in the association between SRH and mortality risk with adjustments of demographic information (i.e. sex, age, marital status, and region). The differential effect of SRH by race is captured with a series of interaction terms for each group. We then include information about socioeconomic status (i.e. education, poverty status, and employment status) to examine how they modify the racial and ethnic differentials in the association. We next control for immigration status to further tease out the differentials by immigration status and the duration in the US. To further investigate the effects of socioeconomic status, we perform stratified models by education. Finally, we examine separate models for the ten underlying cause of death categories. All of the Cox proportional hazard models were estimated using ‘proc surveypreg’ in SAS to adjust for the complex sampling design and the estimates were weighted for non-response of the NHIS-LMF. We also used ‘efron’ option to handle ‘ties.’

## RESULTS

### Descriptive Statistics

Table 1 presents the sample characteristics.

(Table 1 about here)

Because our analysis is limited to those who age 55 and above, high proportion of the deceased was observed with almost 30% out of the sample over the mortality follow-up period. Similarly, while majority of the sample reported their health ‘good’ or better, substantial proportions rated their health ‘fair’ (16%) or ‘poor’ (7%). Our sample also shows somewhat different racial and ethnic compositions from the general population as well. For example, our sample consists of 83% non-

Hispanic and 9% non-Hispanic black. The percentages of Hispanics and non-Hispanic Asians are very small (6% and 2%, respectively). As expected, there are more females (55%) than males (45%). It is also worth mentioning that while 66% of the sample is married at the time of the survey, a relatively large proportion (20%) is of widowed. Either divorced or never married are small (10% and 4%, respectively). A larger proportion of the sample resides in South (36%) than in other regions. Regarding the socioeconomic indicators, more than half of the sample (64%) has high school or less than high school education. Seven percent live below the poverty threshold and 33% are employed. The table also shows that 9% of the sample is immigrants and most of them have stayed in the US more than 10 years. Distribution of the cause of death is presented in Table 2.

(Table 2 about here)

As shown, almost 80% of deaths are caused by chronic conditions, such as heart disease, cancer, respiratory disease, stroke and diabetes. While heart disease and cancer are two of the top leading causes of death for all of the race and ethnic groups, some differences are observed. For example, the proportion of those who died from respiratory disease appears to be higher among non-Hispanic whites than others. However, the proportions of those who died from diabetes are higher among non-Hispanic blacks and Hispanics. The proportion of those who died from stroke is higher among non-Hispanic Asians.

#### Self-Rated Health and Mortality by Race and Ethnic Groups

We now turn into our proportional hazard models. Table 3 presents three models: Model 1 estimates race and ethnic differentials in the association between SRH and mortality risk with various demographics adjusted. Model 2 adds socioeconomic conditions including education, poverty status and employment status to Model 1. Lastly, Model 3 adds immigration status to Model 2.

(Table 3 about here)

According to Model 1, as expected, the coefficients of the categories for SRH indicate that people with lower ratings of SRH reveal higher risks of mortality. For example, among non-Hispanic whites, those who rated their health ‘very good’ show over 20% higher mortality risk compared to those with ‘excellent’ health. The disparities are larger as SRH ratings are lower indicating 68%, 162%, and almost five times (i.e. Hazard Ratio=4.807) higher among those with ‘good’ health, ‘fair,’ and ‘poor,’ respectively.

We also found race and ethnic differentials in the predictive strength of SRH for mortality risk. Compared to non-Hispanic whites, SRH is a weak predictor of mortality risk for non-Hispanic Asians and Hispanics among those who rated ‘excellent,’ but SRH is a strong predictor for non-Hispanic blacks. However, for those who rated other than ‘excellent,’ the predictive strength of SRH for non-Hispanic Asians does not appear to be different from that for non-Hispanic whites given that the coefficients of the interaction terms between non-Hispanic Asian and SRH categories are not significant. On the contrary, the coefficients of the variables (both race and ethnic variables and the levels of SRH) and interaction terms between these two indicate that the predictive strength of SRH is lower for non-Hispanic blacks as well as Hispanics compared to their counterpart (with an exception of Hispanics with ‘very good’ health). Moreover, the race and ethnic differentials seem more evident among those with lower ratings of SRH especially for non-Hispanic blacks. In other words, the relationship between SRH and subsequent mortality risk decreases with lower ratings of SRH among both Hispanics and non-Hispanic blacks, this pattern seems more consistent among non-Hispanic blacks.

These differences are partly explained by socioeconomic conditions, measured by educational attainment, poverty status, and employment status, as shown in Model 2. In fact, the

differences in the predictive strength of SRH for mortality risk appear to be attributed to differences in socioeconomic status particularly for non-Hispanic blacks, especially those who rated their health either ‘good’ or ‘fair.’ On the other hand, the mediating effects of socioeconomic indicators seem relatively diminutive for Hispanics. However, results of Model 3, which further controls for immigration status, show that the some differences in the predictive strength of SRH among Hispanics compared to non-Hispanic whites are explained by immigration status. According to Model 3, while race and ethnic variations in the association between SRH and mortality risk are still observed even after controlling for socioeconomic and immigration statuses, the differences between Hispanics and non-Hispanic whites are in part due to immigration status among Hispanics. These results are also presented in Figure 1.

(Figure 1 about here)

While the predictive strength of SRH on mortality risk is weaker for non-Hispanic blacks and Hispanics, we additionally conducted stratified models by levels of education.

(Table 4 about here)

The results in Table 4 generally confirm with previous research that higher education is associated with greater predictive strength of SRH. However, race and ethnic variations are also found. For example, the educational gradient in the predictive strength of SRH on mortality risk is less steep for non-Hispanic blacks. In other words, while the association between SRH and mortality risk becomes stronger with increases of education, non-Hispanic blacks ‘gain less’ in terms of the greater predictive power of SRH.

Finally, we test our third hypothesis about chronic conditions contributing the predictive strength of SRH for mortality risk by running a series of proportional hazard models for five underlying cause specific mortality risk for heart disease, cancer, respiratory disease, stroke and

diabetes. While replicating Model 3 in Table 3, we perform five cause specific models. Coefficients and hazard ratios for the main effects and the interaction terms are presented in Table 4.

(Table 4 about here)

Compared to the results in Table 3, while the predictive strength of SRH on mortality risk is generally greater for non-Hispanic whites, the results also show that there are considerable differences for different causes of death. Although many of the coefficients are not statistically significant for Hispanics and non-Hispanic Asians, we still find consistent patterns for non-Hispanic blacks in that the association between SRH and mortality risk is less steep compared to non-Hispanic whites.

#### PRELIMINARY DISCUSSION POINTS

Self-rated health has been widely used as a measure of population health trends and disparities. If respondents across race/ethnic groups do not assess their health in a comparable way, however, then the SRH measure may result in a biased view of the health disparities. We addressed this question by testing whether SRH predicts mortality in the same way for non-Hispanic white, non-Hispanic black, Hispanic, and Asian adults.

We found significant differences across these groups in the SRH-mortality association. Black and Hispanic respondents, in particular, provide SRH ratings that are less strongly predictive of their future mortality. This pattern generally held for specific causes of death, suggesting that the race/ethnic differences pertain to the underlying health judgment process rather than differences in the composition of causes of death. Socioeconomic status and acculturation factors explain some of the differences – hence, future studies should take SES and immigration status into account to lessen the evaluation differences across the major race/ethnic groups.

Table 1. Sample Characteristics (N=289,432)

Variables		Unweighted Frequency	Weighted Proportion	Mean	Std Dev	Min.	Max.	
Mortality Status	Dead	88,954	0.28			0	1	
	Alive	200,478	0.73			0	1	
Self Rated Health	Excellent	52,820	0.19			0	1	
	Very good	72,735	0.26			0	1	
	Good	92,687	0.32			0	1	
	Fair	49,335	0.16			0	1	
	Poor	21,855	0.07			0	1	
Demographics	Age, in years			66.84	8.06	55	84	
	Non-Hispanic white	226,051	0.83			0	1	
	Non-Hispanic black	33,135	0.09			0	1	
	Hispanic	24,781	0.06			0	1	
	Non-Hispanic Asian	5,465	0.02			0	1	
	Female	160,365	0.55			0	1	
	Male	129,067	0.45			0	1	
	Married	188,818	0.66			0	1	
	Widowed	58,558	0.20			0	1	
	Divorced/Separated	29,887	0.10			0	1	
	Never married	12,169	0.04			0	1	
	Region	North	60,242	0.21			0	1
		Mid west	68,868	0.24			0	1
Mid-west		56,320	0.19			0	1	
South		104,002	0.36			0	1	
Education	Less than high school	89,103	0.27			0	1	
	High school	104,507	0.37			0	1	
	Some college	48,552	0.18			0	1	
	College or more	47,270	0.18			0	1	
Poverty Status	Above poverty	208,998	0.72			0	1	
	Below poverty	23,235	0.07			0	1	
	Missing on poverty	57,199	0.21			0	1	
Employment	Employed	94,467	0.33			0	1	
	Unemployed	194,965	0.67			0	1	
Immigration	Non-immigrant	258,872	0.91			0	1	
	Immigrant	30,560	0.09			0	1	
	Immigrated less than 10yrs ago	3,550	0.01			0	1	
	Immigrated more than 10yrs ago	27,010	0.08			0	1	
Mortality follow-up	Follow-up period, in quarters			8.10	4.53	0.125	17.875	

Table 2. Chronic Causes of Death

Chronic Cause of Death	All		non-Hispanic white		non-Hispanic Black		Hispanic		non-Hispanic Asian	
	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
	Frequency	Proportion	Frequency	Proportion	Frequency	Proportion	Frequency	Proportion	Frequency	Proportion
Heart disease	28,285	31.37	22,712	31.18	3,762	32.58	1,577	32.81	234	29.94
Cancer	23,183	26.47	18,900	26.59	2,948	26.55	1,117	23.73	218	26.87
Respiratory disease	9,373	10.71	8,111	11.32	801	6.81	397	7.96	64	8.21
Stroke	6,190	6.81	4,955	6.74	820	7.13	351	7.21	64	8.19
Diabetes	2,935	3.23	1,979	2.80	585	5.36	338	6.83	33	4.17
Total Deaths	88,954	78.59	71,971	78.63	11,351	78.44	4,841	78.54	791	77.37



Table 3. Proportional Hazard Models Estimating Effects of SRH on Mortality Risk (N=289,432)

Variables	Model 1			Model 2			Model 3		
	Coefficient	SE	HR	Coefficient	SE	HR	Coefficient	SE	HR
<b>SRH (Excellent)</b>									
Very good	0.203	0.014 ***	1.225	0.179	0.014 ***	1.196	0.177	0.014 ***	1.194
Good	0.520	0.013 ***	1.681	0.472	0.013 ***	1.603	0.472	0.013 ***	1.603
Fair	0.964	0.014 ***	2.623	0.886	0.015 ***	2.424	0.887	0.015 ***	2.427
Poor	1.570	0.018 ***	4.806	1.463	0.018 ***	4.317	1.467	0.018 ***	4.336
<b>Race/Ethnicity (Non-Hispanic white)</b>									
Non-Hispanic Black	0.356	0.040 ***	1.428	0.323	0.041 ***	1.382	0.328	0.041 ***	1.389
Hispanic	-0.137	0.051 **	0.872	-0.173	0.051 ***	0.841	-0.051	0.051	0.950
Non-Hispanic Asian	-0.664	0.112 ***	0.515	-0.658	0.112 ***	0.518	-0.441	0.113 ***	0.644
<b>Interactions</b>									
NHB × Very good	-0.278	0.050 ***	0.757	-0.268	0.050 ***	0.765	-0.271	0.050 ***	0.762
NHB × Good	-0.313	0.046 ***	0.732	-0.289	0.046 ***	0.749	-0.293	0.046 ***	0.746
NHB × Fair	-0.420	0.046 ***	0.657	-0.405	0.046 ***	0.667	-0.413	0.046 ***	0.662
NHB × Poor	-0.646	0.051 ***	0.524	-0.634	0.051 ***	0.530	-0.648	0.051 ***	0.523
Hispanic × Very good	-0.056	0.066	0.945	-0.051	0.066	0.951	-0.041	0.066	0.960
Hispanic × Good	-0.210	0.059 ***	0.810	-0.207	0.059 ***	0.813	-0.188	0.059 **	0.829
Hispanic × Fair	-0.332	0.060 ***	0.718	-0.335	0.060 ***	0.716	-0.314	0.060 ***	0.731
Hispanic × Poor	-0.240	0.067 ***	0.787	-0.238	0.066 ***	0.788	-0.211	0.066 **	0.810
NHA × Very good	0.081	0.143	1.085	0.079	0.144	1.082	0.067	0.144	1.069
NHA × Good	0.004	0.129	1.004	-0.008	0.129	0.992	0.012	0.129	1.012
NHA × Fair	0.017	0.140	1.017	0.006	0.140	1.006	0.052	0.141	1.053
NHA × Poor	-0.152	0.170	0.859	-0.181	0.170	0.835	-0.093	0.171	0.911
<b>Age, centered on 55</b>									
Male (Female)	0.084	0.001 ***	1.088	0.079	0.001 ***	1.082	0.079	0.001 ***	1.082
<b>Marital status (Married)</b>									
Widowed	0.214	0.010 ***	1.239	0.210	0.010 ***	1.234	0.211	0.010 ***	1.234
Divorced/Separated	0.309	0.014 ***	1.362	0.312	0.014 ***	1.367	0.311	0.014 ***	1.365
Never married	0.264	0.019 ***	1.303	0.266	0.019 ***	1.305	0.262	0.019 ***	1.299
<b>Region (South)</b>									
Northeast	-0.028	0.010 **	0.973	-0.029	0.010 **	0.972	-0.006	0.011	0.994
Mid-west	-0.006	0.010	0.994	-0.009	0.010	0.991	-0.004	0.010	0.996
West	-0.012	0.011	0.988	-0.006	0.011	0.994	0.004	0.011	1.004
<b>Education (College or more)</b>									
Less than high school				0.186	0.014 ***	1.204	0.182	0.014 ***	1.200
High school				0.153	0.013 ***	1.165	0.145	0.013 ***	1.156
Some college				0.144	0.015 ***	1.155	0.139	0.015 ***	1.149
<b>Below poverty (Above poverty)</b>									
Missing on poverty				0.043	0.014 **	1.043	0.051	0.014 ***	1.052
<b>Unemployed (Employed)</b>									
Missing on poverty				-0.096	0.010 ***	0.909	-0.095	0.010 ***	0.910
<b>Unemployed (Employed)</b>									
Unemployed (Employed)				0.286	0.011 ***	1.331	0.286	0.011 ***	1.331
<b>Immigration (non-immigrant)</b>									
Immigrant, less than 10 years							-0.712	0.055 ***	0.491
Immigrant, more than 10 years							-0.245	0.017 ***	0.783
-2 Log L	1823171.7			1821975.3			1821555.0		
AIC	1823225.7			1822041.3			1821625.0		

Note: The values in parenthesis are references. \*p < .05; \*\*p < .01; \*\*\*p < .001.

Table 4. Proportional Hazard Models Estimating Effects of SRH on Mortality Risk by Education

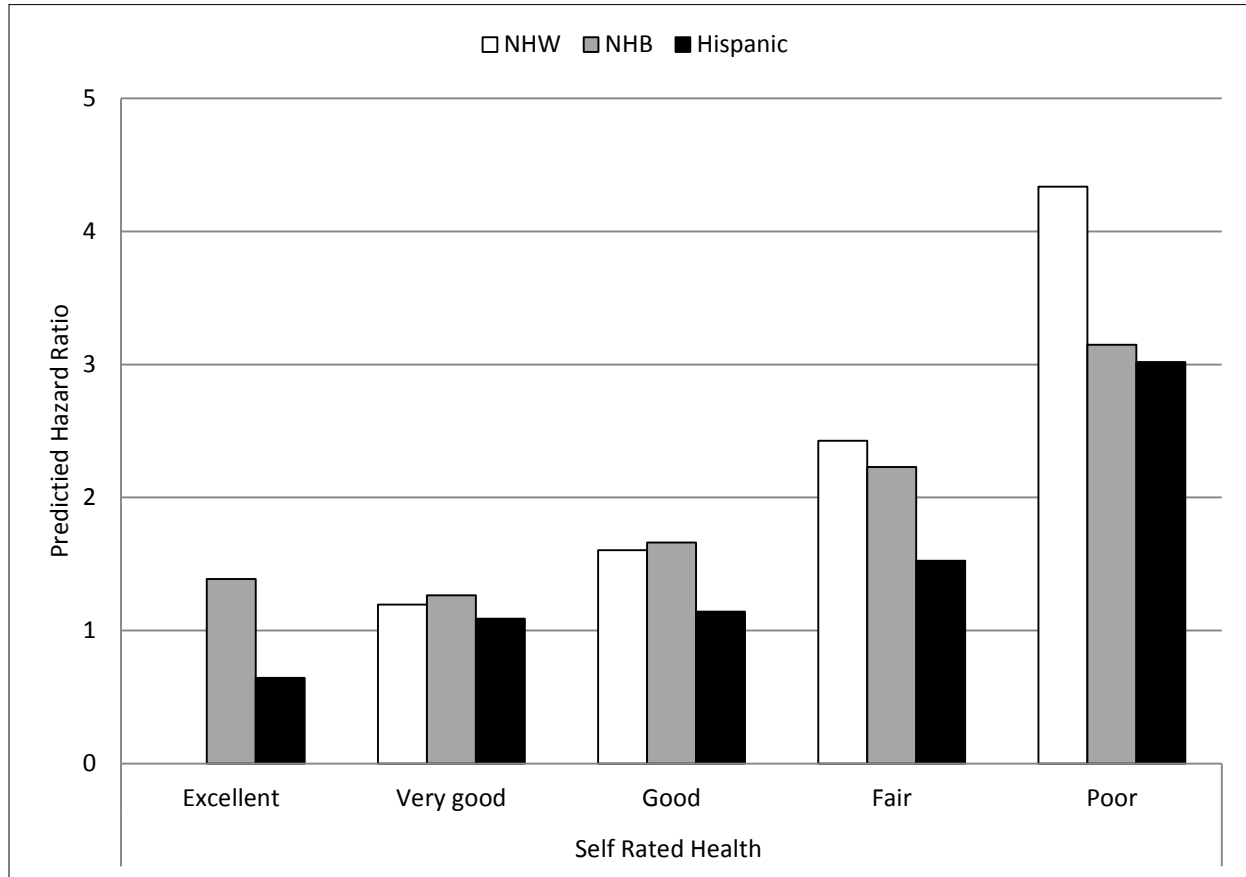
Variables	Less than high school		High school		Some college		College or higher	
	Coefficient	HR	Coefficient	HR	Coefficient	HR	Coefficient	HR
<b>SRH</b>								
Very good	0.083 **	1.086	0.184 ***	1.202	0.163 ***	1.177	0.226 ***	1.253
Good	0.284 ***	1.328	0.475 ***	1.609	0.487 ***	1.627	0.627 ***	1.871
Fair	0.610 ***	1.841	0.921 ***	2.512	0.992 ***	2.697	1.169 ***	3.220
Poor	1.132 ***	3.101	1.563 ***	4.774	1.646 ***	5.184	1.853 ***	6.380
<b>Race/Ethnicity</b>								
Non-Hispanic Black	0.152 *	1.164	0.336 ***	1.399	0.104	1.110	0.574 ***	1.776
Hispanic	-0.211 **	0.810	0.037	1.038	-0.122	0.885	-0.168	0.846
Non-Hispanic Asian	-0.423 †	0.655	-0.425 *	0.654	-1.217 **	0.296	-0.285	0.752
<b>Interactions</b>								
NHB × Very good	-0.136 †	0.873	-0.381 ***	0.683	-0.006	0.994	-0.533 ***	0.587
NHB × Good	-0.116 †	0.891	-0.330 ***	0.719	-0.025	0.975	-0.631 ***	0.532
NHB × Fair	-0.243 ***	0.784	-0.377 ***	0.686	-0.083	0.920	-0.554 ***	0.575
NHB × Poor	-0.435 ***	0.648	-0.593 ***	0.553	-0.139	0.871	-0.885 ***	0.413
Hispanic × Very good	0.062	1.063	-0.253 *	0.777	0.075	1.078	0.232	1.262
Hispanic × Good	-0.049	0.952	-0.299 **	0.742	-0.019	0.981	0.078	1.081
Hispanic × Fair	-0.123	0.884	-0.317 **	0.728	-0.255	0.775	0.118	1.125
Hispanic × Poor	0.029	1.029	-0.163	0.850	-0.124	0.883	-0.097	0.908
NHA × Very good	0.301	1.352	-0.205	0.814	0.856 †	2.355	-0.102	0.903
NHA × Good	-0.005	0.995	0.102	1.107	0.590	1.804	-0.209	0.812
NHA × Fair	0.046	1.048	0.144	1.155	0.597	1.816	-0.135	0.874
NHA × Poor	-0.228	0.796	-0.107	0.898	1.251 *	3.495	0.204	1.226
<b>N</b>	<b>89,103</b>		<b>104,507</b>		<b>48,552</b>		<b>47,270</b>	

Note: The models include all of the covariates and the references are 'Excellent' for SRH and 'NHW' for Race/Ethnicity. + $p < .10$ ; \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

Table 5. Proportional Hazard Models Estimating Effects of SRH on Underlying Cause Specific Mortality Risk										
Variables	Heart disease		Cancer		Respiratory disease		Stroke		Diabetes	
	Coefficient	HR	Coefficient	HR	Coefficient	HR	Coefficient	HR	Coefficient	HR
SRH										
Very good	0.24 ***	1.27	0.07 **	1.07	0.29 ***	1.34	0.21 ***	1.24	0.49 ***	1.63
Good	0.59 ***	1.81	0.34 ***	1.40	0.74 ***	2.09	0.56 ***	1.75	1.10 ***	2.99
Fair	1.10 ***	3.02	0.72 ***	2.06	1.44 ***	4.22	0.92 ***	2.50	1.98 ***	7.27
Poor	1.72 ***	5.56	1.40 ***	4.06	2.32 ***	10.21	1.52 ***	4.56	2.81 ***	16.64
Race/Ethnicity										
Non-Hispanic Black	0.44 ***	1.55	0.33 ***	1.39	0.11	1.12	0.34 *	1.41	1.08 ***	2.96
Hispanic	0.09	1.09	-0.28 **	0.76	-0.45 *	0.64	-0.03	0.97	0.70 *	2.01
Non-Hispanic Asian	-0.51 *	0.60	-0.43 *	0.65	-0.27	0.76	-1.18 *	0.31	0.48	1.62
Interactions										
NHB × Very good	-0.36 ***	0.70	-0.25 **	0.78	-0.42 *	0.66	-0.28	0.76	-0.33	0.72
NHB × Good	-0.38 ***	0.68	-0.29 ***	0.75	-0.59 ***	0.55	-0.32 †	0.73	-0.60 *	0.55
NHB × Fair	-0.54 ***	0.58	-0.45 ***	0.64	-0.94 ***	0.39	-0.39 *	0.68	-0.76 **	0.47
NHB × Poor	-0.82 ***	0.44	-0.73 ***	0.48	-1.30 ***	0.27	-0.53 **	0.59	-1.13 ***	0.32
Hispanic × Very good	-0.22 †	0.80	0.07	1.07	-0.09	0.91	-0.14	0.87	0.09	1.09
Hispanic × Good	-0.38 ***	0.68	-0.16	0.85	-0.07	0.93	-0.24	0.79	-0.26	0.78
Hispanic × Fair	-0.59 ***	0.55	-0.30 *	0.74	-0.45 †	0.64	-0.27	0.76	-0.57 †	0.57
Hispanic × Poor	-0.36 **	0.70	-0.43 **	0.65	-0.42 †	0.66	-0.51 *	0.60	-0.19	0.83
NHA × Very good	-0.03	0.97	-0.12	0.89	-0.10	0.91	0.55	1.74	-1.00	0.37
NHA × Good	-0.07	0.94	-0.22	0.80	-0.58	0.56	0.93 †	2.55	-0.48	0.62
NHA × Fair	0.02	1.02	-0.07	0.93	-0.58	0.56	0.57	1.77	-1.47 *	0.23
NHA × Poor	-0.33	0.72	-0.35	0.71	-1.22 *	0.29	0.63	1.87	-0.45	0.64
N	228,763		223,661		209,851		206,668		203,413	

Note: The models include all of the covariates and the references are 'Excellent' for SRH and 'NHW' for Race/Ethnicity. +*p* < .10; \**p* < .05; \*\**p* < .01; \*\*\**p* < .001.

Figure 1. Hazard Ratio of SRH on Mortality Risk by Race/Ethnic Groups



Note: This figure is based on the results of Model 3 in Table 3.

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