Socio-economic status and mortality: perceptions and outcomes.

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This paper uses the Health and Retirement Study (HRS) to study the relationship of education, income, and wealth to mortality expectations and mortality outcomes. The HRS is now a pre-eminent source for the study of social differentials in mortality over the age of 50. From 1992 to 2008 it has produced over 300,000 person-years of observation. Nearly 10,000 people have died out of over 30,000 ever interviewed. Mortality ascertainment by regular tracking is nearly complete, and complemented by linkage to the National Death Index. Mortality recorded in the HRS has been shown to replicate US life tables by age, sex, and race very closely. The HRS also excels at the measurement of income and wealth.

In addition to the value of carefully documenting the respective roles of education, income, and wealth in social differentials in mortality outcomes, the HRS allows us to assess the extent to which people "know" these differentials and account for them in shaping their own expectations about their survival prospects. The HRS asks questions of the form "what are the chances you will survive to the age of 75?". The target age is varied according to the age of the respondent. A number of papers have established that there is substantial measurement error and heaping in these survival probability reports. Classical measurement error in the dependent variable would not distort the estimates of the relationship between it and right hand side variables, but other forms might and so we have to interpret results in light of that possibility. The most natural way to make use of these probability estimates is to compare them with the life table survival rates for someone of the same age and sex and construct a relative force of mortality (equivalent to a proportional hazard). The force of mortality is given by –log(Sxt), where Sxt is the probability of survival from age x (age at interview) to age t (target age). The relative force of mortality is the ratio of the force of mortality from the individual's reported expectation of Sxt to the force of mortality in the life table Sxt.

Preliminary results are shown in the tables that follow. To make it easier to compare the effects of education to those of income, for example, all the SES variables are converted to quintiles. Education is somewhat heaped at 12 years, but otherwise is reasonably converted to quintiles at 0-8, 9-11, 12, 13-15, 16+. In each case the top (highest SES) quintile is the omitted reference category. The mortality outcomes presented here are logit models of two-year survival between interview dates. Results are not sensitive to variation in interview timing. The final paper will also present proportional hazard models for comparison.

Table 1 shows actual mortality outcomes. The first three models include each of the SES variables individually. Individually, each is highly significant. The predictive power of the models with income or wealth are higher than the model with education alone, and wealth is the best single predictor. Because each variable is measured in quintiles, the coefficients can be directly compared and the steepness of the mortality gradient compared across variables. Education has a much flatter gradient than the other two. Model 4 includes all three measures simultaneously. It predicts only slightly better than the model with wealth alone. Education is scarcely significant when income and wealth are included, suggesting that later life SES outcomes are more correlated with mortality than early life outcomes. The gradient in wealth is slightly steeper than that for income. These findings are also significant because education, which is the most commonly measured SES variable, is the least useful for predicting mortality. Wealth, which is by far the least commonly measured SES variable, is the most predictive. (In other analyses not shown here, we demonstrate that the importance of wealth is robust to whether it is adjusted for marriage and family size or not).

Table 2 shows an analogous set of models for mortality expectations using the relative force of mortality described above. We include age and sex in the models even though the dependent variable controls for age and sex (in each case the force of mortality is calculated relative to the life table by age and sex). The coefficients on age and sex would be zero if there were no systematic deviations from the life table. The significant estimated coefficients reflect a tendency to over or underestimate mortality by age and sex. Thus, the negative coefficient on age indicates that older persons lower their mortality expectations (raise their survival expectations) relative to life tables compared with younger people. The positive coefficient on female indicates that women tend to overstate their mortality rates (understate survival) relative to life table differences by sex, compared with men.

In these models of mortality expectations the gradient in mortality expectations is about the same across the three different variables entered individually. Income explains the most variance, wealth the least. In the combined Model 4, education and income have rather similar gradients with wealth still significant but somewhat flatter.

Comparing Tables 1 and 2, we see that mortality expectations give relatively more credit to education and less to wealth compared with actual mortality outcomes. That is, people overvalue education and undervalue wealth in thinking about their mortality prospects. One cannot directly compare the R-squared of the two models, but it does seem reasonable to conclude that mortality expectations are either measured with a great deal of error, or influenced by factors not included in these models.

It is also of interest to examine the racial differences across these models. We did not show models with only age, sex, and race in the tables. In a logit on actual mortality, blacks have higher mortality and Hispanics about the same as whites by age and sex. In models of expectations, both blacks and Hispanics overestimate their mortality (underestimate survival) relative to whites, but Hispanics much more so than blacks. As SES variables are added to the actual mortality models in Table 1 we see the black mortality disadvantage all but disappears while the Hispanic differential goes from nonexistent to distinctly positive, i.e, controlling for SES Hispanics have lower mortality than whites while blacks are about the same. In terms of expectations, adding any SES variable eliminates the black overestimate of their mortality, and adding all simultaneously actually reverses the sign so that controlling for all SES variables blacks underestimate their mortality. Hispanic overestimates of their mortality are somewhat reduced by controlling for SES.

We can extend these models to consider the influence of known risk factors such as smoking and obesity, or diagnosed health conditions.

Table 1. Logit models of SES and mortality, controlling for age, sex, and race

	Model 1		Model 2		Model 3		Model 4	
	B	z	B	z	B	z	B	z
age	**0.095**	**85.1**	**0.088**	**76.7**	**0.095**	**86.8**	**0.090**	**76.7**
female	**-0.415**	**-17.8**	**-0.551**	**-23.0**	**-0.508**	**-21.5**	**-0.562**	**-23.1**
black	**0.210**	**6.4**	**0.113**	**3.5**	0.011	0.3	-0.027	-0.8
hispanic	**-0.193**	**-3.9**	**-0.302**	**-6.3**	**-0.346**	**-7.2**	**-0.412**	**-8.3**
edq1	**0.572**	**13.5**					0.076	1.6
edq2	**0.545**	**12.7**					**0.143**	**3.1**
edq3	**0.315**	**8.1**					0.059	1.4
edq4	**0.241**	**5.5**					0.074	1.6
edq5	0.000	0.0						
iq1			**1.111**	**22.4**			**0.633**	**10.9**
iq2			**0.782**	**16.0**			**0.474**	**8.6**
iq3			**0.501**	**9.9**			**0.324**	**6.0**
iq4			**0.324**	**6.0**			**0.231**	**4.2**
iq5			0.000	0.0				
wq1					**1.091**	**27.5**	**0.760**	**16.2**
wq2					**0.659**	**16.0**	**0.388**	**8.3**
wq3					**0.450**	**10.8**	**0.248**	**5.5**
wq4					**0.234**	**5.4**	0.112	2.5
wq5					0.000	0.0		
_cons	-9.670	-108.4	-9.356	-103.9	-9.714	-111.5	-9.586	-99.1
pseudo-R		0.149		0.157		0.160		0.162

Notes: N= 147,809 observations (two-year intervals). Coefficients and z-statistics in bold indicate p<.01.

Table 2. OLS models of the relative force of mortality

	Model 1		Model 2		Model 3		Model 4	
	B	z	B	z	B	z	B	z
age	**-0.032**	**-49.0**	**-0.038**	**-56.2**	**-0.026**	**-40.1**	**-0.036**	**-51.7**
female	**0.532**	**39.1**	**0.448**	**32.7**	**0.521**	**38.4**	**0.461**	**33.7**
black	-0.011	-0.5	**-0.070**	**-3.4**	**-0.130**	**-6.3**	**-0.209**	**-10.2**
hispanic	**0.616**	**22.7**	**0.674**	**25.8**	**0.707**	**27.0**	**0.467**	**17.2**
edq1	**1.102**	**41.2**					**0.668**	**23.4**
edq2	**0.965**	**41.1**					**0.622**	**24.9**
edq3	**0.494**	**26.4**					**0.291**	**14.8**
edq4	**0.204**	**9.8**					**0.083**	**3.9**
edq5	0.000	0.0						
iq1			**1.193**	**51.7**			**0.684**	**25.0**
iq2			**0.786**	**36.3**			**0.426**	**17.5**
iq3			**0.577**	**27.9**			**0.338**	**15.2**
iq4			**0.328**	**16.4**			**0.193**	**9.3**
iq5			0.000	0.0				
wq1					**0.979**	**43.6**	**0.404**	**15.5**
wq2					**0.670**	**31.4**	**0.248**	**10.5**
wq3					**0.344**	**16.7**	**0.068**	**3.1**
wq4					**0.168**	**8.2**	0.016	0.8
wq5					0.000	0.0		
_cons	2.987	66.8	3.371	75.6	2.670	58.7	3.075	63.6
Rsquared		0.067		0.069		0.064		0.081

Notes: N= 115,082 observations with survival expectations reported. Coefficients and z-statistics in bold indicate p<.01.