Healthy, Wealthy, and Wise?
Socioeconomic Status and Morbidity/Mortality

by

Michael D. Hurd, Angela Merrill, and Daniel McFadden*

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ABSTRACT: Differential morbidity and mortality by socio-economic status (SES) have been observed over a wide range of data and populations, with higher SES associated with lower morbidity and mortality. The association has been attributed to differential access to medical services, to the impact of disabilities and medical costs on savings, and to genetic and behavioral factors that influence economic productivity, tastes for accumulation, and exposure to health hazards. We examine these relationships in the population of individuals aged 70 or over, using the Asset and Health Dynamics of the Oldest Old (AHEAD) panel survey sponsored by the Institute on Aging of the National Institute of Health. We find in this elderly population that there is a strong association between SES and prevalence of health conditions. However, there is only weak evidence that SES influences the incidence of new health conditions, controlling for existing conditions, or that the incidence of new health conditions influences SES. We conclude that in this Medicare-eligible population, the wealthy are either unable to buy significant add-on medical services, or do not derive significantly better health outcomes from the additional medical services they buy. The paper also treats a number of technical issues in the analysis of panel data, including cross-wave imputation of missing and incomplete responses, and handling errors in measured assets. A revision of this paper to be completed in Spring 2000 will include results from the third wave of AHEAD, including revised data on mortality by cause.

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Health and money go far. (Herbert, 1640)

1. Introduction

Differential morbidity and mortality by socio-economic status (SES) have been observed over a wide range of data and populations: morbidity and mortality rates are lower among those from higher SES groups (Kitagawa and Hauser, 1973; Shorrocks, 1975; Hurd, 1987; Hurd and Wise, 1989; Jianakoplos, Menchik and Owen, 1989; Feinstein, 1992).[1] This paper examines these relationships in the population of individuals aged 70 or over, using the Asset and Health Dynamics of the Oldest Old (AHEAD) survey. This is a biennial panel study conducted by the University of Michigan Survey Research Center for the National Institute on Aging.

Causal mechanisms that may be responsible for the observed association of SES with the hazards of morbidity and mortality have been the subject of considerable discussion. Measurement problems that could contribute to ecological correlation have also been an issue. The issue of differential access to medical services, and differential treatment, was raised during the debate in the early 1990's on health insurance. Differential exposure to risk factors that are linked to environmental or occupational hazards associated with low SES could reinforce this causal link. The postulated causal path is shown below:

SES ⇒ **Access to Medical Care, Environmental/Occupational Hazards** ⇒ **Morbidity & Mortality**

Economists have postulated an alternative causal path from health to wealth. Chronic health problems reduce the ability to work and productivity, leading to reduced income and accumulation of assets, and increased medical care expenditures, as the next path illustrates:

Morbidity ⇒ **Work-Limiting Disability, Medical Expenses** ⇒ **SES**

The final possibility is that correlation between SES and Morbidity/Mortality is ecological, the result of underlying causal factors of genetic or behavioral origin that influence both health and the ability to accumulate assets. Frailty, perhaps genetically determined, may influence both economic productivity and resistance to disease. Behavioral factors such as childhood nutrition, exercise, and smoking may influence both health and economic activity level. Tastes for work and for "clean living" may influence both health and earnings. Finally, rational economic decision-making may induce robust consumers to accumulate in order to finance consumption over a long expected retirement.

Tastes & Behavior (e.g., foresight, energy, nutrition) ⇐ Genetic Endowment

Genetic Endowment ⇓ Morbidity & Mortality

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Tastes & Behavior (e.g., foresight, energy, nutrition) ⇓ SES

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[1] Socioeconomic status is associated with wealth, income, education, and occupation. Many studies of health and SES have utilized education as an indicator of SES. In this study, we use total wealth, measured by accumulating over self-reported holdings in nine asset categories, total income and education.

The relationship between SES and health is of direct policy interest in assessing the impact on morbidity and mortality of changes in Medicare and other aspects of the financing and delivery of medical care. It is also of interest because it influences the economic interpretation of data on asset holdings and savings. A classical economic model of life-cycle consumption postulates that consumption will be smoothed over the consumer's life; this implies in particular that there will be substantial accumulation of assets prior to retirement, and spending down of these assets over remaining life. A stylized characterization of the empirical evidence is that relative to the life-cycle model, Americans "accumulate too little and save too much." While bequest motives may be a factor in the retention of assets late in life, a principle factor appears to be strong risk aversion, leading to substantial precautionary asset holdings. Overly optimistic consumer expectations about longevity may be one of the reasons for a strong precautionary motive. A wealth-mortality gradient causes difficulty in using cross-section variations in wealth to understand life-cycle behavior. Cohort effects, operating through differentials in the present value of lifetime earnings streams, will cause wealth to decline with age in cross-section. On the other hand, the mortality gradient will cause wealth to increase both in cross-section and in a panel: as a cohort ages, those with less wealth die, leaving survivors from the upper part of the wealth distribution. Thus, even if no couple or single person saves after retirement, the wealth of the cohort would tend to increase with age. This makes it difficult to study life-cycle wealth paths based on synthetic cohorts, which will eliminate cohort differences in lifetime resources, but not differential mortality. These difficulties carry over to studies of income and consumption in synthetic cohorts.

In this paper, we exploit the panel structure of the AHEAD study to investigate the plausibility of these three causal models. Our main interest in this paper is to understand the predictors of morbidity and mortality between waves 1 and 2, especially income and wealth. Using what can be interpreted as a Granger-causality test, we find that the evidence supports the hypothesis that health conditions influence SES in the elderly. There is at least weak evidence that SES influences morbidity and mortality, either directly or through hidden factors (e.g., robustness) that cause both SES and Health.[2]

2. Data

Our data come from the Asset and Health Dynamics among the Oldest-Old (AHEAD) study.[3] This is a biennial panel of individuals born in 1923 or earlier, and their spouses. At baseline in 1993 the AHEAD panel contained 8222 individuals representative of the community-based population except for over-samples of blacks, Hispanics and Floridians. Of these subjects, 7447 were over age 69; the remainder were younger spouses. There were 6052 households, including individuals living alone or with others, in the 1993 sample. Wave 2 was fielded in 1995.[4] In wave 2, 7027 persons completed the core interview, 6237 of these persons were age eligible. Proxy “exit” interviews were attempted for all individuals reported as having died. By wave 2, 774 individuals over age 69 had died, a crude two-year death rate of 10.4 percent.[5] This is significantly lower than the 1993 life table two-year mortality rate of 15.5 percent. This can be attributed to the exclusion of the institutionalized population, which has substantially higher death rates, from the AHEAD sample. One implication of the AHEAD population is that increasingly at older ages, the sample selects individuals who are sufficiently independent to avoid institutions, and who

[2] A group of variables Y is said to not Granger-cause a group of variables X if the conditional distribution of X given lagged values of X and Y does not depend on the lagged values of Y. Thus, innovations in health variables are not caused by SES variables if the conditional distribution of these innovations, given the history of both health and SES variables, is independent of the SES variables.
[3] See Soldo, Hurd, Rodgers, and Wallace, 1997.
[4] This study uses the public release of AHEAD Wave 1 and the preliminary release of AHEAD wave 2.
[5] There are 45 subjects from Wave 1 who could not be located in Wave 2,either directly by proxy respondent, who are treated as dead for the purposes of our analysis.

are sufficiently robust to avoid or live with major health problems. The main goal of AHEAD is to provide panel data from the three broad domains of economics status, health and family connections. The AHEAD provides a large sample of a sub-population at high risk for morbidity and mortality, with extensive data on economic status. This population is almost completely retired, so that a very strong confounding effect of health on income via work status is practically eliminated. There is a parallel panel of individuals initially aged 50-65, the Health and Retirement Survey (HRS), that has many design features in common with the AHEAD survey. In this paper, we will occasionally refer to results from analysis of HRS data.

AHEAD individuals and couples were asked for a complete inventory of assets and debts, and about income sources. Subjects are asked first if they have any assets in a specified category, and if so, are asked for the amount. A nonresponse to the amount is followed by unfolding bracket questions, which may result in complete or incomplete responses. Through the use of unfolding brackets, non-response to asset values was reduced to levels usually less than 5 percent, much lower than would be found in a typical household survey such as the SIPP. A possible price of techniques that increase response rates may be noisy or biased responses. This is a particular issue for economic variables such as assets and income, but may also be important for self-reported health events.[6] Hurd et al. (1997) used experimental variation in the bracket sequences for two economic questions on Wave 2 of AHEAD to test for anchoring, a psychometric phenomenon in which an individual asked whether an ambiguous quantity exceeds a stated threshold tends to start from this threshold and adjust back incompletely to her prior beliefs. They find strong effects that could bias estimates of population means by as much as a factor of two.

To handle missing asset data and bracket data on assets, we use a nested hot-deck imputation procedure that conditions on asset information in the other wave of data. First, missing ownership in a wave is imputed by choosing randomly from respondents, conditional on ownership in the other wave; for persons missing ownership in both waves, an ownership pair is drawn from complete respondents in both waves. Then, an amount or change in asset value is imputed to a complete or incomplete bracket response by drawing from continuous responses, conditioning on the bracket range in both waves. Total assets are then accumulated across categories following the imputation process. Mean asset levels in AHEAD, with imputation, are generally consistent with other economic surveys of wealth, such as the Survey of Consumer Finance, but exhibit larger variances.

AHEAD queries about many health conditions. Questions regarding health condition are generally asked in the form of “Has a doctor ever told you had….”. We will use information on 13 conditions including cancer, heart disease, and diabetes and high blood pressure. Depressed mood is measured by the CESD-battery of questions measuring general mood; we form an indicator for depression based on these questions. The study also collects data on self-assessed health status where the subject is asked to rate his or her health as excellent, very good, good, fair or poor. No reference is made to other groups such as "people of your age." Self-assessed health is highly predictive of mortality in the HRS (Hurd and McGarry, 1997). General measures of health status are counts of the number of ADL (activities of daily living) limitations and IADL (instrumental activities of daily living) limitations. A high ADL limitation count indicates that the individual has difficulty with personal self-care, while a high IADL limitation count indicates difficulty in household management.

AHEAD measures cognitive status in a battery of questions which aim to test a number of domains of cognition (Herzog and Wallace, 1997): learning and memory are assessed by immediate and delayed recall from a list of 10 words that were read to the subject; reasoning, orientation and attention are assessed from Serial 7's, counting backwards by 1 and the naming of public figures, dates and objects.[7] This score reflects both long-term ability and impairments due to health events. To isolate the latter, we

[6] The AHEAD panel will be linked to Medicare records, Social Security earnings records, and the National Death Index, providing administrative cross-checks on reported health problems and income, and identification of cause of death. However, these links are not available yet.

[7] Serial 7’s asks the subject to subtract 7 from 100, and then to continue subtracting from each successive difference for a total of five subtractions.

take education to be an indicator of long-term ability, and construct a scale that removes this component. In the AHEAD population, average education levels are higher in the younger cohorts due to changing education policy in the first decades of this century. We first regress years of education on age, by sex, and then for each subject predict an age-adjusted education level. We then regress the cognitive score on age adjusted education, and use the residuals from this regression to produce a scale for variation in cognitive performance from long-term level. Finally, we construct an indicator of cognitive impairment that picks out the bottom 25 percent of the baseline sample in terms of this scale.

3. Results

Consider mortality in the AHEAD panel between 1993 and 1995. Figure 1 shows two-year mortality rates by age and sex. For comparison, 2-year mortality rates are given for females and males from the 1993 Life Tables of the National Center for Health Statistics. Because the AHEAD panel was drawn from the non-institutionalized population, which is healthier than the institutionalized population, the AHEAD mortality rates are lower than life table rates, particularly at older ages. The AHEAD panel confirms the usual pattern that mortality rates are higher for men than for women, and for singles compared to couples.

Figures 2 presents prevalence rates for a severe or chronic health condition at AHEAD baseline. A severe condition is defined as having a history of one or more of the following: heart disease/attack, stroke, cancer, lung disease, or diabetes.[8] A chronic condition is defined as having arthritis, high blood pressure, psychiatric disease, incontinence, hip fracture, or a fall requiring treatment, depression, or cognitive impairment. Prevalence rates for one or more severe conditions in figure 2a are higher for men than for women, and among women, are higher for singles. However, there is not a noticeable age gradient among any of the groups. This is primarily because individuals with these diseases are selected out of the surviving population, but partly because these diseases at older ages are more likely to lead to institutionalization so they are excluded from the AHEAD sample. In figure 2b, however, prevalence rates for any chronic condition is highest for women, and among men, are highest for singles. Chronic conditions show a slight gradient with age, especially among women.

Table 1 gives the prevalence of individual health conditions and health status in the AHEAD baseline sample in 1993 among those 70-74, stratified by sex and marital status. Males have higher prevalence of heart disease/attack, stroke and lung disease. Married women are more likely to have had psychiatric disease or a fall. Singles have higher prevalence rates for cognitive impairment, arthritis, fair or poor self-rated health, and depression. As in figure 2, males have higher prevalence rates for severe conditions, and females and singles have higher prevalence of chronic conditions, even among the 70-74 age group.

Figures 3 and 4 show median wealth and income in the AHEAD sample in 1993, by age, sex, and marital status. Wealth is the total of housing wealth, financial, business and other real estate wealth, but excludes the asset value of pensions. Income includes all financial income such as pension income and transfers, but no imputed income from owner occupied housing.

As in other cross-section data sets, wealth and income fall with age, and both are higher among couples than among singles. This reflects a combination of *cohort effects*, in which older individuals worked in eras when productivity and wages were lower, and could accumulate less; *life-cycle effects* in which individuals spend down assets near the end of life; and *survival effects* in which low-wealth individuals die at a higher rate because of the wealth/mortality gradient. The confounding of these effects makes it clear that we cannot study the relationship between mortality and morbidity and socioeconomic status without effectively controlling for age. The figure for income shows a sharper gradient with age than one would expect, given that pension income, typically adjusted for cost of living, is a major component of total income; this is primarily a reflection of cohort effects. Also, among couples, where

[8] These conditions represent five of the six leading causes of death for elderly Americans in 1996 (National Center for Health Statistics).

the age gradient is most noticeable, younger couples may have a working spouse; the age gradient is less among singles, especially females.

The mean years of education of the elderly declines sharply with age, a cohort effect, as depicted in Figure 5. As a consequence, studies that have related mortality risk to socioeconomic status as measured by educational attainment, without adequate control for age, confound cohort and survival effects. It is notable that the educational level of women is higher than that of men even though for these cohorts the educational level of a complete population of men would have been considerable higher. This occurs because women consistently have a higher mortality gradient by education than do men.

The Association of Wealth and Health

Figure 6 shows prevalence rates of a severe or chronic health condition at baseline in AHEAD, stratified by wealth quartiles, sex, and marital status, among 70-74 year olds.[9] As seen in figure 6a, the prevalence rate for a severe condition (heart disease/attack, cancer, stroke, lung disease, or diabetes) declines with wealth quartile among all groups but single males. The prevalence rate of chronic conditions, in figure 6b, shows a consistent negative relationship with wealth quartile among all groups.

Figure 7 gives mortality rates between 1993 and 1995 among 70-74 year-olds in the AHEAD, stratified by wealth quartile and by sex and marital status. The figure shows a strong, statistically significant, negative correlation between baseline wealth and mortality hazard for all groups but married males.

To investigate the correlation between wealth and health further, we have estimated logit models for the prevalence of baseline health as functions of baseline wealth, income, education, and demographic variables. To bound the influence of tails and to allow for nonlinear effects, we use wealth and income quartiles, defined separately for single and married households, rather than dollar values. Wealth, income, or education effects that are economically or statistically significant in these models establish an association between SES and the health condition, but not necessarily that SES causes the health condition. The baseline models use a linear spline in age, with knots at 70 and 80, interacted with indicator variables, to control for age effects.

Table 2 presents logit results for of four summary health variables: any severe condition, any chronic condition, fair or poor self-rated health, and poor functioning as measured by three or more ADL impairments. We test the joint effect of the wealth and income quartile variables and education with a likelihood ratio test. We also estimate logits for each of the individual health conditions, but the results are too voluminous to present here. The significance of the SES variables in these individual condition models is summarized in table 3.

The logit results mainly establish that the relationships that can be seen in simple cross-tabulations continue to hold when age, SES and baseline health behaviors are controlled for. Despite the inclusion of behaviors and conditions that are themselves associated with wealth in cross-section, wealth is negatively related to each of the health measures. Current income and education are not significantly correlated with the summary conditions, except for a negative relationship to fair or poor self-rated health. The tests of joint SES significance, using a likelihood ratio test, are significant for the presence of a severe condition, of fair or poor self-rated health and for ADL impairment, but not for the presence of a chronic condition.

The demographics associations show that the older a person is, the more likely they are to have a health condition, poor self-rated health, and poor functioning. Being female is a significant positive predictor of a chronic health condition even controlling for age. Widows are more likely to have a severe health condition. Being black or Hispanic is negatively related to having a severe health condition, while being black is positively related to having a chronic condition. The age of death of the parents of the AHEAD respondents is negatively related to a number of the health measures, but only the age of father's

[9] The wealth quartile boundaries are $4,050, $46,100, and $119,000 for singles, and $55,000, $127,700, and $272,000 for couples.

death is significant for poor or self-rated health. Both low and high body-mass index are associated with increased probability of each of the health measures except for a negative and insignificant relationship between low BMI and having a chronic condition. Having ever smoked is associated with increased probability of a severe condition, but not of a chronic condition or functioning. Drinking three or more alcoholic drinks per day and current smoking at baseline have a negative relationship with conditions, probably due to a selection effect. Interview by proxy in this age group is mostly due to frailty, and, indeed, it is positively and significantly associated each of the summary health measures.

The same pattern between SES and health is seen in the prevalence of individual conditions, summarized in Table 3. Among the individual conditions in Table 3, all conditions except for high blood pressure, fall requiring treatment, hip fracture, and incontinence show a strong relationship between SES and health conditions. This relationship is mainly driven by the negative association of wealth with the health condition, except for cancer, for which there is a strong *positive* association between income and education and cancer. Conditions which also show a significant negative relationship with total income include cognitive impairment, IADLs, and depression.

Overall, there is a strong association of health and wealth at baseline. Several caveats apply to the interpretation of these results. First, by definition of the AHEAD population, individuals in the 1993 sample are *survivors* of these diseases as of the date of the interview, and further have not been sufficiently incapacitated to be institutionalized. Second, the conditions are self-reported, and at present cannot be checked against Medicare records. Approximately 1.1 percent of individuals that report in 1993 that they have ever had high blood pressure, diabetes, heart disease, stroke, or arthritis revise their response in 1995 and report that they have never had the disease. This gives some indication of rates of misreporting. In addition, there may be recall bias, particularly among more elderly, cognitively impaired individuals.

Is SES a Causal Factor in Morbidity and Mortality?

The event of death or onset of a new health condition in the AHEAD panel between 1993 and 1995 can be related to past health history, demographics, and SES. Because SES is measured temporally prior to these events, a significant correlation indicates either a causal relationship, the continued operation of hidden factors that influence both SES and health, or the operation of a complex selection phenomenon. To test for the presence of correlation, we estimate logit models for death or onset of a new health conditions or impairment as functions of the listed variables, with and without the SES variables. One can give this the interpretation of a test for whether SES is Granger-causal for onset of health problems or mortality. A failure of this test may indicate causality from SES to health, or may indicate the mutual impact of hidden factors.

The findings on mortality and summary health outcome variables are presented in Table 4. The summary health outcomes include an indicator for the onset of a new severe or a chronic health condition, an indicator for reporting fair or poor health in wave 2, and for three or more ADL impairments by wave 2. Several important caveats are necessary in interpreting these results. First, as noted before, the AHEAD baseline sample selects non-institutionalized survivors of previous health conditions. Second, we control for the effects of age, sex, and marital status by using a linear spline, with knots at ages 70 and 80, that is interacted with demographic group; this will standardize much of the age effect, but will fail to capture interactions between pre-existing health conditions and demographic variables. Third, death and onset of some conditions are competing risks in our analysis, because the exit proxy interview for the deceased does not ask about diabetes, arthritis, psychiatric disease or high blood pressure. Therefore, our outcome measures for a new severe or chronic condition will not capture the onset of these conditions among persons who died. Fourth, because of the manner in which health data for a number of conditions is collected in AHEAD, for some conditions we cannot distinguish in 1995 whether there has been a new health event in the past two years if there was a pre-existing condition in 1993. We cannot tell whether an individual who had arthritis, high blood pressure, lung disease or psychiatric disease prior to 1993 still has the condition in the 1993-1995 period: it was assumed by the designers of the survey that these conditions are chronic and no questions were asked about new episodes. Therefore, with the exception of stroke, cancer, and heart disease/attack, onset of a condition is restricted to a sample without that condition in wave 1. For stroke, cancer, and heart, the outcome variable includes persons who had a history in wave 1 but reported a new event such as a repeat stroke or a new cancer, as well onset among persons with no baseline history. The summary measures for severe conditions also count repeat events for these three conditions.

We first estimate a logit for mortality by wave 2. As seen in Table 4, we find that income and wealth have no significant impact on the probability of death, once previous health conditions are accounted for. This is inconsistent with the hypothesis of a negative causal link from SES to mortality rates that might be attributed to differential access to medical diagnosis and treatment. The age of maternal death is predictive of lower mortality of the AHEAD respondent. Low BMI has a powerful effect on mortality, while high BMI is slightly protective. Ever having smoked is positively predictive or mortality. Wave 1 proxy status is significantly related to risk of death. The number of severe conditions at baseline, and ADL and IADL limitations also have significant predictive power for subsequent mortality. After controlling for the presence of major health conditions, fair or poor self-reported health status has also has predicative power for mortality. The Granger test for causality of SES on mortality is not rejected at the five- percent level.

The remaining columns in Table 4 present results for summary health outcome measures. The samples for the onset of a chronic or severe health condition models include the entire baseline sample, regardless of the presence of other conditions at baseline. The samples for the onset of poor health and ADL impairment include only persons without fair/poor health or less than three ADL impairments at baseline.

The SES variables taken individually are not significant predictors of a new severe or chronic condition, ADL impairment, or worse health. Being female is positively related with a new chronic condition, and negatively related to a new severe condition, even after controlling for age. The number of chronic conditions at baseline is a significant predictor of a new severe event, worse self-rated health, or ADL impairment, but is a negative predictor of a new chronic condition. A severe health condition at baseline is predictive of worse self-rated health and of onset of ADL impairment. Excellent or very good self-rated health is negatively related to the onset of a new condition or worse health, but is positively related to the onset of ADL impairment. Baseline IADL impairment is a significant predictor of the onset of ADL impairment. The tests of SES causality are not rejected at the five- percent level for any of the summary outcome measures. Only for the onset of fair or poor self-rated health is SES significant at the 10 percent level.

We also estimate logit models for the incidence of individual health conditions. Table 5 summarizes the significance of the 8 SES variables for the onset of the individual health conditions. The table shows that SES is significant for only two of the events we study: onset of cognitive impairment and onset of psychiatric disease. The correlation with onset of cognitive impairment is driven by a significant and positive coefficient on college education. For psychiatric disease, wealth quartiles are negative, but no SES variables are individually significant. Future work will quantify the importance of the effects, but detailed examination does not show quantitatively large effects.

Are the Onset of Health Conditions Causal to Savings?

New health conditions could influence savings behavior because of the cost of medical treatment, because health may limit the consumption of other goods, and because health status is an indicator of longevity, and an individual planning consumption and precautionary reserves over her lifetime may adjust target wealth based on altered perceptions of longevity. We measure wealth changes for households between 1993 and 1995 as changes in the percentile the person occupies in the wealth distribution. We regress this wealth change measure of net saving on demographic, health, and baseline SES variables. Due to response errors and item non-response, this variable is noisy, and is sensitive to the imputation procedure used to handle item non-response. The next revision of this paper will include a discussion of alternative imputation and error-reduction methods for wealth. It will include a discussion of econometric methods for controlling the impact of wealth measurement error on tests for causality, and the results of their application.

Table 6 presents results for the households who have a surviving member who was interviewed in wave 2. For households with a married couple, spouse variables are also included as explanatory variables. Wealth change is measured as the change in the percentile ranking among the panel from wave 1 to wave 2. College education is associated with an increase in wealth. Being black is negatively correlated with wealth change for singles and the whole sample. Saving is significantly positively correlated with income for the whole sample, and for singles and married households. There is a negative correlation with initial wealth, but this is most likely "regression to the mean" caused by errors in measured wealth. To correct for this measurement error, we use the predicted probabilities of the wealth quartiles, estimated from logit regressions on capital income variables (results not presented). In these regressions, we still see some regression to the mean in the top two quartiles, but at a lesser magnitude than before.

Mostly there are no significant correlations between baseline health and wealth change except for ADL impairment among singles and the number of severe conditions at baseline among married households and the whole sample. The number of chronic conditions is negative but not significant in each regression. However, a Granger test for a causal relationship from health events to savings does not pass for the whole sample or for singles, suggesting that prior health has some effect on wealth change over the two-year period for these groups.

4. Summary

Socioeconomic status and the prevalence of health conditions are generally negatively correlated in the baseline AHEAD sample in 1993, so that high SES is associated with low disease prevalence. When we look at changes in health conditions and changes in wealth between the 1993 and 1995 waves of the panel, we find, at a formal level, that the Granger test of causality does not universally pass. However, the overall evidence is fairly weak for the influence of SES on health: the test is rejected only for the summary health variable for the onset of fair or poor self-rated health. And among models for the onset individual conditions, only two conditions can reject the test, and the magnitudes of the individual coefficients are small and not consistent. The effects of health status on wealth are considerably stronger with a number of the disease conditions significantly affecting wealth change. Therefore, the SES gradient for morbidity and mortality that is present in baseline, and apparently much weaker in incremental changes from baseline, may come from hidden genetic and behavioral factors that influence both productivity at earlier ages and health hazard rates at older ages, and possibly from a direct gradient of increasing access to medical diagnosis and treatment at younger ages where access to health insurance is limited to private sources.

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Table 1.
Prevalence of Health Conditions Wave 1, Ages 70-74

	All	Married Female	Single Female	Married Male	Single Male
Cancer	0.12	0.11	0.13	0.12	0.15
Heart Disease/Attack	0.28	0.21	0.27	0.33	0.35
Stroke	0.06	0.04	0.06	0.08	0.08
Lung Disease	0.12	0.09	0.12	0.13	0.16
Diabetes	0.15	0.12	0.19	0.14	0.16
High Blood Pressure	0.49	0.49	0.55	0.45	0.50
Arthritis	0.23	0.23	0.27	0.17	0.26
Psychiatric Disease	0.12	0.15	0.14	0.08	0.13
Incontinence	0.18	0.14	0.21	0.16	0.20
Cognitive Impairment	0.18	0.14	0.21	0.16	0.20
Depression	0.09	0.07	0.12	0.04	0.17
Fall Requiring Treatment	0.06	0.08	0.06	0.04	0.06
Hip Fracture	0.03	0.03	0.04	0.03	0.02
ADL impairment (>2)	0.06	0.06	0.08	0.04	0.07
IADL impairment (>2)	0.04	0.04	0.04	0.04	0.05
Fair/poor self-rated health	0.31	0.27	0.37	0.28	0.32

Notes:

Cognitive impairment indicator is adjusted for age and education effects.

Depression is measured as a score of more than 4 on the CESD-8 scale, and is asked of self-respondents only.

Table 2
Health Conditions at AHEAD Baseline. Logits.

	Health Status Indicators							
	Any Severe Condition (mean=0.540)		Any Chronic Condition (mean=0.784)		Fair or Poor Self-rated Health Status (mean=0.367)		ADL Impairment (3+) (mean=0.105)	
Variable	Coef.	Chi-Sq.	Coef.	Chi-Sq.	Coef.	Chi-Sq.	Coef.	Chi-Sq.
Intercept	0.486	5.847	1.070	17.991	0.004	0.00	-2.379	43.973
2nd Wealth Qrtl.	-0.261	12.571	-0.280	7.981	-0.283	14.55	-0.429	14.296
3rd Wealth Qrtl.	-0.392	25.698	-0.310	9.307	-0.557	48.76	-0.553	19.044
4th Wealth Qrtl.	-0.440	26.309	-0.325	8.795	-0.740	64.62	-0.708	21.609
2nd Income Qrtl.	-0.009	0.016	-0.120	1.526	-0.162	4.69	-0.301	6.847
3rd Income Qrtl.	-0.036	0.212	-0.171	2.938	-0.259	10.35	-0.321	6.143
4th Income Qrtl.	0.018	0.042	-0.161	2.202	-0.419	19.92	-0.338	4.728
High School	-0.027	0.199	-0.060	0.616	-0.340	29.80	-0.168	2.647
College	-0.038	0.234	0.143	2.351	-0.324	11.86	0.244	2.474
Age 70 spline	0.048	13.150	0.068	21.201	0.093	42.12	0.095	12.862
Age 80 spline	-0.113	18.671	-0.085	7.975	-0.174	38.31	-0.029	0.442
Female	-0.260	6.140	0.518	18.425	0.261	4.93	0.575	6.202
Female*age 70 spline	-0.025	2.243	0.006	0.100	-0.055	9.14	-0.037	1.293
Female*age 80 spline	0.067	4.331	0.067	2.500	0.125	13.22	0.044	0.698
Widow	0.245	17.337	0.016	0.048	0.072	1.29	0.194	3.539
Divorced/Separated	0.245	4.571	-0.032	0.048	0.128	1.14	0.168	0.730
Age mother die	-0.001	0.488	-0.003	3.199	-0.002	1.98	-0.003	0.994
Age father die	-0.003	3.626	-0.002	0.654	-0.006	10.58	-0.008	7.423
Black	-0.377	21.759	0.827	40.498	0.203	6.02	-0.101	0.648
Hispanic	-0.496	18.209	0.074	0.228	0.055	0.21	-0.048	0.077
Low body mass index	0.117	8.288	-0.031	0.374	0.206	24.12	0.179	12.412
High body mass index	0.026	9.651	0.072	33.059	0.039	20.34	0.075	39.719
Ever smoke	0.399	48.939	0.106	2.168	0.204	10.81	0.025	0.063
Smoke now	-0.372	17.603	-0.179	2.893	0.178	3.59	-0.060	0.134
Drink 3+ drinks/day	-0.482	7.182	0.064	0.095	-0.690	9.86	-0.702	2.150
Proxy	0.322	13.515	0.467	14.158	0.729	68.06	1.616	238.624
SES Test:								
Statistic	19.542		4.82		196.99		60.53	
P-value	0.012		0.777		0.000		0.000	
N	6867		6867		6867		6867	

Notes:
A severe condition is defined as a history of one or more of: heart disease/attack, cancer, lung disease, diabetes, or stroke. Chronic conditions include arthritis, high blood pressure, cognitive impairment (age and educ adjusted), psychiatric disease, incontinence, falls requiring treatment, hip fracture and depression.

Table 3
Individual Health Conditions, AHEAD Wave 1:
Significance Level of SES Variables in Logistic Regression

Condition	P-value	Notes:
Heart disease/attack	.000	male positive and significant
Cancer	.000	high school and college positive and significant
Stroke	.000	
Diabetes	.000	
Lung Disease	.000	
High Blood Pressure	.109	
Arthritis	.001	
Cognitive impairment	.000	
Psychiatric Disease	.014	college positive
Depression	.000	income negative
Hip Fracture	.701	
Fall requiring treatment	.058	
Incontinence	.226	

Notes:

Cognitive impairment indicator is adjusted for age and education effects.
Depression is measured as a score of more than 4 on the CESD-8 scale, and is asked of self-respondents only.
Significance of wealth quartile, income quartile, and education tested using likelihood ratio test.

Table 4
Morbidity and Mortality Outcomes AHEAD Wave 2. Logits.

	Mortality mean=0.1044		New Severe Condition mean=0.2177		New Chronic Condition mean=0.3313	
Variable	Coef.	Chi-Sq.	Coef.	Chi-Sq.	Coef.	Chi-Sq.
Intercept	-3.019	68.697	-1.491	34.023	-1.053	22.639
2nd Wealth Qrtl.	0.109	0.821	-0.051	0.320	-0.077	1.014
3rd Wealth Qrtl.	0.127	0.936	0.112	1.406	-0.049	0.359
4th Wealth Qrtl.	0.077	0.261	0.013	0.015	-0.078	0.732
2nd Income Qrtl.	0.061	0.259	0.046	0.271	-0.008	0.010
3rd Income Qrtl.	-0.154	1.319	0.060	0.390	-0.201	6.061
4th Income Qrtl.	-0.036	0.055	0.074	0.468	-0.137	2.245
High School	0.174	2.862	-0.097	1.740	-0.048	0.569
College	-0.021	0.022	0.024	0.054	0.162	3.745
Age 70 spline	0.097	18.561	0.036	5.199	0.055	14.967
Age 80 spline	-0.012	0.104	-0.028	0.857	-0.054	3.741
Female	0.071	0.108	-0.383	7.553	0.330	8.035
Female*age 70 spline	-0.064	4.466	0.018	0.726	-0.002	0.016
Female*age 80 spline	0.050	1.056	-0.018	0.231	-0.013	0.139
Widow	0.085	0.674	0.014	0.036	0.048	0.608
Divorced/Separated	0.030	0.023	-0.090	0.382	-0.008	0.005
Age mother die	-0.008	9.038	-0.004	4.728	0.001	0.561
Age father die	-0.006	3.721	-0.004	3.803	0.002	1.431
Black	0.051	0.144	-0.279	7.588	-0.062	0.524
Hispanic	-0.170	0.715	-0.612	15.006	-0.341	7.181
Low body mass index	0.273	31.900	0.131	9.196	-0.032	0.599
High body mass index	-0.051	9.597	0.014	1.872	0.006	0.559
Ever smoke	0.281	7.607	0.065	0.829	-0.068	1.253
Smoke now	0.159	1.212	0.171	2.562	0.141	2.256
Drink 3+ drinks/day	0.103	0.098	0.035	0.024	-0.006	0.001
Proxy	0.507	17.173	0.062	0.351	-0.258	6.841
Impairment 3+ ADLs	0.359	7.691	0.240	5.084	0.305	9.045
Impairment 3+ IADLs	0.703	25.176	0.287	5.346	-0.170	1.983
Health excellent/v. good	-0.239	3.272	-0.235	7.262	-0.290	18.084
Health fair/poor	0.436	15.713	0.461	35.067	0.186	7.462
Num. severe health cond.	0.364	58.212	0.320	79.373	0.021	0.404
Num. chronic health cond.	0.066	2.927	0.123	18.945	-0.171	45.700
SES Test:						
Statistic		4.413		4.170		10.348
P-value		0.818		0.841		0.241
N		6867		6867		6867

Note: Severe conditions include heart disease/attack, cancer, lung disease, diabetes, or stroke. Chronic conditions include arthritis, high blood pressure, cognitive impairment (age and educ adjusted), psychiatric disease, incontinence, falls requiring treatment, hip fracture and depression.

Table 4, continued
Morbidity and Mortality Outcomes AHEAD Wave 2. Logits.

	Fair Or Poor Self-Rated Health Mean=0.1783908		ADL Impairment Mean=0.0846216	
Variable	Coef.	Chi-Sq.	Coef.	Chi-Sq.
Intercept	-1.361	15.157	-2.879	48.773
2nd Wealth Qrtl.	-0.178	2.111	-0.167	1.599
3rd Wealth Qrtl.	-0.253	3.982	-0.137	0.907
4th Wealth Qrtl.	-0.439	9.587	-0.327	3.720
2nd Income Qrtl.	-0.146	1.420	-0.147	1.196
3rd Income Qrtl.	-0.181	1.990	-0.101	0.481
4th Income Qrtl.	-0.144	1.035	-0.128	0.561
High School	-0.198	3.818	0.068	0.351
College	0.146	1.338	-0.065	0.143
Age 70 spline	0.038	3.008	0.037	1.989
Age 80 spline	-0.052	1.507	0.007	0.021
Female	-0.214	1.384	-0.572	5.433
Female*age 70 spline	0.027	0.916	0.067	3.736
Female*age 80 spline	-0.020	0.141	-0.080	1.797
Widow	-0.252	6.265	0.266	5.181
Divorced/Separated	-0.438	4.421	0.150	0.464
Age mother die	-0.001	0.152	-0.006	5.106
Age father die	0.001	0.130	0.000	0.000
Black	0.260	3.729	0.062	0.188
Hispanic	-0.100	0.238	-0.637	6.553
Low body mass index	0.104	1.987	0.130	3.951
High body mass index	0.006	0.157	-0.001	0.005
Ever smoke	-0.084	0.755	0.044	0.151
Smoke now	0.344	5.300	-0.274	2.168
Drink 3+ drinks/day	0.035	0.015	-0.484	1.043
Proxy	0.044	0.074	0.244	2.333
Impairment 3+ ADLs	0.249	1.432	-	-
Impairment 3+ IADLs	-0.098	0.181	1.123	38.681
Health excellent/v. good	-0.859	92.713	-0.365	6.340
Health fair/poor	-	-	0.479	16.449
Num. severe health cond.	0.285	27.851	0.219	15.043
Num. chronic health cond.	0.237	33.335	0.224	27.465
SES Test:				
Statistic	20.931		7.063	
P-value	0.007		0.530	
N	4350		6145	

Note: Severe conditions include heart disease/attack, cancer, lung disease, diabetes, or stroke. Chronic conditions include arthritis, high blood pressure, cognitive impairment (age and educ adjusted), psychiatric disease, incontinence, falls requiring treatment, hip fracture and depression.

Table 5
Incidence of Health Conditions AHEAD Wave 1 to Wave 2.
Significance level for SES Variables in Logistic estimation

Event	P-value	Comment
Heart attack-new	.423	
Heart attack-new or repeat	.929	
Cancer - new	.629	
Cancer - new or repeat	.936	
Stroke - new	.323	
Stroke - new or repeat	.929	
Diabetes	.489	
Lung disease	.017	wealth quartiles 3 & 4 negative
High blood pressure	.237	
Arthritis	.022	
Cognitive impairment	.001	HS, college positive
Psychiatric Disease	.000	wealth quartile 3 negative
Fall	.097	
Hip Fracture	.057	
IADL impairment (3+)	.072	
Incontinence	.855	
Depression	.080	

* SES variables include indicators for wealth quartiles 2-4, income quartiles 2-4, and high school and college indicators.
Significant tested using likelihood ratio test.

Table 6
Change in Percentile of Wealth, AHEAD wave 1 to 2. OLS.

	All (n=5407) mean=-0.0246		Singles (n=2601) mean= -0.1337		Couples (n=1723) mean= 0.0835	
Variable	**Coeff.**	**t-statistic**	**Coeff.**	**t-statistic**	**Coeff.**	**t-statistic**
Intercept	5.926	3.651	5.279	1.881	9.765	3.090
2nd Wealth Qrtl.	-4.318	-7.104	-4.911	-5.391	-3.860	-3.769
3rd Wealth Qrtl.	-11.733	-18.589	-10.874	-11.615	-12.394	-11.412
4th Wealth Qrtl.	-17.945	-25.940	-18.364	-17.813	-17.367	-14.707
2nd Income Qrtl.	1.703	2.822	1.923	2.120	1.084	1.065
3rd Income Qrtl.	4.352	6.921	3.940	4.120	3.590	3.390
4th Income Qrtl.	8.526	12.262	8.511	7.952	6.834	5.755
High School	0.892	1.822	0.527	0.732	1.245	1.388
College	2.274	3.774	2.425	2.471	2.481	2.563
Age 70 spline	0.190	1.827	0.144	0.646	0.258	1.813
Age 80 spline	-0.411	-1.828	-0.231	-0.546	-0.321	-0.946
Female	0.120	0.145	0.943	0.594	-0.965	-0.674
Female*age 70 spline	-0.025	-0.190	-0.066	-0.265	0.030	0.122
Female*age 80 spline	0.311	1.124	0.288	0.617	-0.646	-0.998
Widow	0.543	1.143	1.031	0.951	NA	NA
Divorced/Separated	0.168	0.179	0.689	0.501	NA	NA
Black	-4.275	-5.903	-3.285	-3.436	-3.460	-0.600
Hispanic	-2.784	-2.726	-2.155	-1.487	-1.122	-0.343
Age mother die	-0.007	-0.610	-0.017	-0.993	-0.035	-1.725
Age father die	-0.014	-1.036	0.001	0.073	-0.042	-1.911
Low body mass index	-0.765	-2.032	-0.937	-1.886	-1.388	-1.536
High body mass index	-0.036	-0.530	-0.132	-1.313	0.118	0.983
Ever smoke	0.361	0.822	0.158	0.244	0.731	0.938
Drink 3+ drinks/day	-2.063	-1.481	0.576	0.238	-1.215	-0.594
Proxy	0.404	0.482	-0.136	-0.093	1.517	0.955
Impairment 1-2 ADLs	-0.920	-1.583	-1.327	-1.622	-1.883	-1.726
Impairment 3+ ADLs	-0.039	-0.041	0.428	0.319	-1.047	-0.531
Impairment 1-2 IADLs	-0.654	-1.173	-1.975	-2.229	0.678	0.680
Impairment 3+ IADLs	-2.211	-1.878	-2.844	-1.608	-2.707	-1.104
Health excellent/v. good	0.547	1.094	0.676	0.896	0.157	0.192
Health fair/poor	-0.155	-0.286	-0.450	-0.566	0.540	0.573
Number severe health cond.	-0.704	-2.722	-0.476	-1.235	-1.024	-2.358
Number chronic health cond.	-0.157	-0.783	-0.055	-0.191	-0.628	-1.669

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Table 6, continued
Change in Percentile of Wealth, AHEAD wave 1 to 2. OLS.

	All (n=5407) mean=-0.0246		Singles (n=2601) mean= -0.1337		Couples (n=1723) mean= 0.0835	
Variable	**Coeff.**	**t-statistic**	**Coeff.**	**t-statistic**	**Coeff.**	**t-statistic**
Spouse variables						
Spouse high school					0.158	0.178
Spouse college					1.306	1.246
Spouse*age spline 70					0.000	-0.001
Spouse*age spline 80					-0.015	-0.154
Spouse black					-2.639	-0.460
Spouse Hispanic					-2.663	-0.810
Spouse low BMI					0.492	0.721
Spouse high BMI					-0.137	-1.269
Spouse ever smoke					0.173	0.236
Spouse drink 3+drink/day					-5.662	-2.621
Spouse proxy					0.752	0.672
Sp. impairment 1-2 ADLs					1.451	1.400
Sp. impairment 3+ ADLs					1.829	1.115
Sp. impairment 1-2 IADLs					0.175	0.199
Sp. impairment 3+ IADLs					-1.054	-0.589
Sp. health exc/v. good					1.283	1.496
Sp. health fair/poor					-0.248	-0.262
Sp. num. severe health cond.					-0.389	-0.846
Sp. num. chronic health cond.					0.264	0.789
Health test:						
Test Statistic	3.945		2.742		1.648	
P-value	0.000		0.005		0.050	
Adjusted R-square	0.1323		0.119		0.145	

Notes: Severe conditions include heart disease/attack, cancer, lung disease, diabetes, or stroke. Chronic conditions include arthritis, high blood pressure, cognitive impairment (age and educ adjusted), psychiatric disease, incontinence, falls requiring treatment, hip fracture and depression.
Test of joint significance of health variables includes ADL impairment through number of chronic conditions, and for married persons, includes spouse ADL impairment through number of health conditions.

Figure 1. Two-year mortality rates

AHEAD and lifetable

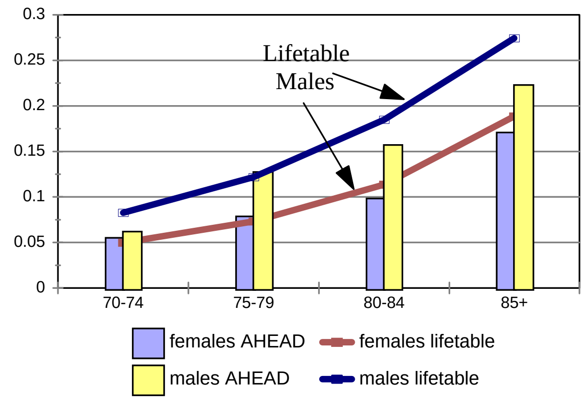

Figure 2

Major health conditions

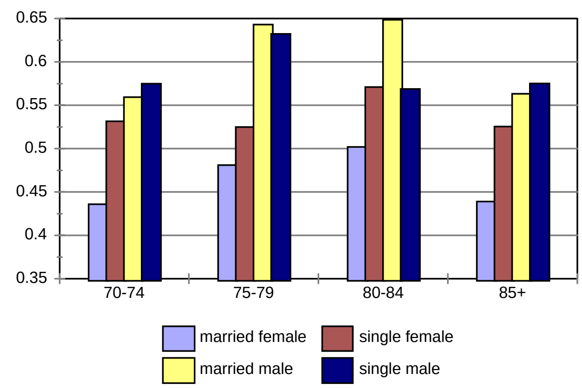

Fig. 3. Median Wealth

AHEAD 1993

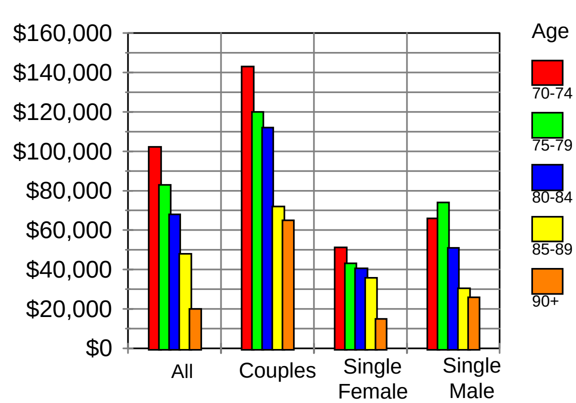

Fig. 4. Median Income
AHEAD 1993

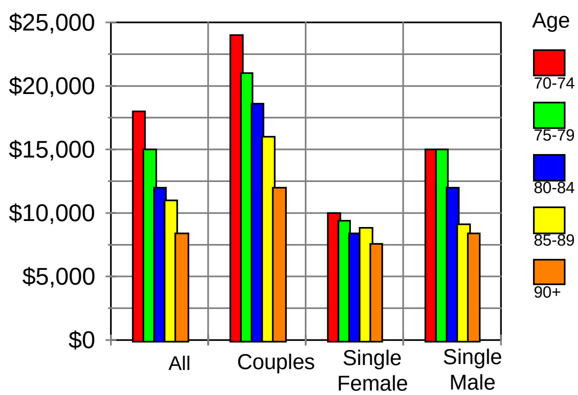

Fig. 5. Mean Years of Education
AHEAD 1993

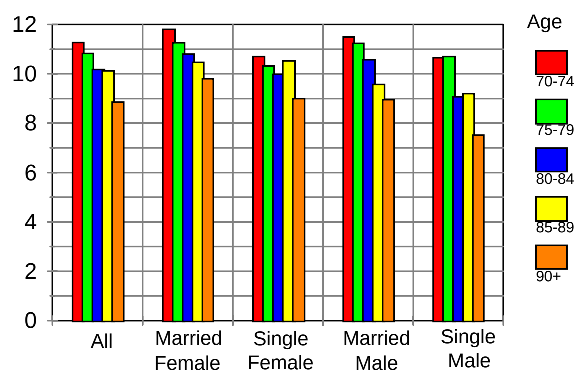

Fig. 6. Wealth & Major Health Problems

AHEAD, 1993. 70-74 year-olds

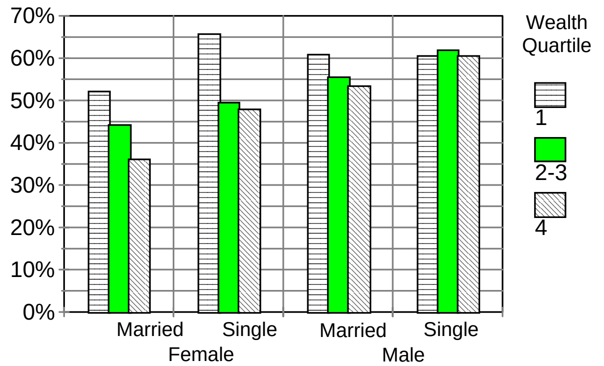

Fig. 7. Wealth & Mortality

AHEAD, 1993-1995. 70-74 year-olds