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DETERMINANTS OF HEALTH

On the empirical association between poor health and low socioeconomic status at old age

Christian Salas*
Health Services Management Centre, University of Birmingham, UK

Summary

Epidemiologic studies using mortality rates as indicators of health fail to find any meaningful association between poor health and low socioeconomic status in older age-groups, whereas economic studies using self-assessed health consistently find a significant positive correlation, even after controlling for self-reporting errors. Such contradictory results have not been reported for working age individuals. A simple explanation might be that the elderly samples on which the epidemiologic and economic studies are based come from different populations. However, this paper shows that similar contradictory results are obtained even when *the same samples* are used, simply by switching between self-assessed health and mortality as health indicators. An alternative explanation is proposed, namely that these health indicators yield different results because they relate to different ranges of the latent health variable at old age. Copyright © 2002 John Wiley & Sons, Ltd.

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Introduction

The relationship between poor health and low socioeconomic status in the population as a whole is viewed as one of the most firmly established patterns in social epidemiology [1]. It exists throughout the industrialised world, in developing countries, and across a range of health indicators including mortality rates, life expectancy, acute and chronic illness rates, days of restricted activity, psychiatric symptoms, high blood pressure, height below mean values, obesity, prematurity of birth, low birth-weight, ability to conceive and self-assessed health [2]. The link has also been extensively documented in the health economics literature among individuals of working age, and is taken as evidence that those in lower socioeconomic strata have reduced access to health inputs [3].

In contrast to the findings for working age individuals, conflicting results have been reported in the epidemiologic and economic literatures on the link between poor health and low socioeconomic status at old age. A number of epidemiologic studies have indicated that poorer health is not associated with lower socioeconomic status in older age-groups [4–6]. In multivariate analyses of samples from Alameda County in California, for example, respondents under 60 years of age who have *inadequate* family incomes (adjusted for family size) have a 20–27% higher risk of death than those with *very adequate* family incomes, but there is no corresponding

*Correspondence to: Health Services Management Centre, University of Birmingham, Park House, 40 Edgbaston Park Road, Birmingham B15 2RT, UK. Tel.: +0121 4147705; fax: +0121 4147051; e-mail: c.p.sales@bham.ac.uk

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increased risk for those over 60 [4]. Similarly, Kaplan and Haan [5] find no meaningful association between the level of income and mortality risk for those aged 50 and over in the Alameda County Study (although large decreases in income over a short period of time are associated with higher mortality risk thereafter).

The association might decline in older age-groups due to previously higher mortality rates among younger people in the lower socioeconomic positions (a 'survivor effect'), and because publicly provided health services for the elderly significantly reduce the link between ability to pay and access to health care. However, the epidemiologic findings disagree with studies in the economics literature, which suggest that socioeconomic variables like income, occupation and education continue to be significant risk factors at old age. In an analysis of five biennial panels of elderly males from the US Retirement History Survey, for example, Sickles and Taubman [7] find that years of schooling, longest occupation and social security/private pension income are highly significant correlates of self-assessed health. An annual increase in Social Security or private pension income by 10 000 dollars is predicted to increase the probability of being in better health by 0.14 or 0.09, respectively. Using data on elderly respondents from the British Household Panel Survey, Herrera-Salas [8] also finds a strong positive correlation between self-assessed health and socioeconomic status in the context of a latent variable statistical model designed to control for self-reporting measurement errors.

If self-assessed health and mortality both reflect the underlying long-run health of individuals, a question arises as to how such disparate results can be obtained in two disciplines which are essentially investigating the same relationship. Other modifiable risk factors have been clearly identified for older age-groups, including social isolation, physical inactivity, extremes of body mass, poor nutrition, alcohol consumption and tobacco use [4,5,9–19]. Evidence on the significance of socioeconomic status as a risk factor at old age is important for the development of preventive health strategies for the elderly, and for a proper assessment of the nature and extent of inequalities in health.

One possibility already explored by Herrera-Salas [8] is that measurement errors in self-assessed health and income are positively correlated in older age-groups, reflecting systematic understatements or overstatements by both self-assessed health and income of the underlying variables they are supposed to measure. This could explain why apparent positive correlations disappear when mortality is used as the health indicator. However, no evidence is found to support this hypothesis. All measurement error correlations are found to be statistically insignificant, and both self-assessed health and income are found to be highly reliable indicators of health and socioeconomic status, respectively.

Another possibility is that the discrepant results simply reflect different patterns of association between health and socioeconomic status in different populations from which samples in the epidemiologic and economic studies are drawn. The empirical evidence presented in this paper suggests that this explanation is also unlikely to be adequate, since the conflicting results are reproduced in a *single sample* of elderly individuals simply by switching between self-assessed health and mortality as health indicators.

The conflicting results are reproduced here by estimating health-investment equations using data from the 1991 and 1995 waves of the British Household Panel Survey. The same data are then used to investigate a third possibility which seems more plausible, namely that the epidemiologic and economic results differ because mortality and self-assessed health relate to different ranges of the latent health variable at old age. The econometric model and the data are described in the next two sections, followed by the results and a brief concluding discussion.

The econometric model

The health-investment framework is employed because it is analogous to the epidemiologic approach. It is based on Grossman's [20] model of the demand for health. Consumers derive utility and income in period t from a stock of health capital H_t which depreciates exogenously at the rate $\delta_t \in (0, 1)$. The stock can be augmented by household production of gross health-investments using time and health care as inputs. It evolves according to the difference equation

$$H_t = (1 - \delta_{t-1})H_{t-1} + I_{t-1} \quad (1)$$

where I_{t-1} is gross health-investment during period $t-1$. Intertemporal utility maximisation subject to (1), an asset accumulation constraint, and boundary conditions yields an optimality condition which implicitly defines the equilibrium stock of health capital at each t as a function of predetermined variables. In Grossman's formulation, δ_t depends only on the individual's age. In this paper, δ_t is also treated as exogenously determined, but is assumed to depend on other variables in addition to age (see below).

In the conventional health-investment approach, the econometric model is 'derived' from Grossman's model by assuming functional forms for the components of Equation (1) [cf. 21, 22]. The application of the health-investment framework in this paper uses an approach introduced by Wagstaff [23], in which H_t is additionally assumed to evolve according to a Partial Adjustment Model (PAM) of the form

$$H_t - H_{t-1} = (1 - \alpha)(H_t^* - H_{t-1}) \tag{2}$$

where $\alpha \in (0, 1)$, and H_t* is the health capital stock desired *at the beginning of period* $t-1$ for the beginning of period t. The PAM is particularly suitable for older persons, since it is reasonable to assume that the elderly find it harder than the young to fully adjust their health stocks to optimal levels. Since H_t* cannot be observed directly, it is modelled (as per Grossman's model) as a function of predetermined variables

$$H_t^* = \boldsymbol{\beta}\mathbf{X}_{t-1} + \varepsilon_t \tag{3}$$

where $\mathbf{X}_{t-1}$ is a vector of variables at time $t-1$, $\boldsymbol{\beta}$ is a coefficient vector, and ε_t is a zero-mean error term reflecting the fact that $\mathbf{X}_{t-1}$ cannot realistically contain all of the variables which influence H_t*. The vector $\mathbf{X}_{t-1}$ includes determinants of the depreciation rate, such as time (i.e. age), smoking, housing problems and social isolation. It also includes socioeconomic variables such as education and income. The fact that it appears in lagged form is particularly helpful for this study, since it enables the use of different waves of the British Household Panel Survey to obtain mortality data. As discussed in the next section, the one period lag in the model is implemented using a 4-year lag in the data, to increase the number of deaths in the sample. Rearranging (2) gives

$$H_t = \alpha H_{t-1} + (1 - \alpha)H_t^* \tag{4}$$

and substituting (3) into (4) yields the empirical equation

$$H_t = \alpha H_{t-1} + \tilde{\beta}\mathbf{X}_{t-1} + (1 - \alpha)\varepsilon_t \tag{5}$$

where $\tilde{\beta}$ is a vector of coefficients with the same signs as those in Equation (3).

It is assumed that all the variables on the right-hand side of Equation (5) are predetermined at time t i.e. $E[H_{t-1}\varepsilon_t] = 0$ and $E[\mathbf{X}_{t-1}\varepsilon_t] = 0$. However, it should be noted that this assumption is untenable when there is an individual component to ε_t that is constant over time. It is also possible that variables in $\mathbf{X}_{t-1}$, particularly smoking behaviour, are affected by person-specific unobservable traits such as 'attitude to healthy living'. If these are also correlated with an individual component in ε_t, then $E[\mathbf{X}_{t-1}\varepsilon_t] \neq 0$. The significance of both of these problems in the present study depends on whether or not there is a significant time-persistent individual component to ε_t. As there are no techniques which can control for unobserved heterogeneity in the context of the statistical methods used in this paper, this problem could not be controlled for, and should be borne in mind when interpreting the results.

Equation (5) can be used to examine the same relationships between health status and risk factors that are the focus of socio-epidemiologic studies of the elderly. It therefore provides an ideal framework for comparison of interdisciplinary results. Risk factors such as tobacco use, housing problems and social isolation are conceptualised as the arguments of a dynamic demand-for-health function, with negative coefficients in Equations (3) and (5). In terms of Grossman's model, they raise the marginal cost of capital by increasing the depreciation rate, and thus reduce equilibrium health levels. Higher socioeconomic status should be positively correlated with good health if health is a normal good, since it indicates that more resources are available for health-investments.

The data

The model is implemented using individual-level data on elderly men and women from the 1991 and 1995 waves of the British Household Panel Survey (BHPS) [24]. Data spanning five waves are used to increase the number of deaths in the sample. The BHPS is a nationally representative survey of some 5500 households, covering approximately 10000 individuals, randomly selected south of the Caledonian Canal (the north of Scotland is excluded). The first wave was collected from September to

December 1991, with subsequent waves collected annually.

The BHPS is particularly suitable for this study because it has an extensive set of questions on health and socioeconomic status in its core questionnaire, as well as relatively large samples of men and women aged 60 and above. Unusually among studies of the elderly, data on men and women are analysed separately in the next section to highlight any differences by sex.

After listwise deletion of all missing cases, the samples consist of 799 men and 1044 women aged 60 and above in 1991. Of these, 641 men and 894 women survived to interview in 1995, raising sample selection issues which are addressed below. Definitions and means for the principal variables are provided in Table 1 for the survivors.

The health status indicators include self-assessed overall health (SAHL95, SAHL91), indicators of health problems (NOHPRB95, NOHPRB91), dummies for activity limitation due to health (HLIMIT95, HLIMIT91), disability indicators (DISAB95, DISAB91), and indicators of formal health care utilisation (GP95, GP91, HOSP95, HOSP91). Age (AGE), smoking behaviour (SMOKER), housing problems (HSPRB) and isolation (proxied by SINGLE) are assumed to raise health depreciation.

Socioeconomic status is viewed as a measure of the resources available for the production of gross health-investments. Seven indicators of socioeconomic position in 1991 are used: annual household income per person in the household (AHINCOME), a dichotomous income variable (INCOMEM), an indicator of retirement status (RETIRED), dummies for housing tenure (OWNHOUSE) and car ownership (ACARUSE), and two education dummies (SCHOOL14 and COLLEGE). A number of other BHPS indicators, particularly occupation-based variables, are not used here because missing values reduced the subsamples of elderly men and/or women by a third or more.

Retirement status is included because it relates directly to an individual's income level. Seventy per cent of men and women aged 60 and over in the BHPS sample were 'retired' at the interview date in 1991, the majority of the remaining 30% being either self-employed or in paid employment. Housing tenure and car ownership are the two most commonly used indicators of social inequality in health surveys. In an analysis of General Household Survey data for 1982, Haynes [25] found that differences in self-reported acute and chronic sickness by housing tenure and car ownership persist even after controlling for social class. Those who own their home and two or more cars have the lowest sickness rates, while those who rent and have no car have the highest.

While there is considerable evidence that higher levels of education and good health are positively correlated, the conventional theoretical interpretation that education increases the efficiency of the household production of health remains controversial. On the basis of existing empirical evidence, it is equally plausible that education merely acts as a proxy for socioeconomic position [cf. 22]. Since the aim of this study is to examine the significance of socioeconomic status as a risk factor among the elderly, education is treated as being primarily an indicator of socioeconomic position, although it should be borne in mind that it may also have an efficiency role which is not separately identifiable in the empirical model.

It is known from US research that elderly Blacks generally score lower than elderly Whites on self-ratings of health status, and that there are racial differences in health care use [26]. Data limitations preclude a study of these issues here.

Estimation results

Tables 2 and 3 present estimates of Equation (5) for men and women, respectively, with SAHL95 as the dependent variable. Men and women are analysed separately, since little is known about the role of socioeconomic status among elderly women. To control for sample selection bias due to the death of individuals before the interview date in 1995, eight ordered probit models with sample selection are estimated for each sex using a Full Information Maximum Likelihood procedure in the software package LIMDEP v. 7.0. The ordered probits in Tables 2 and 3 assume that SAHL95 takes the value m ($m = 1, 2, 3, 4, 5$) only if health capital in 1995 lies in the interval $(c_{m-1}, c_m]$, where $-\infty = c_0 < c_1 < c_2 < c_3 < c_4 < c_5 = +\infty$. LIMDEP normalises c_1 at 0, so only c_2, c_3 and c_4 are estimated.

The approach involves the joint estimation of a probit sample selection model with each health-investment equation, using a dummy variable SURVIVOR as the dependent variable. SURVIVOR takes the value 1 if a respondent survived to

Table 1. Variable definitions and means

Variable	Definition	Mean	
		Men $N=641$	Women $N=894$
Health status			
SAHL95	1995 assessment of own health over the previous twelve months compared to others of the same age on a five point scale (5 = excellent, 1 = very poor)	3.65	3.49
NOHPRB95	1 if the respondent had none of the following health problems in 1995: problems with arms or legs, difficulty seeing, difficulty hearing, skin conditions or allergies, chest or breathing problems, heart and blood, stomach, liver or kidneys, diabetes, nerves, anxiety or depression, alcohol or drugs, epilepsy, migrain, chronic headache	0.17	0.14
HLIMIT95	1 if the respondent's health in 1995 limited his/her daily activities in some way compared to others of the same age	0.25	0.31
DISAB95	1 if the respondent was registered as disabled in 1995, either with Social Services or with a green card	0.10	0.10
GP95	1 if at the time of the interview in 1995, the respondent had consulted a GP or family doctor about his/her own health more than once or twice since 1.9.94	0.45	0.54
HOSP95	1 if at the time of the interview in 1995, the respondent had been in a hospital or clinic as an inpatient, overnight or longer, since 1.9.94	0.16	0.16
SAHL91	The 1991 equivalent of SAHL95	3.88	3.70
NOHPRB91	The 1991 equivalent of NOHPRB95	0.24	0.21
HLIMIT91	The 1991 equivalent of HLIMIT95	0.20	0.22
DISAB91	The 1991 equivalent of DISAB95	0.10	0.06
GP91	The 1991 equivalent of GP95	0.42	0.50
HOSP91	The 1991 equivalent of HOSP95	0.10	0.11
FAIRSRH	1 if SAHL91 = 3 ('fair' self-assessed health in 1991)	0.21	0.25
POORSRH	1 if SAHL91 = 2 ('poor' self-assessed health in 1991)	0.07	0.07
VPOORSRH	1 if SAHL91 = 1 ('very poor' self-assessed health in 1991)	0.02	0.03
Health depreciation			
AGE[a]	Age in years on 1.12.91	68.87	69.88
AGEM[a]	1 if AGE exceeds the sample mean	0.41	0.47
SMOKER	1 if the respondent smoked cigarettes in 1991	0.22	0.21
HSPRB	1 if the respondent's home had one or more of the following problems in 1991: condensation, damp, difficult to keep warm, leaking roof, rot in wood, not enough space	0.46	0.48
SINGLE	1 if neither married nor living with a partner in 1991	0.25	0.54
Socioeconomic status			
AHINCOME	Annual household income (1.9.90-1.9.91) in thousands of pounds per person in the household (includes imputed values)	6.08	5.40
INCOMEM	1 if AHINCOME exceeds the sample mean	0.38	0.34
RETIRED	1 if employment status was 'retired' in 1991	0.71	0.71
OWNHOUSE	1 if the respondent's accommodation was either owned by the household or on mortgage in 1991	0.71	0.62
ACARUSE	1 if owned or had use of a car or van in 1991	0.68	0.28
SCHOOL14	1 if the respondent was still at school after the age of 14	0.34	0.34
COLLEGE	1 if the respondent had a vocational or academic college education (includes university degrees, teaching, nursing and other higher qualifications)	0.22	0.15

[a] The age distributions of the BHPS sample and the estimated population aged 60 and above in England and Wales according to the 1991 Census are reasonably similar prior to the exclusion of BHPS respondents who died, although women are shifted over slightly towards the younger age groups in the BHPS. 41% of men ($N=799$) and 46% of women ($N=1044$) in the BHPS sample were over 70 years of age in 1991. Mid-year estimates of the population aged 60+ in England and Wales in 1991 are 4 508 300 men and 6 164 100 women, with 42% of men and 52% of women over 70.

Table 2. Health-investment equations for men, with SAHL95 as the dependent variable

Variable	Mean ($N = 641$)	I	II	III	IV	V	VI	VII	VIII
Constant		4.39***	4.46***	4.99***	4.56***	4.61***	4.78***	4.67***	4.49***
		(5.33)	(5.44)	(5.81)	(5.46)	(5.42)	(5.84)	(5.69)	(4.75)
Health status									
FAIRSRH	0.21	−0.94***	−0.93***	−0.97***	−0.95***	−0.95***	−0.96***	−0.94***	−0.92***
		(−5.71)	(−5.65)	(−5.81)	(−5.53)	(−5.48)	(−5.86)	(−5.69)	(−4.82)
POORSRH	0.07	−1.12***	−1.12***	−1.14***	−1.12***	−1.13***	−1.14***	−1.09***	−1.09***
		(−4.78)	(−4.79)	(−4.87)	(−4.67)	(−4.58)	(−4.86)	(−4.69)	(−4.21)
VPOORSRH	0.02	−1.02**	−1.05**	−1.11**	−1.07**	−1.05**	−1.07**	−1.05**	−1.06**
		(−2.13)	(−2.19)	(−2.24)	(−2.08)	(−2.07)	(−2.17)	(−2.08)	(−2.02)
NOHPRB91	0.24	0.32***	0.31***	0.32***	0.32***	0.31***	0.32***	0.30**	0.32***
		(2.65)	(2.61)	(2.73)	(2.69)	(2.58)	(2.65)	(2.55)	(2.63)
HLIMIT91	0.20	−0.30**	−0.30**	−0.29**	−0.28**	−0.29*	−0.29**	−0.30**	−0.29*
		(−2.08)	(−2.08)	(−1.99)	(−1.78)	(−1.94)	(−2.04)	(−2.09)	(−1.77)
DISAB91	0.10	−0.13	−0.11	−0.13	−0.14	−0.13	−0.13	−0.13	−0.11
		(−0.81)	(−0.69)	(−0.81)	(−0.88)	(−0.81)	(−0.83)	(−0.81)	(−0.67)
GP91	0.42	−0.44***	−0.45***	−0.45***	−0.45***	−0.45***	−0.45***	−0.45***	−0.45***
		(−4.18)	(−4.26)	(−4.34)	(−4.20)	(−4.33)	(−4.30)	(−4.37)	(−4.20)
HOSP91	0.10	0.25	0.27	0.27	0.25	0.26	0.27	0.27	0.27
		(1.49)	(1.62)	(1.60)	(1.34)	(1.39)	(1.55)	(1.59)	(1.32)
Health depreciation									
AGE	68.87	−0.02*	−0.02*	−0.03**	−0.02*	−0.02*	−0.02*	−0.02*	−0.03
		(−1.70)	(−1.68)	(−2.14)	(−1.71)	(−1.67)	(−1.94)	(−1.88)	(−1.54)
SMOKER	0.22	−0.34***	−0.34***	−0.38***	−0.34***	−0.36***	−0.38***	−0.35***	−0.31**
		(−2.59)	(−2.60)	(−2.86)	(−2.60)	(−2.73)	(−2.86)	(−2.67)	(−2.25)
HSPRB	0.46	−0.02	−0.14	−0.02	0.01	−0.01	−0.02	−0.00	−0.02
		(−0.20)	(−0.15)	(−0.18)	(0.06)	(−0.08)	(−0.18)	(−0.01)	(−0.16)
SINGLE	0.25	−0.18	−0.18	−0.16	−0.14	−0.14	−0.16	−0.14	−0.13
		(−1.58)	(−1.57)	(−1.42)	(−1.20)	(−1.15)	(−1.45)	(−1.25)	(−1.04)
Socioeconomic status									
AHINCOME	6.08	0.27**	—	—	—	—	—	—	—
		(2.06)	—	—	—	—	—	—	—
INCOMEM	0.38	—	0.22**	—	—	—	—	—	0.19*
		—	(2.18)	—	—	—	—	—	(1.67)
RETIRED	0.71	—	—	0.12	—	—	—	—	0.15
		—	—	(1.00)	—	—	—	—	(1.12)
OWNHOUSE	0.71	—	—	—	0.15	—	—	—	0.07
		—	—	—	(1.18)	—	—	—	(0.54)
ACARUSE	0.68	—	—	—	—	0.11	—	—	0.05
		—	—	—	—	(0.84)	—	—	(0.36)
SCHOOL14	0.34	—	—	—	—	—	0.02	—	—
		—	—	—	—	—	(0.21)	—	-
COLLEGE	0.22	—	—	—	—	—	—	0.25**	0.16
		—	—	—	—	—	—	(2.17)	(1.35)
Inv. Mills ratio		0.05	0.05	0.00	−0.00	0.00	0.00	0.00	0.00
		(0.00)	(0.00)	(0.00)	(−0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Thresholds									
$\hat{c}_2$		0.93***	0.94***	0.94***	0.94***	0.94***	0.93***	0.94***	0.94***
		(7.61)	(7.59)	(7.65)	(7.69)	(7.66)	(7.65)	(7.69)	(7.52)
$\hat{c}_3$		2.09***	2.10***	2.10***	2.10***	2.09***	2.09***	2.10***	2.11***
		(15.59)	(15.52)	(15.53)	(15.74)	(15.72)	(15.62)	(15.68)	(15.20)
$\hat{c}_4$		3.74***	3.74***	3.73***	3.73***	3.73***	3.73***	3.74***	3.76***
		(25.68)	(25.54)	(25.56)	(25.91)	(25.88)	(25.73)	(25.79)	(25.03)
Log-likelihood (LL)		−1036.05	−1035.76	−1037.97	−1037.53	−1038.02	−1038.55	−1035.97	−1033.02
Restricted LL (all slopes = 0)		−1163.27	−1163.08	−1163.08	−1163.08	−1163.08	−1163.08	−1163.08	−1163.08
Chi-squared statistic		254.44	254.64	250.22	251.10	250.12	249.06	254.22	260.12

Numbers in parentheses are t-ratios.
***Significant at the 1% level in a two-tailed test (critical value = 2.5758).
**Significant at the 5% level in a two-tailed test (critical value = 1.9600).
*Significant at the 10% level in a two-tailed test (critical value = 1.6449).

Table 3. Health-investment equations for women, with SAHL95 as the dependent variable

Variable	Mean ($N = 894$)	I	II	III	IV	V	VI	VII	VIII
Constant		3.18***	3.28***	3.63***	3.37***	3.14***	3.46***	3.46***	2.91***
		(4.80)	(4.99)	(5.24)	(5.40)	(4.90)	(5.53)	(5.49)	(3.80)
Health status									
FAIRSRH	0.25	−0.69***	−0.68***	−0.71***	−0.70***	−0.68***	−0.67***	−0.69***	−0.67***
		(−6.12)	(−6.10)	(−6.32)	(−6.24)	(−6.19)	(−6.05)	(−6.15)	(−6.01)
POORSRH	0.07	−0.95***	−0.93***	−0.97***	−0.92***	−0.94***	−0.93***	−0.96***	−0.92***
		(−5.54)	(−5.33)	(−5.11)	(−5.33)	(−5.47)	(−5.46)	(−5.64)	(−4.79)
VPOORSRH	0.03	−1.46***	−1.45***	−1.48***	−1.44***	−1.42***	−1.43***	−1.42***	−1.37***
		(−6.52)	(−6.35)	(−6.46)	(−6.49)	(−6.35)	(−6.52)	(−6.44)	(−5.92)
NOHPRB91	0.21	0.44***	0.45***	0.44***	0.45***	0.45***	0.45***	0.44***	0.44***
		(4.41)	(4.49)	(4.46)	(4.52)	(4.44)	(4.51)	(4.36)	(4.42)
HLIMIT91	0.22	−0.52***	−0.52***	−0.52***	−0.55***	−0.50***	−0.53***	−0.54***	−0.52***
		(−4.09)	(−4.01)	(−3.87)	(−4.21)	(−3.91)	(−4.25)	(−4.22)	(−3.47)
DISAB91	0.06	−0.33**	−0.34**	−0.31*	−0.29*	−0.37**	−0.32*	−0.31*	−0.36**
		(−1.99)	(−1.98)	(−1.87)	(−1.77)	(−2.17)	(−1.91)	(−1.85)	(−2.04)
GP91	0.50	−0.18**	−0.17**	−0.16*	−0.15*	−0.17**	−0.17**	−0.17**	−0.17*
		(−2.16)	(−2.13)	(−1.93)	(−1.89)	(−2.05)	(−2.04)	(−2.02)	(−1.95)
HOSP91	0.11	−0.15	−0.14	−0.14	−0.16	−0.15	−0.15	−0.15	−0.17
		(−1.00)	(−0.98)	(−0.87)	(−1.06)	(−1.06)	(−1.05)	(−1.05)	(−1.03)
Health depreciation									
AGE	69.88	−0.01	−0.01	−0.01	−0.01	−0.01	−0.01	−0.01	−0.01
		(−0.97)	(−0.97)	(−1.21)	(−1.24)	(−0.86)	(−1.31)	(−1.22)	(−0.52)
SMOKER	0.21	−0.18*	−0.19*	−0.20*	−0.18*	−0.18*	−0.19*	−0.18*	−0.16*
		(−1.73)	(−1.76)	(−1.82)	(−1.77)	(−1.74)	(−1.83)	(−1.74)	(−1.41)
HSPRB	0.48	0.00	−0.00	−0.01	0.02	0.03	0.01	0.00	0.05
		(0.03)	(−0.06)	(−0.09)	(0.30)	(0.41)	(0.14)	(0.04)	(0.56)
SINGLE	0.54	−0.01	0.00	−0.02	0.02	0.03	−0.00	−0.02	0.03
		(−0.11)	(0.01)	(−0.19)	(0.21)	(0.32)	(−0.04)	(−0.26)	(0.30)
Socioeconomic status									
AHINCOME	5.40	0.03***	—	—	—	—	—	—	—
		(2.98)	—	—	—	—	—	—	—
INCOMEM	0.34	—	0.20**	—	—	—	—	—	0.09
		—	(2.45)	—	—	—	—	—	(1.02)
RETIRED	0.71	—	—	0.02	—	—	—	—	0.02
		—	—	(0.22)	—	—	—	—	(0.21)
OWNHOUSE	0.62	—	—	—	0.18**	—	—	—	0.08
		—	—	—	(2.23)	—	—	—	(0.81)
ACARUSE	0.28	—	—	—	—	0.38***	—	—	0.29***
		—	—	—	—	(4.09)	—	—	(2.76)
SCHOOL14	0.34	—	—	—	—	—	0.25***	—	—
		—	—	—	—	—	(3.09)	—	—
COLLEGE	0.15	—	—	—	—	—	—	0.37***	0.22**
		—	—	—	—	—	—	(3.60)	(2.03)
Inv. Mills ratio		0.00	0.08	0.00	−0.00	0.03	0.00	−0.00	−0.02
		(0.00)	(0.19)	(0.00)	(−0.00)	(0.07)	(0.00)	(−0.00)	(0.00)
Thresholds									
$\hat{c}_2$		0.82***	0.82***	0.82***	0.82***	0.83***	0.82***	0.82***	0.83***
		(10.02)	(9.92)	(10.11)	(9.97)	(9.94)	(10.10)	(10.14)	(9.92)
$\hat{c}_3$		2.09***	2.09***	2.09***	2.10***	2.11***	2.09***	2.10***	2.11***
		(22.17)	(21.30)	(22.28)	(21.96)	(21.78)	(22.27)	(22.36)	(21.87)
$\hat{c}_4$		3.68***	3.68***	3.66***	3.68***	3.70***	3.68***	3.69***	3.72***
		(35.12)	(32.78)	(35.23)	(34.77)	(34.25)	(35.12)	(35.54)	(34.92)
Log-likelihood (LL)		−1369.85	−1370.62	−1373.93	−1371.36	−1364.60	−1369.14	−1367.84	−1360.50
Restricted LL (all slopes = 0)		−1548.15	−1548.15	−1548.15	−1548.15	−1548.15	−1548.15	−1548.15	−1548.15
Chi-squared statistic		356.60	355.06	348.44	355.06	367.10	358.02	360.62	375.30

Numbers in parentheses are t-ratios.
***Significant at the 1% level in a two-tailed test (critical value = 2.5758).
**Significant at the 5% level in a two-tailed test (critical value = 1.9600).
*Significant at the 10% level in a two-tailed test (critical value = 1.6449).

interview in 1995, and 0 otherwise. The mean is 0.80 for men ($N = 799$) and 0.86 for women ($N = 1044$). Estimation results for the probit sample selection model are not presented here since the specification and results are very similar to those of Model VIII in Tables 4 and 5. The only additional variables in the selection equations are four regional dummies, but none of their coefficients are significantly different from zero at the 5% level. Note that a wide range of alternative specifications of the empirical models in this section were also explored, including models with squared and cubed age and income terms, and models with interaction terms. These are not reported here since they did not provide significant new insights, and neither cast doubt nor shed further light on the results reported below.

The predicted values of the sample selection equation are used to compute values of the hazard function for the standard normal distribution (the 'Inverse Mills ratio'), which appears as an extra regressor variable in the health-investment equations [27]. None of the coefficients of the Inverse Mills ratio in Tables 2 and 3 are different from zero at the 1, 5 or 10% significance levels, indicating no sample selection bias for either sex.

This result may be questioned on the grounds that almost the same set of variables appears in both the health-investment and the sample selection equations, suggesting that identification of the sample selection component can only occur through the functional form of the hazard rate. It is known that identification is often untenable through functional form alone. The explanatory variables are similar because health changes and mortality are generally associated with similar types of risk factors. However, four variables (HOSP91, AGE, RETIRED and OWNHOUSE) have strong differential effects in the health-investment and sample selection equations, making the identification stronger in this case. For one or both sexes, these variables are always insignificant in the health-investment equations, but significant at the 10% level or below in the sample selection equations. When these variables are dropped from the health-investment equations but retained in the probit sample selection equations, and the sample selection models are re-estimated with these new specifications, the remaining coefficient estimates are almost identical to those presented in Tables 2 and 3. In particular, the coefficients of the Inverse Mills ratio remain insignificant, even though the strength of identification is increased relative to that of functional form alone by dropping HOSP91, AGE, RETIRED and OWNHOUSE from the health-investment equations.

When the health-investment equations are re-estimated *without* controlling for sample selection, the remaining coefficient estimates are again almost identical to those presented in Tables 2 and 3. Numerous other versions of the sample selection models estimated in the course of this study also failed to show any evidence of significant sample selection effects. Note that relatively few individuals died during the 4-year observation period (20% of men, 14% of women).

The eight models in Tables 2 and 3 differ from each other only in the variables used to represent socioeconomic position. The indicators of socioeconomic status are AHINCOME (Model I), INCOMEM (Model II), RETIRED (Model III), OWNHOUSE (Model IV), ACARUSE (Model V), SCHOOL14 (Model VI), COLLEGE (Model VII), and a combination of variables excluding AHINCOME and SCHOOL14 (Model VIII). AHINCOME and INCOMEM are both included in the analysis to examine the effect of dichotomisation on the estimated significance of income as a risk factor. Likelihood ratio tests overwhelmingly reject the null hypothesis that all slope coefficients are zero.

All the statistically significant coefficient estimates in Tables 2 and 3 have signs which are consistent with the underlying economic theory. With the exception of RETIRED, all the socioeconomic variables have positive coefficients which are significant at the 10% level or below for one or both sexes. In particular, AHINCOME and INCOMEM in Models I and II are highly significant for both sexes, and dichotomisation of the income variable does not affect its significance. COLLEGE is also highly significant for both sexes, but OWNHOUSE, ACARUSE and SCHOOL14 in Models IV, V and VI are only significant for women.

The results seem to corroborate the findings of Sickles and Taubman [7], which imply that socioeconomic status is an important correlate of health at old age. Table 3 suggests that this is just as true for elderly women as for elderly men. Among the health depreciation variables, only SMOKER has a consistently significant negative coefficient in all the models, a result which corroborates the epidemiologic evidence cited earlier. AGE is never significant below the 5% level for men, and not

Table 4. Health-investment equations for men, with SURVIVOR as dependent variable

Variable	Mean ($N = 799$)	I	II	III	IV	V	VI	VII	VIII
Constant		5.31***	5.38***	5.36***	5.00***	4.85***	5.36***	5.31***	4.73***
		(7.76)	(8.13)	(8.01)	(7.53)	(7.14)	(8.32)	(8.23)	(6.52)
Health status									
FAIRSRH	0.24	−0.57***	−0.58***	−0.58***	−0.55***	−0.53***	−0.58***	−0.56***	−0.53***
		(−4.01)	(−4.04)	(−4.04)	(−3.87)	(−3.73)	(−4.03)	(−3.95)	(−3.64)
POORSRH	0.09	−0.67***	−0.67***	−0.67***	−0.62***	−0.61***	−0.67***	−0.65***	−0.58***
		(−3.12)	(−3.12)	(−3.12)	(−2.86)	(−2.84)	(−3.11)	(−3.00)	(−2.65)
VPOORSRH	0.03	−0.85**	−0.85**	−0.85**	−0.82**	−0.75**	−0.85**	−0.84**	−0.75**
		(−2.49)	(−2.50)	(−2.49)	(−2.41)	(−2.17)	(−2.50)	(−2.46)	(−2.18)
NOHPRB91	0.21	−0.01	−0.01	−0.01	−0.01	−0.01	−0.01	−0.01	−0.01
		(0.08)	(−0.08)	(−0.08)	(−0.07)	(−0.08)	(−0.08)	(−0.08)	(−0.06)
HLIMIT91	0.25	−0.34**	−0.35**	−0.35**	−0.33**	−0.34**	−0.35**	−0.35**	−0.33**
		(−2.42)	(−2.42)	(−2.42)	(−2.28)	(−2.38)	(−2.42)	(−2.43)	(−2.27)
DISAB91	0.11	−0.08	−0.08	−0.09	−0.11	−0.08	−0.09	−0.08	−0.10
		(−0.47)	(−0.48)	(−0.48)	(−0.59)	(−0.44)	(−0.47)	(−0.45)	(−0.55)
GP91	0.45	0.06	0.06	0.06	0.06	0.06	0.56	0.06	0.06
		(0.45)	(0.44)	(0.43)	(0.46)	(0.44)	(0.44)	(0.43)	(0.45)
HOSP91	0.13	−0.41***	−0.41***	−0.41***	−0.45***	−0.42***	−0.41***	−0.41***	−0.45***
		(−2.68)	(−2.68)	(−2.68)	(−2.91)	(−2.72)	(−2.67)	(−2.69)	(−2.89)
Health depreciation									
AGE	69.74	−0.06***	−0.06***	−0.06***	−0.06***	−0.05***	−0.06***	−0.06***	−0.05***
		(−6.46)	(−6.54)	(−5.87)	(−6.34)	(−6.01)	(−6.65)	(−6.59)	(−5.26)
SMOKER	0.23	−0.35***	−0.35***	−0.35***	−0.30**	−0.32**	−0.35***	−0.34***	−0.29**
		(−2.61)	(−2.67)	(−2.67)	(−2.22)	(−2.42)	(−2.67)	(−2.62)	(−2.16)
HSPRB	0.45	0.09	0.08	0.08	0.12	0.11	0.08	0.09	0.13
		(0.75)	(0.74)	(0.74)	(1.06)	(0.93)	(0.74)	(0.82)	(1.12)
SINGLE	0.27	0.10	0.10	0.10	0.14	0.18	0.10	0.11	0.19
		(0.79)	(0.81)	(0.81)	(1.08)	(1.33)	(0.81)	(0.86)	(1.45)
Socioeconomic status									
AHINCOME	5.91	0.004	—	—	—	—	—	—	—
		(0.22)	—	—	—	—	—	—	—
INCOMEM	0.36	—	−0.01	—	—	—	—	—	−0.08
		—	(−0.10)	—	—	—	—	—	(−0.58)
RETIRED	0.74	—	—	−0.01	—	—	—	—	−0.02
		—	—	(−0.04)	—	—	—	—	(−0.12)
OWNHOUSE	0.68	—	—	—	0.25**	—	—	—	0.19*
		—	—	—	(2.05)	—	—	—	(1.44)
ACARUSE	0.63	—	—	—	—	0.27**	—	—	0.21
		—	—	—	—	(2.23)	—	—	(1.67)
SCHOOL14	0.33	—	—	—	—	—	0.00	—	—
		—	—	—	—	—	(0.01)	—	—
COLLEGE	0.21	—	—	—	—	—	—	0.10	0.04
		—	—	—	—	—	—	(0.67)	(0.24)
Log-likelihood (LL)		−331.76	−331.78	−331.79	−329.69	−329.31	−331.79	−331.56	−328.12
Restricted LL (all slopes = 0)		−397.31	−397.31	−397.31	−397.31	−397.31	−397.31	−397.31	−397.31
Chi-squared statistic		131.10	131.06	131.06	135.25	136.01	131.05	131.51	138.38

Numbers in parentheses are t-ratios.
***Significant at the 1% level in a two-tailed test (critical value = 2.5758).
**Significant at the 5% level in a two-tailed test (critical value = 1.9600).
*Significant at the 10% level in a two-tailed test (critical value = 1.6449).

Table 5. Health-investment equations for women, with SURVIVOR as dependent variable

Variable	Mean ($N=1044$)	I	II	III	IV	V	VI	VII	VIII
Constant		5.10***	5.16***	4.91***	4.92***	5.15***	5.18***	5.05***	4.80***
		(8.36)	(8.86)	(8.72)	(8.49)	(8.72)	(9.16)	(8.95)	(7.80)
Health status									
FAIRSRH	0.25	0.06	0.06	0.02	0.08	0.06	0.05	0.07	0.03
		(0.43)	(0.41)	(0.12)	(0.54)	(0.41)	(0.34)	(0.50)	(0.21)
POORSRH	0.09	−0.40**	−0.40**	−0.43**	−0.36**	−0.40**	−0.41**	−0.39**	−0.40**
		(−2.14)	(−2.15)	(−2.30)	(−1.96)	(−2.15)	(−2.19)	(−2.10)	(−2.12)
VPOORSRH	0.04	−0.33	−0.34	−0.32	−0.29	−0.34	−0.36	−0.32	−0.28
		(−1.35)	(−1.37)	(−1.27)	(−1.17)	(−1.37)	(−1.44)	(−1.30)	(−1.11)
NOHPRB91	0.19	0.07	0.07	0.06	0.08	0.07	0.07	0.06	0.06
		(0.42)	(0.41)	(0.39)	(0.46)	(0.42)	(0.39)	(0.38)	(0.38)
HLIMIT91	0.27	−0.42***	−0.42***	−0.44***	−0.43***	−0.42***	−0.43***	−0.42***	−0.46***
		(−3.03)	(−3.05)	(−3.12)	(−3.09)	(−3.05)	(−3.07)	(−3.05)	(−3.25)
DISAB91	0.08	−0.05	−0.05	−0.00	−0.05	−0.05	−0.05	−0.05	0.03
		(−0.29)	(−0.26)	(−0.02)	(−0.26)	(−0.27)	(−0.27)	(−0.27)	(0.16)
GP91	0.52	0.09	0.10	0.11	0.10	0.10	0.10	0.09	0.11
		(0.79)	(0.80)	(0.88)	(0.81)	(0.80)	(0.83)	(0.74)	(0.93)
HOSP91	0.13	−0.47***	−0.47***	−0.48***	−0.47***	−0.47***	−0.46***	−0.48***	−0.49***
		(−3.40)	(−3.39)	(−3.43)	(−3.42)	(−3.39)	(−3.36)	(−3.47)	(−3.50)
Health depreciation									
AGE	70.66	−0.05***	−0.05***	−0.05***	−0.05***	−0.05***	−0.05***	−0.05***	−0.05***
		(−6.50)	(−6.63)	(−6.73)	(−6.52)	(−6.55)	(−6.74)	(−6.60)	(−6.47)
SMOKER	0.22	−0.35***	−0.35***	−0.35***	−0.34**	−0.35***	−0.35***	−0.34***	−0.33**
		(−2.69)	(−2.71)	(−2.70)	(−2.57)	(−2.71)	(−2.71)	(−2.65)	(−2.52)
HSPRB	0.47	0.05	0.05	0.08	0.07	0.05	0.05	0.06	0.09
		(0.49)	(0.47)	(0.72)	(0.61)	(0.46)	(0.47)	(0.52)	(0.83)
SINGLE	0.56	−0.12	−0.12	−0.16	−0.09	−0.12	−0.12	−0.12	−0.13
		(−1.02)	(−1.03)	(−1.35)	(−0.73)	(−1.03)	(−1.05)	(−1.04)	(−1.12)
Socioeconomic status									
AHINCOME	5.30	0.002	—	—	—	—	—	—	—
		(0.10)	—	—	—	—	—	—	—
INCOMEM	0.35	—	−0.03	—	—	—	—	—	−0.05
		—	(−0.23)	—	—	—	—	—	(−0.44)
RETIRED	0.70	—	—	0.37***	—	—	—	—	0.38***
		—	—	(3.21)	—	—	—	—	(3.33)
OWNHOUSE	0.60	—	—	—	0.15	—	—	—	0.21*
		—	—	—	(1.36)	—	—	—	(1.74)
ACARUSE	0.26	—	—	—	—	−0.02	—	—	−0.13
		—	—	—	—	(−0.16)	—	—	(−0.88)
SCHOOL14	0.34	—	—	—	—	—	−0.10	—	—
		—	—	—	—	—	(−0.85)	—	—
COLLEGE	0.14	—	—	—	—	—	—	0.21	0.21
		—	—	—	—	—	—	(1.25)	(1.21)
Log-likelihood(LL)		−361.60	−361.58	−356.50	−360.68	−361.59	−361.24	−360.79	−354.07
Restricted LL (all slopes = 0)		−429.69	−429.69	−429.69	−429.69	−429.69	−429.69	−429.69	−429.69
Chi-squared statistic		136.20	136.24	146.38	138.03	136.21	136.91	137.82	151.24

Numbers in parentheses are *t*-ratios.
***Significant at the 1% level in a two-tailed test (critical value = 2.5758).
**Significant at the 5% level in a two-tailed test (critical value = 1.9600).
*Significant at the 10% level in a two-tailed test (critical value = 1.6449).

significant at all for women, but this is to be expected since SAHL95 is self-assessed health compared to others of the same age. HSPRB and SINGLE are not significantly associated with lower self-assessed health in 1995 for either sex.

Tables 4 and 5 present results from re-estimating Models I-VIII with SURVIVOR as the dependent variable instead of SAHL95. The models are binomial probits, estimated using LIMDEP v. 7.0. The samples used are those without exclusion of respondents who died before the interview date in 1995. Thus, $N = 799$ for men and $N = 1044$ for women. This should not affect the comparability of the results with those in Tables 2 and 3, since there is no evidence of sample selection bias in the latter. As before, a likelihood ratio test for each model rejects the null hypothesis that all slope coefficients are zero.

There is a marked decline in the significance of self-assessed health variables for 1991 among women, but not among men. In contrast to Tables 2 and 3, GP91 is now insignificant in all the models, whereas HOSP91 is significant at the 5% level or below for both sexes, and always has a negative coefficient. In this case, HOSP91 reflects health problems in 1991 that lead to death before the interview date in 1995. SMOKER, and now also AGE, are both highly significant in all the models, but the other health depreciation variables remain insignificant.

The most striking result is that AHINCOME and INCOMEM are no longer significant for either sex, but OWNHOUSE and ACARUSE are significant for men, and OWNHOUSE is also significant at the 10% level in Model VIII for women. An interesting difference between the sexes is that RETIRED is highly significant for women but not for men. The positive coefficients in Table 5 suggest that retirement is associated with *higher* socioeconomic status among women.

The insignificance of income in Tables 4 and 5 seems to confirm the findings of Kaplan and Haan [4] and others, which suggest that there is *no* meaningful association between poor health and low socioeconomic status at old age. However, socioeconomic variables which are not significant when SAHL95 is the dependent variable (such as OWNHOUSE and ACARUSE for men, and RETIRED for women) become highly significant when SURVIVOR is the dependent variable. On the basis of the results in Tables 2–5, it is difficult to decide whether socioeconomic status is, or is not, a significant correlate of long-run health among the elderly. This mirrors the conflicting evidence from the economic and socio-epidemiologic literatures, and suggests that *either* hypothesis can be supported by using these health and socioeconomic indicators.

It may be that mortality and self-assessed health are yielding different results for the elderly because they are capturing different ranges of the latent health variable. In particular, *death* might represent an even worse health state than the *very poor* self-assessed health category, corresponding to a range of the latent health variable that is not covered by self-assessed health. The apparently conflicting results in Tables 2–5 might then simply reflect the fact that explanatory variables have different effects in the different ranges of the latent health variable at old age. In particular, while low socioeconomic status may have a significant effect on health measured over more of its range, it might not have enough of an effect to push people past the ‘death threshold’.

To investigate this possibility, the ordered probits in Tables 2 and 3 can be re-estimated with a new dependent variable which combines the mortality and self-assessed health data.[a] The new dependent variable takes the value m ($m = 1, 2, 3, 4, 5, 6$) only if health in 1995 lies in the interval $(c_{m-1}, c_m]$, where $-\infty = c_0 < c_1 < c_2 < c_3 < c_4 < c_5 < c_6 = +\infty$, and where c_1 is now the minimum stock of health capital consistent with life. Thus, the new dependent variable takes the value 1 if the respondent died, 2 if self-assessed health in 1995 is *very poor*, and so on. It should be emphasised that an assumption is being made in representing *death* as the lowest category of the dependent variable that death represents the least health possible. This seems reasonable in the context of this study. The relevant samples are those without exclusion of respondents who died, so $N = 799$ for men and $N = 1044$ for women.

When Models I to VIII in Tables 2 and 3 are re-estimated using this new dependent variable, the coefficient estimates are very similar, but the estimated thresholds are consistent with the view that *death* occupies a portion of the range of the latent health variable that is to the left of the *very poor* category. Table 6 shows the results for Model I for men and women (the other models yield virtually the same threshold estimates as Model I, and coefficient estimates which are very similar to those already presented in Tables 2 and 3). Again, LIMDEP normalises c_1 at 0, so only c_2, c_3, c_4 and c_5 are estimated. As in Tables 2 and 3, income has

Table 6. Health-investment equations for men and women, with composite dependent variable*

Variable	Men Mean ($N = 799$)	Men I	Women Mean ($N = 1044$)	Women I
Constant		4.36***		3.83***
		(9.40)		(9.92)
Health status				
FAIRSRH	0.24	−0.85***	0.25	−0.49***
		(−7.77)		(−4.91)
POORSRH	0.09	−0.91***	0.09	−0.72***
		(−4.77)		(−5.04)
VPOORSRH	0.03	−1.09***	0.04	−0.88***
		(−3.32)		(−3.83)
NOHPRB91	0.21	0.23**	0.19	0.39***
		(2.33)		(4.38)
HLIMIT91	0.25	−0.32***	0.27	−0.51***
		(−2.76)		(−5.16)
DISAB91	0.11	−0.09	0.08	−0.16
		(−0.58)		(−1.09)
GP91	0.45	−0.23**	0.52	−0.07
		(−2.48)		(−1.00)
HOSP91	0.13	−0.12	0.13	−0.32***
		(−1.01)		(−3.09)
Health depreciation				
AGE	69.74	−0.41***	70.66	−0.03***
		(−6.75)		(−6.16)
SMOKER	0.23	−0.38***	0.22	−0.25***
		(−3.90)		(−2.96)
HSPRB	0.45	0.03	0.47	0.04
		(0.32)		(0.62)
SINGLE	0.27	−0.06	0.56	−0.06
		(−0.61)		(−0.80)
Socioeconomic status				
AHINCOME	5.91	0.002**	5.30	0.002**
		(1.97)		(2.47)
Thresholds				
$\hat{c}_2$	—	0.08***	—	0.17***
	—	(4.06)	—	(6.30)
$\hat{c}_3$	—	0.36***	—	0.52***
	—	(9.21)	—	(12.21)
$\hat{c}_4$	—	1.08***	—	1.44***
	—	(18.53)	—	(25.03)
$\hat{c}_5$	—	2.50***	—	2.88***
	—	(31.90)	—	(39.37)
Log-likelihood (LL)		−1079.02		−1432.63
Restricted LL (all slopes = 0)		−1234.77		−1625.05
Chi-squared statistic		311.50		384.85

Numbers in parentheses are *t*-ratios.
***Significant at the 1% level in a two-tailed test (critical value = 2.5758).
**Significant at the 5% level in a two-tailed test (critical value = 1.9600).
*Significant at the 10% level in a two-tailed test (critical value = 1.6449).

a significant positive coefficient in the models in Table 6, but the estimated thresholds for self-assessed health are clearly to the right of the threshold for *death*. The estimated values of c_2, c_3, c_4 and c_5 are 0.08, 0.36, 1.08 and 2.50 for men, respectively, and 0.17, 0.52, 1.44 and 2.88 for women, respectively. All these threshold estimates are statistically significant well below the 1% level.

Discussion

The evidence presented in this paper suggests that conflicting results in epidemiologic and economic studies are not solely due to samples being drawn from different populations. The conflicting results were reproduced here with samples from the BHPS, simply by switching between self-assessed health and mortality as health indicators.

As outlined in the Introduction, another reason for the conflicting results might be that measurement errors in single-variable indicators of health and socioeconomic status are positively correlated among the elderly, producing a positive correlation between the two variables even if 'true' long-run health is independent of socioeconomic position. Since SURVIVOR is not affected by self-reporting errors, this could then explain why the income variables are statistically insignificant in Tables 4 and 5. However, no evidence of such effects could be found in the context of statistical models designed specifically to control for self-reporting errors in self-assessed health and socio-economic variables [8].

The empirical evidence in this paper suggests a third explanation, namely that mortality and self-assessed health yield different results because they relate to different ranges of the latent health variable at old age. In particular, while low socioeconomic status may have a significant effect on health measured over more of its range, it might not have enough of an effect to push people past the 'death threshold'. This should make both epidemiologists and economists wary about making generalisations from empirical results based solely on mortality or self-assessed health.

Notes

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