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Healthy Aging at Older Ages: Are Income and Education Important?

Neil J. Buckley, Frank T. Denton, A. Leslie Robb, Byron G. Spencer

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Title: HEALTHY AGING AT OLDER AGES: ARE INCOME AND EDUCATION IMPORTANT?

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HEALTHY AGING AT OLDER AGES:
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ABSTRACT

Being higher on the socioeconomic scale is correlated with being in better health, but is there is a *causal* relationship? Using three years of longitudinal data for individuals aged 50 and older from the Canadian Survey of Labour and Income Dynamics, we study the health transitions for those who were in good health in the first year, focussing especially on income and education. The initial good health restriction removes from the sample those whose incomes may have been affected by a previous history of poor health, thus avoiding a well known problem of econometric endogeneity. We then ask, for those in good health, whether later transitions in health status are related to socioeconomic status. We find that they are – that changes in health status over the subsequent two years are related in particular to income and education.

JEL Classification: I12
Key Words: aging, health, income, education

VEILLIR EN BONNE SANTÉ: LES NIVEAUX DE REVENU ET L'ÉDUCATION: SONT-ILS IMPORTANT ?

RÉSUMÉ

Un statut socio-économique élevé est positivement corrélé avec un bon état de santé; existe-t-il cependant une relation de causalité ? En utilisant trois années de données longitudinales de personnes âgées de 50 ans et plus de l'Enquête sur la Dynamique du Travail et du Revenu, nous examinons les variations de l'état santé des personnes se déclarant initialement en bonne santé, concentrant principalement notre analyse sur les effets du revenu et de l'éducation. Se restreindre aux personnes se déclarant initialement en bonne santé, permet d'éliminer tous ceux dont les revenus pourraient avoir été affectés par des problèmes de santé antérieurs, évitant ainsi tout problème d'endogénéité. Nous essayons ensuite d'identifier si toute variation de l'état de santé d'un individu postérieure à la période initiale d'observation est liée à son statut socio-économique. Nous trouvons que c'est effectivement le cas: les variations de l'état de santé sur les deux années postérieures à la période d'observation initiale sont étroitement liées au revenu et à l'éducation.

Classification JEL: I12
Mots clés: vieillissement, santé, revenu, éducation

HEALTHY AGING AT OLDER AGES:

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INTRODUCTION

It is well documented that people with higher socio-economic status (SES) tend to be in better health. But do people, especially older people, enjoy better health *because* they have higher SES? That is what concerns us in this paper. Of particular interest is whether two indicators of SES, income and education, are associated in a causal way with health status as people age.

The relationship between SES and health has been a matter of research attention for several decades. The most influential early investigation was undoubtedly the 1967 Whitehall study of British civil servants that documented a steep inverse relationship between employment rank and poor health outcomes, including mortality (Marmot, Rose, Shipley, and Hamilton, 1978). As Smith notes (Smith, 1999, p. 158) that study was particularly influential because the health gradient was steep in a population where the poor were not represented and, furthermore, because not much of the gradient could be explained by poor health behaviours or access to medical care. That classic study was followed up 20 and 25 years later. The "Whitehall II" studies (Marmot, Smith, Stansfeld, Patel, North, Head, White, Brunner, and Feeny, 1991, Marmot, 1999) provide striking confirmation that the SES gradient in health has persisted even in a country that has experienced rising incomes, advances in health technology, and on-going policy efforts to ensure that low income people have equitable access to health care services.

Smith (1999), Goldman(2001), and Evans (2002) have recently reviewed the relevant literature while Buckley et al. (forthcoming) provide further discussion of relevant Canadian studies. However, the question remains as to whether SES affects health outcomes in a causal way. As Evans (2002, p. 77) observes, "[t]he association between income inequality and health inequality ... is now pretty well established ... but the causality is less clear ...". Our concern in this paper is with causality.

A convincing answer demands a good data base for analysis. Ideally we would like to know how the health status of a large number of individuals changed over a period of many years. Knowledge of their health status might be based both on objective measures made by health professionals and on the subjective responses of those surveyed. We would like to know also about a variety of personal characteristics of those individuals (smoking behaviour, other risk factors) that would bear on health status. In addition, we would want appropriate indicators of socioeconomic status itself. A long view is important: while some markers of socioeconomic status (education, in particular) are usually firmly established in early adulthood, and change little after that, income can vary greatly over the life course. In particular, the current level of income might be an especially poor indicator for older people, who have little or no wage income but may have accumulated assets on which they can draw. In any event, if income has an effect on health, we would expect that effect to come more from its average level over one's lifetime than from its level in any given year. In what follows we pay particular attention to that issue.

No ideal data set exists in Canada or elsewhere, but in the last decade or so Statistics Canada

has undertaken a number of longitudinal surveys in which respondents are followed (statistically speaking) for several years. Two of these surveys, the National Population Health Survey (NPHS) and the Survey of Labour and Income Dynamics (SLID), collect information about (self-reported) health status and hence warrant consideration for the purpose at hand. The two surveys collect a variety of other information as well. While the NPHS provides a much richer source of data relating to health and associated risk factors, SLID has a larger sample and much better information about household income since most households in the survey opt to have Statistics Canada obtain such information directly from tax files. In this paper we focus attention solely on the analysis of SLID data, and pay particular attention to the effect of income while taking account of education and such other factors as can be considered with the SLID data. (A brief description of SLID is provided in Appendix A.)

We take a first look at the SLID survey data in the next section and examine cross tabulations of reported health status, on the one hand, with income, education, and age, on the other. The purpose of this descriptive analysis is to illustrate the apparent relationship between indicators of socioeconomic status and health for the entire population aged 50 and older, as seen both in a single cross section and over time. That helps to put the multivariate analysis that follows in context. We then proceed to develop the framework for empirical analysis of the data and, in the section that follows, to present our results. The paper concludes with a discussion and summary of those results.

A FIRST LOOK AT THE EVIDENCE

SLID does not involve any measurement or testing on the part of health or other professionals to assess the 'objective' physical or psychological health status of individual respondents. Instead people are asked about their health as follows: "Compared to other people your age, how would you describe your state of health? Would you say it is excellent, very good, good, fair or poor?". The responses to questions of that sort have been widely analysed in the literature on the determinants of health, and have been found to be good predictors of subsequent health care utilization and mortality (see, for example, McCallum, Shadbolt, and Wang, 1994, Idler and Benyamini, 1997, Bierman, Bubolz, Fisher, and Wasson, 1999, and Badley, Wang, Cott, and Gignac, 2000). In any event, that is all that is available to us here. Our concern is with how this 'subjective' measure of health status varies with socioeconomic status, and two indicators of SES are available in the data: income and education[1]. Table 1 shows how the distribution of health status differs across household income quartiles, ranging from the lowest (quartile 1) to the highest (quartile 4), for the population aged 50 and older at the time of the survey in 1996[2]. Reported income, here as elsewhere in this study, is expressed relative to the Statistics Canada low-income cutoff (LICO) level for the household before being assigned to quartiles[3]. That adjustment takes account of differences in household composition and in the cost of living among rural areas and urban areas of differing population size.

Table 1 shows the relationship between reported health status as of the 1996 survey date and household income in the previous calendar year[4]. The proportion reporting excellent or very good

health is notably higher at high income levels; the proportion reporting fair or poor health is notably higher at low income levels. The pattern is similar for men and women.

– Table 1 about here –

Table 2 is based on the same observations as Table 1, but shows how the distributions within each health status category differ across income groups. High proportions reporting very good or excellent health are found in the upper two quartiles, high proportions reporting fair or poor health in the lower two. Again, the pattern is similar for men and women.

– Table 2 about here –

Tables 1 and 2 relate only to the 1996 survey. Table 3 provides information about the distribution across health states for the same set of individuals in 1997 and 1998, as well as 1996, but distinguishes only between 'below median income' (the two lower quartiles) and 'above median income' (the two higher ones) as measured in 1996. (Again income is household income.) Health status appears to change relatively little from one year to the next, on average, but one would expect such changes as do occur to be most often in the direction of worsened health. While everyone with reported health status in the 1996 survey was living in a private household at that time, some had moved in the subsequent two years to nursing homes and others had died. In the latter two cases SLID provides no information about health status but does record the change in circumstances, as shown in the table.

– Table 3 about here –

Consider first those with 'below median income' in Table 3. The proportion of males reporting either 'excellent' or 'very good' health fell from 40.4 percent in 1996 to 37.7 percent in 1998. Over the same period the proportion who reported health as 'fair' or 'poor', or had moved into

an institution or died, increased from 29.6 to 33.1 percent. Similar patterns hold for women with household incomes below the median, and for both men and women with incomes above the median. The most striking feature of the table, however, is that much higher proportions of those with 'above median income' report remaining in the healthier categories, as compared to those with 'below median income'. It is of particular note that only about half as many in the higher income groups are institutionalized or dead within two years, as compared to the lower income groups.

Education is our other indicator of socioeconomic status. While it is appropriate to work with a measure relating to the household in the case of income, so that both the husband and wife in a husband-wife household would be in the same income category even though one or other might have little personal income, education relates to individuals. Hence we consider *own* education in relation to health status[5]. Table 4 shows the distribution of health status within two education groups, 'low' and 'high', for the same three survey years as before. (The 'low' education category refers to those who, as of 1996, had completed high school or less while 'high' refers to those who had some education beyond the high school level.) The distributions are much the same as those reported in the previous table. That is, those with 'high' education are much more likely to be in better health initially, and to remain that way, as compared to those with 'low' education. They are also much less likely to become institutionalized or die. These results suggest (not surprisingly) that education and income are highly correlated.

– Table 4 about here –

Finally, consider the relationship between age in two broad categories, 'old' (defined as 70 and older) and 'young' (50-69), as shown in Table 5. One would of course expect older people to

experience poorer health, on average. But people were asked to compare their health to others in their own age group. Had they done so we would expect this table to show similar distributions across health status categories within each age group. In fact, we find that those who are 'old' are distributed across the various health status categories not unlike those who have 'below median income' or 'low education'; at the same time, those who are 'young' look more like those who have 'above median income' or 'high education'[6]. The major difference is that the reduction in the proportion in 'excellent' [or 'good'] health between 1996 and 1998 is much sharper among the 'old' than among those with 'below median income' or 'low education', and the increase in the proportion institutionalized or dead is much higher.

– Table 5 about here –

While the cross tabulations are suggestive, the direction of causality remains unclear. We proceed now to describe the framework that we have designed to measure the separate effects of income and education, while taking account of other variables as well. Our approach involves taking advantage of the longitudinal nature of the survey to ask whether changes in health, as effect, can be associated with one's income and education, as cause, if one controls for age and other factors.

FRAMEWORK FOR ANALYSIS

An important concern is to isolate the effect of income on health while avoiding a possibly confounding effect in the other direction – of health to income. To that end, two aspects of our approach to the use of the SLID longitudinal data file deserve particular attention. The first is that in the analysis that follows we restrict the sample of observations to individuals aged 50 and older who were in *good health* in 1996, the first year for which we have information. (The *good health*

restriction reduced our sample by 23 percent.) Health is coded as *good* for our purposes if it was reported as 'good', 'very good', or 'excellent' in the survey; all those whose health was *poor* in 1996, i.e., reported 'fair' or 'poor' in the survey, were dropped. By restricting the sample to those who were initially in good health we avoid concerns about the possible confounding influence of health on income. With everyone in our sample initially in good health we then draw specifically on the longitudinal nature of the survey to ask how likely they were to remain in good health in each of the next two years, and whether we can identify and explain systematic differences in the likelihood of remaining in good health[7]. The possible transition to *poor* health is defined to include those who died or became institutionalized (for those aged 50 and older that typically means entering a nursing home).

The second aspect to which we draw attention is the measure of income. We have argued that income at the time of the survey may not be appropriate; one would like to have a measure that better reflects lifetime income or wealth. Consistent with the economic life cycle approach and much empirical evidence (Benjamin et al., 2002, for example), one would expect that earnings would generally increase with age, at least until late middle age, and more so for those with higher education than for others. However, income levels would tend to be relatively low in retirement, such that using measures of current income to compare individuals at different stages of the life cycle would be inappropriate. Our solution is to estimate, for each respondent, what household income would have been when that respondent was of prime working age. More specifically, we estimate a regression equation of the following general form:

(1) $\ln Y_i = f(A_i, Z_i) + e_i$

where $\ln Y_i$ is the natural logarithm of household income associated with respondent i (expressed relative to the household's LICO) in the initial year of the survey, f stands for 'is a function of', A_i indicates the respondent's age in the initial year of the survey, Z_i is a set of other explanatory variables, and e_i is a residual term. The equation is estimated separately for males and females.

The full set of explanatory variables is as follows. Age is represented by eight dummy variables (five-year age groups from 50-54 to 80-84, and an open-ended age group 85+). The variables caught up in Z include education (four categories – less than grade 11, grade 11 or more of high school, some postsecondary, university degree), marital status (five categories – single, married, separated, divorced, widowed), immigration period (four categories – non-immigrant, immigrated 0-10 years ago, 11-14 years ago, 15+ years ago), location (four categories – census metropolitan area, census agglomeration, other urban, rural), province (ten categories), and LICO expressed in natural logarithm form[8].

Equation (1) is fitted to the (weighted) survey data for 1996 by least squares, and is then used to infer a household income level for the individual when he or she was in the age group 50-54. All of the explanatory variables other than age are assumed to have been the same at age 50-54 as at the time of the survey. The residual from the fitted equation is included in estimating what income would have been, thus allowing for the effects of unobservable characteristics: some one who had a relatively high or low income level when observed in the survey is assumed to have had a similarly high or low income at 50-54. The calculated 50-54 income variable, transformed into income quartiles, then enters the equation relating to health status transitions[9].

ESTIMATION RESULTS

The model sketched in the previous section relates to the probability of remaining in good health conditional on having been in good health initially. A formal statement of the model can be given as:

(2) $$prob(H_{it} = G, t > 0 | H_{i0} = G) = f(R_i, A_i, E_i, X_i) + \eta_i$$

where *H* denotes health state with possible values *G*, good, and *B*, bad, *i* refers to the individual, *t* to survey year with $t = 0$ standing for the initial year (1996), *R* is 'predicted' income quartile, *A* respondent age, *E* educational attainment, *X* a vector of other (control) variables, and η an individual-specific error term[10]. With appropriate assumptions about the error term, this specification leads naturally to a probit model, and that is the type of model that we employ. (We would expect estimates based on a logit model specification to yield similar results.)

The results are reported in Table 6, separately for males and females and for both combined, based on probit models estimated using STATA. The coefficients of the probit equations are difficult to interpret, so we report instead the implied effects on the probabilities of remaining in good health in each of the next two years. (Poor health is defined as being in that state in one or both of 1997 and 1998.) For income quartile 4, for example, the value shown, 0.073 in the case of males, is to be interpreted relative to the reference category, which is income quartile 1, indicated by a dash (–). We thus see that a male in the highest income category is about 7½ percent more likely to remain in good health than a male in the lowest income category with similar other characteristics. The figures in Table 6 for the other explanatory variables, and for females, are interpreted in a similar

fashion. Finally, we note that the p-values (and the underlying estimated standard errors) are based on bootstrap estimation procedures as described in Yeo, Mantel, and Liu (1999, 2001) and Pierard, Buckley, and Chowhan (forthcoming).

– Table 6 about here –

More generally, we see that higher income is associated with a higher probability of remaining in good health, for both men and women. The results are statistically highly significant (the p-value for the income categories collectively is less than 0.001 for both males and females) and the pattern – an increase from one income quartile to the next, with similar magnitudes for both sexes – gives some confidence in the results[11].

A broadly similar pattern applies in the case of education: higher levels of education are associated with higher probabilities of remaining in good health. The differences are substantial: a male with otherwise similar characteristics, but in the highest education level, has an estimated probability of remaining in good health for the next two years that is 0.093 higher than one in the lowest category. The difference for females, 0.137, is even greater.

Other things equal, one would expect that older age would be associated with a reduced probability of remaining in good health. The estimates provide support, and indicate a similar pattern of decrease for men and women. For example, a 65-69-year-old male has a probability of remaining in good health for the next two years that is 0.112 lower than one 50-54 years old; for women the difference is 0.101. By age 75-79 the probabilities are lower still, by about a further 0.11 for both men and women[12].

Another variable, 'became non-married', relates to a possible change in marital state for someone married (predominantly the death of a spouse for the age range in our sample, but inclusive also of divorce and separation). We find that the estimated effect is statistically significant for males but not for females. That is plausible and consistent with the literature: older men generally have fewer household skills (including cooking ability) than women, and less developed support networks that may be helpful in seeing them through difficult times[13]. We find a notable reduction of 0.122 in the probability of remaining in good health for males who lose a partner.

Finally, we include a dummy variable that indicates whether the respondent lived in a rural (value 1) or urban (value 0) setting. We find that the estimated effect is not statistically significant for either males or females[14].

The final two columns report results with the male and female observations pooled[15]. A single dummy variable has been added to indicate whether the respondent was male or female. As can be seen, the sex dummy is not significant and the individual coefficient estimates differ little from the corresponding coefficients estimated for each sex separately. The only exception is for the variable 'became non-married', which was highly significant for men but not for women. When the observations are pooled the significance level of that variable is low. In further work (not reported here) we interacted the sex dummy with all variables; in no case did we find that gender differences were statistically significant. While the variable 'became non-married' remains significant for men it is so ill-determined for women as not to be significantly different from either men or 'no effect'.

It is well-known that women's life expectancy is greater than that of men; indeed, as observed in Tables 3 - 5, much higher proportions of men than women in the 50 and older group die within the two-year period of the panel. Hence our finding that there is so little difference between the sexes in this case is quite striking. What it says is that for older men and women who are initially in good health *the probability of remaining in good health* (as distinct from the overall proportion in good health) is the same for men as for women, once account is taken of age, income, and education. However, it also appears that marital status may be of some consequence, especially for males. That, in our view, is sufficient reason to estimate the relationships separately for men and women.

Only about 8 percent of the variance in the dependent variable is explained by the factors included in the probit regression equations; 92 percent is left unexplained. That is not surprising in that one would expect genetic factors, personal risk factors (smoking behaviour, eating habits, frequency of exercise), and possibly environmental factors, to be of principal importance. Even if other "observable" factors were taken into account, much of the variance would likely remain unexplained[16].

One might ask how the absence of information about personal risk factors affects the analysis. With appropriate data we would have considered smoking behaviour, body mass index, and other indicators of personal risk explicitly. However, some of these factors would be caught up in our analysis as it stands. Suppose, for example, that low education is correlated with a higher incidence of smoking (as much evidence suggests), or with other health risk factors. Our reported

estimate of the effect of education would then pick up such effects, at least in part. A similar argument can be made for income: to the extent that income is correlated with risk factors (beyond the correlation of such factors with education), the effects of those factors would be captured in our estimated income effects. Indeed, one can argue that education and income in themselves have no direct effects at all; having a high level of education or income does not itself affect health except to the extent that it alters behaviour.

Figures 1 through 4 are based on the equations estimated separately for men and women. Figures 1 and 2 provide age-health profiles that depict the combined effects of income and age on the probability of remaining in good health, holding education constant at its reference category level (education category 2). Figures 3 and 4 depict the combined effects of education and age, holding income quartile constant at its reference category level (income quartile 1). Given the specification of the equations, the differences between each of the income and education categories is the same at each age. The figures show clearly how the probabilities of remaining in good health decline with age, and show also how they decline from higher to lower income and education levels. For example, Figure 1 shows that the probability that a male in the highest income quartile and in initial good health would remain in good health for the next two years declines from about 0.93 for age group 50-54 to 0.83 for 65-69 and 0.63 for 80-84. For a male in the lowest quartile the decline over those same ages is from 0.85 to 0.75 to 0.55. The patterns for females (Figure 2) are similar.

– Figures 1, 2, 3, and 4 about here –

CONCLUSION

It is a matter of observation that being higher on the socioeconomic scale is correlated with being in better health, as is evident in several cross tabulations that we have presented. However, our major concern is whether there is a *causal* relationship running from income and education, on the one hand, to health status, on the other. We find evidence that there is. Furthermore, we find that the relationship is quantitatively important: for persons initially in good health (and after controlling for other factors), the probability of remaining in good health for the next two years is estimated to be 0.073 greater for males in the top income quartile than for those in the bottom quartile, and 0.071 greater for females. The differential between the highest and lowest education categories is even greater: 0.093 for males, 0.137 for females.

In the model estimation we are able to test whether there are significant male-female differences in health transitions in later life, as suggested by the simple cross tabulations. It appears that the differences are small. After controlling for other factors, men and women in the same income, education, and age categories are equally likely to remain in good health. The only significant difference we find relates to a change in marital status: men *but not women* who were married in the initial survey period but who, through the death of a spouse, divorce or separation, were not married in a later survey, were significantly less likely to remain in good health.

In reaching these conclusions access to longitudinal panel data has been critical. The analysis is restricted to the population aged 50 and older in the first year of the three-year survey period, with

a further restriction to individuals who were in good health in the first year. By restricting the sample to those who initially were in good health we removed those who were most likely to have had a history of poor health that would have affected their income levels. The advantage of using longitudinal data about health status is that it has allowed us to assess whether *changes* in health status are related to socioeconomic status (including "lifetime income") for a sample population initially in good health[17].

APPENDIX A: THE SLID SURVEY DATA SET

SLID, a national household survey, is primarily concerned with the labour force and income characteristics of respondents. However, questions have been asked also about a variety of other characteristics, including health. The survey follows a panel of about 15,000 households, including 35,000 adults, for a period of six years. Household members who were present when the household was first interviewed are followed for a six-year period, even if they move, and changes in household composition are noted. Those who join the household at a later time are counted as members of the household but not followed if they leave subsequently.

Each household is interviewed twice in each year; labour topics are covered in January, income topics in May. In both cases the questions relate to the previous calendar year. Importantly for our purposes, respondents can opt to have Statistics Canada access their tax files directly to obtain income information, and thereby avoid being interviewed about their incomes. Seventy-seven percent of the sample that we have worked with had income information for 1996 derived from tax files. The quality of the income data thus collected is thought to be much better than similar data obtained by interview. (We note, though, that our analysis is not restricted to those whose income information was derived from tax files.)

The first panel was surveyed in January and May of 1994 (when it was asked about income and labour activity in the reference year 1993), and then followed each year until 1999 (when it was asked about activity in 1998). The second panel started three years later, in 1997, and a third panel three years after that. Hence for the three surveys carried out in 1997, 1998, and 1999, two panels overlapped (were "active"), and by the time of the 1999 survey about 30,000 households

(representing 70,000 adults) had been enumerated for a full three-year period. Throughout the paper, and henceforth here, we adopt the practice of referring to each survey by its income reference year rather than the year in which interviews were conducted; 1996 thus refers to the survey carried in 1997, for example. The sample attrition rate has been low: less than one percent of the 1996 respondents were lost to our analysis by 1998. (Note that those who have died or been institutionalized are identified in the survey and included in our analysis.)

The questions about health were not asked in the first three years of SLID; thus the first health information is for 1996. At the time of our study useful information was available for respondents in the first panel for 1996, 1997, and 1998 (thereby providing two year-to-year transitions in health status), and for those in the second panel for the four years 1996 through 1999 (thereby providing three transitions). Using both panels roughly doubles the sample size but means that it is not possible to take advantage of the four-year time period for the second panel. We chose the larger sample option (using both panels for three years) but experimented also with the second panel alone for the four-year period. The results obtained in the latter case were essentially similar to those for the larger sample over the three-year period.

ENDNOTES

1. Occupation is also available, but only for those who are currently working or looking for work, or who were recently in the labour force. That means that an indicator of occupation is not available for most who have retired, a large portion of our sample.

2. The data set we use starts with the first year in which health questions were asked in SLID, which was 1997. The health questions were asked in January of that year but the income information was obtained in May and relates to the calendar year 1996. Hence we refer to this survey year as 1996 rather than 1997, and similarly for later surveys. (See Appendix A for more information.) Our sample of observations is restricted to respondents for whom we have information relating to the variables used in the analysis – namely, income, education, and age in 1996 and health status and marital status in both 1996 and later years.

3. See Statistics Canada (1999).

4. All data tabulations and estimates reported in this paper were done in the Statistics Canada Research Data Centre at McMaster.

5. The education level of one's partner might affect also one's health status. That possibility is not pursued in this paper.

6. Perhaps people tend to compare their health not to others in their own age group but to expectations about their own health, and what it used to be.

7. Each panel of respondents is in the SLID survey for a period of six years. A new panel starts in year four, and hence there is a three-year overlap during which two panels are 'active'. By limiting attention to changes over a two-year period (1996-97, 1997-98) we had observations from the last three years of the first panel and the first three years of the second panel of SLID. That effectively doubled the number of observations. See Appendix A for further details.

8. One reviewer asked that we comment on the use of dichotomous variables. In the case of the education variables the choice was dictated by what was available on the survey file. However, the advantage of dichotomous variables is that they do not impose a specific (possibly linear) functional form on, say, income and age; instead, the estimated coefficients associated with the dummy variables indicate the shape of the relationship.

9. One reviewer asked that we provide more descriptive information about the derived income measure, and how it compares to current income. The simple correlations are very high: 0.984 for males, 0.993 for females. When we compare the distribution of predicted income for each quartile of current income we find that by far the largest proportion are in the same quartile (more than 75 percent in all cases for males, more than 85 percent for females) and no predicted value is more than one quartile different from the quartile that includes the current value.

10. Unless otherwise noted, all variables are at their 1996 levels.

11. Meer, Miller, and Rosen (2003), using four waves of data from the University of Michigan Panel Study of Income Dynamics, focus on the effect on individual health status of a change in wealth associated with inheritance. (They use inheritance as an instrumental variable in their regression analysis to eliminate reverse causality.) They find that the effect is quantitatively small, and conclude "that the wealth-health connection is not driven by short run changes in wealth". That conclusion is consistent with our approach, in which it is lifetime income that matters. We would not expect short-run changes in wealth to be important.

12. Van Ourti (2003), working with data from the Panel Study of Belgian Households, finds support for the existence of income-related inequality in ill-health among the population under age 65, whether a current or permanent measure of income is used, but not among the population over 65. He suggests that the discrepancy might be explained by a combination of differential mortality and differential sample attrition across income groups. In our case we are able to account for differential attrition to the extent that it involves transitions to institutions (nursing homes) or mortality. Beyond that we note that sample attrition is very low in the survey used here.

13. Antonucci (1990, p. 213) notes that "[T]here are well-established sex differences in social relationships. ...Women tend to have more people in their networks, to have more family and friends, to have more different types of relationships with different types of people ..., to have more frequent contact with their network members, and to receive supports from multiple sources. ... Evidence suggests that a more extensive network can be useful for adapting to such stresses of late life as widowhood or illness. Thus, men, because of their more limited networks, have been shown to be at greater disadvantage in the face of widowhood." Denton and Walters (1999) also explore gender differences.

14. It is of interest to observe that in an earlier version of this paper we found the difference to be statistically significant. However in this revised version the standard errors have been calculated by a bootstrap procedure using 1000 bootstrap weights supplied by Statistics Canada. The use of this procedure is encouraged by Statistics Canada. The weights are designed to account for the multistage sampling nature of the surveys. See Yeo, Mantel, and Liu (1999, 2001) and Pierard, Buckley, and Chowhan (forthcoming).

15. We are grateful to two referees who suggested that we test for male-female differences.

16. In related work, we considered the possible impact on health status of a number of environmental variables representing characteristics of the areas in which respondents live, such as average family income, incidence of poverty, population density, proportion of population aged 15 and older with university degrees, proportion who are immigrants, and province of residence. We found no additional explanatory power associated with these variables. See Buckley, Denton, Robb, and Spencer (forthcoming); see also Tremblay, Ross, and Berthelot (2002), who reach similar conclusions based on an analysis of a very large

cross-sectional data set, the Statistics Canada Canadian Community Health Survey.

17. Few other studies have attempted to exploit the distinctive advantages of longitudinal files to disentangle the effect of SES on health. An important exception is Adams, Hurd, McFadden, Merrill, and Ribeiro (2003), which uses US data from the Asset and Health Dynamics of the Oldest Old (AHEAD) Panel. (Of note also are the commentaries on the Adams et al. paper by Poterba, 2003, and Adda, Chandola and Marmot, 2003.) Their study was restricted to individuals 70 or older at the time of the first survey; hence the authors were working with a sample population considerably older than ours. At the same time they had the advantage of much more detailed health information than was available to us in SLID. In consequence they were able to study acute conditions separately from chronic conditions, and distinguish mental conditions from physical conditions. They find important differences in the link between SES and various long-term health limitations. While they find no direct causal link from SES to mortality or to incidence of most sudden onset illnesses, once initial health conditions are controlled for, they do find some association with the incidence of gradual onset health illnesses (mental conditions and some degenerative and chronic conditions). It is not possible to make direct comparisons with our work since the approach is different, the survey information is richer, the sample is older, and the health care systems in Canada and the US different.

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Figure 1. Age and Income Effects: Males

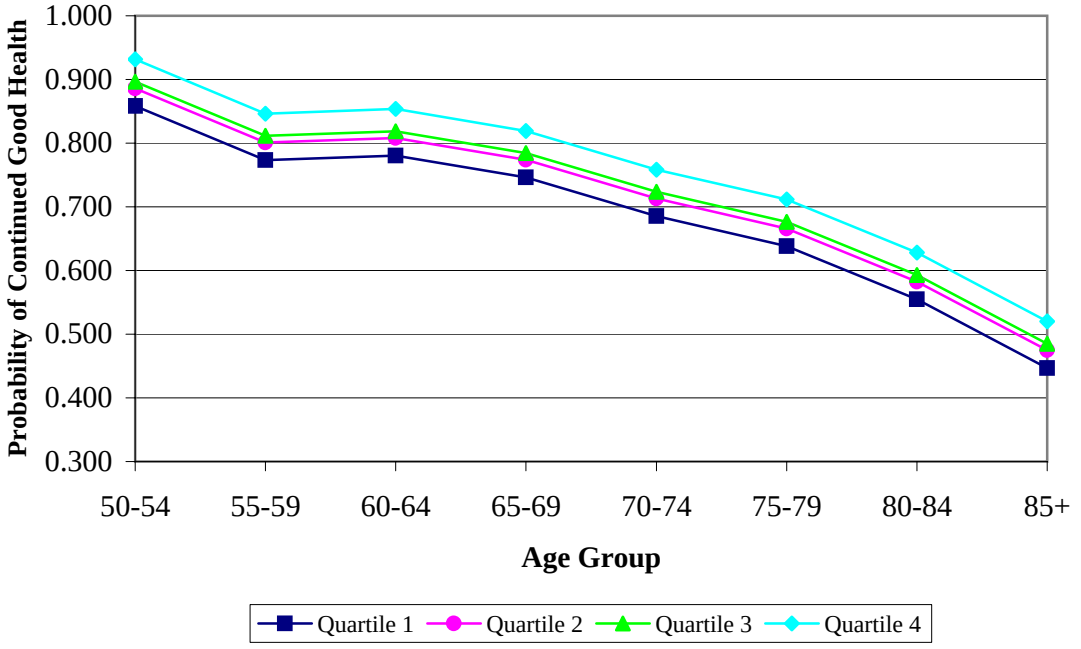

Figure 2. Age and Income Effects: Females

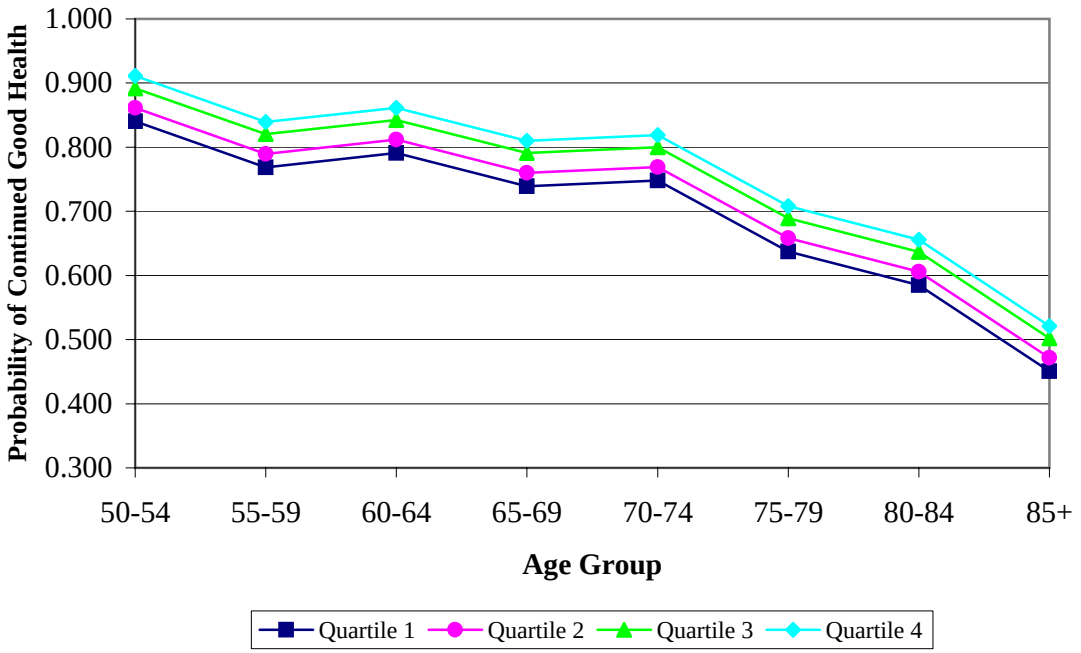

Figure 3. Age and Education Effects: Males

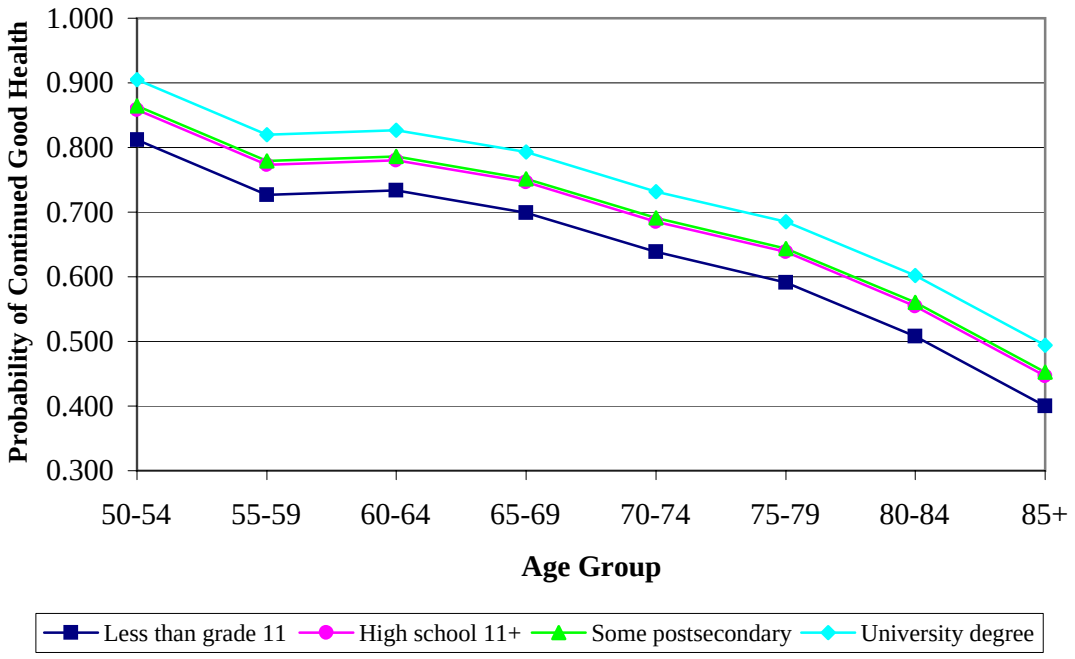

Figure 4. Age and Education Effects: Females

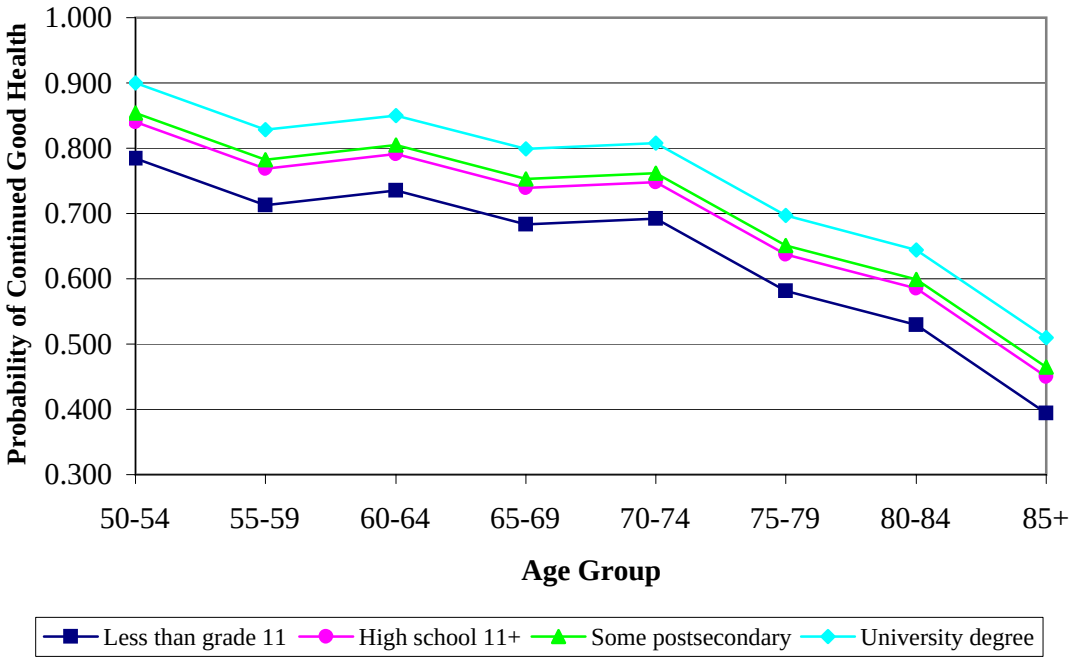

Table 1. 1996 Distribution of Health Status Categories in Each Income Quartile: Population Aged 50 and Older

		Health Status					
Sex	**Income Quartile**	**Excellent**	**Very Good**	**Good**	**Fair**	**Poor**	**Total**
				percent			
Male	Quartile 1	11.2	24.8	28.9	22.7	12.5	100.0
	Quartile 2	16.9	27.9	31.2	16.6	7.4	100.0
	Quartile 3	19.6	33.6	29.8	11.9	5.1	100.0
	Quartile 4	28.4	38.2	21.4	8.5	3.5	100.0
	Total	19.0	31.1	27.8	14.9	7.1	100.0
Female	Quartile 1	10.5	24.9	32.5	22.1	10.1	100.0
	Quartile 2	12.5	28.3	32.1	19.3	7.8	100.0
	Quartile 3	16.3	33.0	31.8	14.0	4.9	100.0
	Quartile 4	23.8	37.8	26.7	7.8	3.9	100.0
	Total	15.8	31.0	30.8	15.8	6.7	100.0

Note: Sample weights are used to derive population proportions. The sample consists of 7752 males and 9137 females.

Table 2. 1996 Distribution of Each Health Status Category Across Income Quartiles: Population Aged 50 and Older

		Health Status					
Sex	**Income Quartile**	**Excellent**	**Very Good**	**Good**	**Fair**	**Poor**	**Total**
				percent			
Male	Quartile 1	14.7	19.9	26.0	38.0	43.9	25.0
	Quartile 2	22.2	22.4	28.0	27.9	26.1	25.0
	Quartile 3	25.8	27.0	26.8	19.9	17.8	25.0
	Quartile 4	37.3	30.7	19.3	14.2	12.2	25.0
	Total	100.0	100.0	100.0	100.0	100.0	100.0
Female	Quartile 1	16.7	20.1	26.4	35.0	37.7	25.0
	Quartile 2	19.8	22.9	26.1	30.6	29.3	25.0
	Quartile 3	25.9	26.6	25.8	22.1	18.5	25.0
	Quartile 4	37.7	30.5	21.7	12.4	14.6	25.0
	Total	100.0	100.0	100.0	100.0	100.0	100.0

Note: See note to Table 1.

Table 3. 1996-98 Distribution of Health Status Categories within Income Groups Below and Above the Median: Population Aged 50 and Older in 1996

		Below Median Income			Above Median Income		
Sex	**Health Status**	**1996**	**1997**	**1998**	**1996**	**1997**	**1998**
				percent			
Male	Excellent	14.0	14.1	12.0	24.0	23.3	20.9
	Very good	26.4	24.8	25.7	35.9	34.0	34.8
	Good	30.0	28.2	29.2	25.6	26.8	25.1
	Fair	19.6	19.0	17.4	10.2	10.2	11.1
	Poor	10.0	10.7	9.4	4.3	4.4	4.3
	Institutionalized	-	0.6	0.7	-	0.4	0.8
	Deceased	-	2.6	5.6	-	1.1	2.9
	Total	100.0	100.0	100.0	100.0	100.0	100.0
Female	Excellent	11.5	9.6	9.4	20.1	18.0	17.2
	Very good	26.6	25.3	26.2	35.4	34.7	35.6
	Good	32.3	31.8	30.5	29.2	29.8	29.1
	Fair	20.7	20.8	19.5	10.9	12.5	11.2
	Poor	8.9	10.0	8.8	4.4	3.7	4.3
	Institutionalized	-	0.8	1.9	-	0.2	0.6
	Deceased	-	1.8	3.8	-	1.1	2.1
	Total	100.0	100.0	100.0	100.0	100.0	100.0

Note: See note to Table 1.

Table 4. 1996-98 Distribution of Health Status Categories within 'Low' and 'High' Education Groups: Population Aged 50 and Older in 1996

		'Low' Education			'High' Education		
Sex	**Health Status**	**1996**	**1997**	**1998**	**1996**	**1997**	**1998**
				percent			
Male	Excellent	13.4	14.1	13.6	26.5	24.9	20.2
	Very good	30.8	27.1	27.6	31.6	32.5	33.8
	Good	29.3	28.7	27.6	25.9	25.9	26.6
	Fair	17.6	17.8	16.6	11.3	10.4	11.2
	Poor	8.9	9.5	8.4	4.7	4.9	4.8
	Institutionalized	-	0.6	1.0	-	0.2	0.5
	Deceased	-	2.3	5.2	-	1.2	3.0
	Total	100.0	100.0	100.0	100.0	100.0	100.0
Female	Excellent	12.4	10.2	9.6	21.7	20.0	20.0
	Very good	28.0	27.2	28.7	36.4	34.9	34.7
	Good	33.0	32.7	31.2	26.7	27.5	27.3
	Fair	18.7	19.2	18.4	10.7	12.3	9.8
	Poor	7.9	8.4	7.2	4.5	4.1	5.4
	Institutionalized	-	0.6	1.4	-	0.3	0.9
	Deceased	-	1.7	3.6	-	0.9	1.9
	Total	100.0	100.0	100.0	100.0	100.0	100.0

Note: 'Low' education includes the categories 'less than grade 11' and 'high school 11+'; 'high' education includes the categories 'some postsecondary' and 'university degree'. The categories are defined as of 1996, but people 50 and older are unlikely to have changed categories. The sample consists of 4746 males and 5995 females in the 'low' education category, 3006 males and 3142 females in the 'high' category. See also note to Table 1.

Table 5. 1996-98 Distribution of Health Status Categories, 'Young' and 'Old' Age Groups: Population Aged 50 and Older in 1996

		'Old' (Ages 70+)			'Young' (Ages 50-69)		
Sex	**Health Status**	**1996**	**1997**	**1998**	**1996**	**1997**	**1998**
				percent			
Male	Excellent	12.7	11.4	7.2	21.4	21.5	20.0
	Very good	25.2	23.0	23.5	33.4	31.9	32.8
	Good	31.4	30.8	30.6	26.5	26.2	25.8
	Fair	20.5	19.2	17.2	12.8	12.9	13.1
	Poor	10.2	10.1	9.0	6.0	6.5	6.1
	Institutionalized	-	1.2	2.0	-	0.2	0.3
	Deceased	-	4.3	10.4	-	0.9	2.0
	Total	100.0	100.0	100.0	100.0	100.0	100.0
Female	Excellent	10.2	8.0	7.1	18.8	16.9	16.7
	Very good	27.7	26.5	25.4	32.8	31.9	33.9
	Good	35.3	33.5	32.1	28.3	29.3	28.5
	Fair	19.7	19.4	18.7	13.7	15.2	13.5
	Poor	7.1	8.4	7.4	6.5	6.0	6.0
	Institutionalized	-	1.3	3.4	-	0.1	0.1
	Deceased	-	3.0	5.9	-	0.6	1.3
	Total	100.0	100.0	100.0	100.0	100.0	100.0

Note: The sample consists of 2242 males and 3302 females in the 'old' category, 5510 males and 583[illegible] females in the 'young' category. See also note to Table 1.

Table 6. Probit Regression Models of Health Transition Probabilities and Associated p-values

	Male		Female		Both Sexes	
Independent Variable	**ΔP**	**p-value**	**ΔP**	**p-value**	**ΔP**	**p-value**
Income quartile: 1	–	–	–	–	–	–
2	0.0277	*0.078*	0.0210	*0.221*	0.0258	*0.043*
3	0.0382	*0.013*	0.0517	*0.002*	0.0465	*0.000*
4	0.0731	*0.000*	0.0706	*0.000*	0.0731	*0.000*
All income categories		*<0.001*		*<0.001*		*<0.001*
Education: Less than grade 11	-0.0467	*0.019*	-0.0634	*0.001*	-0.0559	*0.000*
High school 11+	–	–	–	–	–	–
Some postsecondary	0.0058	*0.762*	0.0206	*0.212*	0.0138	*0.277*
University degree	0.0467	*0.032*	0.0737	*0.007*	0.0595	*0.001*
All education categories		*<0.001*		*<0.001*		*<0.001*
Age group: 50-54	–	–	–	–	–	–
55-59	-0.0851	*0.000*	-0.0718	*0.004*	-0.0798	*0.000*
60-64	-0.0780	*0.001*	-0.0495	*0.055*	-0.0645	*0.000*
65-69	-0.1123	*0.000*	-0.1011	*0.000*	-0.1085	*0.000*
70-74	-0.1731	*0.000*	-0.0921	*0.001*	-0.1307	*0.000*
75-79	-0.2202	*0.000*	-0.2030	*0.000*	-0.2165	*0.000*
80-84	-0.3036	*0.000*	-0.2553	*0.000*	-0.2819	*0.000*
85+	-0.4114	*0.000*	-0.3899	*0.000*	-0.4047	*0.000*
All age categories		*<0.001*		*<0.001*		*<0.001*
Became non-married	-0.1219	*0.022*	-0.0067	*0.849*	-0.0510	*0.097*
Rural/urban	-0.0250	*0.132*	-0.0009	*0.953*	-0.0136	*0.279*
Female					0.0091	*0.282*
No. of observations	5947		6977		12924	
Pseudo R^2	0.0759		0.0770		0.0749	

Note: ΔP is the estimated change in the probability of continuing in good health due to the discrete change from 0 to 1 in the value of a dummy variable. The p-value corresponds to a two-tailed test of the null hypothesis that the underlying coefficient is zero, calculated using all 1000 bootstrap weights provided with the Statistics Canada survey data. Variables are defined in the text.

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