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ABSTRACT

Research shows an older adult's education is strongly associated with mortality. But in societies such as Taiwan, where families are highly integrated, the education of family members may be linked to survival. Such may be the case in settings where there are large gaps in levels of education across generations and high levels of resource transfers between family members. This study employs 14 years of longitudinal data from Taiwan to examine the combined effects of education of older adults and their adult children on mortality outcomes of older adults. Nested Gompertz hazard models are used to evaluate the importance of education of an older adult and their highest-educated child after controlling for socioeconomic, demographic, and health characteristics. To gain further insight, additional models stratify results by whether older adults report serious chronic health conditions. Results indicate that educational levels of both parent and child are associated with older adult mortality, but the child's education is more important when a) controlling for the health of the older adult, and b) when examining only those older adults who already report a serious chronic condition, suggesting different roles for education in onset versus progression of a health disorder that may lead to death.

A common finding in the study of social status and health is the association of higher educational attainment with lower mortality (see, for example, the classic 1973 work by Kitagawa and Hauser on adult mortality in the United States in 1960). This positive relationship is especially well documented in rich countries (Liang et al. 2002; Preston and Taubman 1994; Valkonen 1989). The association also persists across the life span, although there is some evidence of its attenuation at older ages (Elo and Preston 1996; House et al. 1990; Liang et al. 2002; Ross and Wu 1995, 1996).

Less well understood are the underlying mechanisms of the effects of education on health.[1] Although early-life health status may influence opportunities to attend school and learn, or there may be unmeasured but common influences on both education and health, the usual presumption is that education per se confers a health benefit. The pathways from education to health span include a wide range of economic, psychological, and sociological factors. For example, education may serve as an indicator of health knowledge, access to economic resources and thus health care, ability to navigate health care systems, ability to understand and follow the instructions of health care providers, and, thus, propensity to adopt health-related lifestyles (House et al. 1994; Williams 1990).

Other questions surround the link between education and the onset as opposed to the progression of health problems. Zimmer and House (2003) find that between 1986 and 1994 in the United States, greater income and higher education were associated with a lower likelihood of onset of functional limitations, but that only income was associated with progression of such limitations. This result is consistent with evidence from Taiwan which showed, between 1989 and 1993, that education was associated with onset of functional limitations but not with their progression (Zimmer et al. 1998). Thus, education's influence may be greatest in the prevention of initial health problems but may have a less substantial role in recovery from health problems once they arise.

Evidence of the influence of education on mortality in poor countries is generally limited, although there is a growing body of research on East and Southeast Asian societies. Liang et al. (2000) show education to be an important determinant of old-age mortality in Wuhan, China; and Liu, Hermalin, and Chang (1998) find that the influence of education on mortality in Taiwan operates primarily indirectly through health status, health behaviors, and social relationships. Similarly, Zimmer, Martin, and Lin (2005) observe in their analysis of additional waves of the same survey that the strong effect of education on mortality is attenuated when measures of functional status and self-assessed health are added to models.

One of the weaknesses of the literature on education and mortality is that it generally takes an individualistic approach, that is, it models health outcomes as a function of one's own level of education.[2] Yet, the health benefits of social support from others have been widely documented (Anderson and Armstead 1995; House et al. 1994; House, Umberson, and Landis 1988; Mendes de Leon et al. 1999; Uchino, Caciappo, and Keicolt-Glaser 1996), and the importance of family support in particular has been emphasized in settings where extended families dominate (Hermalin, Ofstedal, and Chang 1995; Ofstedal, Knodel, and Chayovan 1999; Su and Ferraro 1997; Wu and Rudkin 2000). The apparent links between support and familial interrelations have not, however, been assessed in studies of how health is affected by the education of family members. A recent exception is a study by Zimmer, Hermalin, and Lin (2002), which investigated the influence of both own and children's education on physical functioning among older Taiwanese. They found that both are associated with the existence of physical limitations, but that only children's education predicts severity of limitations. This result again points to the potential of different roles of education in the onset versus progression of health disorders.

In this paper, we extend the analysis of Zimmer and colleagues by focusing on mortality outcomes of older Taiwanese. We ask whether, in the last critical stage of life, own education continues to matter for one's survival. Alternatively, in a setting in which there are substantial intergenerational differences in educational attainment, does children's education matter more? Taiwan is characterized by a very high degree of family cohesion, as indicated by high rates of coresidence between older adults and their adult children and by children's substantial involvement in the lives of older adults, even among those who do not coreside (Hermalin, Ofstedal, and Chang 1995; Knodel and Ofstedal 2002). Thus, it seems plausible that older adults would benefit in various ways from the resources available to their children. Second, a wide generation gap in education exists between older adults and their children. The current generation of older adults was brought up during a time of poverty, a weak health infrastructure, Japanese colonial rule, and limited education. Their children, meanwhile, were reared during a time of growing national prosperity, social development, and greater access to high-quality health services, and they have much higher levels of education. Thus, children's education may be more consequential than parents' education when it comes to securing familial resources.

METHODS

Data

Data used in this analysis come from the 1989 Survey of Health and Living Status of the Elderly in Taiwan, a project conducted jointly by the University of Michigan and the Taiwan Provincial Institute of Family Planning (now the Bureau of Health Promotion), which is a unit under the Ministry of Health. The data consist of 4,049 face-to-face interviews with adults aged 60 and older, 97 percent of which were completed in April or May, and 3 percent conducted between June and October. Topics covered in the interview included demographic, socioeconomic, and health characteristics of the respondent and some demographic and socioeconomic information about household members and the respondent's children living outside the household. For children of the respondent, data were collected on age, sex, marital status, proximity of residence, work status, and educational level. The response rate for the survey was 92 percent. (Descriptions of the data can be found in Casterline et al. 1991; Cornman et al. 1996; Hermalin 2002; Hermalin, Ofstedal, and Chi 1992; Zimmer, Martin, and Lin 2005.) The current analysis is limited to the 3,821 respondents who reported having at least one living child as of the time of first interview in 1989.

Cases from this data set have been linked to a registry that provides the date of death for individuals who died since the time of interview. For all but 64 individuals, information from the death registry is complete up to December 31, 2003, providing for almost 14 years of observation. Those for whom mortality information is complete either survived until that date and are considered to be right-censored in the following analysis, or they died and the date of death is recorded. Survival time for those who did not die is between the date of first interview in 1989 and December 31, 2003; survival for those who died is between date of first interview and date of death. Survival information for the other 64 cases is complete up to a date prior to December 31, 2003. Most of these individuals are known to have survived until December 31, 1999, whereas the remainder are known to have survived to an earlier point in time. These individuals are also right-censored, with their survival time being the time between first interview and last known date of survival.

Measures

For initial descriptive purposes, we consider the chances of surviving to the end of the observation period, December 31, 2003. For multivariate models, we use survival time, measured from date of first interview until death or date of censorship, to estimate hazard rates of dying.

Figure 1 shows the probability of surviving from time of first interview to December 31 of each year from 1989 through 2003, by sex and broad age groups for individuals with complete information through 2003. As one would expect, survival chances decrease much more steeply for older individuals than younger ones. Females in the younger two age groups have higher survival probabilities than do males. The greatest chance of surviving until the end of the observation period exists for females aged 60 to 69 at the time of interview. The lowest chance of surviving exists for males and females aged 80 and older at the time of interview. Survival probabilities are very similar for men and women aged 80 and older, and few of these individuals remained alive on December 31, 2003.

Table 1 indicates the educational attainment of respondents and their children by survival status of the respondent at the last observation. P-values indicate the statistical significance of differences in the distributions between survivors and non-survivors.

Education at the time of the baseline interview was coded as number of years of schooling for respondents and as a categorical measure for their children. Recoding education of respondents into the same categories used for their children resulted in a concentration in the lowest group, whereas children were much more likely to fall into the higher groups. For instance, very few of the older adults have more than a junior high school education, but very few of the children have no education. Accordingly, education of respondents and their children were recoded into three broad categories representing low, middle, and high levels of schooling for each group. Thus, the low category is no education for respondents but no, primary, or junior high school for their children; middle is primary education for respondents but senior high school for their children; and high is junior high, senior high, or university or college for the respondents but university or college for their children.

Because the average number of children per respondent is almost five, there are multiple responses for level of schooling of a respondent's children. All of the analyses that follow were run several times, treating children's education as a single variable but measured three ways: 1) as the highest education level of all living children, 2) as the lowest education level of all living children, and 3) as the highest education level of children living in closest proximity to the older adult. In general, the three ways of measuring child's education resulted in similar conclusions, although the highest education of all children produced the strongest findings and the lowest education produced the weakest. In the end, we assumed that the health of an older adult is most strongly influenced by the one child with the highest education, who is likely to have the greatest availability of resources.

Table 1 also shows the distribution by respondent's survival status of other covariates to be used in the multivariate analysis. In addition to educational attainment, some other information about the respondent's children is available. First, many have more than one child with a similar level of education. It is possible that an individual with several children who have, say, university education will be advantaged in comparison to an individual with just one child with a similar level of education. Therefore, we included a variable indicating the number of children who have the highest level of schooling. Second, the sex of the child with the highest level of schooling may be important. The elderly in Chinese societies are often thought to be more dependent on sons than daughters, so having a highly educated son may be more critical than having a highly educated daughter. We included the sex of the child who has the highest level of education, including a category for having both a son and a daughter with a similar high level of schooling.

We include various demographic characteristics of the respondent: age (measured continuously), sex (female or male), marital status (married or other), place of residence (rural or urban), total number of living children (measured continuously), and ethnicity (Mainlander or other). Taiwan is ethnically homogeneous, although a proportion of individuals migrated from Mainland China after the 1949 Revolution. These individuals have distinct characteristics that influence their survival chances. They are more likely than others to be male, unmarried, and former soldiers, to have worked in government positions, and to have had access to medical insurance for most of their adult life. Previous research has shown these characteristics to have health implications for Mainlanders, who tend to live longer than other Taiwanese (Zimmer, Martin, and Lin 2005).

Finally, we control for initial health status using self-reported health measures. First, we construct a measure of functional limitations according to responses to five questions regarding the ability to perform general physical movements that might be necessary for conducting daily tasks: crouching, climbing stairs, walking, grasping with fingers, reaching for objects. Individuals were asked whether they could accomplish these tasks without assistance; if they reported difficulty, they were asked whether they had a little difficulty, a lot of difficulty, or could not do the task at all. In addition, they were allowed to give no answer if the task mentioned was one that they never attempted. A four-category variable was constructed from the responses. Those who had no problem with any task are coded as having no functional limitations. Those with a little difficulty doing one or two tasks are considered to have mild limitations. Those with a little difficulty with more than two tasks, or more than a little difficulty with one or two tasks, or a combination of these two criteria, are coded as having moderate limitations. Those with more than a little difficulty with three or more tasks are considered to have severe limitations. Coding decisions for 77 individuals who did not respond to one of the five items, and for 12 others who did not respond to two, were made on the basis of the remaining non-missing responses. Nine individuals with more than two missing responses were omitted from analyses.

Second, we use dichotomous measures for self-reporting of seven individual diseases: lung disease, heart disease, stroke, diabetes, kidney disease, liver disease, and hypertension. These diseases were chosen because they represent seven of the eight leading causes of death in Taiwan (DGBAS 2003). Questions about cancer, the eighth leading cause, were not asked at baseline. For each disease, respondents are coded as 1 if they report having the disease and as 0 if not. Table 1 also includes a summary measure indicating reporting of at least one of the seven diseases.

Third, we included a measure of self-assessed health derived from a question asking individuals to rate their overall health as excellent, very good, good, fair, or poor. Excellent and very good were combined. There were no responses from 3.6 percent of respondents, who are mostly individuals with cognitive or other health disorders serious enough to hamper their ability to answer questions and who were thus interviewed by proxy. Therefore, the missing respondents tend to be individuals with very poor health, and an additional category was constructed for them.

Table 1 shows that survivors and non-survivors have very different characteristics. Compared to non-survivors, for instance, survivors are generally better educated, younger, more likely to be female, married, and Mainlander. They also are more likely to have a child with more education and less likely to have health problems at baseline.

Analysis

In the multivariate models, we examine survival between the time of interview in 1989 until time of death or censoring, using STATA 8.0 software for maximum likelihood survival regression, with a Gompertz hazard distribution (Finch and Pike 1996; Franses 1994; Lee and Wang 2003; Statacorp 2003). The Gompertz distribution has been shown to be suitable for old-age mortality generally, and has been determined to be specifically appropriate for the current sample (Manton et al. 1994; Mueller, Nusbaum, and Rose 1995; Zimmer, Martin, and Lin 2005). The distribution assumes an underlying rate of mortality, determined by the data, that is monotonically increasing or decreasing with time of exposure, represented by α in the hazard equation:

$$h(t) = \lambda e^{\alpha t}$$

where α is fixed across individuals, and λ, our primary interest, is estimated by a vector of covariates that includes measures of education of the respondents and their children. The effect of these covariates on the hazard of dying is represented by their coefficients.

We take a nested modeling approach and estimate a series of models. Differences in log-likelihoods between two nested models are used to establish whether a set of added variables significantly improves predictions of survival. The first considers the hazard to be a function of age and sex only. Next, we add respondent's education and determine whether individuals with higher education have lower mortality when adjusting for age and sex. We then add education of the highest-educated child and determine whether this variable has an added influence net of the respondent's own education. Next, we include variables to determine whether effects of education are dependent upon demographic characteristics of the respondent and other information about the children. Finally, to assess whether the effect of education on the hazard of dying operates through health measures at baseline, we add indicators of functional, disease-specific, and general self-assessed health.

Given the possibility that education operates differently for onset versus progression of a disease, we also explore whether or not education has differing effects depending upon the initial disease status. For instance, among those without diseases, education may influence prevention and in this way decrease the hazard of dying. For those with diseases, education may influence reaction to and treatment of the disease, and in this way affect recovery or progression to death. To assess this possibility, after estimating the above models for the total population, we estimate them again stratifying the sample into individuals who do and do not report any diseases at the time of first interview.

RESULTS

We begin, in Table 2, by examining the relationship between education and the probability that an older adult survived until December 31, 2003. We omit the 64 cases for whom survival information is known only up to an earlier date. The upper-most panel shows a strong association of survival with education of the older adult. About 37 percent of the elderly without education survived the period compared to about 47 percent of those with middle level of education and 55 percent of those with high education.

The next three panels examine survival probabilities by education of the highest-educated child within categories of education of the older adult. For example, the second panel shows survival probabilities by education of the child for those older adults with a low level of education. For all levels of respondent's education, the education of the highest-educated child is significantly associated with survival, suggesting an added effect. For older adults with low education, the chances of surviving are 35 percent if their highest-educated child has low level of education, about 45 percent if the child has middle education, and 47 percent if the child has the high education level. Similar gradients exist among older adults with middle and high education. The lowest overall chance of survival exists when both the older adult and child have low level of education (35 percent), whereas the highest chance exists when they both have a relatively high level of education (60 percent).

Table 2 also shows the numerical distribution of highest level of children's education across categories of education for the older adult. Although there is a strong association, education of respondent and child are not perfectly correlated. For instance, the educational level of highest-educated child of more than 900 older adults with low education is also low, but over 500 older adults have a child with middle level education and over 400 have a child with a high level of education. Among older adults with middle education, there is a fairly even distribution for the highest education of children. For older adults with high education, very few have children with only low education, but a good number have children with middle education.

Thus, the initial indication is that educational levels of both respondents and their highest-educated children are strongly linked to survival, each playing a distinct role. Of course, many confounding factors may be at work here. For instance, the measures of education and survival may be a function of the age of the older adult. Table 3 presents a series of hazard models beginning with Model 1, which controls for age and sex of respondent. As expected, older adults have a higher risk of dying and females have a lower risk. Model 2 adds education of the older adult, and those in the top two education groups have a statistically significant lower risk of dying than those in the lowest group, even after adjusting for age and sex. The magnitude of the effect is much larger for those with high education than for those with middle.

Model 3 adds education of the highest-educated child. The change in log-likelihood is significant, indicating that the education of the child improves model fit. Education of the older adult remains important, but having a child with high education further reduces the risk of dying. However, there is no significant difference in survival for those whose highest-educated child has middle rather than low education. High education for the child means that at least one child has a university or college education, and the result of Model 3 indicates that university or college education for a child confers a net benefit on the survival of their elderly parent, and that having a child with this level of education operates as an additional and separate influence on adult mortality beyond the education of the older adults themselves.

When other characteristics of the older adult and their children are added in Model 4, educational levels of respondents and their highest-educated children remain important predictors. The coefficient for high education of respondents is greater than for middle, but it is not significant, likely owing to the smaller number. In addition, those who are married and Mainlanders have a lower risk than do those not married and non-Mainlanders. If the highest-educated children are both male and female, that is, at least one child of each sex has a similar high level of education, the risk of mortality is also reduced ($p<.10$). This result suggests that having children of both sexes may provide complementary resources that confer a survival advantage. For example, a son may offer material resources while a daughter provides physical assistance.

Model 5 includes the indicators of health status. One would expect these measures to be strongly related to the hazard of dying and the effects of other variables to be reduced if the effect of the other variables operates through health status. Baseline functional limitation and self-assessed health are indeed strong and significant predictors of mortality. Respondents with severe functional limitations and those with missing self-assessed health information are particularly vulnerable to the risk of dying. Of the individual diseases, lung disease, stroke, diabetes, and hypertension significantly increase the hazard, whereas heart disease, kidney disease, and liver disease have positive but insignificant coefficients. The addition of these health controls eliminates completely the effect of an older adult's own education on survival. In contrast, the effect of the education of the highest-educated child persists. Specifically, having a child with a high level of education is beneficial compared with having children with only low levels of education, even when accounting for the respondent’s health. The effects of age, sex, marital status, being a Mainlander, and sex of children with highest education also remain after adding indicators of health.

Results thus far suggest that educational levels of both the older adult and his or her children influence the survival of the older adult. However, because the importance of an older adult’s education is reduced to insignificance, whereas the child’s education is not, the results also suggest an additional benefit of children’s education that operates independently of health status. This pattern may indicate that the education of an older adult helps in the prevention of health problems, whereas both onset and the course of illness are influenced by the education of children. To test this possibility further, Table 4 examines two sets of hazard models, stratified by whether or not the older adult had at least one of the seven diseases at the time of first interview in 1989. The models are the same as those in the previous table, except that Model 5 adds only functional and self-assessed health.

The first part of the table, which looks at 1,641 individuals who began the study period without any of the diseases, indicates a strong influence of older adult education, particularly the highest category, which persists across the models, even after controlling for demographic characteristics, functional limitations, and self-assessed health. In fact, coefficients on respondent’s education here are much larger than they were when the analysis was not stratified. Having a child with a high level of education is also a benefit, but its effect is insignificant in Models 4 and 5.

The second part of the table, which considers the 2,066 individuals beginning the study period with one or more of the diseases, shows very different effects of education. An older adult’s own level ceases to be an influential factor once demographic variables other than age and sex are added. The education of the highest-educated child remains an important determinant. In Model 5 with health measures, the coefficient for a child with high education is significant at a .10 level (two-tailed test). Although this p-value is slightly beyond the conventional level of statistical significance, the effect is highly significant using a one-tailed test, which may be more appropriate here given the expectation that education reduces mortality. In addition, the coefficient remains fairly substantial in size and therefore an effect is clearly present.

DISCUSSION

Our objective was to examine the effect of education on old-age mortality in Taiwan. The paper extends previous work by considering education as a family resource, rather than an individual one. We hypothesized that, in a society such as Taiwan that is characterized by a high degree of family integration and wide gaps in the education of current cohorts of older parents and their children, the education of one’s children may have as important an effect, if not a greater effect, on parents’ health and mortality than the parents’ own education.

The findings suggest that educational levels of both the older parent and his or her children play important protective roles for survival in old age. In our analysis of the full sample, we found that older parents who had middle or high levels of education (primary school or higher) had a significantly lower mortality risk than those with no education, at least before we entered health status as a control. In addition, controlling for parents’ education, older parents who had at least one highly educated child (university or higher) had a substantially lower risk of mortality in all models than parents whose highest-educated child had a junior high school education or less. In addition, having both a son and daughter with high education conferred an additional protective effect. This effect is net of the number of children with the highest level of education and suggests that sons and daughters offer distinct, complementary resources that are beneficial to their parents' health.

Stratification of the sample into respondents with and without a disease at baseline revealed a potential difference in the mechanisms by which own and children's education influence health and mortality. Among those without a disease at baseline, the older adult's education was a strong predictor of mortality in all models, whereas children's education mattered only in models without other sociodemographic and health measures. In contrast, for parents who had acquired one or more diseases by the time of the baseline interview, children's education was the more salient factor. This result suggests that the older adult's own education may operate primarily through factors that protect against the onset of a life-threatening health problem, whereas children's education may be more important in influencing the course and treatment of disease, determining the progression to recovery or death, and mitigating its impact on mortality.

Although our primary focus was on the effects of education of children and older adults, a number of other findings are worth reiterating. Age, sex, marital status, and being a Mainlander or not are strong predictors of mortality in either the stratified or unstratified models. They remain so after controlling for indicators of health, suggesting that they have some additional influence on mortality that does not operate through the health measures included. For age and sex, this result is expected, but for marital status and Mainlander ethnicity, the explanation is less straightforward. Married individuals may have advantages related to having an immediate source of social support, which is itself a determinant of health. Mainlanders may have derived certain advantages through their employment. Their work as soldiers during their younger years likely demanded a high level of physical fitness perhaps not captured in our health measures, and their more likely involvement in government work throughout their adult lives provided access to health care.

The effects of both self-assessed health and functional limitation are extremely strong even when controlling for specific diseases in the analysis of the full sample. Functional limitation and self-assessed health are comprehensive measures and as such likely involve subtle aspects of health that are difficult to capture using self-reports of specific diseases. In addition, they may be picking up health information related to diseases that exist but are unreported, health disorders in a pre-clinical stage, and psychological factors that may also relate to survival. These comprehensive questions may be more "accurately" answered than disease-specific questions, and the question about self-assessed health reflects an assessment of severity of health problems. In any case, the results suggest that these measures are important determinants of mortality and operate, at least to some extent, outside of the processes involved in the seven specific diseases included as indicators of health.

Our findings may be affected by the particular way in which we represented education in our models. To address this potential limitation, we conducted sensitivity analyses to assess whether the findings were replicated under alternate specifications of education for both the older adult and his or her children. Regardless of how education was represented in the models, the results were quite consistent with what we show here. Throughout the models tested, when the education of the child is important, it is having a child with a high level of education (i.e., university level) that leads to lower mortality. A child with senior high school education as the highest level does not improve survival when compared with a child with less education.

Whether children's education will continue to play an important role in the health and mortality of older Taiwanese is uncertain. The education of older Taiwanese will increase dramatically in the future (Christenson and Hermalin 1991), far outpacing further increases in education for younger cohorts, for whom education levels have been high for some time (Knodel, Ofstedal, and Hermalin 2002). On the one hand, higher education of both parents and their children may be extremely beneficial for the health and survival of older adults. On the other hand, a narrowing educational gap between the generations may imply a more salient role for parents' education relative to children's. Moreover, thresholds at which education exhibits protective effects on health may change. Our findings suggest that, for adult children, only university or higher education has had an important protective effect on parents' survival, whereas for parents the threshold appears to be junior high education or even primary education. As the education of older adults (and to a lesser extent their children) increases, the threshold at which education confers a benefit may also change.

It is also unclear whether children's education would be as important to the survival of older parents in other settings with different family structures. An informative extension of this work would be to replicate the analysis using data from other Asian settings with different family systems—for example, to contrast the bilateral family systems of Southeast Asia with the patrilineal family system of Taiwan—as well as data from the United States, where intergenerational family ties and forms of support differ from those in Asia.

NOTES

1 Ross and Mirowsky (1999) provide a recent exception in their effort to understand what aspects of education matter (i.e., quantity, credentials, and selectivity) and how they operate (e.g., through employment, sense of control, lifestyle, physical functioning).

2 There is a substantial body of evidence regarding parents' education and child mortality, especially in poorer countries. See Cleland and van Ginneken (1988) and Hobcraft (1993) for reviews of the influence of maternal education in particular on child survival.

Figure 1 Probability of surviving from date of first interview to Dec. 31 of various years by age and sex

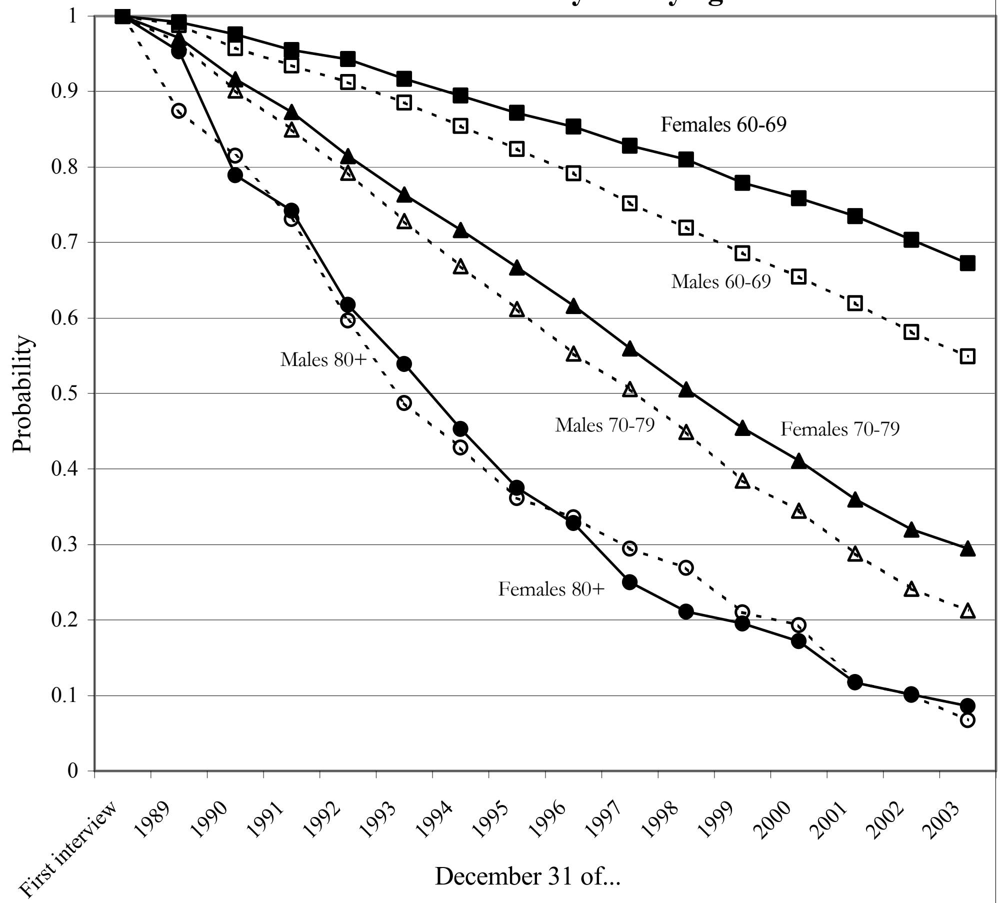

Table 1. Descriptive statistics by survival status, showing percent or mean, with standard deviation in parentheses

	Survivors[a] (N= 1,805)	Non-survivors[b] (N= 2,016)	P-Value[c]
Education of respondent (%)			
Low	44.2	56.5	
Middle	32.7	28.6	
High	23.1	14.9	.000
Education of highest-educated child (%)			
Low	27.4	40.6	
Middle	28.6	28.5	
High	43.9	30.9	.000
Mean number of children who have the highest level of education	2.8 (1.9)	3.2 (2.2)	.000
Sex of highest-educated child (%)			
Female	18.4	18.8	
Male	43.1	47.0	
Both male and female	38.5	34.1	.015
Demographic characteristics			
Mean age	65.6 (4.6)	70.7 (6.9)	.000
Female	48.6	41.2	.000
Married	74.4	61.1	.000
Mainlander	23.1	15.2	.000
Rural	32.8	37.2	.000
Mean number living children	4.8 (2.0)	4.9 (2.2)	.022
Functional limitations (%)			
None	74.6	52.0	
Mild	1.6	17.1	
Moderate	9.1	19.1	
Severe	7.1	11.8	.000
Diseases (%)			
Lung disease	14.1	22.2	.000
Heart disease	18.5	24.4	.000
Stroke	1.5	7.0	.000
Diabetes	5.0	11.8	.000
Kidney disease	5.2	7.5	.004
Liver disease	5.6	6.3	.353
Hypertension	23.0	29.7	.000
At least one disease	48.5	62.7	.000

Continued on next page

Table 1 (continued)

	Survivors[a] (N= 1,805)	Non-survivors[b] (N= 2,016)	P-Value[c]
Self-assessed health (%)			
Excellent/Very good	45.2	30.5	
Good	38.3	36.8	
Fair	14.1	21.1	
Poor	1.6	5.6	
Missing	0.9	6.1	.000

[a]Survived to last observation, including 1,741 cases known to have survived to December 31, 2003 and 64 cases surviving but censored prior to December 31, 2003
[b]Known to have died prior to December 31, 2003
[c]Compares distribution of survivors to non-survivors

Table 2. Probability of surviving from first interview to December 31, 2003, by education of respondent and highest education of all living children[a]

Education of older adult	Highest education of all living children	N	Probability
Low	All	1899	.369
Middle	All	1150	.469
High	All	690	.551
$\chi^2 = 64.1$**			
Low	Low	940	.351
	Middle	535	.447
	High	411	.474
$\chi^2 = 23.4$**			
Middle	Low	305	.423
	Middle	391	.494
	High	445	.562
$\chi^2 = 14.1$**			
High	Low	38	.395
	Middle	137	.489
	High	510	.602
$\chi^2 = 10.5$**			

** $p < .01$ * $p < .05$

[a]64 cases censored prior to December 31, 2003 are omitted

Table 3. Nested hazard models (N=3707)

	Model 1	Model 2	Model 3	Model 4	Model 5
Respondent's education (comparison = low)					
Middle		-.137*	-.097^	-.115*	-.042
High		-.371**	-.256**	-.137	-.052
Education of highest-educated child (comparison = low)					
Middle			-.019	-.008	-.034
High			-.205**	-.193*	-.173*
Age	.097**	.094**	.093**	.089**	.081**
Female	-.299**	-.395**	-.383**	-.447**	-.579**
Married				-.139**	-.155**
Mainlander				-.279**	-.325**
Rural				.046	.041
Number of living children				-.004	.001
Number of children with highest education				.000	-.011
Sex of highest-educated child (comparison = female)					
Male				-.002	.003
Both male and female				-.138^	-.120^
Functional limitations (comparison = has none)					
Mild					.122^
Moderate					.303**
Severe					.719**
Diseases					
Lung disease					.115**
Heart disease					.072
Stroke					.414**
Diabetes					.579**
Kidney disease					.054
Liver disease					.039
Hypertension					.142**
Self-assessed health (comparison = excellent/ very good)					
Good					.096^
Fair					.292**
Poor					.486**
Missing					.761**
Constant	-16.062	-15.668	-15.576	-15.119	-15.014
Λ	.00022	.00022	.00022	.00022	.00026
LL	-4053.4	-4039.1	-4032.3	-4016.3	-3819.0
Д –2 X LL	811.7**[a]	28.7**[b]	13.5**[b]	32.1**[b]	394.5**[b]

** p < .01 * p < .05 ^ p < .10

[a]Compared to a model with intercept only

[b]Compared to previous model

Table 4. Nested hazard models, stratified sample for respondents with and without a disease at baseline

Those without a disease (N=1641)	Model 1	Model 2	Model 3	Model 4	Model 5
Respondent's education (comparison = low)					
Middle		-.179*	-.117	-.142	-.126
High		-.558**	-.384**	-.378**	-.340*
Education of highest-educated child (comparison = low)					
Middle			.011	.109	.131
High			-.306**	-.182	-.111
Age	.108**	.103**	.102**	.098**	.091**
Female	-.244**	-.368**	-.356**	-.464**	-.586**
Married				-.246**	-.245**
Mainlander				-.263*	-.275*
Rural				.074	.042
Number of living children				-.041	-.034
Number of children with highest education				.015	.013
Sex of highest-educated child (comparison = female)					
Male				-.052	-.066
Both male and female				-.107	-.096
Functional limitations (comparison = has none)					
Mild					-.137
Moderate					.497**
Severe					.710**
Self-assessed health (comparison = excellent/ very good)					
Good					.059
Fair					.475**
Poor					.318
Missing					.947**
Constant	-17.295	-16.734	-16.664	-16.006	-15.759
Λ	.00028	.00028	.00029	.00029	.00032
LL	-1556.6	-1544.9	-1538.8	-1529.7	-1490.7
Д –2 X LL	385.6**[a]	23.4**[b]	12.4**[b]	18.2**[b]	78.0**[b]

Continued on next page

Table 4 (continued)

Those with a disease (N=2066)	Model 1	Model 2	Model 3	Model 4	Model 5
Respondent's education (comparison = low)					
Middle		-.089	-.061	-.067	.009
High		-.267**	-.186^	-.015	.161
Education of highest-educated child (comparison = low)					
Middle			-.060	-.103	-.096
High			-.157**	-.220*	-.185^
Age	.091**	.088**	.087**	.080**	.070**
Female	-.395**	-.469**	-.460**	-.497**	-.554**
Married				-.054	-.116^
Mainlander				-.303**	-.321**
Rural				.019	.008
Number of living children				.021	.031
Number of children with highest education				-.007	-.025
Sex of highest-educated child (comparison = female)					
Male				.028	.047
Both male and female				-.148	-.115
Functional limitations (comparison = has none)					
Mild					.246**
Moderate					.340**
Severe					.847**
Self-assessed health (comparison = excellent/ very good)					
Good					.114
Fair					.305**
Poor					.602**
Missing					.825**
Constant	-15.297	-15.028	-14.901	-14.627	-14.137
λ	.00019	.00019	.00019	.00019	.00023
LL	-2439.2	-2434.5	-2432.3	-2420.2	-2333.1
Д –2 X LL	444.8**[a]	9.4**[b]	4.3 [b]	24.2** [b]	174.2**[b]

** p < .01 * p < .05 ^ p < .10

[a]Compared to a model with intercept only

[b]Compared to previous model

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