The Effect of Education of Adult Children on Mortality of Elderly Parents in Taiwan

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ABSTRACT

Research shows an older adult's education is an important mortality determinant. But, in societies such as Taiwan, where families are highly integrated, it is possible that the education of family members also influences 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 fourteen 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 both the education of parent and child influence 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 determining onset versus progression of a health disorder that may lead to death.

INTRODUCTION

A common finding in the study of social status and health is that greater educational attainment is associated 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 relation 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 education's effects on health.[1] Although early-life health 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 confers a health benefit. The pathways from education to health span a wide and complex array of economic, psychological and sociological. 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, stress, social support, and a differential time horizon 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 for the United States that between 1986 and 1994 greater income and education were associated with a lower likelihood of onset of functional limitations, but that only income was associated with progression. This result is consistent with evidence from Taiwan that showed, between 1989 and 1993, education to be associated with onset of functional limitations but not with progression (Zimmer et al. 1998). Thus,

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

education's power 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 for Taiwan that the important influence of education on mortality 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 disadvantages of this the literature on education and mortality is that it generally takes an individualistic approach, that is, modeling health outcomes as a function of one's own level of education.[2] Yet, the health benefits of social support 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, translated into 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 limitations, but that only children's education predicts severity of

[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.

limitations. This result again speaks to the potential of different roles of education in the onset versus progression of health disorder.

In this paper, we extend the analysis of Zimmer and colleagues by focusing on mortality outcomes of older Taiwanese, and ask: In the last critical stage of life, does own education continue to matter for survival? Or in a setting in which there are substantial intergenerational differences in educational attainment, does children's education matter more? The Taiwan setting is a particularly interesting one for a study of this nature. First, 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 substantial involvement in the lives of older adults by children, even among those that do not coreside (Hermalin, Ofstedal, and Chang 1995; Knodel and Ofstedal 2002). Thus, it seems plausible that older adults would benefit in a variety of ways from the resources that are available to their children. Second, there is a tremendous generation gap in education 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 most have low levels of education. Their children, however, were brought up during a time of growing national prosperity, social development, greater access to quality health services, and have much higher levels of education. Thus, children's education may be more consequential than parent's 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) that is a unit under the Ministry of Health. The data consist of 4,049 face-to-face interviews with adults age 60 and older, 97% of which were completed in April or May, and 3% conducted between June and October. Topics covered in the interview were wide-ranging and included, among other things, 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 on age, sex, marital status, proximity of residence, work status, and educational level were collected. The response rate for the survey was 92%. Good descriptions of the data can found in several previous reports and publications (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 that 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 that died since the time of interview. For all but 64 individuals, the mortality information from the death registry is complete up to December 31, 2003, providing for almost fourteen years of observation. Those for whom mortality information is complete either survived until that date and they 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. As for the other 64 cases, survival information 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

Survival: 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 would be expected, 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 time of interview. The lowest chance of surviving exists for males and females aged 80 and older at time of interview. Survival probabilities are very similar for men and women aged 80 or older, and few of these individuals remained alive on December 31, 2003.

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

Education at time of baseline interview was coded as number of years of schooling for respondents, but 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 in the higher groups. For instance, very few of the older adults have more than junior high 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 respectively. So the low category is no education for respondents but no, primary, or junior high for their children; middle is primary education for respondents but senior high 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 education of child 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 determined that it made sense to assume that the health of an older adult is most influenced by the one child with the highest education, who is likely to have the greatest availability of resources.

Other Covariates: 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 additional 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 with, 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 that 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 important than having a highly educated daughter. We included the sex of the child that 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 a series of 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, but there are a fair proportion of individuals that 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 throughout most of their adult life. Previous research has shown these characteristics to have health implications for Mainlanders, and they tend to live longer than others (Zimmer, Martin, and Lin 2005).

Finally, we will control for initial health status using a series of self-reported health measures. First, a measure of functional limitations is constructed using responses to five questions regarding the ability to carry out general physical bodily movements that might be necessary for conducting daily tasks: crouching, climbing stairs, walking, grasping with fingers, reaching for things. Individuals were asked if they could accomplish these tasks without assistance, and 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 not answer if it is a task that they never attempt. A four-category variable was constructed from the responses. Those that 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 as having severe limitations. Coding decisions for seventy-seven individuals that did not respond to one of the five items, and twelve others that did not respond to two, were made based on the remaining non-missing responses. Nine individuals with more than two missing responses were omitted from analyses.

Second, we included dichotomous measures for reporting having 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). The eighth leading cause is cancer, but questions about cancer were not asked at baseline. For each disease, respondents are coded as a 1 if they report having the disease and a 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% of respondents, who are mostly individuals with cognitive or other health disorders that were serious enough to hamper their ability to answer questions and 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. For instance, survivors are generally better educated, younger, more likely to be female, married and Mainlander than non-survivors. They also are more likely to have a child with more education and less likely to have health problems at baseline.

Analysis

For the multivariate models, survival is examined 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 if those with higher education have lower mortality when adjusting for age and sex. Then, we 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. In order to assess this possibility, after estimating the above models for the total population, we estimate them again stratifying the sample into those who do and do not report any diseases at the time of first interview.

RESULTS

We begin, in Table 2, with a descriptive examination of the relation between education and the probability that an older adult survived until December 31, 2003. Omitted are the 64 cases for which 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% of those without education survived the period compared to about 47% of those with middle level of education and 55% 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 low-level education. For all levels of respondent 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% if their highest educated child has low level of education, about 45% if the child has middle education, and 47% if they have high education. 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 (.351), whereas the highest chance exists when they both have a relatively high level of education (.602).

The table also shows the 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 highest educated child for over 900 older adults with low education is also low, but over 500 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 education of both respondents and their highest educated children are important determinants of survival, each playing a distinct role. Of course, there are many confounding factors that may be at work here. For instance, both measures of education and survival may be a function of 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 versus low education. High education for the child means that at least one child has university or college education, and the result of Model 3 indicates that university or college education for a child is a net benefit when it comes to survival of their elderly parent, and that having a child with this level of education operates as an additional and separate influence on older adult mortality above the education of the older adults themselves.

When other characteristics of the older adult and their children are added in Model 4, education of respondents and their highest educated children remain important predictors. The coefficient for high education is greater than for middle, but it is not significant, likely due 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 children of different genders may bring together different resources that may confer survival advantage. For example, the son may offer material resources while the daughter provides physical assistance.

Model 5 includes the indicators of health. 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 very strong and significant predictors of mortality. Those 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 serves to eliminate 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, it is the case that having a child with a high level of education is beneficial over having children with only low levels of education, even when accounting for respondent's health. The effects of age, sex, marital status, being a Mainlander or not, and sex of children with highest education also remain after adding indicators of health.

Results thus far suggest that education levels of both the older adult and his/her children matter when it comes to 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, after adjusting for health, the results also suggest an additional benefit of the children's education that works outside of health status. This pattern may indicate that the education of an older adult helps in the prevention of health problems, but 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 has 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 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 beyond 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 is slightly beyond the conventional level of statistical significance, the effect is highly significant given a one-tailed test, which may be more appropriate here given the expectation that education reduces mortality. In addition, the coefficient remains fairly substantial and therefore an effect is clearly present.

DISCUSSION

The objective of this paper was to examine the effect of education on old-age mortality in Taiwan. The paper extends previous work by considering education as a family, rather than an individual resource. 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 children, the education of one's children may have as important of an effect, if not more, on parent's health and mortality than the parent's own education.

The findings suggest that education of both the older parent and his/her children play important protective roles for survival in old age. In our analysis of the full sample (Table 3), we found that older parents who had relatively high levels of education (junior high or higher) had a significantly lower mortality risk than those with no education, at least prior to entering health status as a control. In addition, controlling for parent's education, older parents who had at least one highly educated children (university or higher) had a substantially lower risk of mortality in all models than parents for whom the highest educated child had high school or less. In addition, having both a male and female child with high education conferred an additional protective. This effect is net of the number of children with the highest level of education and suggests that sons and daughters offer distinct resources that are beneficial to their parent's health.

Stratification of the sample into those 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 those who had acquired one or more disease 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, such as lifestyle, behaviors, or earlier access to care, 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, for example, by helping parents navigate the health care system, follow health care provider instructions, and encouraging beneficial lifestyle modifications.

Although our primary focus was on the effects of education of children and older adults, there are a number of other findings worth noting. Age, sex, marital status, and being a Mainlander or not are strong predictors of mortality in both the stratified and 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 findings are perhaps somewhat more interesting. Married individuals may have advantages with respect 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 young adult lives 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 very global 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 not included in our list, diseases that exist but are unreported, health disorders in a pre-clinical stage, and psychological factors that may also relate to survival. These global 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.

It is possible that our findings are particular to the 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/her set of children. Regardless of how education was represented in the models, the results were quite consistent with what we show here. Recall that for the child, high education is defined as university, middle as senior high, and low as less than senior high, whereas for the respondent high is simply more than primary, middle is primary, and low is none. 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 as the highest level of education does not improve survival versus a child with less education. We tested individual measures for the actual number of children with different levels of education and by coding the education into larger and smaller numbers of categories. In each instance, having at least one child with university turned out to be the key factor in lowering the hazard of dying, and as such, a dichotomous measure that differentiated those with versus without at least one child with university education worked as well as any more detailed description of the education of children. We also cut respondent's own education in different ways, and found that, where it is important, anything more than primary, which could be junior high, senior high, or university, has virtually the same effect.

Whether children's education will continue to play an important role in the heath and mortality of older Taiwanese in the future is uncertain. The education of older Taiwanese will increase dramatically in the future (Christensen 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 children may be extremely beneficial for 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 recently 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 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 interesting extension of this work would be to replicate the analysis using data from other Asian settings with different family systems (e.g., to contrast the bilateral family systems of Southeast Asia with the patrilineal family system of Taiwan), as well as the United States where intergenerational family ties and support take somewhat different forms than is the case in Asia.

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

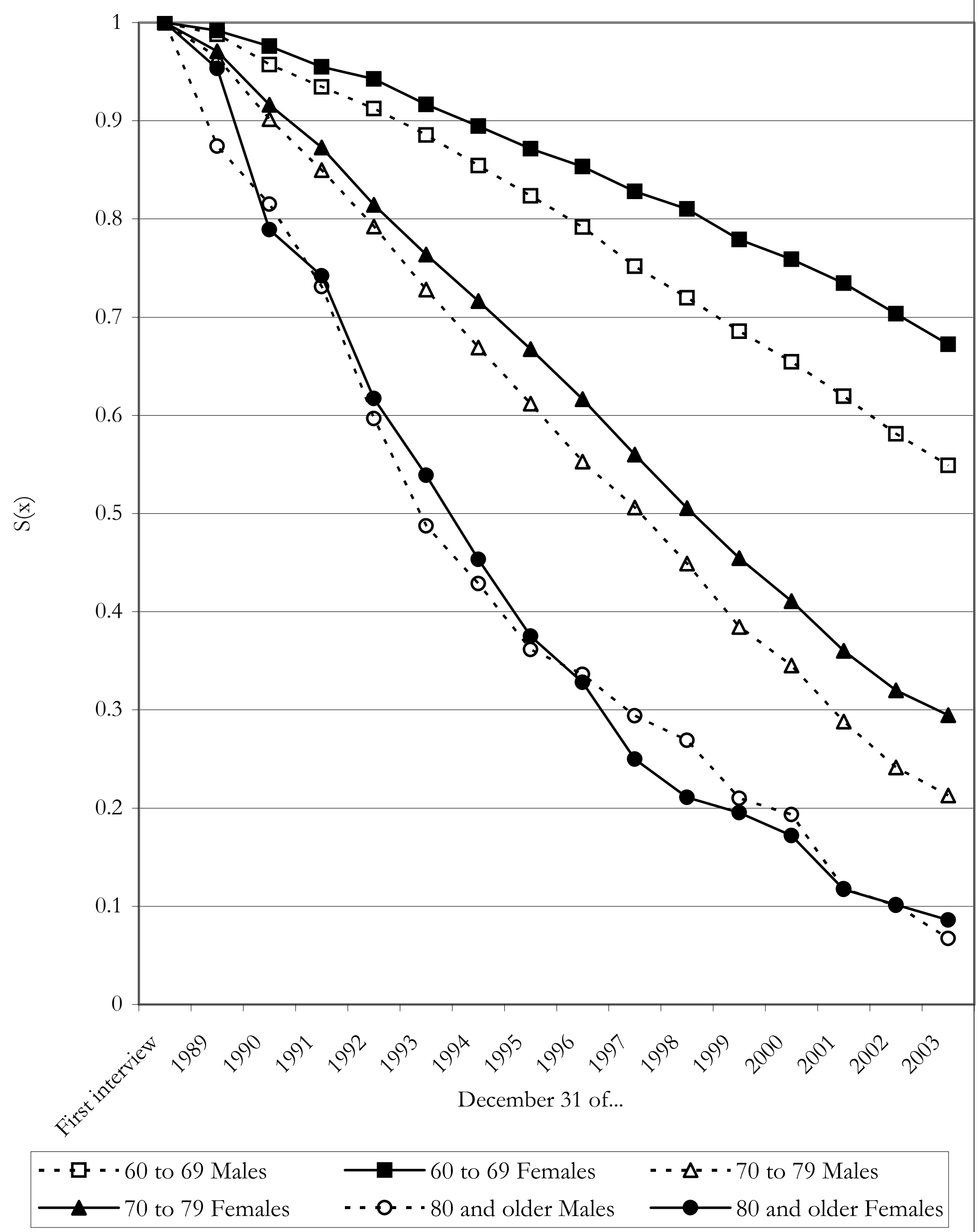

Table 1. Descriptive statistics by survival status, showing percent or mean, with standard deviation in parentheses

	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
Other information about children's education:			
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	
% Who have both a male and a female child with a similarly high level of education	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 1,741cases 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**
Is female	-.299**	-.395**	-.383**	-.447**	-.579**
Is married				-.139**	-.155**
Is mainlander				-.279**	-.325**
Is rural				.046	.041
Number living children				-.004	.001
Number 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					.054
Liver					.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
Δ –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, stratifying sample for those 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**
Is female	-.244**	-.368**	-.356**	-.464**	-.586**
Is married				-.246**	-.245**
Is mainlander				-.263*	-.275*
Is rural				.074	.042
Number living children				-.041	-.034
Number 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
Δ −2 X LL	385.6**[a]	23.4**[b]	12.4**[b]	18.2**[b]	78.0**[b]

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**
Is female	-.395**	-.469**	-.460**	-.497**	-.554**
Is married				-.054	-.116^
Is Mainlander				-.303**	-.321**
Is rural				.019	.008
Number living children				.021	.031
Number 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
Δ –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