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Educational Status and Changes in Functional Health: The Case of Older Adults in Beijing, China

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Introduction

An association between higher socioeconomic status (SES) and better health in old age has been now well-established in the United States and other Western industrialized countries (House et al. 1990; House et al. 1994; Huisman, Kunst and Mackenbach 2003; Knesebeck et al. 2003; Lantz et al. 2001; Marmot 1995; Marmot, Kogevinas and Elston 1987; Melzer et al. 2001; Pappas et al. 1993; Robert and House 1996; Rogers 1992; Ross and Wu 1995; Ross and Wu 1996; Williams 1990). Increasing attention has been turning to understanding the mechanisms underlying the association. One area of study that has proven to be fruitful concerns tests of psychosocial factors, such as social support and locus of control, that act as potential mediators of the association between SES and health (House 2002; Siegrist and Marmot 2004). A very recent issue of the journal, Social Science & Medicine, has been entirely devoted to such psychosocial explanations (Siegrist and Marmot 2004). Examinations of age variations in the association have also revealed differences by age, strengthening through middle and early old age then decreasing thereafter (Beckett 2000; House et al. 1994).

The above findings come predominantly from studies conducted in the Western developed countries. There have been some recent tests of the association between SES and health in old age in several developing countries in Asia, which have shown that the association is in the expected direction, but its strength is somewhat inconsistent (Liang et al. 2002; Liang, Liu and Gu 2001; Zimmer et al. 1998; Zimmer and Amornsirisomboon 2000; Zimmer and Kwong 2004). There have been no tests of age variation and only a limited examination of the mediating role of psychosocial factors in these Asian settings to date. In the current study, we look specifically at the association between education and functional transitions among older

adults in Beijing over a five-year period and test possible age variations in the association as well as the mediating roles of a more inclusive set of psychosocial factors than have been previously tested in Asian contexts. Because of differences in socioeconomic, political and historical factors between China and the Western developed nations where most previous findings come from, China provides an interesting setting to test the generalizability of these findings. In addition, the rapidly increasing proportion of persons in China who are elderly and the concurrent rise in challenges to maintaining and improving their health and well-being, suggest the need to understand whether and, more importantly, how socioeconomic inequalities translate into health and mortality in old age.

Background

Previous studies in the United States and other Western developed countries suggest that socioeconomic status affects health through influencing both one's exposure to and experience with psychosocial risk factors (See House (2002) for an overview). The effect of socioeconomic status, such as education and income, has been often shown to be almost entirely explained away once psychosocial factors are taken into account (House et al. 1994). Studies have identified four psychosocial domains that are particularly important for explaining the associations: (1) social relationships and supports (Berkman and Syme 1979; House, Landis and Umberson 1988; House, Robbins and Metzner 1982); (2) psychological dispositions, such as sense of control over one's life and self-efficacy (Rodin 1986); (3) health behaviors, such as smoking and exercising (Berkman and Breslow 1983); and (4) chronic and acute stress, such as that resulting from financial difficulty and negative life events including loss of family members, criminal

victimization and war (Beckett et al. 2002; Pearlin et al. 1981; Stroebe and Stroebe 1987; Theorell 1982).

Age variation in health inequalities, that is, increasing inequality into middle and early old age and decreasing inequality at older ages, has also been explained with reference to differential exposure to and impact of psychosocial risk factors (Beckett 2000; House et al. 1994). Exposure and impact increase with age due to longer periods of time experiencing certain risk factors, increased physiological vulnerability, and increased importance of certain risk factors in old age, such as the importance of losing supporting relationships (House et al. 1994). At the same time, a decline in inequality at very old ages is often attributed to social welfare policies for the elderly and retirement from work that reduce exposures to the risk factors, such as financial stress and occupational hazards, across all socioeconomic groups, but especially among those of lower status (Beckett 2000; House et al. 1994). Some have also suggested that selection effects contribute to a narrowing of the association at old ages (Markides and Machalek 1984; Robert and House 1994). That is, higher mortality and attrition rates among those of lower status across all ages leaves behind a more select group surviving to older ages, narrowing the socioeconomic inequality in health.

To our knowledge, there has been only one earlier study in Mainland China that has explicitly tested for mediating factors in the association between education and functional transitions (Liang, Liu and Gu 2001). Based on a sample of older adults from the city of Wuhan in south central China, Liang et al. (2001) examined the roles of social relationships and baseline health status in accounting for the effect of two measures of socioeconomic status, one of which was education, the other was urban/rural residence, over a three-year period. Their results

showed that functional transitions were associated with educational attainment, though the nature of the association was less consistent among those with some baseline functional limitations. They provided quantitative estimates of direct and indirect effects of education on functional transitions and showed that social relationships and baseline health status explained between about 20% and 40% of the total effect of education depending on specific transitions, of which social relationships generally accounted for only about one-third to a half**.** It is also noteworthy that they found the indirect effects of education via social relationships and baseline health status to operate in opposite directions, raising the importance of analyzing different pathways through which education indirectly influences health. Unfortunately, they did not test for other domains of psychosocial factors[1] nor did they examine age variation in these effects. The current study is in some ways an expansion of this work in that we test for both age variations and the mediating roles of a more comprehensive set of psychosocial factors and some clinical health conditions. We generally follow the methodological approach of Liang et al. (2001) by quantifying estimates for direct and indirect effects of education through different pathways to assess their relative importance.

Because of contextual differences in history, culture, and systems of political economy, we believe that age variation and mediating roles may not be the same in China from those typically found in the West. Cohorts of older adults in China today have experienced periods of dramatic political and social events, including the war against the Japanese in the mid-1930s, the civil war that gave rise to the Communist Party and led to their rule starting in 1949, the Great Leap Forward, a famine in the late 1950s, the Cultural Revolution that led to mass political

[1] They include variables representing health behaviors in their model, but do not assess their mediating effects as they are treated as controls.

persecution in the mid-1960s, and a series of drastic socioeconomic reforms in the era following Mao's death in the late 1970s. This might suggest that today's elderly have been exposed to high levels of stress over long periods of time regardless of educational levels. If anything, because intellectuals were among main targets for political persecution during the Cultural Revolution, the educated may have experienced higher levels of stress than those with no education. While life-time stress has likely been high for the elderly in China, their sense of control over their lives may have been low. Strict government regulations under the Communist rule, especially before the 1980s, has meant that individuals have been subject to a high level of political control over various aspects of their lives, including places of residence and work (Harrell 2000). Given the high level of government intervention in work, educated individuals may not have enjoyed much benefit from the labor market. Individual choices regarding healthy behaviors may also have been limited due to customs, limited knowledge on health-related behaviors, and limited availability or access to resources.

While age variations in the association between education and functional health is considered partly due to the leveling effects of universal retirement and health programs for the elderly (i.e., Social Security, Medicare), retirement programs for elderly are underdeveloped in China, covering only a small minority of older population (Chow 1995; Olson 1993). Instead, most Chinese elderly continue to work into old age until they can no longer work, then rely on their children for support, both financially and instrumentally, which, in turn, fosters close intergenerational support ties (Davis-Friedmann 1991; Ikels 1990). Family support relationships may, thus, have greater impact on health outcomes in China than in the United States. Exposure to stress may also be mediated by close family interactions that cut across socioeconomic groups.

Finally, despite the absence of universal welfare coverage in old age, access to basic health care has been relatively equal in the health care system under Communist rule, especially prior to the 1980s (Henderson 1990; Whyte and Parish 1984). Access to basic health care earlier in life could, thus, have reduced the influence of socioeconomic factors on health outcomes in old age. Given the historical, cultural, and political contexts discussed above, with their potential impacts on chronic stress, locus of control, health behavior and social support, it is important to examine how each domain of psychosocial risk works to mediate the education-functional health relationship among older adults in China.

Data and Methods

Sample

Data for all our analyses come from the Beijing Multidimensional Longitudinal Study on Aging, a panel study conducted by the Beijing Municipal Network for Health and Care of the Elderly at the Capital University of Medical Science. This is an on going study that monitors trends in various aspects of health among older adults with six waves of data already collected in 1992, 1993, 1994, 1995, 1997, and 2000 (Jiang et al. 2002; Tang et al. 1999). In order to capture sufficient changes in functional health and mortality, the current study utilizes data from the 1992 and 1997 waves, which are also waves in which detailed information on social factors were collected. Older adults aged 55 and above living in three districts within the Beijing area are represented in the data. The first is Xuanwu district, which is located within the metropolitan area of Beijing, and it is the only urban district that is part of the study. The other two districts are Daxing county, a suburban area, and Huairou county, a rural mountainous county located in

the rural suburbs. The data is weighted by age and sex based on census results so that the weighted sample is representative of the population of these districts[2]. The response rates were 90.1% and 88.4% in 1992 and 1997, respectively. After excluding 88 cases due to missing data in variables included in the analysis, the current study employs a sample of 3,168 adults who were age 55 or over in 1992. Further information on the data can be found in Jiang et al. (2002) and Tang et al. (1999).

Functional Health

Our main dependent variable is functional dependency at follow-up in 1997. In both 1992 and 1997 interviews, respondents were asked to report whether they could perform several activities without any help from others. We construct functional health measures based on questions regarding the following activities: walking 300 meters, getting on and off a bed, eating, dressing, bathing, and walking up and down stairs to the second floor. Response categories for each item were "independent", "with some help", and "totally dependent". In both 1992 and 1997, we identify a respondent as functionally independent if they report being able to perform all six activities without any help from others. We identify a respondent as being functionally dependent if they report needing some help or being totally dependent in performing at least one of the six activities. We include two additional outcome categories for the 1997 functional status to identify respondents who died and those who had missing data due to either attrition or having non-response items. We refer to the functional status in 1992 and 1997 as 'baseline' status and 'follow-up' status, respectively, in the remainder of the paper.

[2] Throughout the paper, we refer broadly to situations in Beijing, though our data come from these three districts.

Educational Status

We measure educational status, our key independent variable, as whether or not an individual has any years of formal schooling. Initially, we operationalized education as a series of dichotomous variables to capture its non-linear association with health transitions. Preliminary analysis (not presented here) suggested, however, that most of the association between education and health was due to differences between those with no and those with some education. Furthermore, the number of cases in higher educational categories was too small to derive reliable estimates. Half of older adults in our sample had no formal schooling, as shown in Table 1. Descriptive statistics for all the explanatory variables are presented in Table 1. They are all measured in 1992 unless otherwise noted.

Psychosocial Factors

We include a series of variables representing four psychosocial domains.

1. Social relationships: We measure social relationships and support mechanisms using four variables. First, we code *marital status* dichotomously indicating whether one is currently married versus never married, separated, divorced, or widowed. Second, we measure *affective family relationships* based on responses to a questionnaire item on how harmonious respondents think their family relationships are. We consider responses of "very good" or "good" to indicate that family relationships are perceived to be harmonious, and responses of "neither good nor poor", "poor" or "very poor" to indicate that they are not harmonious. Third, we operationalize *involvement in family decisions* based on how often a respondent reports being consulted in

decisions made by the family. The variable is coded dichotomously indicating whether they are consulted "most of the time" versus "sometimes", "not very often" or "never". Last, *social participation* is based on whether respondents ever participated in activities organized by the neighborhood/village committee, "Senior Citizens Station" or their former work unit. The response categories are either "yes" or "no".

2. Psychological disposition: We measure psychological disposition using a *locus of control index*. Respondents were asked to report the extent to which they agreed or disagreed with the following statements: (1) getting success is a matter of hard work, luck has little or nothing to do with it; (2) many times I feel that I have little influence on the things that happen to me; (3) I can do just about anything I set my mind to do; (4) Maintaining a good health strongly depends on our own efforts; (5) whether one's health is good or bad doesn't depend on one's own maintenance; (6) one contracts a disease only because he (she) ought to; and (7) I think it is best to let everything take its own course. The response categories for these items are 1="agree", 2="hard to say", and "3=disagree." To create an index, we first standardized item responses individually, averaged across items, and standardized the final index to have a mean of 0 and standard deviation of 1 (House citation). We reversed the coding of the second, fifth, and sixth items before indexing, so that larger index value indicates higher perceived locus of control.

3. Health behaviors: We measure health behaviors using three variables. *Ever smoked regularly* is measured with questions on whether one currently or has ever smoked regularly. We code those who answered "yes" to either of these questions as smokers and others as non-smokers. We assess *immoderate drinking* based on how much beer, wine, and liquor respondents report drinking per day. Among our sample, liquor is by far the most popular

alcoholic beverage. We code those who answered drinking at least one or two bottles a day as those who drink immoderately. *Exercising regularly* is based on a questionnaire item regarding how often one participated in the following in the last 12 months: going for walks, free-standing exercises, taijiquan, qigong, bowling, running, dancing and other type of exercise. We code those as exercising regularly if they report participating in any of the above activities "sometimes (1-2 times a week)" or "often (almost everyday)", versus "never seldom (less than once a week)".

4. Chronic and acute stress. Chronic and acute stress (hereafter referred to as stress) is measured using three variables. First, we measure *financial stress* based on whether respondents think their income at present meets the needs of their daily living expenses. We code those who report "enough with money left" and "enough" as having no financial stress and those who report "just enough", "not enough" or "far from enough" as having financial stress. Second, we measure *recent stressful events* based on questionnaire items on whether respondents have encountered the following events that affected their emotions over the previous three years: severe illness of spouse, death of spouse, death of children, severe illness of children, death of parents, children's difficulty in life, death of close friends, natural disaster (fire, flood, earth quake), great losses of property (burglary, loss), and others. The response to each of these is coded "no such events", "no effects", "effect", and "serious effect". We code respondents as having experienced recent stressful events if they experienced any of these events and reported the effect to be serious. Given the historically volatile time that today's elderly in China have experienced, we also measure *lifetime stressful events* based on whether respondents report experiencing political persecution, war, or natural disaster in their lifetime.

Clinical Health Conditions

Because Liang et al. (2001) showed that education indirectly influences functional transitions via other health conditions at baseline, we also include measures of clinical health conditions in our analyses. We measure them using questionnaire items at baseline regarding conditions that were diagnosed by a doctor at hospitals at a district-level or higher. We distinguish between 'serious' conditions and 'other' conditions. A serious health condition refers to having ever been diagnosed with cancer, diabetes, heart disease, hypertension, or stroke. The presence of other condition is based on a series of less serious conditions including chronic bronchitis, asthma, small stroke, migraine, arthritis, anemia, allergy and cataract.

Controls

In addition to the measures described above, we control for basic demographic characteristics, namely, age (in 10-year age groups), gender and urban/rural residence. Because previous studies on the association between socioeconomic status and functional transitions among Chinese elderly suggest the association differs by baseline functional status (citations here, use Jersey and my paper from Demography), we also control for functional status at baseline and include its interaction with education in our analysis. Older individuals, women, those living in rural areas, and those with functional dependency at baseline are all less likely to have received any formal education, while they are more likely to be functionally dependent at follow-up, compared to younger individuals, men, urban residents, and those with no baseline dependency, respectively.

Analysis

Figure 1 presents the conceptual model for our study. We model follow-up functional status as a function of educational status, psychosocial factors, clinical health conditions, baseline functional status, and demographic characteristics. The model reflects the hypothesis that education operates through psychosocial factors. Education also possibly moderates the effect of age on being functionally dependent or dying. Because we control for functional status at baseline in the analysis, our model essentially examines the effect of education on *changes* in functional health over the five-year period between baseline and follow-up. There are eight possible transitions during the study period, which we specify as competing risks. Older adults are in a state of either functional independence or dependence at baseline, then at the follow-up five years later, they are either functionally independent, dependent, deceased or they have missing data. We do not interpret the results for transitions involving the missing data category, which is included in the analysis for methodological reasons, specifically, to control for bias introduced by excluding cases with missing data.

Given a four non-ordered categorical outcome, an appropriate model for our multivariate analysis is the multinomial logistic regression model (Greene 1997). Our analysis takes place in several stages. We first run a base model to test if education is significantly associated with the likelihood of making different functional transitions, controlling for baseline functional status and demographic characteristics. Next, we add to the base model interaction terms involving age dummies and education to test for age variations in the association. In the final set of analyses, we examine mediating effects of psychosocial factors and clinical health conditions on functional

health transitions. To this end, we first estimate six multinomial logistic regression models, that is, five intermediate models and one final model. Each intermediate model starts with the base model and includes one of the mediating factors. The final model tests the effects of all mediating factors simultaneously. In all the analyses above, we include an interaction term between education and baseline functional status to allow for the effect of education to differ between those with and without functional dependency at baseline.

For each of the models above, we calculate discrete effects of education on the predicted probabilities of being in one of the four follow-up status categories. Based on differences in the discrete effects of education across these models, we assess how much of the total effect of education can be explained through each mediating factor. These latter procedures are described in more detail in the results section.

Results

Descriptive Analysis

Table 2 presents the percent distribution of the number of functional tasks with which older adults reported needing some help from others (top panel) and the percent needing help for each specific task (bottom panel) at baseline. Among our sample, 10% reported requiring some help in performing at least one of the six tasks at baseline. Those with some functional difficulty were most likely to report needing some help with just one task, and only a small percent reported needing help with more than two tasks. The most frequent difficulty cited was walking up and down stairs to the 2nd floor, although a fair proportion reported problems walking 300 meters.

In Table 3, we present unadjusted gross changes in functional status over the five-year period between baseline and follow-up. There is significant movement in and out of functional states during the five years. Recovery among those who were functionally dependent at baseline is not uncommon. However, follow-up status is strongly related to baseline status. While about 69% of adults who were independent at baseline reported being independent at follow-up, this is true of just 15% of those who were dependent at baseline. On the other hand, about 9% of those who were independent at baseline reported being dependent at follow-up, while this is the case with 27% of those who were dependent at baseline. The probability of dying during the five years is also strongly associated with baseline status. During the five-year period, 12% of those who began independent at baseline died versus 50% of those who began dependent. The probability of missing data at follow-up is not strongly related to baseline functional status.

Testing the Base Model and Age Variations

Table 4 presents relative risk ratios from multinomial logistic regression models predicting transitions in functional status with and without age interaction terms. Because the category for being functionally independent is the reference, the three equations represent, from left to right, the relative risk ratios of being functionally dependent versus independent, dying versus being independent, and having missing data versus being independent. Relative risk ratios below one indicate negative associations, meaning that a given independent variable reduces the odds of being in the outcome category versus the reference category that is being functionally independent at follow-up in our analyses. Similarly, relative risk ratios above one indicate positive associations, meaning that a given independent variable increases the odds of

being in the outcome category versus being functionally independent at follow-up. Model χ^2 statistics show that both models fit well.

The regression results for the main effect of education from the base model show that, for those with some education, the odds of being functionally dependent and dying (versus being independent) over the study period are 54.7% and 62.9%, respectively, compared to the odds for those with no education. Hence, having education results in a more favorable outcome. The interaction term between education and baseline functional status is statistically significant in the equation contrasting being functionally dependent versus independent, indicating that the effect of education on whether one is dependent or independent at follow-up differs significantly between those with and without functional dependency at baseline. The interaction term is, however, not significant in the equation contrasting dying versus being independent, suggesting that whether one dies or becomes functionally independent at follow-up does not differ significantly by baseline functional status.

To test for age variation in the effects of education, we add to the base model interaction terms between educational status and dummy variables representing age groups. The directions of the relative risk ratios for age interaction terms are positive, indicating that the beneficial effect of education on functional transitions is greater in older ages. The interaction terms are, however, not statistically significant at conventional levels[3]. To allow for age variation in the effects of education to differ between those with functional dependency at baseline and those without, we included a three-way interaction involving education, the age dummies, and baseline

[3] We also examined the effect of age and its interaction with education by including age in single years and also as a squared-term, but neither treatment improved the fit of the model significantly.

functional status (analysis not presented here). The effects of three-way interaction terms were, however, not statistically significant at conventional levels. In sum, the results from age interaction terms are in contrast to those from studies in Western developed countries in that we find no evidence that the association between education and functional health transitions diminishes at very old ages.

Testing the Intermediate and Full Models

We now turn to our intermediate and full models. We use discrete effects, presented in Tables 5 and 6, to interpret the results from these six models, one for each of the four psychosocial domains, one for clinical health conditions, and a full model including all factors simultaneously. Multinomial logistic regression results from these models are included in the Appendix. The effects of education are generally significant across the models even after including mediating factors. Model χ^2 tests show that the mediating factors all improve the fit of the model, indicating that each of them is an important predictor of functional transitions.

Table 5 presents discrete effects for all explanatory variables, except for those for education. The discrete effects for education are presented in Table 6 and will be discussed in the following section. The discrete effects are calculated based on the results from the full model and are derived in a three-step process. First, for each individual in the sample, we generate predicted probabilities for being in each of the four follow-up categories. For the dichotomous explanatory variables, we generate the predicted probabilities when the variable is coded as 0 and when it is coded as 1. For the one non-dichotomous variable in the analysis, locus of control index, we generate the predicted probabilities at the mean and one standard deviation above the

mean. When simulating these predicted probabilities, we leave the values for the other explanatory variables unchanged, thus reflecting their actual values for each individual. Second, we average the predicted probabilities for each of the four outcomes across all individuals in the sample to obtain mean predicted probabilities. Third, we subtract the mean predicted probabilities determined for the two values of the explanatory variable for each outcome, and the result is the discrete effect.

The effects of explanatory variables presented in Table 5 are frequently significant and in the expected directions. Among our sample, being in the youngest age-group (ages 55-64), living in an urban area, having ever participated in an organized social event, having higher locus of control, having never smoked regularly, having no financial stress, and having no serious clinical conditions, are all significantly associated with a higher probability of being functionally independent, a lower probability of being functionally dependent, and a lower probability of dying at follow-up, as expected. Also consistent with our expectations, being female, married, being consulted often for family decisions, drinking immoderately, and not having recently experienced stressful events are all significantly associated with a lower probability of dying compared to either being functionally independent or dependent at follow-up. Contrary to our expectations, however, none of the following variables are statistically significant: having affective family relationships, exercising regularly, having experienced lifetime stressful events[4], and having less serious clinical health conditions.

[4] Instead of measuring these events as a dichotomous summary measure, we also examined their effects individually, yet none of them were significantly associated with functional transitions among our sample.

We now move on to discuss the effects of education on functional transitions, which are provided in Table 6. In the top panel, we present the discrete effects of education on functional transitions. To reflect the statistically significant interaction effect between education and baseline functional status, discrete effects of education are derived separately for those with and without functional dependency at baseline. The predicted probabilities of making one of the eight possible functional transitions (from two baseline functional statuses to four follow-up statuses) are simulated by setting the values of education, functional status at baseline, and the interaction term between education and functional status, accordingly.

The discrete effects of education presented in the first row are from the base model where only control variables are included. This can be considered the 'total' effect of education. The discrete effects of education from intermediate models are presented in the subsequent rows. Differences between the discrete effects of education from the base model and those from each of the intermediate models reflect the 'indirect' effects of education through each corresponding psychosocial domain or clinical health conditions.[5] The last row in the top panel presents the discrete effects of education from the full model including all mediating factors simultaneously. These effects can be, therefore, considered the 'direct' effects of education.

The discrete effects from the full model (the last row in the top panel) show that, among those who were independent at baseline, education is associated with a 0.051 point increase in the predicted probability of remaining functionally independent and a 0.035 point decrease in the predicted probability of becoming dependent at follow-up. Among those who were dependent at

[5] The mediating effects reported here represent upper-bounds, because we include variables representing one set of psychosocial factors and clinical health conditions at a time, not taking into account correlations across these factors.

baseline, the effect of education operates in the opposite direction. Education decreases the predicted probability of becoming functionally independent by 0.062 and increases the predicted probability of remaining dependent by 0.103. These results suggest that having some formal education (versus no education) leads to favorable functional transitions over a five-year period among those who were functionally independent at baseline, but it lowers the chance of recovery. Education, however, protects against mortality over a five-year period for everyone regardless of the baseline functional status. The discrete effects show that the probability of dying is decreased by 0.031 among those with education originating in a state of independence. It is decreased by 0.044 among the educated originating functionally dependent.

The discrete effects of education from intermediate models are all in the same directions as those from the base model and the full model, through the sizes of effects differ across the models. For example, among those who were independent at baseline, introduction of the variables representing social relationships reduces the discrete effect of education on the chance of remaining independent at follow-up from 0.082 to 0.055. This suggests that social relationships, as they are measured in the current study, have a fairly large net mediating effect on remaining functionally independent. We would note that on one hand, the differences across the mediating effects partly reflect methodological differences involving the measurement and the number of variables used to represent each mediating factor, rather than the disparity in actual sizes. On the other hand, however, health behaviors and chronic and acute stress, measured as they are in the current study, account for very little of the total effect of education and therefore have somewhat smaller mediating effects than does social relationships and psychological disposition.

While the discrete effects of education become reduced when including any of the psychosocial factors in the model, they increase when including clinical health conditions. This suggests that the directions of the indirect effects of education via clinical health conditions are opposite those via psychosocial factors. Thus, the indirect effects through clinical health conditions and psychosocial factors work to offset each other to some extent. For example, among those who were functionally independent at baseline, education works through clinical health conditions to reduce the chance of remaining independent and to increase the risks of becoming dependent and dying at follow-up. This finding suggests that education actually increases rather than decreases the likelihood of reporting clinical health problems. Although this possibility seems opposite of expectations, it is, in fact, consistent with findings from previous studies (Liang et al. 2001; Zimmer and Kwong 2004).

In the bottom panel of Table 6, we present our 'decomposition' results showing the percent of the total effect of education accounted for by direct effect and indirect effects. Psychosocial factors and clinical health conditions together account for between 20% to 45% of the total effects of education (depending on specific functional transition) among those functionally independent at baseline, and between 9% to 51% of the effects among those dependent at baseline. Across all transitions that were made during the five years, psychosocial factors explain substantially higher proportions of the total effects of education than do clinical health conditions, and from the upper panel, we know that most of this is accounted for by social relationships and psychological disposition, measured as they are here.

The extent to which psychosocial factors account for the total effect of education depend greatly on the types of transitions involved, reflecting the nature of the association between

education and functional transitions as described earlier. Psychosocial factors explain as much as 39% of the effect of education on the likelihood of being functionally independent both at baseline and follow-up. They also account for about one-third of the effect of education on dying during the five-year period, both among those with and without baseline functional dependency. On the other hand, psychosocial factors are generally much less effective in explaining the transitions involving the state of functional dependence, either at the time of baseline, follow-up, or both.

Conclusion

The current study examined the association between education and transitions in functional health among older adults in Beijing over a five-year period during the 1990s. The study aimed to bring us a little closer to understanding the mechanisms underlying the association by examining age variations and the mediating roles of psychosocial factors. Consistent with previous findings from the West, we found some evidence of the benefits of education. The beneficial effects, however, are concentrated mostly among those who initially were functionally independent at baseline. Among those who were initially functionally dependent, education, in fact, diminished one's chances of recovery and raised the risk of remaining functionally dependent. Education, however, did lower the risk of dying for those with and without baseline functional dependency. These finding are generally consistent with those found in several other Asian settings (Kaneda and Zimmer 2003; Zimmer et al. 1998).

The beneficial effects, however, are concentrated mostly among those who initially were functionally independent at baseline. We find no evidence that the association between education and health decreases at very old ages, in contrast to findings that have been published in the West. If anything, age interactions suggest that the magnitude of the association may actually increase, though they are insignificant in the models we test. That the education-functional health association does not decline at older ages in China may reflect the fact that there is extremely limited access to welfare programs for the elderly, such as those that offer retirement pensions and subsidized health care, which in the West may operate to level socioeconomic inequality in old age. Further, mortality among Chinese elderly may not vary enough across educational levels to result in selection effects, for instance, weeding out the uneducated who are frail, thereby reducing inequalities in health among those who survive to advanced age.

We found that psychosocial factors did not completely explain away the effects of education, unlike it was the case in some of the previous studies in the West (see House 2002). Yet, they did explain some of the education effects. Compared to the findings in Liang et al. (2001) that considered social relationships as the one psychosocial intervening mechanism, we were able to account for a larger proportion of the education effects among those who were initially functionally independent. We were, however, able to explain less of the education effects among those functionally dependent at baseline. The disparities between the current and previous studies partly reflect differences in definitions and measurements of the variables in analyses. But, they may also reflect differences that result from considering different aspects of psychosocial factors.

In the current study, we found that social relationships are important for most transitions, and this is consistent with the common view that family and social support are critical components of the well-being of all older adults in China regardless of their educational background. Psychological disposition, measured as locus of control, had some fairly strong effects. Health behaviors and stress explained very little of the total education effect. As for stress, we noted earlier that today's elderly in China have lived through a number of potentially stressful periods of history and it may be that this has influenced their health in fairly equitable ways across education groups. As to exposures to risky health behaviors, we would note that the associations between education and smoking and drinking may be weaker in current China than is the case in the West.

On balance, the results suggest a good degree of complexity in the associations we seek to understand. They suggest that there are likely several processes that determine the role education has in functional status outcomes among older adults in China. For instance, among those with functional limitations, the effect of education may not be wholly favorable. Another complexity is the role of clinical health conditions, which in our findings operate in an opposite direction than do psychosocial factors. This suggests the possibility that older adults with higher education are able to delay the onset of more mild forms of functional limitation, but when they do contract such limitations, they tend to be of a more severe magnitude (Zimmer et al. 1998).

Further analyses we conducted to explain these associations showed that the prevalence of some clinical conditions, like cancer, stroke, and diabetes, revealed a pattern of higher prevalence among the educated than the uneducated in our sample, which is consistent with some other previous findings from China (Liang et al. 2001; Zimmer and Kwong 2004). It is

opposite of what we would expect in the West today but is consistent with the general patterns observed in Western developed countries in the past (Heck et al. 1997; Marmot and Mustard 1994; Preston and Nelson 1974). With medical advances and improved understanding of preventive care and behaviors, the relationship between socioeconomic status and prevalence of some chronic conditions have become reversed in the West, as those of higher status took advantage of the new developments more than did the lower status group.

Several limitations must be considered when interpreting the results from our study. Our analyses are based on data from Beijing, the capital city of Mainland China, where the standard of living is much higher than in much of the rest of the country. It may be, thus, difficult to generalize these findings across the country. Assuming other parts of China are developing with Beijing as a model, our findings may, however, provide some useful information in predicting future situations elsewhere in the country for policy makers and researchers.

We also rely on education as a sole indicator of socioeconomic status. Some studies have shown other socioeconomic indicators, such as income and occupation, to be even more strongly related to health. Education, in our sample, has low levels of variation and therefore may be a less sensitive measure of inequality. It, however, has several important advantages. Studies of socioeconomic status and health often have difficulty in assuming the causal order, but education, unlike income and occupation, is typically fixed early in life and remains constant thereafter, and is therefore not as likely to be affected by health (Freedman and Martin 1998). Education is also easily measured for every adult, whereas other socioeconomic indicators may not be available, or may be misleading for older adults (Crimmins and Cambois 2003).

Finally, we use measures of self-reported health, which may be subject to reporting bias. It is conceivable that older adults with education may be more likely to see a doctor, thus, receive diagnosis, and are subsequently more likely to understand and recall accurately their health condition. Still, we know from our analysis that those reporting serious clinical conditions are more likely to die and are more likely to report functional limitations, suggesting that clinical health conditions are operating at least in some part as expected.

The socioeconomic inequality in health and mortality in the United States and other Western industrialized countries has remained stable over the years, and in some cases even increased, despite improved standards of living and overall levels of population health, changing relationships between risk factors and socioeconomic status, and the emergence of new risk factors to health (House et al. 1990; House et al. 1994; Marmot, Kogevinas and Elston 1987; Pappas et al. 1993; Robert and House 1996; Williams 1990). This may mean that education operates to produce inequality in health through different risk factors at different times or places. To better understand the changing nature of the association between education, psychosocial risk factors, and functional outcome, it is highly valuable to compare not only the findings from societies at different levels of socioeconomic development but also to monitor changes in these associations within a society as it undergoes socioeconomic development. In the context of rapid social, economic, and demographic changes facing China today, it provides a valuable opportunity for monitoring of the association between education and health.

Figure 1. Conceptual Model: Effects of Education on Functional Transitions between 1992 and 1997

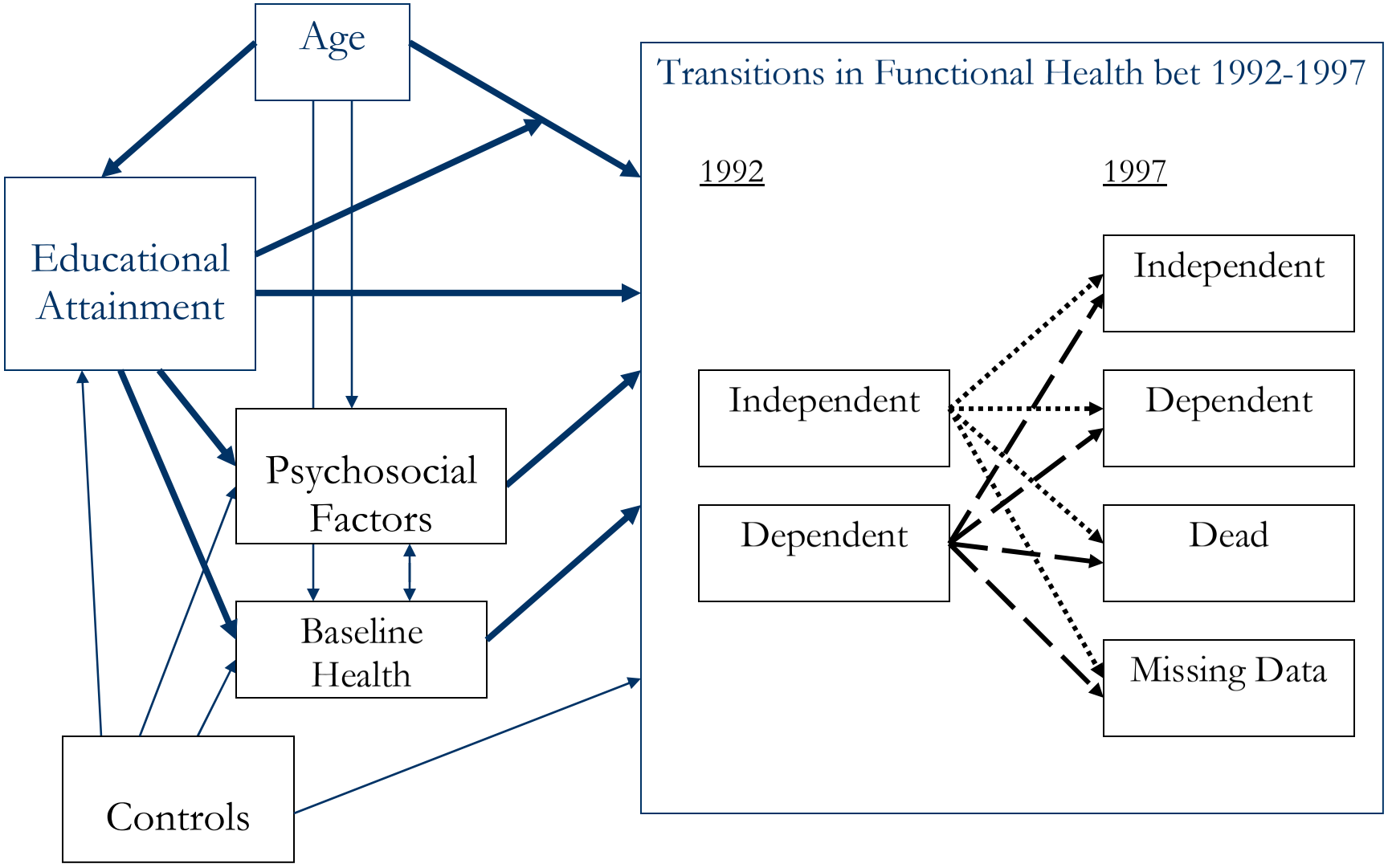

Table 1. Descriptive Statistics for Explanatory Variables (N=3,168)

Variables	Mean	Std. Dev.
Some formal education	0.501	0.011
Age: 55-64	0.568	0.010
65-74	0.306	0.009
75 and over	0.126	0.005
Female	0.505	0.011
Urban residence	0.498	0.011
Functionally dependent at baseline	0.101	0.006
Social Relationships and Supports		
Married	0.770	0.008
Affective family relationship	0.872	0.007
Involvement in family decisions	0.527	0.011
Missing data in family decision var.	0.053	0.004
Social Participation	0.152	0.007
Psychological Dispositions		
Locus of control index	0.000	1.000
Missing data in locus of control index	0.090	0.006
Health Behaviors		
Ever smoked regularly	0.462	0.011
Immoderate drinking	0.037	0.005
Exercising regularly	0.564	0.011
Chronic and Acute Stress		
Financial stress	0.473	0.011
Missing data in financial stress	0.014	0.002
Recent stressful events	0.056	0.005
Lifetime stressful events	0.082	0.006
Clinical Health Conditions		
Serious conditions	0.342	0.010
Other chronic conditions	0.480	0.011

Table 2. Total Number of Functional Limitations and Specific Limitations Prevalent at Baseline (N=3,168)

Functional Limitations	%
Percentage of adults with the following number of limitations:	
0	89.9
1	2.7
2	3.8
3	1.7
4	0.6
5	0.5
6	0.9
Total %	100.0
Percentage of adults needing some help with:	
Walking 300 meters	7.4
Getting on and off a bed	1.6
Eating	1.2
Dressing	1.5
Bathing	4.5
Walking up and down stairs to 2nd floor	9.0

Table 3. Distribution of Follow-up Functional Outcome by Baseline Functional Status (N=3,168)

	Follow-up Functional Outcome					
Baseline Functional Status	Independent	Dependent	Deceased	Missing Data	Row Total %	Row Total N
Independent	68.5	8.5	12.0	11.0	90.0	2654
Dependent	15.0	26.7	50.0	8.3	10.0	514
Column Total %	63.1	10.3	15.8	10.7	100.0	3168
Column Total N	1671	347	745	405		

Table 4. Multinomial Logit Models for Follow-up Functional Status showing Relative Risk Ratios: Base Model and Model with Age Interaction Terms (N=3,168) [a]

	Base Model						with Age Interaction Terms					
	Dependent		Deceased		Missing		Dependent		Deceased		Missing	
Some education	0.547	*	0.629	*	0.936		0.692		0.663		1.214	
Baseline function	5.735	***	9.053	***	2.645	**	5.546	***	8.971	***	2.475	*
Educ*baseline function	3.948	**	1.937		1.435		4.366	**	1.935		1.623	
Ages 65-74	1.889	***	2.553	***	1.218		2.309	***	2.730	***	1.692	*
Ages 75 & up	4.807	***	10.579	***	2.812	***	5.771	***	11.398	***	3.828	***
Female	1.321		0.578	***	1.239		1.311		0.576	***	1.220	
Urban residence	0.474	***	0.666	**	2.172	***	0.472	***	0.663	**	2.111	***
Educ*age 65-74	-----		-----		-----		0.551		0.866		0.554	
Educ*age 75 & up	-----		-----		-----		0.592		0.840		0.547	
Model Chi Square	614.81, d.f.=21, p<.000						637.09, d.f.=27, p<.000					

* p<.05 **p<.01 ***p<.001

[a] Functionally independent is the reference category.

Table 5. Discrete Effects of Explanatory Variables, Except for Education, on Follow-up Functional Outcome[a] (N=3,168)

		Independent	Dependent	Deceased	Missing data
Ages 65-74[a]	*	-0.105	0.032	0.077	-0.004
Ages 75 and up	*	-0.329	0.069	0.238	0.022
Female	*	0.031	0.053	-0.096	0.012
Urban residence	*	0.020	-0.064	-0.058	0.102
Social Relationships and Supports					
Married	*	0.036	0.025	-0.042	-0.018
Affective family relationship		-0.012	-0.013	0.000	0.026
Involvement in family decisions	*	0.053	0.004	-0.051	-0.006
Social Participation	*	0.071	-0.027	-0.042	-0.001
Psychological Dispositions					
Locus of control	*	0.029	-0.009	-0.011	-0.008
Health Behaviors					
Ever smoked regularly	*	-0.015	0.001	0.046	-0.032
Immoderate drinking	*	0.052	0.101	-0.070	-0.083
Exercise regularly		0.028	0.015	-0.022	-0.021
Chronic and Acute Stress					
Financial stress	*	0.035	-0.025	-0.005	-0.006
Recent stressful events	*	-0.020	-0.053	0.053	0.020
Lifetime stressful events		-0.033	0.029	0.020	-0.017
Clinical Health Conditions					
Serious clinical conditions	*	-0.087	0.017	0.087	-0.017
Other clinical conditions		-0.012	-0.004	0.023	-0.006

*At least one of the logistic regression coefficients associated with the variable is statistically significant at the .05 level.

[a] The omitted categories, in order, are: ages 55-64, ages 55-64, male, rural residence, not married, not harmonious family relationship, not being consulted for family decisions often, never participated in social organization, never smoked, drink no alcohol or moderate amount, do not exercise regularly, no financial stress, no recent negative life events with serious effects, no lifetime stressful events, no serious health conditions at baseline, no chronic health conditions at baseline.

Table 6. Discrete Effects of Educational Status on Eight Functional Transitions and Decomposition of its Total Discrete Effect (N=3,168)

	From functionally independent at baseline to:				From functionally limited at baseline to:			
Type of effect	Indepe-ndent	Depen-dent	Deceased	Missing data	Indepe-ndent	Depen-dent	Deceased	Missing data
Discrete effect of education from:								
Base model (total effect)	0.082	-0.042	-0.046	0.006	-0.056	0.113	-0.055	-0.002
Intermediate models								
w/ social rel. & supports	0.055	-0.037	-0.032	0.013	-0.065	0.111	-0.044	-0.002
w/ psychological dispositions	0.070	-0.039	-0.039	0.008	-0.057	0.107	-0.044	-0.006
w/ health behaviors	0.079	-0.042	-0.044	0.008	-0.061	0.118	-0.051	-0.006
w/ chronic and acute stress	0.078	-0.040	-0.046	0.008	-0.056	0.108	-0.051	-0.001
w/ clinical health conditions	0.088	-0.043	-0.052	0.008	-0.048	0.113	-0.073	0.008
Full model (direct effect)	0.051	-0.035	-0.031	0.016	-0.062	0.103	-0.044	0.003
Direct and indirect effects of education (%):								
Direct effect	54.9	79.8	56.2	62.5	74.8	90.8	49.1	17.6
Indirect effect (total):	45.1	20.2	43.8	37.5	25.2	9.2	50.9	82.4
through psychosocial factors	39.0	17.2	35.1	35.7	16.3	9.0	31.8	25.9
through clinical health conditions	6.1	2.9	8.7	1.8	8.8	0.1	19.2	56.5
Total effect	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

APPENDIX. Multinomial Logit Models for Follow-up Functional Status showing Relative Risk Ratios: Intermediate Models with Different Sets of Mediating Factors and Full Model (N=3,168) [a]

	Model w/ Social Rel. & Support						Model w/ Psychological Disposition					
	Indepe -ndent		Depen -dent		Missing data		Indepe -ndent		Depen -dent		Missing data	
Some education [b]	0.604	*	0.731		1.021		0.573	*	0.678	*	0.964	
Baseline function	5.543	***	8.683	***	2.630	**	5.581	***	8.408	***	2.640	**
Educ*baseline function	3.728	*	1.777		1.366		3.660	*	1.827		1.343	
Ages 65-74	1.960	***	2.413	***	1.178		1.840	***	2.499	***	1.201	
Ages 75 & up	4.938	***	8.449	***	2.405	***	4.519	***	9.632	***	2.728	***
Female	1.341		0.539	***	1.213		1.229		0.536	***	1.198	
Urban residence	0.495	***	0.704	*	2.257	***	0.498	***	0.681	**	2.269	***
Social Rel. & Supports												
Married	1.032		0.715		0.785		-----		-----		-----	
Family relationship	0.827		0.965		1.234		-----		-----		-----	
Family decisions	0.877		0.666	**	0.846		-----		-----		-----	
Missing in fam. decisions	0.814		1.185		1.214		-----		-----		-----	
Social participation	0.553	*	0.577	*	0.762		-----		-----		-----	
Psychological Dispositions												
Locus of control	-----		-----		-----		0.815	*	0.836	**	0.856	
Missing in locus of control	-----		-----		-----		1.175		1.628	**	0.938	
Health Behaviors												
Ever smoked	-----		-----		-----		-----		-----		-----	
Immoderate drinking	-----		-----		-----		-----		-----		-----	
Exercise regularly	-----		-----		-----		-----		-----		-----	
Chronic and Acute Stress												
Financial stress	-----		-----		-----		-----		-----		-----	
Missing in financial stress	-----		-----		-----		-----		-----		-----	
Recent events	-----		-----		-----		-----		-----		-----	
Lifetime events	-----		-----		-----		-----		-----		-----	
Clinical Health Conditions												
Serious conditions	-----		-----		-----		-----		-----		-----	
Other conditions	-----		-----		-----		-----		-----		-----	
Model Chi Square	627.29, d.f.=27, p<.000						621.72, d.f.=36, p<.000					

* p<.05 **p<.01 ***p<.001

[a] Functionally independent is the reference category.

[b] The omitted categories, in order, are: have no formal education, ages 55-64, male, rural residence, not married, not harmonious family relationship, not being consulted for family decisions often, never participated in social organization, never smoked, drink no alcohol or moderate amount, do not exercise regularly, no financial stress, no recent negative life events with serious effects, no lifetime stressful events, no serious health conditions, no other chronic health conditions.

APPENDIX (Continued).

	Model w/ Health Behaviors						Model w/ Chronic and Acute Stress					
	Indepe -ndent		Depen -dent		Missing data		Indepe -ndent		Depen -dent		Missing data	
Some education [b]	0.547	*	0.639	*	0.950		0.558	*	0.634	*	0.956	
Baseline function	5.774	***	8.945	***	2.564	**	5.629	***	8.595	***	2.654	**
Educ*baseline function	4.097	**	1.970		1.404		3.777	**	1.911		1.409	
Ages 65-74	1.903	***	2.558	***	1.234		1.872	***	2.598	***	1.237	
Ages 75 & up	4.786	***	10.774	***	2.890	***	4.826	***	10.759	***	2.883	***
Female	1.482		0.649	*	1.083		1.348		0.581	***	1.221	
Urban residence	0.469	***	0.675	**	2.261	***	0.505	***	0.702	*	2.253	***
Social Rel. & Supports												
Married	-----		-----		-----		-----		-----		-----	
Family relationship	-----		-----		-----		-----		-----		-----	
Family decisions	-----		-----		-----		-----		-----		-----	
Missing in fam. decisions	-----		-----		-----		-----		-----		-----	
Social participation	-----		-----		-----		-----		-----		-----	
Psychological Dispositions												
Locus of control	-----		-----		-----		-----		-----		-----	
Missing in locus of control	-----		-----		-----		-----		-----		-----	
Health Behaviors												
Ever smoked	1.126		1.399	*	0.824		-----		-----		-----	
Immoderate drinking	1.515		0.580		0.306	*	-----		-----		-----	
Exercise regularly	1.088		0.891		0.786		-----		-----		-----	
Chronic and Acute Stress												
Financial stress	-----		-----		-----		0.661	*	0.784		0.845	
Missing in financial stress	-----		-----		-----		1.477		1.637		0.389	
Recent events	-----		-----		-----		0.606		1.350		1.244	
Lifetime events	-----		-----		-----		1.374		1.136		0.913	
Clinical Health Conditions												
Serious conditions	-----		-----		-----		-----		-----		-----	
Other conditions	-----		-----		-----		-----		-----		-----	
Model Chi Square	630.61, d.f.=30, p<.000						625.07, d.f.=33, p<.000					

* p<.05 **p<.01 ***p<.001

[a] Functionally independent is the reference category.

[b] The omitted categories, in order, are: have no formal education, ages 55-64, male, rural residence, not married, not harmonious family relationship, not being consulted for family decisions often, never participated in social organization, never smoked, drink no alcohol or moderate amount, do not exercise regularly, no financial stress, no recent negative life events with serious effects, no lifetime stressful events, no serious health conditions, no other chronic health conditions.

APPENDIX (Continued).

	Model w/ Health Conditions						Full Model					
	Indepe -ndent		Depen -dent		Missing data		Indepe -ndent		Depen -dent		Missing data	
Some education [b]	0.529	*	0.585	**	0.937		0.609	*	0.730		1.052	
Baseline function	5.325	***	8.097	***	2.568	**	5.005	***	6.821	***	2.472	*
Educ*baseline function	3.775	*	1.821		1.449		3.335	*	1.623		1.281	
Ages 65-74	1.862	***	2.510	***	1.214		1.893	***	2.357	***	1.187	
Ages 75 & up	5.076	***	11.829	***	2.787	***	5.029	***	9.103	***	2.471	***
Female	1.271		0.547	***	1.229		1.409		0.530	***	0.996	
Urban residence	0.427	***	0.557	***	2.164	***	0.483	***	0.626	**	2.447	***
Social Rel. & Supports												
Married	-----		-----		-----		1.116		0.728		0.792	
Family relationship	-----		-----		-----		0.902		1.016		1.285	
Family decisions	-----		-----		-----		0.854		0.634	**	0.836	
Missing in fam. decisions	-----		-----		-----		0.853		1.199		1.214	
Social participation	-----		-----		-----		0.591		0.609	*	0.831	
Psychological Dispositions												
Locus of control	-----		-----		-----		0.831	*	0.854	*	0.870	
Missing in locus of control	-----		-----		-----		1.161		1.533	*	0.936	
Health Behaviors												
Ever smoked	-----		-----		-----		1.120		1.390	*	0.813	
Immoderate drinking	-----		-----		-----		1.756		0.597		0.310	*
Exercise regularly	-----		-----		-----		1.058		0.823		0.793	
Chronic and Acute Stress												
Financial stress	-----		-----		-----		0.709	*	0.860		0.880	
Missing in financial stress	-----		-----		-----		1.392		1.275		0.398	
Recent events	-----		-----		-----		0.569		1.350		1.233	
Lifetime events	-----		-----		-----		1.464		1.277		0.947	
Clinical Health Conditions												
Serious conditions	1.647	**	2.089	***	1.072		1.662	**	2.182	***	1.103	
Other conditions	0.987		1.129		0.936		1.016		1.185		0.983	
Model Chi Square	625.41, d.f.=27, p<.000						675.28, d.f.=69, p<.000					

* p<.05 **p<.01 ***p<.001

[a] Functionally independent is the reference category.

[b] The omitted categories, in order, are: have no formal education, ages 55-64, male, rural residence, not married, not harmonious family relationship, not being consulted for family decisions often, never participated in social organization, never smoked, drink no alcohol or moderate amount, do not exercise regularly, no financial stress, no recent negative life events with serious effects, no lifetime stressful events, no serious health conditions, no other chronic health conditions.

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