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Economic Stress and Mortality for the Oldest-old in China

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Abstract

China's oldest-old population is estimated to quadruple by 2050. Yet, poverty rate for the oldest-old is the highest among all age groups in China. This paper investigates the relationship between economic stress and mortality among the oldest-old in China. Both objective economic hardships and perceived economic strain are examined. We base our investigation on data drawn from the Chinese Longitudinal Healthy Longevity Survey conducted between 2000 and 2005. We find that economic stress is negatively associated with the quality of medical care and mental well-being which contribute to the higher mortality rate for the oldest-old. Results also show that the perceived economic strain increases the mortality risk by 40 percent in rural area but not in urban area. For rural oldest-olds, having children as a main source of income and having pension alleviate the impact of economic hardship and reduce the mortality hazard by 23 percent and 66 percent respectively.

Introduction

The changing demographic landscape, globalization, natural disasters, financial crises, and the revamping of social safety nets in many Asian countries in the past few decades have subjected countless people to economic stress and significantly affected their quality of life. Research has shown that economic stress can have long-term implications for the well-being of a population. At an aggregate level, economic stress is related to the economic growth and human capital development of a population. At an individual and family level, economic stress has been shown to be related to increased physical and mental health problems, deteriorated education trajectories, and more turbulent family relationships. Falling incomes and rising poverty may also erode a family's social networks of support, leaving them isolated and unable to engage in social exchange. The ability of families and governments to address economic stress has long lasting implications for human capital development, intergenerational mobility, and future economic growth of a society.

The impact of economic stress on health remains largely unexplored except for several longitudinal studies conducted in European countries or in America (Stuckler et al., 2009). At an aggregate level, the Russian Federation suffered a major increase in male mortality in the early 1990s, and mortality increased in Thailand during the 1990s' Asian Economic Crisis, while on the other hand, short-term mortality effects of the South Korean economic crisis were relatively small (Khang et al., 2005, 2010). Catalano (2003) and Catalano et al. (2005) show that poor macroeconomic conditions seem to induce a biological response in men and women.

Ruhm (2000) and Van Den Berg (2008) show a relationship between economic recession and individual health. A longitudinal study on women with breast cancer found that patients

who reported concerns about job security, medical costs, or financial stress at the baseline had significantly poorer functional, mental and affective well-being over the subsequent 12 months (Ell et al. year, Cancer 2008; American Cancer Society, 2007.) Research has shown that stress and depression are likely to trigger inflammatory response, enhancing proinflammatory cytokine production (Goebel et al., 2000; Steptoe et al., 2001; Maes et al., 1998; Irwin 2007; Miller 2002). Depressive symptoms were linked to increased IL-6, TNF-α, and CRP in community samples of older adults (Dentino et al., 1999; Penninx et al., 2003; Lutgendorf et al., 2008; Kiecolt-Glaser et al., 2003; Glaser et al., 2003).

Friedman and Thomas (2008) use data from the Indonesia Family Life Survey to examine the impact of the 1997 Asian financial crisis on individuals' psychological well-being. They found that the crisis had detrimental consequences on psychological well-being (depression, anxiety, and lowered aspirations) across the entire age group distribution over the crisis period. The impact was strongest on the low education group, the rural landless, and residents in the hardest hit areas. Furthermore, the negative impact persisted after the financial crisis, suggesting financial crisis has long-term deleterious effects of the crisis on one's psychological well-being.

Two Swedish and Finnish studies show that parental economic stress was associated with low self-rated health to a statistically significant degree, even when accounting for employment status and foreign origin. They found that trauma triggered the inflammatory response. Researchers have underscored the significant epidemiology of economic stress (Dooley and Catalano, 1984) and some have argued that "It, therefore, deserves to be seriously considered as a potential public health risk factor among families." (Olivius et al., 2004)

This paper examines the relationship between economic stress, quality of life, and health for the oldest-old population in China. We start by describing the social-demographic contexts in China today that make this an important topic. We then move to a description of a conceptual framework and our analytical strategy before presenting results of our analysis.

Recent Social Contexts for the Elderly in China

China has experienced a dramatic decline in fertility due to the one-child policy and the unprecedented speed of socioeconomic development since the economic reform in the late 1970s. As a result, the Chinese population is aging at a rate faster than those in many developed counties. In 2009, the percentage of those above the age of 65 was about 8.5 percent, and this percentage is forecasted to increase to 17 percent in 2030, and to 27 percent in 2050 (Chinese Ministry of Civil Affairs Report, 2010) . The proportion of the oldest-olds among the elderly (65 years and older) is expected to climb rapidly, from 14 percent in 2000 to 34.4 percent in 2050, amounting to 114 million (Zeng and George, 2000). This demographic landscape presents a tremendous challenge for the Chinese society to support and care for the elderly because both private and public assistance for the elderly have been weakening in China in the past few decades.

The availability of family support for the Chinese elderly has dwindled as the number of children and kin to provide care has declined and the old age dependency ratio has increased drastically since the 1979 one-child policy. Many single children will have the responsibility to care for their parents, parents-in-law, and grandparents, resulting in the infamous "4-2-1" problem. This problem is particularly salient in light of the combination of the nature of caregiving tasks and the increasingly skewed sex ratio in China since the initiation of the one-

child policy. As the caregiving responsibility often falls on the shoulders of daughters and daughters-in-law, the "missing girls" problem makes the challenge of caring for the elderly even more formidable.

To address the challenge of elderly care, the Chinese government has explicitly written into the laws that require children to care for elderly parents in China. Marriage Law of P. R. China stipulates that children shall be under the obligation to support their parents; where any child fails to perform his or her obligations, the parents who are unable to work or who are living a difficult life shall be entitled to ask their child(ren) to provide aliments. In addition, according to the Law of P.R. China on the Protection of Rights and Interests of the Aged launched in 1996, a child of the aged person should perform the duty of paying the aged person living expenses, looking after him, comforting him mentally and give consideration to his special requirements. Despite these laws, economic stress among the elderly remains pervasive, particularly among those who live in the rural areas where many young adults migrate to the cities for work.

In the public domain, the social safety nets for the elderly in China have weakened since the economic reform started as health care provision began to be privatized and out-of-pocket medical costs borne by individuals skyrocketed. The China National Health Service Survey reported that the percentage of out-of-pocket cost increased by about 60 percent from 1992 to 1997, from 28 percent to 44 percent (England, 2005). A substantial proportion of elderly do not have medical insurance or access to adequate medical care. Secondly, the pension system is not well established and not available to many people. Again, rural elderly face particularly hard times due to very weak public safety nets in most rural areas for decades.

To appreciate the intricacy of China's public safety nets system, one needs to understand the *Hukou* system initiated in the late 1950s which serves as the most predominant social stratification mechanism in China since then. The system assigns people, according to an individual or individual's parents' birth place, to either agricultural or non-agricultural *hukou* status. Since the late-1950s, this system was used to officially differentiate residential groups for controlling movement. The *Hukou* system is also used by the Chinese government to allocate socioeconomic benefits, such as income, housing, social security, medical care, education and retirement benefits, according to one's residence (Cheng and Selden, 1994). As a result, two different worlds have been created; while the "urban aristocrats" were entitled to these benefits, those in rural areas were left to fend for themselves with little social security or public health services. Research has shown that the *Hukou* system is a main contributing factor to urban-rural economic and social inequality (Selden, 1999; Wu and Treiman, 2007).

Poverty Rate among Chinese Elderly

Research by Wang and Zhang (2005) examines elderly poverty in China based on subjective assessment by the elderly of their own financial circumstances. The elderly were asked if they felt their financial resources were "more than sufficient", "have some left over", "just sufficient to make ends meet", "somewhat difficult", or "very difficult". Those who felt that their financial situation was very difficult were defined as "poor". This study shows that there were 9.2□11.7 million elderly living in poverty in 2000, accounting for about 7.1 to 9.0 percent of the elderly population. Moreover, poverty has been shown to be more prevalent in rural than in urban areas, with 4.2□5.5 percent of urban elderly, as opposed to 8.6□10.8 percent rural elderly, living in poverty. Qiao et al. (2005), based on objective indicators that use the

urban minimum subsistence level to represent urban absolute poverty with 30 percent of the urban minimum subsistence level as the rural absolute poverty level, reported that the poverty rate for Chinese elderly was 17.5 percent in 2000.

The poverty rates in China have also been shown to be higher for the elderly than for other age groups. The Sampling Survey of the Aged Population in China conducted in 2000 shows that the proportion of the poor among those aged 60□64 was 11.3 percent, and this proportion increased dramatically to 22.6 percent for those aged 75□79, 27.7 percent for those aged 80□84, and to 30.3 percent for those aged 85□89 (Qiao et al., 2006). Among elderly females, those who resided in rural areas, were less educated, and who had no pension were more likely to be at higher risk of poverty than other groups. Since the rural elderly are not entitled to pension, they have little choice but to turn to their children for assistance (Zeng, 1995).

III. Methods

Given these socioeconomic contexts in China, we examine how quality of life indicators of economic stress affects the mortality hazard of the elderly. Figure 1 depicts the conceptual framework we use to guide our analysis.

(Figure 1 about here)

We hypothesize that economic stress of the oldest-olds has both direct and indirect effects on the outcome of mortality. The poorer financial resources are likely to lead to poorer medical care and higher mental distress which will then have negative effects on one's health status and the hazard of mortality. There are several factors that may potentially moderate the

impact of economic stress on health. These factors include the human capital of the oldest-old, the social support network available to the oldest-old for help, and the public assistance the oldest- old receives. Another potential moderator is the psychological resources of the elderly. Strong psychological resources may help insulate the oldest-old from the harm of stressors and allow him or her to cope better with the economic stress. One such psychosocial resource that has been given much attention in the literature is an individual's sense of control. Previous research has shown that one's sense of control not only reduces stress but influences one's ability to manage life challenges (Turner and Noh, 1988; Kessler, Turner, and House, 1988; Pearlin et al., 1981).

Data

We draw data from the Chinese Longitudinal Healthy Longevity Survey (CLHLS) conducted between 2000 and 2005. The CLHLS was launched in 1998 in China. In 2000, 2002, 2005 and 2008, follow-up surveys were conducted. The sample was randomly collected from half of the counties and cities in 22 of China's 31 provinces, which constitutes about 85 percent of the total population in China (Zeng, Dudley L. Poston et al. 2009). The CLHLS interviewed 8,959 and 11,161 individuals aged 80□112 in 1998 and 2000 respectively, and 16,057 and 15,638 individuals aged 65□112 in 2002 and 2005 respectively. In the four waves of the study from 1998 to 2005, the survivors in the baseline were re-interviewed, and the deceased interviewees were replaced by new participants.

In the 2000 survey, an item that is critical for our analysis was added to the survey. This question assesses whether income from all sources for the oldest-old is sufficient to support his or her daily needs. We use this information as one of our key indicators of "economic stress".

Therefore, we draw our data from the 2000, 2002 and 2005 panel surveys. Our sample includes 10,972 men and women between the age of 80 and 105 in 2000.

Of the 10,972 oldest-old interviewed in 2000, 18.5 percent had died before the 2002 interview and 12 percent of them were lost via the follow-up interview. This left about 70 percent of the original oldest-old (n=7,600) in the sample in 2002. Between 2002 and 2005, about 23.5 percent of them had passed away, and 6.4 percent were lost due to attrition. At the time of the 2005 interview, only 39.4 percent of the original respondents (n=4,322) were still alive. In all our analyses, sampling weights are used to adjust for differential sampling probability and attrition rates.

Measures

Independent Variable

The main independent construct in our study is economic stress. We measure this construct with both objective indicators of economic hardships and a subjective indicator of the perceived economic strain for the elderly.

For the objective economic hardship measures, data for household income or earnings are unfortunately not available in the 2000 survey. We use several alternative indicators of economic hardships in this paper. These measures include (i) whether the oldest-old were receiving welfare from the government or community assistance, (ii) whether the oldest-old ate fruits, and (iii) whether the oldest-old had access to drink tap water.

The Chinese government provides a meager amount of welfare to the very poor to support their daily lives. According to official reports and statistics, the amount of financial aid in urban areas varies across areas, with a monthly average of about RMB 150 (approximately $25USD) per person in the urban areas per month (Chinese Civil Affairs Statistical Yearbook, 2008). The frequency of fruits consumption is used as an indicator of the quality of life. As fruits are more expensive and not often considered as a basic necessity in daily life in China, we take it as another indication of daily financial difficulty if an elderly rarely or never ate fruits. This variable is measured in the survey on a 4-point scale, with 1 indicating "almost every day" and 4 indicating "rarely or never". The third indicator of economic stress is whether the oldest-old obtained his or her daily drinking water from the tap. The original survey question asks about the source of the drinking water, whether it was from a well, lake or river, spring, pond or pool, or tap water. We construct a variable indicating whether the oldest-old had access to tap water for daily drinking.

We also include a childhood economic stress indicator in our preliminary analysis. This measure assesses whether the oldest-old often went to bed hungry during his or her childhood. Results show that this childhood economic stress was very pervasive (two-thirds of the elderly had such an experience) indicating that this variable reflects the general economic difficulty in China at the turn of the twentieth century. This variable does not have a significant impact on the mortality of the oldest-old, so we do not report these results in this paper.

Economic stress theories postulate that objective economic stress induces perceived (subjective) economic strain which then exerts a more direct impact on the well-being of the elderly. We measure the subjective economic stress (economic strain) with an indicator that

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assesses whether the oldest-old perceived that income from all sources is sufficient to support all his or her daily expenditures at the time of the 2000 interview. These income sources include pension, spouse, child, grandchild, other relatives, local government or community, income from own work, and any other sources.

Dependent Variable

The dependent variable is the hazard rate of mortality. We examine the hazard of mortality from 2000 to 2005 for the 8,928 men and women interviewed in 2000. This dependent variable is a time-variant variable, indicating whether the respondents in 2000 had or had not passed away by 2005 at different time points. The unit of time for the dependent variable is the number of days under risk. The dependent variable records two dimensions of the mortality hazard. The first dimension characterizes whether the respondents who entered observation in the 2000 interview had or had not died by the time of the follow-up surveys. The other dimension is the time stage which refers to the number of days between entry and exit in the analysis.

Moderators

As depicted in the conceptual framework, several factors including one's human capital, social support network, public assistance, and sense of control can potentially moderate the impact of economic stress on health. We measure human capital with the educational attainment and occupation of the oldest-old. As the Chinese oldest-olds generally have low educational attainment, we divide the years of school into three categories: (1) no schooling, (2) one to five years, and (3) six or more years. Occupational level is measured with the occupational status of

one's job before the age of 60. The occupational status is defined as high for professional and technical personnel, and governmental, institutional or managerial personnel, and as low for all other occupations, including agricultural, forestry, animal husbandry, industrial, service fishery workers, military personnel, housework, and others.

The social support network of the oldest-old is measured with (1) whether he or she had at least one living child, and (2) whether the main financial support for the oldest-old came from children in 2000, and (3) whether the oldest-old was receiving pension.

Another potential mediator in this framework is the psychological attributes of the oldest-old, specifically the extent to which the elderly felt he or she was in control. We assess the sense of control by measuring the degree to which the elderly felt he or she had a say about matters concerning him or herself in daily living. This scale ranges from 1 indicating "never" to 5 "always".

Mediators – Quality of Medical Care and Mental Distress

We hypothesize that the impact of economic stress on health is mediated by the quality of medical care and the psychological well-being of the oldest-old. The quality of medical care is measured with whether the oldest-old can obtain immediate medical service when ill. We create a dichotomized variable for "poor medical care" from these data.

For the mental well-being, we include indicators of psychological resources associated with the positive and negative aspects of the oldest-olds' emotions. Mental distress is measured with four items in 2000 and 2002: Optimism ("I look at the bright side of things"), Conscientiousness ("I like to keep my belongings neat and clear"), Neuroticism ("Often feel

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fearful or anxious"), and Loneliness ("Often feel lonely and isolated"). Responses are recorded in a 5 point scale (1- always, 2-often, 3-sometimes, 4-seldom, and 5-never). The last items (Neuroticism and Loneliness) for the negative aspects of emotions are reverse coded. Then we construct an index of mental distress by taking the average of the four items, with a higher score indicating a higher level of mental distress. Both mediators are measured in two points of time □ 2000 and 2002.

Other Control Variables

We control for basic demographic characteristics, the life style and diet consumption of the oldest-old. Basic demographic variables include age, gender, ethnicity, residence, and marital status. Ethnicity is measured by whether he or she was Han. Residence is measured by whether the oldest-old resided in an urban (city and town) or rural area at the time of the 2000 interview. We also control for three aspects of the life style - whether or not the oldest-old smoked, drank, or exercised in the past.

In terms of diet, we create an index of protein consumption composed of the frequency of meat, fish and egg consumption measured on a three-point scale with 1 indicating "rarely or never" and 3 indicating "almost every day".

We also control for baseline health status, activities of daily living (ADL) and the cognitive functioning of the oldest-old. The self-reported health is measured on a five point scale, which we later collapse into 3 categories, with 1 indicating "very good and good", 2 indicating "so-so", and 3 indicating "poor and very poor". We create the cumulated activities of daily living

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index (ADL index) with six items □ bathing, dressing, visiting the toilet, transferring, continence and feeding (Katz et al., 1963). Each item ranges from 1 to 3, with 3 indicating the highest level of disability. Additionally, we measure the cognitive functioning of China's oldest-olds using the Chinese version of Mini-Mental State Examination (MMSE), which records four aspects of cognitive functioning - orientation, calculation, recall and language (Folstein, Folstein, McHugh,1975). MMSE covers 30 questions, and the respondents receive one point for answering each question correctly. The key point for score differentiating cognitive functioning is 18 (Zhang, 2006). An oldest-old is considered cognitively impaired when he or she scores lower than 18 in this test.

In addition, about 36 percent of the interviews were conducted with a proxy respondent at the time of the 2000 interview. This was often done when the respondents were too impaired to participate in the survey. We create a variable indicating whether a proxy respondent was used as a control for both the quality of the report and as an indicator of the disability status of the oldest-old.

Analytical Strategy

Sampling weights are applied to all analyses in this paper to adjust for initial selection probability and attrition over time. First, we investigate potential risk factors for living under economic stress, including the basic demographic characteristics, baseline health status, private support network, and public assistance. Then we examine whether economic stress affects mortality through (1) the quality of medical care, and (2) emotional distress of the oldest-old.

Subsequently, we estimate the Kaplan-Meier survival curves (Kaplan and Meier, 1958) for the 8,928 oldest-old, comparing those who lived under economic stress in 2000 to those who did not. As shown in the formula below, n_j represents the number of respondents who had not died and were not censored at t_0 -- the beginning of time period t, d_j represents the number of respondents who died during the time period t, and $S(t)$ denotes the outcome of survival probabilities in t and the preceding periods.

$$S(t) = \prod_{j=t_0}^{t} \{(n_j - d_j)/n_j\}$$

Finally, we use a Cox's proportional hazard model to estimate the impact of economic stress on the hazard rates of mortality, using data from 2000 to 2005. The Cox proportional hazard regression model (Cox 1972) stipulates that the hazard rate for the nth subject is

$$h(t \mid x_n) = h_0(t) \exp(x_n \beta_x)$$

where the regression coefficients β_x are to be estimated from the data. The exponentiated individual coefficient $\exp(\beta_x)$ represents the ratio of the hazards for a one-unit change in the corresponding covariate. The Cox model assumes that the independent variable (economic stress) and the covariates (control and mediating variables) are independent with time. The advantage of Cox model is that no particular parametrization is left to be estimated. That is, it has no assumption about the shape of hazard over time.

Due to the distinct socioeconomic contexts and social support network available to elderly in urban and rural areas, we estimate separate models for urban and rural residence.

Results provide convincing evidence in support of the difference in the impact of economic stress on the hazard of mortality by residence.

IV. Results

(Table 1 about here)

Table 1 shows the weighted descriptive statistics for the entire sample by residence. Overall, one third of the sample lived in urban areas. Those in urban areas had a higher living standard and socioeconomic status and were more likely to receive benefits. First, we examine the four indicators of the economic stress experienced by the oldest-old in 2000. Overall, about 16 percent of the oldest-old received welfare or felt they lived under economic strain, and about half did not have access to tap water. In the urban area, about 20 percent of the oldest-old had no access to tap water, as opposed to nearly 67 percent in rural areas. The oldest-old in urban areas ate fruits more often than those in rural areas.

The mean age of the sample is 84. The ethnic minority group accounts for 6 percent of the sample which is about the national average. In terms of the marital status, the majority of the oldest-old (about 70 percent) were widowed, 28 percent were still married, 1 percent was divorced, and another 1 percent was never married.

The majority of the oldest-old did not have any formal education (56 percent in urban areas and 70 percent in rural areas), about a quarter of them had one to five years of education, 11 percent had six or more years of education (18 percent in urban areas vs. 7 percent in rural areas). Only a small proportion of them had a high status occupation before; most of them in urban areas (13 percent in urban areas vs. 2 percent in rural areas). In terms of life style, about one-third of

oldest-old drank, and smoked in the past in both urban and rural areas, but more urban oldest-olds exercised than their rural counterparts (45 percent in urban areas vs. 26 percent in rural areas).

Regarding the living arrangements of the oldest-old, the majority of the oldest-old lived with children, more so in rural than in urban areas (57 percent in urban areas vs. 65 percent in rural areas). 16 percent and 13 percent lived only with spouse in urban and rural areas respectively. About 15 percent of them lived alone, a smaller proportion lived in an institution (12 percent in urban areas and 6 percent in rural area), and only 1 percent lived with others.

These oldest-olds had their childbearing period before the initiation of the one-child policy. On average, they had 4.5 children. Five percent of the rural respondents, as opposed to 6.8 percent of those in urban areas, never had any children. On average, these oldest-olds had 3.5 living children at the time of the 2000 interview while 11.7 percent had no living children .

As to the main source of income, a high proportion of the oldest-olds relied on their children, though this proportion was much higher in the rural areas. About three-quarters of oldest-old in rural areas relied on children as his or her main source of income, compared to half of those in urban areas. Public assistance such as pension was not available to the majority of them, particularly to those in rural areas. Thirty-six percent of the oldest-old in urban area had pension while only 8 percent of those in rural areas did. In urban areas, a third of the oldest-old relied on pension as their main source of income. (A more careful analysis reveals that these individuals tended to be those who had higher occupational status and education attainment). In contrast, in rural areas, only 6 percent of the oldest-old had pension as their main source of income.

Data also clearly show that the oldest-old in rural areas received significantly worse quality of medical care and had a higher level of mental distress than their counterparts in urban areas.

Relationship between Economic Stress and Health Status

(Figure 2 about here)

Figure 2 shows that those who felt they were under economic stress, on average, had worse physical and mental health, with significantly more people reported having "bad or very bad" health, having two or more chronic illnesses and limitation in activities of daily living. These relationships have also been corroborated in multivariate analyses. Data also show that those who were under economic strain had poorer mental health and cognitive functioning, as well as a lower sense of control (data not shown). However, we will not focus on these health measures in this paper due to potential endogeneity problems in these analyses (since these health indicators were measured contemporaneously as economic stress in 2000) but rather on the mortality rate over the subsequent five years.

(Table 2 about here)

Risk Factors of Economic Stress

What are the factors that increase the risk of economic stress at an old age? Table 2 shows that, for the oldest-old in the rural area, these risk factors include being aged, being male, having low or no education, being widowed or never married, having no living children, no pension, and not having children as their main source of financial support. The finding that males are more likely to be under economic stress contradicts previous research. After further

examination, however, we find that compared to females, more male oldest-old were never married (2.6 percent vs. 0.40 percent) and did not have children as their main source of income (44 percent vs. 27 percent). These factors partly explain why the male oldest-old are more likely to be under economic stress than females. Previous studies did not control for many of these factors. Risk factors for economic stress also include physical health status. Specifically, diminished ability to engage in ADL is related to economic strain, perhaps because of the high medical costs related to elderly illnesses.

Consistent with the descriptive data, a lower sense of control level, poor self-reported health status, and impaired cognitive conditions are all significantly related to subjective economic strain.

Mediating Mechanisms

We hypothesize that economic stress affects health through its negative effect on (1) the quality of medical care and (2) the mental health of the oldest-old.

(Table 3 about here)

Table 3 shows that the oldest-old who felt they were under economic strain were about seven times more likely to receive poor quality medical care and were in greater emotional distress. Another indicator of economic stress, never or rarely eat fruits is also associated with a higher likelihood of receiving poor quality medical care in rural areas a higher level of emotional distress. Having no access to tap water is significantly related to higher mental stress. Receiving welfare in fact reduces the likelihood of receiving poor quality medical care but increases mental stress in rural areas though not in urban areas. This may be indicative of the general negative

relationship between economic stress and one's mental health despite the benefit of some medical assistance from the government. However, if the oldest-old has his or her children as the main financial source, the negative impact of economic strain on emotional distress decreases by 0.13 percent in urban and 0.16 percent in rural areas.

Additionally, economic stress has both short-term and long-term impact on both the quality of medical care and emotional distress among the oldest-old in 2000 and two years later (results not shown due to space constraint).

Economic Stress and Mortality Hazard

We now turn to the relationship between economic stress and mortality. First, we show the Kaplan-Meier survival curves of the probability of survival, against the number of elapsed days from 2000 to 2005 for those who were under economic strain in 2000 with those who were not. As can be seen, the probability of survival was higher for those who were not under economic strain and the gap seemed to increase as time advanced. At the end of five years, about 46 percent who were not under economic strain, vs 42 percent of those who were, had survived.

(Figure 3 about here)

Hazard Models for Mortality

We then show the impact of economic stress on mortality hazard. As the socioeconomic contexts in urban and rural areas are distinct, we conduct separate analysis for urban and rural areas. Table 4 and Table 5 show the Cox regression estimates for rural and urban areas respectively. The first model includes only the four indicators of economic stress as independent variables. In model 2, we add demographic controls. In model 3, we add moderators, including

private social support network, public assistance, life style, and sense of control, and indicators of prior health status. We also add two interaction terms to see if the impact of economic strain changes when the oldest-old had children as his or her main source of income or had access to pension. Family structure variables are not included in the model because they are highly correlated with whether or not the oldest-old had children as their main source of financial support. In the final model, we further add the two mediators – the quality of the medical care and the mental well-being of the oldest-old.

(Table 4 about here)

As shown in Table 4, in rural areas, two of the indicators - lack of fruits and perceived economic strain – contribute significantly to a higher mortality hazard. These effects remain rather stable in subsequent models as we add the moderators and mediators. Economic strain and the lack of fruit indicator increase mortality hazard by 40 percent and 12 percent respectively in the final model.   Having children as main financial source reduces the mortality hazard by about 23 percent and having pension as a source of income reduces the mortality hazard by 66 percent. In the final model, the two mediators reduce the effect of economic strain although only mental distress has a direct impact on the mortality hazard.   The control variables are related to mortality rates in expected directions.

(Table 5 about here)

In the urban area, a very different picture emerged. All four economic stress indicators were related to a higher mortality hazard but none to a statistically significant level. Having children as a main source of financial support and having pension were not significantly associated with a lower mortality rates. Here the main predictors of mortality rates are the

standard demographic (age and gender), socioeconomic status (occupation), health status, and life style indicators. Having a lower sense of control and higher level of mental distress also contributed significantly to a higher mortality rate.

V. Summary and Discussions

We examine the relationship between economic stress, quality of life, and mortality for the oldest-old in China based on data from the Chinese Longitudinal Healthy Longevity Survey conducted between 2000 and 2005. Despite the limitation that we do not have direct measures of family income but only crude measures of economic stress, our findings lend some support for treating economic stress as a potentially serious public health issue. We find that the oldest-old in rural areas have significantly poorer quality of life than those in urban areas. They rely more heavily on children and have less access to public assistance. Economic stress significantly increased the mortality hazard in rural but not in urban areas. The elderly in rural areas who experience greater hardships than those in the urban areas had a significantly higher probability of not receiving adequate medical care when needed and being in greater mental distress. The negative impact of economic strain was ameliorated by the presence of private (children) and public (pension) support network. Since the public protection system in rural areas is next to non-existent, the impact of economic stress in rural areas is more detrimental to the elderly.

For most of the upcoming generation of elderly in China, relying heavily on children for care is not a viable option. The baby boomer generation who were born in the 1950s grew up under the one-child policy. They have fewer children (and many have no son) to rely on than their predecessors who were the respondents in this study. In addition, the unusually high sex ratio in China as a result of the one-child policy means that there will be fewer daughters and

daughters-in-law to perform the care giving tasks which have traditionally been the responsibility of females. The shrinking private and public support will pose great challenge to China's ability to care for its elderly. Although pension reform is under way, a majority of the elderly population still do not have access to these government resources.

Several factors exacerbate the problem of elderly care in China's rural areas: (1) the rural-urban migration of young population, (2) the substantially higher sex ratio in the rural areas, and (3) the absence of social security system in the rural areas. As suggested by Li (2007), as rural migrants move to work and live in urban areas, the rural pay-as-you-go pension systems will only exist in name. Currently, the medical system in China is effectively only serving those who can afford the high cost. For the elderly who have the highest poverty rates, adequate medical care remains inaccessible. Whether the local governments can set up adequate public safety nets in time to alleviate the pension crisis due to rapid urbanization and whether social security can extend coverage to rural elderly are critical to the well-being of the elderly in China.

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Figure 1: Conceptual Framework for the Relationship between Economic Stress and Health

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                          ┌──────────────────────┐
                          │ Poorer resources for │
                          │ medical care & other │
                          │ daily needs          │
                          └──────────────────────┘
         ┌──────────┐                                    ┌────────────────────────┐
         │ Economic │----------------------------------->│ Poor Physical Health,  │
         │ Stress   │                                    │ higher mortality       │
         └──────────┘                                    └────────────────────────┘
              ▲
              │              ┌──────────────────┐
              │              │ Higher mental    │
              │              │ distress         │
              │              └──────────────────┘
  ┌────────────────────────┐          ▲
  │ Control variables:     │          │
  │                        │  ┌────────────────────────────┐
  │ Gender, ethnicity,     │  │ Moderating factors:        │
  │ marital status,        │  │                            │
  │ residence, other       │  │ Human Capital, Social support│
  │ family characteristics,│  │ network, public assistance,│
  │ Life style, prior health│ │ sense of control           │
  │ status                 │  └────────────────────────────┘
  └────────────────────────┘
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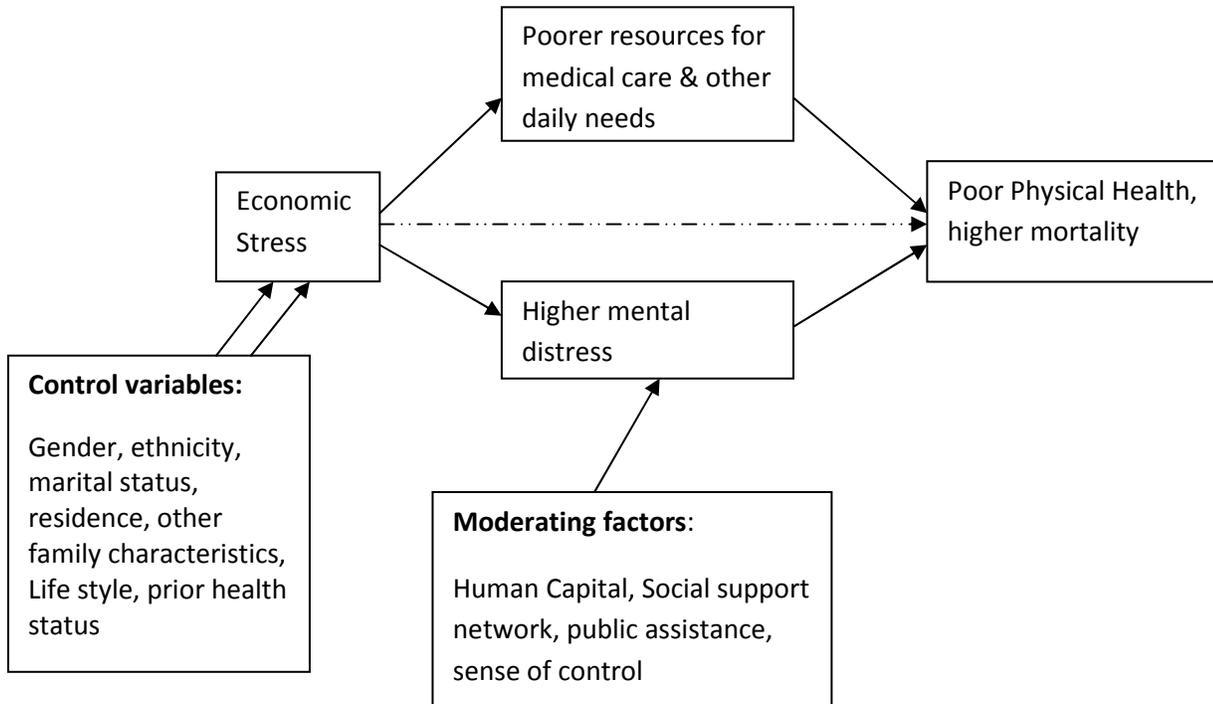
Table 1: Descriptive Statistics for the Characteristics of the Sample

			All	*Urban*	*Rural*
		N	*Mean*(St Dev)	*Mean*(St Dev)	*Mean*(St Dev)
Economic Stress Indicators					
	receiving welfare*	10768	.16(.36)	.15(.36)	.16(.37)
	no tap water	10972	.51(.50)	.20(.40)	.67(.47)
	rarely or no fruits	10970	2.92(.91)	2.69(1.06)	3.04(.80)
	economic strain	10736	.16(.37)	.15(.35)	.17(.37)
Covariates					
Demographic and Socioeconomic Characteristics	age	10972	83.7(3.6)	83.9(3.7)	83.6(3.5)
	female*	10972	.62(.48)	.62(.48)	.63(.48)
	minority	10952	.06(.24)	.05(.22)	.06(.25)
	currently married	10971	.28(.45)	.31(.46)	.28(.45)
	divorced	10971	.01(.07)	.01(.09)	.00(.07)
	widowed	10971	.70(.46)	.67(.47)	.71(.45)
	never married*	10971	.01(.11)	.01(.12)	.01(.10)
	no education	10893	.65(.48)	.56(.50)	.70(.46)
	education (1-5 years)	10893	.24(.43)	.26(.44)	.23(.42)
	education (>5 years)	10893	.11(.31)	.18(.38)	.07(.26)
	high occupation	10965	.06(.23)	.13(.33)	.02(.14)
Life Style	drank*	10951	.30(.46)	.30(.46)	.29(.46)
	smoked*	10954	.34(.47)	.35(.48)	.34(.47)
	exercised	10944	.32(.47)	.45(.50)	.26(.44)
	meat, fish, egg consumption	10958	1.96(.47)	2.03(.50)	1.93(.44)
Family Structure	alone	10972	.15(.35)	.13(.34)	.15(.36)
	with spouse only	10972	.14(.34)	.16(.37)	.13(.33)
	with children	10972	.62(.48)	.57(.49)	.65(.48)
	with others	10972	.01(.11)	.02(.13)	.01(.10)
	institution	10972	.08(.27)	.12(.32)	.06(.24)
Moderators – Family support Community support	have living child	10685	.88(.32)	.87(.34)	.89(.31)
	main financial source from children	10972	.67(.47)	.49(.50)	.75(.43)
	pension	10800	.17(.38)	.36(.48)	.08(.27)
Psychological Attribute	sense of control	9613	3.72(1.12)	3.90(1.12)	3.62(1.11)
Prior Health Status	self-reported health*	10077	1.56(.71)	1.56(.70)	1.56(.72)
	ADL index	10972	.11(.30)	.13(.33)	.10(.29)
	cognitive impaired*	10972	.01(.12)	.01(.12)	.01(.12)
	proxy	10972	.36(.48)	.29(.45)	.40(.49)
Mediating Variables					
	poor medicare (2000)	8447	.07(.26)	.05(.22)	.09(.28)
	poor medicare (2002)	6217	.12(.32)	.10(.30)	.12(.33)
	mental distress (2000)	10011	1.05(.57)	.95(.57)	1.09(.56)

mental distress (2002)	5543	1.13(.58)	1.05(.60)	1.17(.56)

*means not statistically different at .05 level

Figure 2: Economic Stress and the Health Status of the Oldest-old in China

Self Reported Health

Number of Chronic Illness by Economic Stress
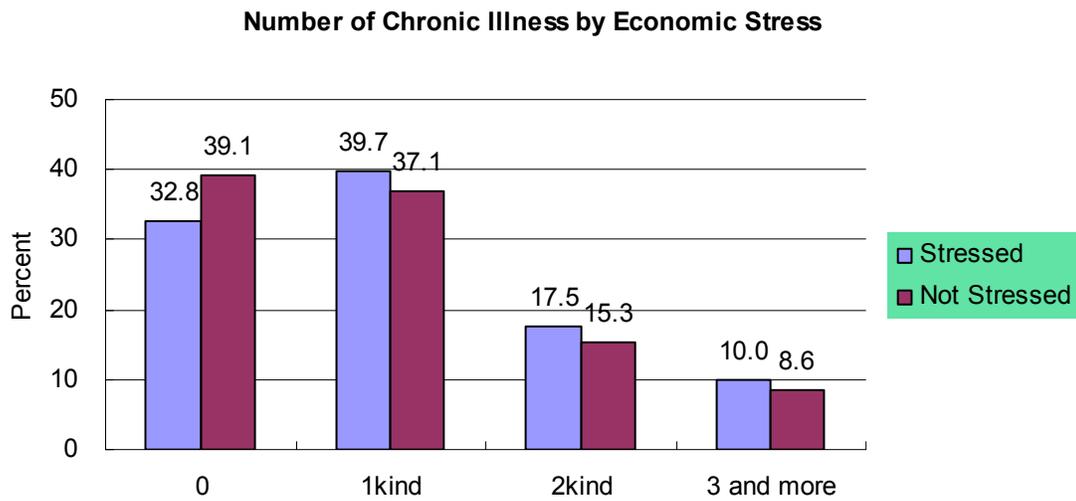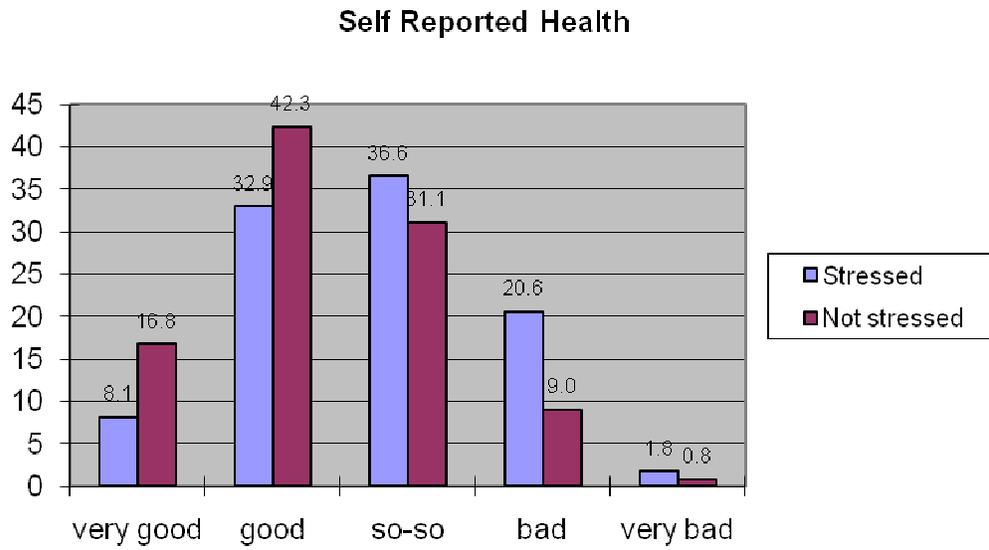
Table 2: Logistic Regression Estimates for the Risk Factors for Economic Stress

Variables	Urban		Rural	
	(1) Receiving Welfare (Odds Ratio)	(2) Economic Strain (Odds Ratio)	(3) Receiving Welfare (Odds Ratio)	(4) Economic Strain (Odds Ratio)
age	0.997	0.991	1.034**	1.037***
	(0.016)	(0.015)	(0.011)	(0.011)
female	0.778	0.819	0.758**	0.683***
	(0.120)	(0.110)	(0.069)	(0.061)
minority	0.479*	1.593*	0.468***	2.837***
	(0.169)	(0.334)	(0.088)	(0.344)
divorced	5.222**	1.879	1.763	1.122
	(2.849)	(0.941)	(0.941)	(0.673)
widowed	2.565***	1.035	1.222*	1.006
	(0.408)	(0.134)	(0.107)	(0.084)
never married	4.045**	0.880	2.352**	0.341**
	(1.916)	(0.403)	(0.748)	(0.140)
education (1-5 years)	0.732*	0.827	0.950	1.061
	(0.115)	(0.112)	(0.093)	(0.100)
education (>5 years)	0.533**	0.555**	0.662*	0.619**
	(0.123)	(0.112)	(0.115)	(0.110)
high occupation	1.787*	0.571*	0.860	1.313
	(0.451)	(0.137)	(0.266)	(0.370)
have living child	0.319***	0.716*	0.400***	0.638***
	(0.046)	(0.106)	(0.040)	(0.069)
main financial source from children	0.134***	0.729*	0.279***	0.523***
	(0.019)	(0.099)	(0.023)	(0.045)
pension	0.060***	0.496***	0.250***	0.372***
	(0.012)	(0.077)	(0.044)	(0.066)
sense of control	1.059	0.891*	0.994	0.784***
	(0.058)	(0.041)	(0.033)	(0.025)
self-reported health	1.170	1.791***	1.095	2.260***
	(0.099)	(0.130)	(0.058)	(0.110)
ADL index	1.169	0.929	1.743***	0.428***
	(0.258)	(0.179)	(0.244)	(0.071)
cognitive impaired	2.231	0.087	0.585	8.011**
	(3.069)	(0.228)	(0.508)	(5.075)
proxy	1.263	0.892	0.799**	0.682***
	(0.174)	(0.110)	(0.063)	(0.053)
Constant	0.951	0.551	0.065**	0.021***
	(1.325)	(0.702)	(0.057)	(0.018)
Observations	3244	3234	6607	6538
Log likelihood	-979.86126	-1238.8044	-2544.3381	-2594.5301

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05

Table 3: Estimates for the Impact of Economic Stress on
Whether the Quality of Medical Care and the Emotional Distress of the Oldest-old in 2000

	Urban		Rural	
	(1)	(2)	(3)	(4)
Variables	Poor Medicare (Odds Ratio)	Emotional Distress (Coef.)	Poor Medicare (Odds Ratio)	Emotional Distress (Coef.)
receive welfare	1.276	-0.004	0.532***	0.098***
	(0.383)	(0.029)	(0.093)	(0.018)
no tap water	0.972	0.055*	1.228	0.061***
	(0.260)	(0.023)	(0.167)	(0.014)
lack of fruits	1.213	0.058***	1.202*	0.047***
	(0.136)	(0.009)	(0.108)	(0.008)
economic strain	7.388***	0.238***	6.956***	0.291***
	(2.078)	(0.037)	(1.507)	(0.031)
economic strain × main financial source from children	0.674	-0.127*	0.797	-0.170***
	(0.291)	(0.050)	(0.205)	(0.036)
age	1.055	-0.001	0.973	-0.001
	(0.031)	(0.003)	(0.018)	(0.002)
female	1.693	-0.010	0.567***	-0.005
	(0.484)	(0.023)	(0.082)	(0.016)
minority	1.201	-0.021	0.506*	-0.076**
	(0.573)	(0.040)	(0.143)	(0.026)
divorced	0.846	0.048	1.336	0.152
	(0.838)	(0.100)	(1.107)	(0.127)
widowed	0.526*	0.098***	1.712***	0.030*
	(0.135)	(0.021)	(0.249)	(0.015)
never married	0.073	0.135	0.872	-0.259***
	(0.116)	(0.090)	(0.510)	(0.071)
education (1-5 years)	0.827	0.017	0.946	0.031
	(0.243)	(0.023)	(0.140)	(0.017)
education (>5 years)	1.374	-0.058*	0.453*	-0.078**
	(0.531)	(0.029)	(0.150)	(0.027)
high occupation	0.311*	-0.030	2.588*	-0.115*
	(0.163)	(0.031)	(1.016)	(0.046)
have living child	0.539*	0.019	0.401***	-0.028
	(0.142)	(0.028)	(0.069)	(0.022)
main financial source from children	0.678	0.001	0.841	0.020
	(0.247)	(0.027)	(0.169)	(0.018)
pension	0.934	-0.084**	0.589	0.029
	(0.296)	(0.028)	(0.175)	(0.027)
sense of control	0.757**	-0.083***	1.019	-0.098***
	(0.066)	(0.008)	(0.053)	(0.006)
self-reported health	2.874***	0.201***	2.369***	0.205***

	(0.413)	(0.013)	(0.191)	(0.010)
ADL index	0.394*	0.098**	1.134	0.153***
	(0.154)	(0.036)	(0.222)	(0.028)
proxy	0.626	0.057**	1.171	-0.030*
	(0.166)	(0.021)	(0.144)	(0.013)
Constant	0.000***	0.761***	0.111	0.992***
	(0.000)	(0.218)	(0.175)	(0.160)
Observations	2523	3204	4940	6523
Log likelihood	-354.82283	—	-1079.6553	—
R-squared	—	0.21	—	0.20

Standard errors in parentheses
*** $p<0.001$, ** $p<0.01$, * $p<0.05$

Figure 3: Kaplan-Meier Survival Estimates by Economic Strain, 2000-2005
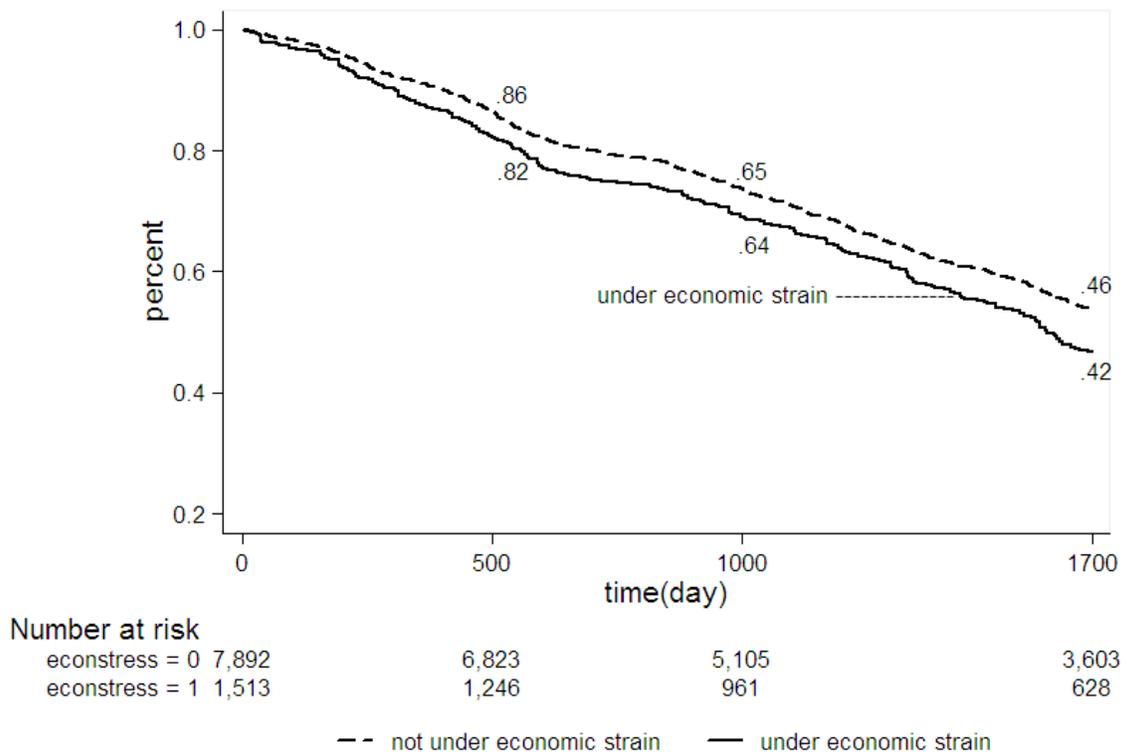
Table 4: Cox Regression Estimates for Mortality Hazard in Rural

Variables	(1) Mortality Hazard	(2) Mortality Hazard	(3) Mortality Hazard	(4) Mortality Hazard
receive welfare	1.037	0.984	1.075	1.151*
	(0.053)	(0.051)	(0.060)	(0.071)
no tap water	1.033	1.005	1.035	1.005
	(0.042)	(0.041)	(0.046)	(0.051)
lack of fruits	1.111***	1.117***	1.107***	1.122***
	(0.028)	(0.028)	(0.030)	(0.036)
economic strain	1.247***	1.179***	1.560***	1.397**
	(0.059)	(0.056)	(0.15)	(0.16)
economic strain × main financial source from children			0.677***	0.773*
			(0.077)	(0.10)
economic strain× pension			0.334***	0.337**
			(0.10)	(0.14)
age		1.084***	1.067***	1.065***
		(0.0052)	(0.0057)	(0.0066)
female		0.695***	0.693***	0.750***
		(0.032)	(0.039)	(0.048)
minority		0.905	0.867	0.899
		(0.065)	(0.070)	(0.092)
divorced		1.486	1.352	2.506**
		(0.48)	(0.44)	(0.84)
widowed		1.137**	1.139**	1.126*
		(0.051)	(0.054)	(0.061)
never married		0.975	1.093	1.025
		(0.18)	(0.24)	(0.26)
education (1-5 years)		0.965	0.903	0.898
		(0.048)	(0.048)	(0.054)
education (>5 years)		0.989	1.006	1.091
		(0.080)	(0.087)	(0.11)
high occupation		1.060	1.036	1.168
		(0.13)	(0.14)	(0.17)
have living child			0.985	0.837*
			(0.067)	(0.065)
main financial source from children			1.325***	1.430***
			(0.084)	(0.10)
pension			1.388***	1.536***
			(0.12)	(0.15)
drank			1.120*	1.092
			(0.052)	(0.059)
smoked			1.141**	1.254***
			(0.057)	(0.071)

	(1)	(2)	(3)	(4)
exercised			1.047	1.055
			(0.048)	(0.055)
meat, fish, egg consumption			1.178***	1.213***
			(0.056)	(0.067)
sense of control			0.971	0.981
			(0.018)	(0.021)
self-reported health			1.234***	1.239***
			(0.037)	(0.043)
ADL index			1.839***	1.769***
			(0.13)	(0.13)
cognitive impaired			1.065	1.111
			(0.41)	(0.44)
proxy			1.373***	1.381***
			(0.056)	(0.065)
quality of medical care				1.047
				(0.088)
mental health				1.056
				(0.048)
Observations	6263	6220	5803	4397
R-squared	-24381.121	-24105.795	-21681.665	-15980.741

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05

Table 5: Cox Regression Estimates for Mortality Hazard in Urban

Variables	(1) Mortality Hazard	(2) Mortality Hazard	(3) Mortality Hazard	(4) Mortality Hazard
receive welfare	1.158	1.128	1.125	1.186
	(0.088)	(0.089)	(0.10)	(0.12)
no tap water	1.090	0.974	0.972	0.956
	(0.073)	(0.066)	(0.072)	(0.079)
lack of fruits	1.065*	1.041	1.022	1.037
	(0.030)	(0.030)	(0.032)	(0.036)
economic strain	1.102	1.109	0.834	0.819
	(0.085)	(0.086)	(0.14)	(0.15)
economic strain × main financial source from children			1.337	1.445
			(0.25)	(0.31)
economic strain× pension			1.228	1.192
			(0.28)	(0.30)
age		1.073***	1.050***	1.046***
		(0.0074)	(0.0082)	(0.0093)
female		0.745***	0.708***	0.752**
		(0.053)	(0.061)	(0.075)
minority		1.088	1.089	1.020
		(0.13)	(0.14)	(0.16)
divorced		1.026	0.928	0.815
		(0.32)	(0.31)	(0.30)
widowed		1.142	1.177*	1.147
		(0.080)	(0.088)	(0.098)
never married		0.993	0.791	0.916
		(0.24)	(0.26)	(0.32)
education (1-5 years)		0.975	1.090	1.158
		(0.071)	(0.085)	(0.10)
education (>5 years)		0.858	1.023	1.226
		(0.085)	(0.11)	(0.15)
high occupation		0.748**	0.764*	0.766*
		(0.080)	(0.088)	(0.098)
have living child			0.979	0.966
			(0.093)	(0.10)
main financial source from children			0.894	0.862
			(0.082)	(0.092)
pension			0.843	0.829
			(0.087)	(0.099)
drank			0.911	0.925
			(0.065)	(0.074)
smoked			1.164*	1.183*
			(0.085)	(0.097)
exercised			0.752***	0.690***

			(0.048)	(0.050)
meat, fish, egg consumption			1.044	1.072
			(0.067)	(0.078)
sense of control			0.930**	0.945
			(0.025)	(0.030)
self-reported health			1.178***	1.131*
			(0.052)	(0.058)
ADL index			2.534***	2.533***
			(0.23)	(0.25)
cognitive impaired			2.657	2.671
			(1.36)	(1.40)
proxy			1.222**	1.187*
			(0.082)	(0.090)
quality of medical care				0.894
				(0.15)
mental health				1.221**
				(0.081)
Observations	2900	2880	2693	2102
Log likelihood	-9648.4932	-9545.3181	-8460.5736	-6431.3284

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05