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An exploratory discrete-time multilevel analysis of the effect of social support on the survival of elderly people in China

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Abstract

This study undertakes a survival analysis of elderly persons in China using Chinese Longitudinal Healthy Longevity Survey 2002–2008. Employing discrete-time multilevel models, we explored the effect of social support on the survival of elderly people in China. This study focuses on objective (living arrangements and received support) and subjective activities (perceived support) of social support, finding that the effect of different activities of social support on the survival of elderly people varies according to the availability of different support resources. Specifically, living with a spouse, financial independence, perceiving care support from any resource is associated with higher survival rates for elderly people. Separate analysis focusing on urban elderly and rural elderly revealed broadly similar results. There is a larger difference between those perceiving care support from family or social service and not perceiving care support in urban areas comparing to those in rural areas. Those who cannot pay medical expenses are the least likely to survive. The higher level of economic development in province has no significant effect on the survival of elderly people for the whole sample model and the elderly people in urban areas; however, there is a negative influence on the survival of the rural elderly people.

Keywords

China; discrete-time multilevel analysis; survival; social support

INTRODUCTION

A growing body of studies have illustrated that social support has beneficial effect on various health outcomes, including survival (Lyyra & Heikkinen, 2006; Uchino, 2006). Yet, previous studies also found that social support has multiple dimensions and different sources of social support can have different effects on the health outcomes and survival (Uchino, 2009; Zhou & Qian, 2008). Whereas extensive studies have investigated the relationship between different dimensions of social support and mortality for elderly people in developed countries (Holt-Lunstad et al., 2010; Uchino, 2009), few have focused on such relationships in China; a developing country with a large aging population and severely underdeveloped social security provisions in response to its rapid population aging. Unlike Western nations

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where elderly social support, particularly financial and medical support, are primarily provided by the state, the family has been the cornerstone of such social support for elderly people in China. On the other hand, the Chinese government has been carrying out major social welfare reforms in recent years, seeking to improve China's social security provision for its citizens, especially the elderly population. There are vast differences in social support from family and the state between rural and urban areas. For example, fertility rates are higher in rural areas than urban areas; which may increase the probability of rural elderly persons living with their children compared to urban elderly persons. This also may reduce the likelihood of rural elderly persons living in nursing homes than urban elderly persons as nursing homes in rural areas are very rare and most of rural elderly persons living in such homes are without any living children. On the other hand, rural elderly individuals are less likely to be covered by pension than their urban counterparts, which increases the former's likelihood to rely on themselves or their family for financial support. While medical insurance coverage has dramatic increased in rural areas since 2003, nonetheless, those rural elderly persons who have medical insurance are still stuffing the high out-of-pocket medical expenditure. This could also increase their likelihood of relying on themselves or their family for medical support. Therefore, we hypothesize that the effect of social support on the survival status of older people may be different between rural and urban areas; social support from family may have a more protective effect on the survival in rural areas than urban areas; while, social support from state may have a more beneficial effect on the survival status of urban elderly people compared to rural elderly people.

A systematic study on the relationship between different dimensions of social support and the survival of Chinese elderly persons according to different availability of support resources will not only advance our knowledge and help fill the empirical gap in this field but also contribute greatly to China's social policy decision making on how to improve the well-being and the longevity of elderly persons, especially for its most vulnerable members. In this study, we examine the effects of various dimensions of social support (including living arrangements, received and perceived support) provided by different sources such as family, state or self on the survival of elderly persons. We also compare survival differences between elderly persons living in urban and rural areas to address the substantial socioeconomic and institutional rural-urban inequalities in China. This research is informed by social support theories and the results contribute to a better understanding of the relationships between social supports and the survival of elderly persons in China. The first round of nation-wide longitudinal data from the Chinese Longitudinal Healthy Longevity Survey (CLHLS) is used to examine these relationships in contemporary China.

SOCIAL SUPPORT AND MORTALITY

Social support refers to emotional support, tangible support such as financial assistance, information support and companionship that elderly people receive (Langford, 1997). It has been found to be positively associated with better well-being and lower level social support is linked with higher mortality risks (Holt-Lunstad et al., 2010; Uchino, 2006). This is because as a psychosocial factor, social support provides a buffer against stress and protects people from potential adverse effects in stressful situations (Uchino, 2006). As a physiological factor, social support helps facilitate healthier behaviours and medical regimes

and results in better health outcomes (Uchino, 2009). These factors are particularly important for elderly people as they are more reliant on resources available in the area of residence than younger adults (Robert & Li, 2001). The right type and sources of social support may enhance their capacity to cope with stress, improve their health outcomes and subsequently lower their mortality risks (Uchino, 2006).

Social support for elderly persons includes both objective (such as living arrangements and received support) and subjective activities (such as perceived support) (Zhou & Qian, 2008). Living with their children or other family members, elderly individuals should have regular interactions with their family members and receive physical and emotional support (Zhou & Qian, 2008). Received support is another objective activity, which refers to the reported receipt of support resources (Uchino, 2009). In terms of subjective activity of social support (perceived support), elderly people may believe that they would be taken care by their family members, social networks or community when they are sick; even for those live independently elderly people, having such belief could shape their positive attitudes to buffer the effect of stressful events (Zhou & Qian, 2008). The effect of these two activities (dimensions) of social support on the health outcomes or survival status may vary according to different availability of support resources. The following section summarizes existing findings on the relationship between these dimensions of social support and mortality according to different sources of social support.

Social support and living arrangements

As the objective activity of social support, living arrangements are important to the health of elderly persons because they play a role in providing social support and determining social roles associated with different household structures (Waite & Hughes, 1999). Studies have suggested that living arrangements have a great impact on mortality risks, when comparing people living alone, as a married couple with or without children, as a cohabitating non-married couple or with other persons, and living in private or nursing homes (Davis et al., 1997; Herm et al., 2013; Koskinen et al., 2007).

Living with a spouse has consistently been found to be beneficial for the survival of elderly people (Waite & Hughes, 1999). The explanation has largely been attributed to the protective effect of marriage as marriage provides provision of social/economic support; healthier individuals are more likely to marry or stay married into the married group; and better health behaviours of married individuals may be in turn the result of a direct effect of marriage (Manzoli et al., 2007).

For the other living arrangements, elderly women living alone only exhibit slightly higher mortality risk than married women but the mortality of elderly men living alone is more unfavourable compared to those living with a spouse (Herm et al., 2013; Koskinen et al., 2007). Davis et al. (1997) argued that elderly people who live alone or with spouse are more likely to develop better coping mechanisms and contingency plans (use of formal health services) than those in other living arrangements. Elderly persons living in institutions or nursing homes have higher mortality rates than those living in private households (Herm et al., 2013). The results for elderly people living with adult children in developed countries

are rather mixed depending on the gender of the elderly person and their marital status (Herm et al., 2013; Waite & Hughes, 1999).

In terms of living arrangements in China, Li et al. (2009) found that elderly people living with their spouse are associated with a greater health advantage than elderly people living in other living arrangements. Intergenerational co-residence or living with adult children has been a traditional living arrangement in China for elderly people to facilitate family care and support for elderly persons or out of necessity due to financial constraints of elderly people. As a return for such support, many elderly people are expected to carry out household chores for the entire family or care for grandchildren, both of which may lead to a decline in their physical function (Wang et al., 2009). Moreover, their wellbeing and quality of life may be affected by the potentially complicated family relationships such as intergenerational conflicts (Zhou & Qian, 2008). It appears that elderly persons living in a nursing home are more satisfied with their quality of life than those living with children (Zhou & Qian, 2008). Elderly individuals living alone (who are more likely to be of a higher socioeconomic status) tend to enjoy a better quality of life than those living with children (Sereny, 2011).

Fertility rates are higher in rural areas than urban areas, which may increase the probability of rural elderly persons living with their children compared to urban elderly people. Urban elderly people tend to have higher socioeconomic status than their rural counterparts, which may increase the likelihood to living alone or with spouse to enjoy a better quality of life. Nursing homes are very rare and less developed in rural areas than in urban areas. Most of rural elderly people living in nursing care are without any living children; while in contrast, in urban areas nursing homes have been extended to people who can afford to pay. Therefore, we hypothesize that living with children has no advantage in increased survival compared to living alone or living with spouse, and those elderly persons in a nursing home may have increased survival compared to other living arrangements. We also hypothesize that the different living arrangements contribute different effects on elderly people's survival in rural and urban areas. For the rural elderly persons, we hypothesize that those elderly people in a nursing home may have no benefit effect in increased survival compared to other living arrangements; for the urban elderly people, living alone, living with spouse or living in nursing homes could have advantage in increased survival compared to living with children.

Received support and resources

Received support is another objective activity of social support, which refers to the actual transfer of advice, aid, and other support resources offered by providers (Wethington & Kessler, 1986). The results from testing the relationship between received support and mortality are highly variable, as received support has been found to produce both beneficial and detrimental effects on health or mortality (Uchino, 2009). Uchino (2009) summarized some explanations for such conflicting results. For example, as one of the many coping options, the effectiveness of received support may depend heavily on the context (Berg & Upchurch, 2007). The type of support received in a particularly stressful context may determine whether its influence is positive or negative. The effectiveness of received support could also be affected by conflict in relationships. For instance, a number of laboratory

studies suggest that the coexistence of positivity and negativity in relationships can decrease the efficacy of received support (Holt-Lunstad et al., 2007). Received support could also contribute to a drop in self-esteem or invasion of one's independence. Results from a study (Bolger & Kessler, 2000) suggested that received support may be supportive only if it is not noticed by the recipient.

In terms of the resources that elderly people receive in China, it is a common practice for elderly individuals to receive financial assistance and medical support from family members. It is not only a reflection, but an expectation formally and informally endorsed by the state. This is particularly true for rural elderly persons, as most are not in any pension schemes which would not allow them to be financially independent. Krause et al., (1998) suggest that receiving economic assistance from family members is associated with greater psychological distress among Chinese elderly people. This is because "relations with family members may at times be difficult, and providing economic assistance when resources are scarce may create feelings of burden and promote interpersonal tension" (Krause et al.,1998; pp. 66). On the other hand, as we discussed previously, some elderly persons have to carry out household chores for the entire family or care for grandchildren in order to expect financial or other support from their children. This may lead to a decline in their physical function; hence increase the risk of mortality. Indeed, some researches on the health of elderly people in China find that economically dependent elderly persons are more likely to develop disabilities (Gu & Xu, 2007), less likely to report good health (Feng et al., 2013), and exhibit lower life satisfaction and poorer mental health (Li et al., 2007). The rapidly declining mortality rate and fertility rate in China suggest that fewer adult children now need to economically support their elderly parents for a long period. This may create more tension and conflicts within the household, and may require elderly people to carry out more household chores by their children which could be detrimental to their health and survival. Hence, we hypothesize that economically dependent elderly people have worse survival rates. These effects may be different between rural and urban elderly people. We hypothesize that received financial assistance and medical support from family members may be worse in survival of rural elderly people than urban elderly people as rural elderly people are less likely to be covered by pension and medical insurance and more likely to rely on their family members as resources than their urban counterparts.

Perceived support and resources

Perceived support is a subjective perception which refers to one's potential access to social support (Uchino, 2009). Findings reveal a consistent association between perceived support and lower mortality rates (Berkman et al., 1992; Brummett et al., 2001, Uchino, 2009). Perceived support helps reduce negative emotional and behavioral responses to stressful events (Lyyra & Heikkinen, 2006) and often times is connected with proactive coping, healthier behavioural choices and cooperation with medical regimes (Aspinwall & Taylor, 1997; DiMatteo, 2004). It has been found to be more important in buffering the effect of stressful events (Wethington & Kessler, 1986), acts as a better indicator for people's psychological well-being (van der Zee et al., 1997), and provides more beneficial physical health outcomes than actual received support (Uchino, 2009).

For elderly people in China, the thoughts of being cared for when sick provide a sense of security that could have important beneficial effects on their survival outcomes. Studies have suggested that perceived support contributes to a better quality of life (Zhou & Qian, 2008) and better self-rated health (Feng et al., 2013) for Chinese elderly individuals. This creates a perceived quality of intergenerational relationships which act as a good reflection on perceived social support from adult children while also greatly affecting older Chinese parents' psychological well-being (Chen & Silverstein, 2000). Therefore, we hypothesize that elderly people who perceive they have care and support when sick have higher survival rates than those without any sources of care. This hypothesis may hold true for both rural and urban elderly people.

INEQUALITY IN INSTITUTIONAL SOCIAL SUPPORT PROVISION IN CHINA

A main reason many Chinese elderly people depend so heavily on family as their social support is due to the unequal and inadequate provision of institutional social support. In China, social security systems are severely underdeveloped and unevenly distributed, particularly in rural areas (Lei & Lin, 2009). Less than 5% of rural elderly individuals are covered by pension schemes compared to two thirds of the urban elderly (Han & Wei, 2012). This causes the majority of the rural elderly people to either seek financial support from family or continue working into (extreme) old age (Cai et al., 2012).

Health care is another major component in social security support. Since the economic reforms in China, the government reduced spending on health care, which has greatly exacerbated the inequalities between urban and rural areas in China (Li, 2010). The urban-rural health care inequality has persisted because many of the recent health reforms have focused on urban areas (Li, 2010). In rural areas, although the coverage of the New Cooperative Medical System (NCMS) have extended from 12.6% in 2003 to 92.5% in 2008 (National Health Services Survey, 2008), it has not improved rural residents' formal access to medical care due to high out-of-pocket payments (Lei & Lin, 2009). According to the 2005 WHO report, over 60% of patients in rural areas were unable to afford the cost needed to remain in hospital to complete treatment (WHO, 2005). Gu et al., (2009) showed that access to healthcare increased odds of healthy survival by 22–68% after controlling for demographic and socioeconomic variables in China. The rural-urban disparity in healthcare may lead to differential survival status between elderly people from these two societies.

The institutional provision of social support also exhibits considerable inequality between provinces. Since the fiscal decentralization and increased local financial autonomy after the economic reform, each province is allowed to implement its own social security policy for the contribution rates and benefits of social security. The quality and quantity of the social security resources depends on the level of economic development of each province. This results in great variations between coastal and inland areas (Brixi et al., 2011). Feng et al., (2013) found that elderly people in provinces with higher levels of health facilities are more likely to report adequate medical support. On the other hand, family support also displays geographical disparity with the highest family support found in the most and least developed provinces, and the weakest family support from mid-level developed urban regions (Lin,

2002). Such geographical inequality in institutional social support and family may contribute to the different mortality risks between provinces.

This paper aims to build on that of Feng et al., (2013), but instead of using self-rated health as the outcome, survival is analysed in discrete-time multilevel models (Barber et al., 2000). More specifically, the paper investigates the effects of different dimensions of social support on survival for elderly people including: living arrangements, received support, and perceived support according to different support resources (mainly from state, family and self). Urban-rural difference on the relationship between social support and survival status are also investigated. The study is informed by social support theory and the results will fill the empirical gap in the relationship between social support and survival in a developing country where social security provision has yet to catch up with the speed and degree of aging.

DATA AND METHOD

Data

This study uses the three-wave (2002, 2005 and 2008) Chinese Longitudinal Healthy Longevity Survey (CLHLS). The CLHLS is the first nation-wide longitudinal survey with the largest sample of oldest-old ever conducted in a developing country. The first wave was conducted in 1998 in half of the counties/cities randomly selected from 22 provinces[1] in China with an attempt to interview all centenarians in the sampled counties/cities. For each centenarian with a pre-designated random code, one nearby octogenarian and one nonagenarian were randomly interviewed with pre-designated age and sex. The 'nearby' refers to the same village or street, or the same town, county or city, when applicable. The sampling strategy was designed to ensure comparable numbers of randomly selected male and female octogenarians and nonagenarians at each age from 80 to 99. After the second wave in 2000, the younger elderly people (those who are 60 – 79) were included in the third wave in 2002. There were 4,889 younger elderly people (60 – 79), 4,239 octogenarians, 3,747 nonagenarians, and 3,189 centenarians in the 2002 wave. Of the total 16,064 elderly persons from the 2002 wave, 8,175 were re-interviewed in 2005 and 5,874 elderly persons had died before the 2005 survey whose information was collected from their next-of-kin. In all, 2,129 respondents from the 2002 waves are not present in the 2005 survey, of which 2,015 have unknown information and 114 are known as deceased, but with missing information at the time of their death. We excluded those with missing information from the analysis at the onset. In the 2008 survey, 4,190 were re-interviewed, 2,513 had died before the survey and 1,472 respondents were lost to follow-up. The latter are included in the study but did not contribute any information beyond 2005. To produce unbiased results, we assumed the missing observations on the outcome did not depend on the response after accounting for the predictors to meet the assumption of Missing at Random (MAR) (Rubin, 1976). For those who were lost in the 2008 follow up waves, we found that only their age, urban/rural residence and family income exhibited significant differences from those who stayed in the 2008 wave (all other individual predictor variables showed no significant

[1]Nine provinces in northwest China are excluded from the study due to lack of reliable information on self-reported age.

differences in predicting those lost to follow up (including self-rated health in 2005)). As a result, all these variables are included in the models to help satisfy the MAR assumption. Of course, as the data is missing, these assumptions cannot be fully evaluated. This study is exempt from ethnics approval since it is an analysis of secondary data.

The dependent variable is whether the respondent remained alive or died during each 6 month period between 2002 and 2008. This length of time was chosen to balance between detail and aggregation. Table 1 illustrates the aggregated form for the survival status of the 13,935 elderly people as a life table. The rows of the table represent the 6 month time periods, which include the initial time [brackets] and exclude the concluding time (parentheses). The first column is the risk set and shows the number of people who are known to be alive at the start of each period. This is reduced due to people's deaths and follow up attrition. The second column is the number of people known to have died in each period and is used to calculate the hazard ratio for the risk of dying in each particular period. The final column is the survival function which cumulates the period-to-period hazards of mortality together to assess the probability that a randomly selected elderly person will survive and not experience death. We omitted the final two six-month periods from the analysis since the low numbers of deaths suggest not all deaths are reported.

The predictor variables include four groups: individual demographic and socioeconomic characteristics (age, gender, urban/rural residence, education and income; family per capita income; categorised by quartiles), dimensions of social support (living arrangements, received financial support, received medical expense and perceived care support when sick), individual health status (self-rated health), and province economic development (province mean household income[2]). The distribution of these variables at baseline is shown in Table 2 (the separated distribution of urban-rural areas are also presented). For those variables with missing values, we used a multiple imputation method to estimate the results based on 10 random imputations (Goldstein, 2009).

Methodology

Given the hierarchical structure of the data, the appropriate model is a discrete time multilevel survival analysis (Barber et al., 2000; Goldstein et al., 2002). The discrete time approach has two advantages over continuous-time methods. First, the assumption in the continuous-time methods is the effect of a predictor on event occurrence is constant over time; second, non-proportional hazards and time-varying covariates are allowed in a discrete time approach.

A schematic formulation is as follows:

$$logit\,(\mathrm{p_{ijk}}) = logit\left(\frac{p_{ijk}}{1-p_{ijk}}\right) = \beta_0 + \sum\nolimits_{\mathrm{i}=2}^{13} \alpha_{\mathrm{i}} \mathrm{T_{ijk}} + \beta_1 \mathrm{X_{1ijk}} + \beta_2 \mathrm{X_{2jk}} + \cdots \beta_3 \mathrm{X_{3k}} + \cdots + \mathrm{v_k} + \mathrm{u_{jk}} \quad (1)$$

[2]Province mean household income is the equivalised income which calculated from the per capita disposable income of urban households and per capita net income of Rural Households from National Bureau of Statistics (2002 – 2008).

$$v_k \sim N\left(0, \sigma_v^2\right); u_{jk} \sim N\left(0, \sigma_u^2\right)$$

where the observed response p_{ijk} is being alive (coded 1) at period *i* for individual *j* in province *k*. The logit of being alive in the period is linearly related to the effects of elapsed time since the first interview (captured by the set of coefficients associated with the 12 period dummies, T_{ijk}), individual variables which may be time-variant (X_{1ijk}) or time-invariant (X_{2jk}) (gender, education and urban/rural residence), and province level variables (X_{3k}). The parameter β_0 represents the overall intercept log-odds across provinces for being alive, when all the predictor variables are set to zero. The a's represents the effect of a passage of each 6 month time period. The terms β_1 and β_2 capture the 'micro' individual characteristic effects, and β_3 captures the 'macro' province effect. The inclusion of time in the specification models accounts for the (log) underlying hazard of death (the probability of dying in a six-month period). The other parameters then assess how the hazard is modified by the other predictor variables. The v_k terms are the random effects attributable to province-level residual differences after taking account of the fixed effects of time, individual effects, and province effects; the u_{jk} terms are the random effects for individuals after taking account of time, individual effects and province effects. These random effects are on the logit scale and are assumed to be normally distributed with mean of 0 and variance of σ_v^2 and σ_{u0}^2 respectively. Since this study is a survival analysis, and the elderly people who have passed away are not included in the next period, there are no random effects between individual level and the variance of σ_{u0}^2 is 0 (Although there appears to be a three-level data structure of periods within individuals within provinces, there is a no variation at the individual-level 2 because death is an absorbing end state not a repeated event. The model therefore effectively has a two-level structure as the individual variance is zero).

We apply full Bayesian MCMC methods to estimate the models. Full Bayesian procedures allow the exact estimation of parameters without approximations and with full uncertainty propagation so that the imprecision associated with one parameter is taken into account in characterising the uncertainty of another parameter (Jones & Subramanian, 2012). In particular both the fixed and random parameters are estimated on the basis that the other set of estimates are unknown. Moreover, an important output from this approach is the Deviance Information Criterion (DIC, Spiegelhalter et al., 2002) which allows the comparison of the goodness-of –fit for a sequence of models that takes account of model complexity. This is defined in terms of the effective degrees of freedom consumed in the fitting of the model which is estimated as a by-product of the MCMC estimation. Finally, the confidence intervals for the estimates of the random parameters do not presume normality as they are allowed to be sampled from a positively skewed Gamma distribution.

The models were estimated using the MLwiN 2.27 software (Rasbash et al., 2009), using the default settings of a burn-in of 500 and a monitoring chain of 5000 simulations following the good-practice recommendations of Draper (2006). The convergence to a distribution was sped up by orthogonal parameterisation and hierarchical centring at the highest level three

(Brown, 2012). Visual inspection of the traces of estimates showed that the defaults were sufficient for convergence and characterising the posterior distribution of the estimates, which was confirmed by a range of convergence diagnostics. Default priors were used to start the chains; these are designed to have the least possible effect on the resultant converged estimates.

RESULTS

Table 2 presents descriptive information for the predictor variables at the base line for the current sample. The results indicate family is the dominant source of social support. Less than 20% of respondents live alone or in a nursing home. More than 90% of elderly individuals perceived care and support from their family members in times of sickness. On the other hand, 68.8% and 74.9% of respondents received finance and medical support from family respectively. There are vast differences in social support between urban and rural areas. About 10% of urban elderly persons perceived care support from social service or live-in care giver, while only 3% of rural elderly people perceived care support from such social resources. About 33.4% of urban elderly persons have a pension compared to 5.6% of rural elderly persons. More than 10% of rural elderly individuals have to work for their own financial security while less than 5% of urban elderly people have to work for their finances. Public medical care is quite rare for rural elderly persons (3.8%),with figures revealing 84% of rural elderly people have to rely on their family as medical expense bearer. Urban elderly individuals experience a significantly higher coverage by public medical care than rural elderly people (23.4%). Household income also presents considerable differences between urban and rural areas; as urban residents' income is about double that of rural residents'.

The model building process is guided by the DIC comparison. From the DIC results, the model that includes all predictors has the best fit. The odds-ratios of the estimates for this final full model with 95% Bayesian Credible Intervals are presented in Table 3. The final model was run separately for rural and urban elderly persons. The results of odds-ratios for these two models are also shown in Table 3 (time effects in all three models are treated as nuisance terms and are not shown).

For the full model, accounting for individual demographic and socioeconomic characteristics, there is a negative relationship between age and one's survival status. Elderly women are 47% more likely to be alive than elderly men. Elderly persons in rural areas are 8% more likely to be alive than their counterparts in urban areas whereas the difference between those with and without schooling are negligible: the former are 5% less likely to be alive than the latter (at 90% CI's level). A sizeable effect is found for family income but this is only relevant for the quartiles at both ends: those in the top quartile of income have significantly higher odds of survival than those in the lowest quartile (ORs=1.45).

Living arrangements was found to be an important component of social support in our study. Consistent with our hypothesis, elderly persons living with a spouse are 1.38 times more likely to be alive than those living alone. However, elderly persons living alone are more likely to be alive than those living with family member(s) or in a nursing home (ORs=0.61

and 0.48 respectively). For received support, the main difference lies between elderly people who use family as the main source of finances and those using other financial support (pension, local government and work), as the former have much lower odds of survival. Elderly persons who are able to pay their own medical expenses have higher survival rates than those who rely upon other sources to cover medical expenses (family, public, or insurance) or those with no ability to pay. In terms of perceived support, elderly persons who have perceived care support from family, social service or a live-in care giver when sick are more likely to be alive than those who do not have such perceived support (ORs=2.73, 2.65 and 1.85 respectively).

For self-rated health, the result indicates that those in better health do have higher odds of survival. Elderly people with very good health, good health, and fair health are 2.60, 2.40, and 1.89 times more likely to survive than those with very poor health respectively. Even elderly people with poor health are 1.5 time more likely to be alive than those with very poor health. In terms of the province effect—the provincial household income has no significant effect on the survival of elderly people.

When the final model was run separately for urban and rural elderly people, the results are broadly similar, although certain differences are revealed. Among the urban elderly people, there is a greater level of perceived care supports than among the rural elderly people. In urban areas, elderly individuals with perceived care supports from family or social services are more than three times more likely to be alive than those with no perceived support. The equivalent odds are slightly lower for those in rural areas. There is also no significant difference between elderly individuals perceiving care support from a live-in care giver and those with no perceived support in rural areas. This result might be due to the fact that only a tiny proportion of the rural elderly individuals (0.6%) are either eligible to have a live-in care giver provided by the state or can afford it privately. For received medical support, elderly individuals with no ability to pay for the medical expense have 75% lower odds of survival than those who are able to cover their own medical expense in rural areas, but such a difference is not significant in cities. Provincial household income does not affect the survival of elderly persons in urban areas; however, in rural areas, as household income increases by one unit (1,000 Yuan), the odds of survival decrease by 0.065.

DISCUSSION AND CONCLUSION

Informed by social support theory, we systematically examined the effects of different dimensions of social support on the survival of elderly persons in China. Results show that the effect of different activities of social support on the survival status of elderly people varies according to the availability of different support resources. The empirical results have important implications for policy makers on how to improve the longevity of the rapidly growing elderly population and reduce survival inequality at different scales.

In general, elderly persons who are younger, female, with higher family income, and in better health have higher odds of survival than those who are older, male, with lower family income and in poorer health. Education level and urban/rural residence make only a slight difference to the survival of elderly persons; a minor difference from previous studies which

found no significant effects from these factors on mortality (Li et al., 2009; Sun & Liu, 2006).

Consistent with the existing results from both the West (i.e. Manzoli et al., 2007) and China (i.e. Li et al., 2009), elderly persons living with a spouse have the highest survival rate compared to those in other living arrangements. This result confirms marriage's protective effect identified in the literature. Chappell (1991) argued that having a spouse is the greatest guarantee of support in old age. For widowed elderly persons, remarriage would be a practical solution to relieve their financial and psychological challenges. According to China's 2010 census, 27% of the elderly population are widowed. A survey undertaken in Changzhou city in China suggests that 69% of elderly individuals take opposition towards remarriage (Zang & Yuan, 2013). This is because elderly people in China encounter enormous obstacles from their children when seeking remarriage due to concerns over allocation of family assets, as well as housing and care responsibilities. Fostering a positive societal response towards elderly remarriage, through its encouragement and facilitation, would be essential to improving the well-being and survival of elderly persons in China.

Elderly people who live alone have higher survival rates than those living with family member(s) or in a nursing house. This may pertain to the endogeneity in the social support measures. Elderly people who live independently are more likely to be either in good health (Sereny, 2011) and/or have the means to afford independent living. They may not need personal care through living with others and may be equipped with better coping mechanisms for survival than those living with family member(s) or in institutions. Elderly people with higher economic status have greater ease living independently. On the other hand, living with adult children may not be so beneficial for the survival of elderly people especially if such arrangement comes with physical (household chores and caring responsibility for grandchildren) and/or psychological (conflicting intergenerational relationship) burdens to elderly people. The results suggest that the State should share more support responsibilities to ensure the financial independence of elderly people in order to improve their well-being and survival.

For the received support, elderly people who are able to cover their own medical expenses and support themselves financially through work or pension report the best survival rate than those who rely upon other sources for financial and medical support. The results confirm findings from the literature that indicate received support may not always be beneficial for the survival of elderly people (Uchino, 2009). However, many elderly people, especially those from rural areas, must continue working well into their senior years to maintain financial independence. Approximately thirty eight percent (37.9%) of the rural elderly population rely on labor income as their primary source of support (Cai et al., 2012). Although the old age insurance program was developed to support rural elderly people, participation rates have remained extremely low (7%), and the program itself has been relatively ineffective. The pension level in rural areas is 10 to 20 times lower than the pension level in urban areas (Wu, 2013). Increasing investment in the rural pension scheme and medical facilities, substantially raising the rural pay-out, and reducing the out-of-pocket medical payment in rural areas would not only help reduce urban-rural inequality, but also reduce the mortality rate of rural elderly people.

Elderly persons who perceive to have care support when they are sick have higher survival rates than those without any sources of care. More than 90% of elderly people in this study have perceived care support from their family. However, compared to those elderly people with no perceived support, it appears that the effects of perceived support on the survival of elderly people according to social service and family are similar. Community-based social services and government nursing homes for elderly persons have been promoted by the state in recent years; however, the service provision is far away from meeting the demand for elderly persons in China (Chu & Chi, 2008). Both increased elderly persons life spans, along with smaller family sizes has resulted in declining fertility rates, putting tremendous pressure on the children of these families to provide care for their elderly parents. Transferring some of the family care responsibilities to the society by developing more social services and nursing homes would be advantageous to both families and the survival of elderly persons. Such development needs be more heavily emphasized in rural China. The institutional support for elderly persons in rural areas is non-existent and ineffective as the majority of the social service development and investment have been concentrated in urban areas (Li, 2010). This is evidenced in our results revealing an insignificant difference between elderly persons with perceived care support from a live-in care giver and those with no perceived support in rural areas.

Finally, there is a strong negative effect of provincial household income on the survival of elderly people in rural areas. Rural elderly people from more developed provinces are less likely to survive than those from less developed provinces. This suggests that the rural elderly people may have born a disproportionate cost of their provinces' economic development. Rural industrialization has been one of the main driving forces for China's economic growth (Tilt & Xiao, 2007). Rapid rural industrialization has caused massive ecologically disasters and led to serious air and water pollution in rural areas that now threaten the health and survival of rural residents in China (Ren & Li, 2002).

Although the results are broadly similar for the separately models of urban and rural elderly people which is not fully aligned with our hypotheses, the effect of some mediating factors in the final model (i.e. different support resources, perceived support from social service, and live-in care giver in different dimensions of social support) have been added which effect the substantial difference of the survival status of elderly people in rural and urban areas.

The results of this study help to extend our knowledge of the relationship between social support and survival of elderly people in China. Although family remains a key provider of social support, our results suggest that the effectiveness of family support is not as notable for elderly people's survival. On the contrary, spousal support and financial independence have proven to be the most beneficial factors for the survival of elderly people. In the coming decades, as China faces the daunting challenge of meeting the demands of a rapidly aging population with an ever-increasing life expectancy, elevating the level and the extent of institutional social support for elderly persons, accepting and promoting the social and family environment for elderly remarriage, and developing sustainably to address the environmental issues of the countryside should all become policy priorities in order to

improve the survival of China's elderly population, and especially its most vulnerable groups.

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Table 1

Life table of the survival for 13,935 elderly

		Number		Proportion of	
Period	**Time Interval**	**Alive at the beginning of the 6 month**	**Dead during the 6 month**	**Dead during the 6 month period**	**All the elderly still surviving at the end of 6 month period**
1	–	13935	–	–	1
2	[0,0.5)	13935	613	0.044	0.956
3	[0.5,1)	13322	972	0.073	0.886
4	[1,1.5)	12350	1129	0.091	0.805
5	[1.5,2)	11221	1225	0.109	0.717
6	[2,2.5)	9996	923	0.092	0.651
7	[2.5,3)	9073	891	0.098	0.587
8	[3,3.5)	8182	294	0.036	0.566
9	[3.5,4)	7888*	420	0.053	0.536
10	[4,4.5)	7468*	458	0.061	0.503
11	[4.5,5)	7010	452	0.064	0.471
12	[5,5.5)	6558	431	0.066	0.440
13	[5.5,6)	6127	387	0.063	0.412

*875 respondents lost in a follow-up survey in period 9, and 597 respondents lost in a follow-up survey in period 10. These lost respondents do not contribute to the risk set.

Table 2

Variables used in the analysis: base line values in 2002

	Whole sample	Urban Areas	Rural Areas
Predictor Variables	**n = 13,935**	**n = 6,012**	**n = 7,923**
Demographic and socio-economic			
Age	In years: 62~120, mean = 86	In years: 62~120, mean = 86.5	In years: 62~120, mean = 86.4
Gender	Male (42.6%), Female (57.4%)	Male (42.8%), Female (57.2%)	Male (42.5%), Female (57.5%)
Residence	Urban (43.3%), Rural (56.7%)	–	–
Education	No Schooling (62.4%), Schooling (37.6%)	No Schooling (54.3%), Schooling (45.7%)	No Schooling (68.4%), Schooling (31.6%)
Income (family per capita income)	0~50,000 (unit: Yuan); Quartiles: 1000, 2000 and 4000	0~50,000 (unit: Yuan); Quartiles: 1000, 2000 and 4000	0~50,000 (unit: Yuan); Quartiles: 1000, 2000 and 4000
Activities of Social Support			
Living arrangements	Live with spouse (29%), Live with family member(s) (53.6%), Alone (13.2%), In a nursing house (4.2%)	Live with spouse (30.4%), Live with family member(s) (51.2%), Alone (11.9%), In a nursing house (6.6%)	Live with spouse (28.1%), Live with family member(s) (55.2%), Alone (14.2%), In a nursing house (2.4%)
Received financial support	Local government (5.6%), Pension (17.6%), Family† (68.8%), Work (8%)	Local government (6.6%), Pension (33.4%), Family† (55.7%), Work (4.4%)	Local government (4.9%), Pension (5.6%), Family† (78.8%), Work (10.7%)
Received medical expense	Family† (74.9%), Public medical care (12.3%), Self (12.8%)	Family† (62.9%), Public medical care (23.4%), Self (13.7%)	Family† (84%), Public medical care (3.8%), Self (12.2%)
Perceived care support when sick	Family† (92.1%), Social service (4%), Live-in care giver (1.9%), Nobody (2%)	Family† (88.8%), Social service (5.9%), Live-in care giver (3.6%), Nobody (1.7%)	Family† (94.7%), Social service (2.5%), Live-in care giver (0.6%), Nobody (2.2%)
Health status			
Self-rated health	Very Good (9.6%), Good (34.6%), Fair (32.1%), Poor (14.1%), Very Poor (1.3%), No answer (8.3%)	Very Good (11.2%), Good (35.1%), Fair (31.7%), Poor (13%), Very Poor (1.3%), No answer (7.6%)	Very Good (8.4%), Good (34.4%), Fair (32.4%), Poor (14.9%), Very Poor (1.2%), No answer (8.6%)
Province-level (n=22) variables at baseline in 2002			
Mean household income	0.31~1.10 (Unit: 10k Yuan)	0.60~1.32 (Unit: 10k Yuan)	0.15~0.62 (Unit: 10k Yuan)

† Family includes spouse, children and other relative.

Table 3

Multilevel logistic regression (odds-ratios) of survival (Logit form for the random part)

	Whole Sample			Urban Areas			Rural Areas		
	Odds	**95% CI**		**Odds**	**95% CI**		**Odds**	**95% CI**	
Fixed Part									
CONS	–			–			–		
Age	0.939***	0.935	0.942	0.938***	0.932	0.944	0.938***	0.933	0.943
Age2	1.001***	1.000	1.001	1.001***	1.000	1.001	1.001***	1.000	1.001
Female (ref: Male)	1.471***	1.388	1.557	1.584***	1.446	1.730	1.418***	1.310	1.536
Rural (ref: Urban)	1.084***	1.027	1.147	–	–	–	–	–	–
Schooling (ref: Non-schooling)	0.945*	0.890	1.002	0.944	0.864	1.029	0.946	0.871	1.024
Income (ref: First lowest quartile)									
Second	1.040	0.973	1.110	1.123*	0.989	1.270	1.039	0.962	1.122
Third	1.053	0.979	1.132	1.030	0.903	1.174	1.137***	1.038	1.251
Fourth	1.443***	1.336	1.564	1.567***	1.365	1.804	1.385***	1.239	1.551
Living arrangements (ref: Alone)									
Live with spouse	1.379***	1.245	1.536	1.328***	1.107	1.575	1.413***	1.23	1.623
Live with family member	0.610***	0.561	0.663	0.602***	0.524	0.687	0.607***	0.549	0.67
In a nursing house	0.476***	0.396	0.571	0.489***	0.377	0.624	0.486***	0.365	0.645
Received financial support (ref: Family)									
Pension	1.391***	1.260	1.539	1.420***	1.235	1.623	1.481***	1.230	1.800
Local government	1.514***	1.338	1.721	1.406***	1.183	1.664	1.822***	1.522	2.203
Work	2.895***	2.349	3.633	2.790***	1.939	4.154	3.022***	2.316	4.051
Received medical expense (ref: Self)									
Family	0.557***	0.500	0.623	0.613***	0.532	0.717	0.509***	0.435	0.593
Public	0.573***	0.502	0.657	0.685***	0.575	0.823	0.403***	0.321	0.508
Insurance	0.539***	0.463	0.628	0.423***	0.346	0.511	0.760**	0.593	0.957
Cannot pay	0.402***	0.302	0.530	0.689	0.448	1.085	0.263***	0.185	0.383

	Whole Sample			Urban Areas			Rural Areas		
	Odds	**95% CI**		**Odds**	**95% CI**		**Odds**	**95% CI**	
Perceived care support when sick (ref: Nobody)									
Family	2.732***	2.361	3.168	3.313***	2.71	4.027	2.303***	1.868	2.818
Social service	2.651***	2.117	3.304	3.124***	2.323	4.297	2.232***	1.576	3.111
Live-in care giver	1.846***	1.508	2.273	2.479***	1.923	3.161	0.883	0.603	1.285
Self-rated health (ref: Very Poor)									
Very Good	2.599***	2.109	3.206	3.174***	2.517	4.063	2.261***	1.709	2.965
Good	2.392***	1.962	2.907	2.907***	2.385	3.586	2.092***	1.614	2.670
Fair	1.885***	1.545	2.284	2.226***	1.808	2.768	1.694***	1.302	2.160
Poor	1.502***	1.230	1.829	1.745***	1.416	2.179	1.353***	1.030	1.744
No answer	1.294***	1.049	1.587	1.505***	1.194	1.902	1.162***	0.882	1.492
Mean Household Income	1.010	0.987	1.040	0.992	0.971	1.021	0.935***	0.903	0.978
Random Part (logit scale)									
Level3									
Between Province	0.025*	0.007	0.068	0.014	0.002	0.040	0.005	0.000	0.017

*** p<0.01

** p<0.05

* p<0.1