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Health among the Oldest-Old in China: Which Living Arrangements Make a Difference?

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Abstract

This study aims to (1) examine the association of living arrangements and health among oldest-old Chinese, and (2) investigate gender differences in the association of living arrangements and health. Data were from the first two waves of the Chinese Longitudinal Healthy Longevity Survey, which included 9,093 Chinese averaging 92 years old. Living arrangements had six mutually exclusive categories: living alone, with spouse, with children, with spouse and children, with others and in institutions. Using multinomial logistic regression, we found that baseline living arrangements are significantly associated with mortality, activities of daily living (ADL) disability, and self-rated health at Wave 2, controlling for baseline health, sociodemographic characteristics and availability of children. Further, the linkages between living arrangements and mortality vary by gender. Among the different living arrangements, having a spouse in the household (either with a spouse only or with both a spouse and children) provides the best health protection. Living alone and living with children are associated with both health advantages and disadvantages. Institutional living lowers mortality risk for men but not women. Living with others provides the least health benefits. Our study has extended the research on living arrangements and health to a unique population—the oldest-old in China—and clarified the health advantages and disadvantages of different living arrangements. Future research should examine the mechanisms linking living arrangements and health, and the experience of institutional living for men and women in China.

Keywords

China; oldest-old; living arrangements; mortality; gender

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Studies in Western-developed nations have shown that living arrangements are salient to health in middle and old age (e.g., Davis, Moritz, Neuhaus, Barclay, & Gee, 1997; Lund et al., 2002; Hughes & Waite, 2002; Michael, Berkman, Colditz, & Kawachi, 2001; Sarwari, Fredman, Langenberg, & Magaziner, 1998). However, little relevant research has focused on the oldest-old population, particularly those in Eastern-developing nations. Such gaps deserve attention considering the physical vulnerability of the oldest-old and differences in cultural norms between the East and West (Baltes & Smith, 2003; Bongaarts & Zimmer, 2006). The present study fills these important gaps. Using two-wave longitudinal data collected from the oldest-old in China, it aims to answer two questions: (1) Are living arrangements associated with health among oldest-old Chinese? (2) Are there gender differences in the association of living arrangements and health?

Several reasons have been offered to explain why living arrangements are relevant to health, including availability of social support, regulation of health behavior, supply and consumption of economic resources, and demands on individual roles associated with different household structures (Lund et al., 2002; Waite & Hughes, 1999). Presumably, coresidential arrangements should be better than living alone in protecting health for older persons, as the former are more conducive to social support exchange, healthy lifestyle, and economy of scales. Numerous cross-sectional and some longitudinal studies have reported that older adults living alone, compared with those not, were at greater risk for poor physical and emotional health (e.g., Kharicha et al., 2007), cognitive decline (e.g., van Gelder et al., 2006), and death (e.g., Lund et al., 2002).

However, others found that older adults who lived alone and those living with a spouse were comparable in mortality risk (Davis et al., 1997) and changes in self-rated health (Hughes & Waite, 2002). Still others report that living alone may have health advantages. For example, a study of the old-old in Israel found that those living alone had lower mortality risk compare with those living with children (without a spouse) and in institutions, controlling for demographic, health, and functioning variables (Walter-Ginzburg, Blumstein, Chetrit, & Modan, 2002); another study found that women living alone had lower risk of decline in mental health and vitality compared with those living with a spouse (Michael et al., 2001).

In sum, the literature is not clear whether older adults living alone have health disadvantages or whether coresidential arrangements are beneficial to health. Several factors may account for the inconsistency, including different operationalization of living arrangements, possible gender difference in the association of living arrangements and health, and age and culture of study samples.

Previous studies have used a variety of comparative schemes to operationalize living arrangements. Some have a greater differentiation of coresidential arrangements whereas others have less. For example, Hughes and Waite (2002) used a 6-category and Davis et al. (1997) used a 3-category variable to represent living arrangements. Different schemes of classification lead to difficulty in comparing results across studies. Considering that the social and psychological meaning of coresidence varies depending on the demographic characteristics of the coresident and the cultural context of the study setting, it seems preferable to distinguish different types of coresidential arrangements. Hence, in this study,

we differentiate those who live with a spouse, with children, and with others who are not spouse or children.

The health effects associated with different living arrangements may vary by gender; for instance, it has been reported that men benefit more from marriage than women (Williams & Umberson, 2004). Prior gender-stratified analyses have suggested a different pattern of associations between living arrangements and health for men and women (e.g., Hughes & Waites, 2002; Davis et al., 1997; Lund et al., 2002; Rahman, 1999; Rahman, Menken, & Kuhn, 2004). However, few have formally tested the interaction effects. Among those that did, the effects were not statistically significant, which has been attributed to the small number of a specific gender in some living arrangements (e.g., Hughes & Waite, 2002).

The age of the sample and the cultural context in which the study was conducted may affect study findings. For instance, independent living may be more a challenge to “older” than “younger” elders, due to physical and cognitive deterioration associated with age. A key contribution of our study is that it examines the linkages between living arrangements and health in a unique sample—the oldest old. In contrast to middle-age and young-old adults who have been the focus of previous Western studies (e.g., Lund et al., 2002; Hughes & Waite, 2002), the oldest-old, most often defined as beginning at around age 80, are “at the limits of their functional capacity” and vulnerable to physical and mental decline (Baltes & Smith, 2003, p. 123).

The oldest-old population is growing rapidly not only in developed but also some developing nations. In 1990, about 0.7% of the Chinese population, or fewer than 8 million, were 80 years old or more. The percentage rose to 0.9 (12 million) in 2000 and was predicted to be 8.2 (116 million) in 2050 (U.S. Census Bureau, n.d.). Such rates of growth raise serious concerns in China given that the nation is still developing and has far fewer resources than developed nations to provide services to the oldest-old.

Adult children are the primary source of support for older people in China. Intergenerational coresidence is a tradition as well as a way to ensure that older persons are cared for by their family. The sons' family, especially that of the oldest son, is supposed to live with parents until their death. The ideal household structure consists of multiple generations living under one roof. Indeed, intergenerational coresidence is common in China. About 68.7% of Chinese aged 65 or more lived in intergenerational households in 2000 (Zeng & Wang, 2003). In comparison, only 17.8% of persons aged 60 or more in the United States lived with children and/or grandchildren in 2000 (United Nations, 2005).

To understand the health consequences of living arrangements among oldest-old Chinese, this study overcomes some limitations of as well as extending prior studies. A relatively large sample of oldest-old Chinese men and women (N = 9,093) is used in this study, which allows for a greater differentiation of living arrangements. It also enables us to test the interaction effects of gender and living arrangements on health. Moreover, the sample includes persons living in institutions, in addition to those living in the community. Prior to 1990s, institutional care for older persons was quite rare in China and was largely financed by the government to accommodate the “three-no” elders—those with no income, no

children, and no capability to work. By late 1990s, many of the government-owned elderly homes were asked to be self-financed and therefore made their service available to those who can afford it; privately-owned institutional care facilities also emerged in different parts of China (Gu, Dupre, & Liu, 2007; Zhan, Liu, & Bai, 2005). These have resulted in a substantial increase of older persons living in institutions. The effect of institutional living on older Chinese persons' health, however, has not been studied adequately. In order to assess the health effects of different living arrangements more thoroughly, we will use three indicators—mortality, disability in activities of daily living (ADL; e.g., dressing, bathing, eating), and self-rated health—as outcomes. These three indicators represent both objective and subjective aspects of physical health.

Hypotheses

Figure 1 depicts our conceptualization of the linkages between living arrangements and health. We hypothesize that baseline living arrangements have significant effects on current health (i.e., that measured at Wave 2), independent of baseline health status, sociodemographic characteristics and children's availability. Among the different living arrangements being investigated, we expect oldest-old Chinese living with both a spouse and children to have the best health outcomes, because of the availability of social support and fulfillment of a cultural ideal. They are expected to be followed, in order, by those living with a spouse (without children), with children (without a spouse), and with others (not spouse or children). Those living alone and in institutions are expected to fare the worst in health.

We also hypothesize that men and women differ in the association of living arrangements and health, because of their different roles throughout the life course. Chinese women's life generally centers on domestic responsibility. The life-long experience of managing a household may enable women to live independently in old age. Thus, we expect living alone to be associated with fewer health disadvantages for women than men. Furthermore, we expect that having a spouse in the household is more beneficial to men's health than to women's, based on study findings in the West (Wood, Goesling, & Avellar, 2007).

Methods

Data and Sample

This study was a secondary data analysis that was reviewed and approved by the Health Science Institutional Review Board at the University of Michigan. It was based on the first two waves of data, which had been de-identified, from the Chinese Longitudinal Healthy Longevity Survey (CLHLS). The survey had a randomly selected sample of oldest-old Chinese from almost half of the total number of counties and cities of the 22 provinces in China. The survey areas covered 985 million persons, or 85% of the total population in China (Zeng, Vaupel, Zhenyu, Chunyuan, & Yuzhi, 2002).

The baseline survey, conducted in 1998, included 9,093 respondents whose ages ranged from 77 to 122 years old. A follow-up survey (Wave 2) was conducted in 2000 when more

than half of the baseline respondents (n = 4,831) were re-interviewed. About one-tenth (n = 894) could not be located at follow-up, and about thirty-seven percent (n = 3,368) had died.

Variables and Measures

The outcomes of interest were three measures of physical health at Wave 2. (1) *Mortality*—defined as whether the respondent had died by Wave 2. This information was obtained from close family members of the respondent. (2) *ADL disability*—defined as whether the respondent had limitations in activities of daily living (ADL) at Wave 2. ADL were measured by six items (bathing, dressing, using the toilet, indoor transferring, eating, and controlling bladder and bowel movement). Being incapable to perform any of the six activities independently was considered to have ADL disability. (3) *Self-rated health*—defined as one's assessment of his/her own health (good vs. poor). It was measured by a single item that asked the respondents to rate their health on a 5-point scale (excellent, good, so-so, poor, and very poor). We took the excellent and good ratings to represent good, and the remaining to represent poor self-rated health.

Our key independent variable was living arrangements. Based on the residential setting and household composition of the respondents at baseline, their living arrangements were classified into one of the following six mutually exclusive categories: (a) living alone; (b) with spouse (no children; may have others); (c) with children (no spouse; the definition of children included adult children, grandchildren, and great-grandchildren; may have others); (d) with spouse and children (may have others); (e) with others (not spouse or children); and (f) in an institution.

Three sets of covariates were included in the analyses. The first was sociodemographic characteristics, including age, gender, socioeconomic status (SES), and ethnicity. Age was measured in chronological years. Gender was dichotomized. Three variables were used to assess SES: education, measured as years of formal schooling; occupational status, measured as high (professional and technical personnel, administrative or managerial positions) vs. low (all others, e.g., agricultural, industrial, service and fishery workers; military personnel), based on the respondent or his/her spouse's occupation before the age of 60; and residence, measured as urban vs. rural. The majority of the Chinese population is Han Chinese. A dummy variable was used to denote minority status (non-Han vs. Han).

The second set of covariates was related to the availability of children. It included the number of living children that the respondent had, and whether he/she had any children living nearby (yes vs. no). Nearby was defined as in the same village, neighborhood, township, city, or county of the respondent. The third set was heath status of the respondent at baseline, indicated by ADL disability, self-rated health, chronic conditions, and cognitive limitations. ADL disability and self-rated health were dichotomously coded as described above. We asked the respondents to report the illnesses they had on a list of eleven (e.g., diabetes, heart disease, hypertension, stroke, cancer). Very few had more than one condition, therefore, chronic conditions were coded dichotomously (yes vs. no). Cognitive function was measured by a Chinese-adapted version of the Mini-Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975). The scale ranged from 0 to 30, with higher scores

indicating better cognitive function. A cut-point of less than 18 has been used to indicate cognitive impairment in a prior study of oldest-old Chinese (Zhang, 2006).

Data Analysis

In order to reduce sample selection bias and control for competing risks, we included all sample members and took into account the likelihood of death and loss at follow-up in the analysis. All three health outcomes were coded as multi-category variables (e.g., ADL disability had four categories: no ADL disability, had ADL disability, died, loss). We used multinomial logistic regression to examine whether baseline living arrangements predict the health outcomes at Wave 2, controlling for baseline health, sociodemographic characteristics, and availability of children. We first tested the main effects of living arrangements on each of the three health outcomes. Then we added product terms of gender and living arrangements to the main effect model to test whether the effects of living arrangements on health vary by gender. Likelihood ratio tests were used to determine the significance of the main and interaction effects of living arrangements.

Missing data of individual study variables were modest (the highest was 12.6% for chronic conditions); however, more than one-fifth (21%) of the sample would be excluded if listwise deletion methods were used. We undertook multiple imputation, using the NORM program (Schafer, 1999). Three imputed data sets were analyzed separately. The final estimates and standard errors were calculated using formulas that combined results from the three analyses (Schafer & Olsen, 1998). Relative to other methods of handling missing data, multiple imputation is better in producing estimates that are consistent, asymptotically efficient, and asymptotically normal, under the assumption of missing at random (Allison, 2002; Little & Rubin, 2002).

Considering that baseline living arrangements may be a marker of baseline health, we repeated all analyses using a sub-sample of healthy elders who had no ADL disability, no chronic conditions, and no cognitive impairment (i.e., scored 18 or higher on the Chinese MMSE) at baseline (n=2893). The results of this sub-sample analysis were largely consistent with the ones reported below based on the total sample. Thus, we will not present these additional analyses but they are available upon request.

Results

Description of the Sample

Characteristics of the sample at baseline are shown in Table 1. The sample averaged 92.10 years old (range=77-122). The majority was women (60.0%), had low education (a mean of 1.80 years of schooling), resided in rural areas (61.8%), had low occupational status (92.4%), and was Han Chinese (92.8%). The respondents had 2.39 living children on average and most (82.8%) had at least one child living nearby. At baseline, about 37.1% of the sample had ADL disability, 44.9% reported poor self-rated health, and 45.9% had at least one chronic condition. On average, their mean score on the Chinese MMSE scale was 21.18. Using less than 18 as the cut-point, about 15.8% had cognitive impairment at baseline.

Baseline living arrangements of the sample are shown at the top row of Table 1. The majority of the respondents lived with children (67.6%), followed by living alone (10.1%), with a spouse (7.9%), with a spouse and children (7.5%), in an institution (5.0%) and with others (1.9%). Baseline living arrangements had significant bivariate correlations with all sociodemographic and baseline health characteristics shown in Table 1, as well as all Wave 2 health outcomes. At Wave 2, about 37.0% of the sample had died, 19.7% had ADL disability, 26.1% had poor self-rated health, and 9.8% were loss to follow-up.

Associations of Living Arrangements and Mortality

The multinomial logistic regression models for mortality, which took into account the risk of loss at Wave 2, are presented in Table 2. The analysis shows that the fit of the model is significantly improved after adding living arrangements (Model 2) to a model (Model 1) containing covariates only (comparison of Models 1 and 2: $\Delta\chi^2$=33.67, df=10, p=.000), supporting our hypothesis that living arrangements have significant association with health. We then tested the interaction effects of living arrangements and gender (Model 3), which are also statistically significant (comparison of Models 2 and 3: $\Delta\chi^2$=19.27, df=10, p=.037) and support our hypothesis that the association of living arrangements and health varies by gender.

Specifically, we found that those living with children and with others have the highest mortality risk, and those living with a spouse and with a spouse and children the lowest. For men, living in an institution lowers mortality risk as well whereas it is not the case for women. In addition, being older and male, as well as having low occupational status, fewer living children, and having children living nearby increase mortality risks. Those with ADL disability, poor self-rated health and lower cognitive function at baseline are also more likely to die within the study period.

Associations of Living Arrangements and ADL Disability

The multinomial logistic regression models for ADL disability are shown in Table 3. Consistent with our hypothesis, baseline living arrangements are significantly associated with ADL disability status at Wave 2, controlling for other covariates and taking into account the likelihood of death and loss (comparison of Models 1 and 2: $\Delta\chi^2$=46.67, df=15, p=.000). Specifically, those living with children, with others and in institutions are more likely to have ADL disability at Wave 2, compared with those living alone. We did not find significant interaction effects of living arrangements and gender (not shown). Being older, female, urban residents and Han, as well as having ADL disability, chronic conditions, and lower cognitive function at baseline also increase the risk of ADL disability at Wave 2.

Associations of Living Arrangements and Self-Rated Health

The models for self-rated health also took into account the likelihood of death and loss (Table 4). The results suggest that baseline living arrangements are significantly associated with self-rated health at Wave 2 ($\Delta\chi^2$=47.96, df=15, p=.000) but no significant interaction effects with gender (not shown). More specifically, we found that those living with children are significantly less likely to rate their health as poor in Wave 2 than those living alone and in institutions. Being a minority, having fewer living children, and having poor self-rated

health, chronic conditions, and lower cognitive function at baseline also increase the likelihood of poor self-rated health at Wave 2.

Discussion

Using two waves of penal data derived from a large sample of oldest-old persons in China, this study found that living arrangements predict physical health, indicated by mortality, ADL disability and self-rated health; and that men and women differ in the association of living arrangements and mortality. Consistent findings were obtained when the analyses were repeated in a sub-sample of 'healthy' respondents who had no ADL disability, chronic conditions and cognitive impairment at baseline.

The health advantages and disadvantages of different living arrangements, however, vary by the specific health outcomes. In terms of mortality, we found that living with spouse and with spouse and children lower mortality risks. For men but not women, living in institutions is associated with lower mortality risks as well. Regarding ADL disability, those living alone fare better—they are less likely than those living with children, with others and in institutions to have ADL disability at Wave 2. With respect to self-rated health, those living with children have an advantage—they are less likely than those living alone and in institutions to report poor self-rated health at Wave 2

Note that selection bias was minimized in our analyses as we included all sample members and took into account the likelihood of death and loss to follow-up in all multinomial logistic regression models. Respondents who were loss to follow-up were significantly different from those who were re-interviewed in a number of sociodemographic and health characteristics at baseline—the former were younger, more educated, more likely to live in urban areas, less likely to be minority, and more likely to have ADL disability and low cognitive function at baseline. Therefore, the analyzed sample is likely to be biased if the lost respondents are excluded from the analysis.

Our findings should be interpreted with some caveats in mind. First, the sample selected to be included in the CHLHS survey may over-represent the relatively healthy oldest-old Chinese, as those who were frail or severely impaired cannot participate in the survey. About 10.3% of the baseline sample used proxy respondents for some questions. We have added a dummy variable indicating whether proxy interviews were conducted to the multivariate models. We found that the results remained unchanged and there were no significant differences between respondents using proxy and those who did not. Second, even though our sample size was relatively large, the paucity of some living arrangements in a gender (e.g., only 2.4% of the women sample lived with a spouse) may have reduced the statistical power to test the interaction effects of gender and living arrangements. Third, we have not included changes in living arrangements between baseline and follow-up, which occurred to about 9.5% of the overall sample, in our analyses. To assess how this may bias our findings, we repeated the analyses excluding respondents who had changes in living arrangements. These analyses show a similar pattern of results as in the overall sample, which suggests that the bias is minimal.

The possibility that our findings regarding the effects of baseline living arrangements on Wave 2 health outcomes are confounded deserves more considerations, since baseline living arrangements may be a marker of prior health. We believe that the likelihood of such confounding is low, for two reasons. First, multiple measures of health; including ADL disability, self-rated health, chronic conditions, and cognitive function were used to indicate health status at baseline and controlled in all analyses. Second, our additional analyses with a sub-sample of 'healthy' respondents who had similar health at baseline yielded a similar pattern of results as in the overall sample.

With the trend of solitary living in older people around the world (United Nations, 2005), there is growing concern about the implications on the well-being of older people. Only about ten percent of our sample lived alone. Our findings suggest that living alone is associated with health disadvantages as well as advantages. While living alone increases mortality risks (for men) and the risk of poor self-rated health, living alone lowers the risk of ADL disability. The health advantage of living alone may be related to the requirement of dealing with daily life activities by oneself. Additionally, such advantage may reflect a self-selection process in that those with least disability at baseline were more likely to live in lone households. Our findings regarding the effects of living alone on different health outcomes are consistent with some prior Western studies (e.g., Lund et al., 2002; Kharicha et al., 2007; Michael et al., 2001).

Another independent living arrangement--with a spouse but not children--has increased substantially in the past decade in China, partly due to the increase of life expectancy (Zeng & Wang, 2003). About eight percent of our sample lived with their spouse (without children). We found that this arrangement is associated with health advantages indicated by all three outcome measures. In fact, having children in households where a spouse is present does not add much health benefits. Such findings support the claim that having a spouse is the "greatest guarantee of support in old age" (Chappell, 1991).

The majority of our sample coresided with their children. The importance of intergenerational relationships to older Chinese persons' psychological well-being has been documented (Li, Liang, Toler, & Gu, 2005). However, we found that intergenerational coresidence is associated with both health advantages and disadvantages in oldest-old Chinese. While those coresiding with children are less likely to have poor self-rated health than those living alone, the likelihood of having ADL disability is greater for the former. Men living with children also have higher mortality risks than those living in households with a spouse present and in institutions. Probably, intergenerational coresidence gives oldest-old Chinese a sense of pride, as well as instrumental and emotional support, which has consequence to their subjective assessment of health. However, intergenerational coresidence may encourage dependence and speed up age-related loss of physical ability, which increases the risk of death. The issue of self-selection should also be noted here—those who were more disabled at baseline may be more likely to coreside with their children. Future research is needed to understand the mechanisms leading to the higher risk of physical decline and mortality for oldest-old Chinese living with children. Our measure of "living with children" did not differentiate between living with a son or a daughter. According to Chinese tradition, sons are obligated to live with and take care of parents in old

age whereas daughters should move out from their parents' home and transfer their filial obligations to parents-in-law after married. With the introduction of the one-child birth policy in 1979, however, the extent to which this tradition will continue is unknown.

Although only a small proportion (5%) of our sample lived in institutions, institutional living is increasingly an option for older people in China (Zhan et al., 2005). We found that among oldest-old Chinese, institutional living is associated with negative health consequences--greater risks of ADL disability compared with living alone, and greater likelihood of poor self-rated health compared with living with children. However, institutional living lowers mortality risk for men, compared with living alone, with children and with others. Possibly, the care and support received by men living in institutions help to extend their lives. But it is intriguing that institutional living does not provide similar protection to women. Further research is needed to understand the experience of institutional living for men and women in China.

Two previous studies that are also based on the CLHLS data have reported different results regarding the effects of institutional living on mortality. One found that community residents and those living in institutions were comparable in mortality risk, after controlling for health and family characteristics (Gu, Dupre, & Liu, 2007). Another found that oldest-old Chinese living in institutions had lower mortality risk than those living alone (Sun & Liu, 2006). The first study did not distinguish the different types of living arrangements within community-living elders; both studies did not examine gender difference in the association of living arrangements and mortality. In addition to differentiating community-living arrangements and examining gender difference, our analysis took into account the likelihood of loss to follow-up, which should reduce estimation bias.

Another study of the old-old in Israel found that those living in institutions have greater mortality risk than those living alone in the community (Walter-Ginzburg et al., 2002). The different nursing home populations between China and Israel may explain why our findings are different from theirs. Unlike that in Israel and other developed nations, elderly persons who receive residential care in China are not necessarily frail or severely disabled. A recent study of elder homes in China found that the majority of their residents had no need for assistance in daily life activities, and the major reasons for their institutionalization were unavailability of children and being childless (Zhan et al., 2005). As mentioned in the introduction section, until recently, institutional care in China was limited to the “three-no” elders; levels of impairment or special care needs were not sufficient reasons for residential care.

This study has examined the effects of living arrangements on health in a unique population — oldest-old Chinese. Its methodological strengths include employing prospective longitudinal data, having a large sample, using multiple health indicators as outcomes, and controlling for competing risks in the analyses. Future research should investigate the mechanisms linking living arrangements and health outcomes. Policymakers should keep close attention to changes in living arrangements in the oldest-old population, as it has implications to public health.

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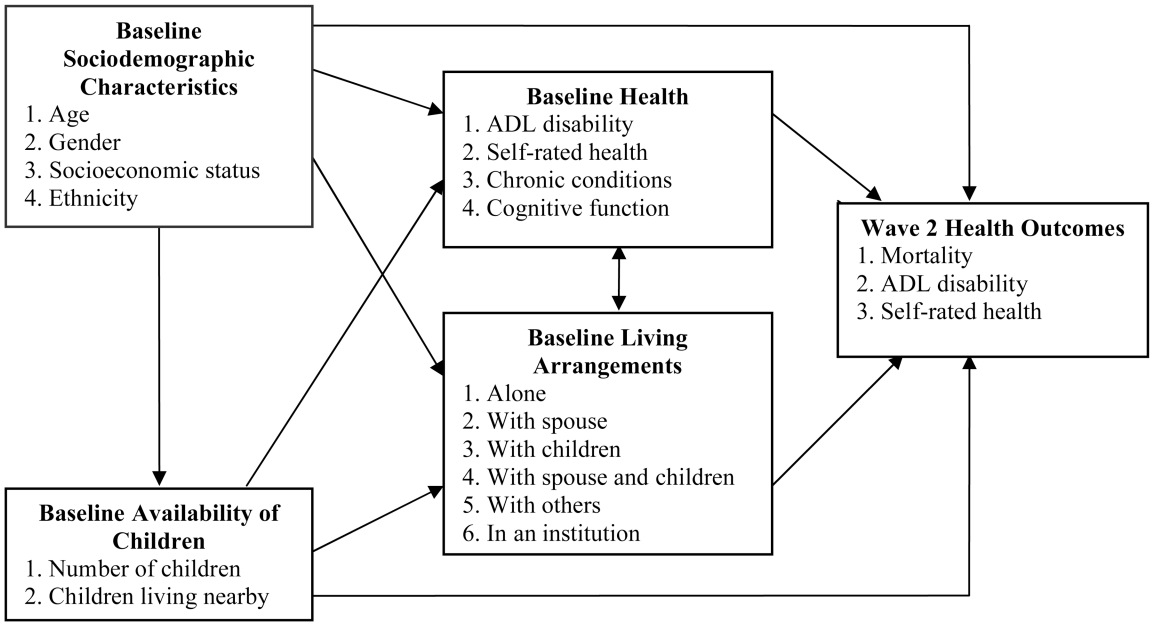

Figure 1. Conceptual model of the linkage between living arrangements and health

Table 1

Sociodemographic and Health Characteristics of the Sample, Total and by Baseline Living Arrangements

	Total (N=9093)	Alone (n=916)	With spouse (n=720)	With children (n=6148)	With spouse & children (n=677)	With others (n=174)	Institution (n=458)
Sociodemographic characteristics							
Age (range=77-122; mean, sd)	92.10 (7.74)	90.44 (7.56)	85.68 (5.44)	93.87 (7.34)	87.01 (6.23)	93.97 (7.83)	88.60 (7.74)
Female (vs. male; %)	60.0	63.1	18.5	69.0	18.0	66.1	57.5
Education (range=0-26; mean, sd)	1.80 (3.60)	1.72 (3.65)	4.50 (5.55)	1.25 (2.86)	3.81 (4.69)	1.76 (3.76)	2.15 (3.73)
Urban residence (vs. rural; %)	38.2	32.2	52.7	33.1	47.5	43.1	79.9
High occupational status (vs. low; %)	7.6	7.4	25.9	4.2	18.0	9.2	8.8
Minority (vs. Han; %)	7.2	7.2	2.2	8.0	7.5	6.9	3.9
No. of living children (range=0-11; mean, sd)	2.39 (1.99)	2.73 (2.23)	3.83 (2.27)	2.22 (1.80)	2.97 (2.03)	1.05 (1.74)	1.33 (1.85)
Had children living nearby (vs. no; %)	82.8	81.5	87.2	85.0	88.5	44.3	56.2
Baseline (BL) health status							
BL had ADL disability (vs. no; %)	37.1	18.7	21.7	43.3	22.9	42.0	34.4
BL poor self-rated health (vs. good; %)	44.9	48.8	39.6	45.7	39.7	46.0	43.1
BL had chronic conditions (vs. no; %)	45.9	39.7	51.5	45.0	52.8	51.1	49.0
BL cognitive function (range=0-30; mean, sd)	21.18 (8.89)	23.06 (7.47)	26.15 (5.33)	19.81 (9.28)	25.28 (6.42)	20.25 (9.57)	22.21 (8.01)
Wave 2 (W2) health status							
W2 died (%)	37.0	20.6	17.9	42.3	23.9	39.1	28.4
W2 loss (%)	9.8	11.7	15.0	8.6	11.8	9.8	11.8
W2 had ADL disability (%)	19.7	14.7	16.4	20.5	17.1	27.0	24.5
W2 poor self-rated health (%)	26.1	31.4	30.0	23.8	29.4	28.2	34.4

Table 2

Multinomial Logistic Regression Models for Mortality Status[a] at Wave 2 (N = 9,093)

	Model 1		Model 2		Model 3	
	Died	Loss	Died	Loss	Died	Loss
	OR (95% CI)[b]	*OR (95% CI)*	*OR (95% CI)*	*OR (95% CI)*	*OR (95% CI)*	*OR (95% CI)*
Age	1.07 (1.06, 1.08)***	.98 (.97, .99)*	1.06 (1.06, 1.07)***	.98 (.97, .99)**	1.06 (1.06, 1.07)***	.98 (.97, .99)**
Female (vs. male)	.57 (.51, .64)***	1.20 (1.01, 1.42)*	.53 (.47, .59)***	1.13 (.95, 1.35)	.49 (.36, .68)***	.93 (.60, 1.46)
Education	.99 (.97, 1.01)	1.09 (1.07, 1.12)***	.99 (.97, 1.01)	1.09 (1.07, 1.12)***	.99 (.97, 1.01)	1.10 (1.07, 1.12)***
Urban (vs. rural)	.92 (.83, 1.02)	1.78 (1.51, 2.09)***	.94 (.84, 1.05)	1.84 (1.57, 2.17)***	.94 (.84, 1.05)	1.84 (1.57, 2.17)***
High occupational status (vs. low)	.64 (.50, .83)***	1.17 (.90, 1.54)	.67 (.52, .87)**	1.18 (.90, 1.55)	.67 (.52, .87)**	1.18 (.90, 1.55)
Minority (vs. Han)	.85 (.71, 1.03)	.44 (.29, .66)***	.84 (.70, 1.01)	.44 (.29, .66)***	.84 (.70, 1.01)	.44 (.29, .66)***
No. of children	.94 (.92, .97)***	.99 (.95, 1.03)	.95 (.93, .98)***	.99 (.95, 1.03)	.95 (.93, .98)**	.99 (.95, 1.03)
Had children living nearby (vs. no)	1.25 (1.08, 1.45)**	.87 (.71, 1.07)	1.23 (1.05, 1.43)**	.86 (.70, 1.06)	1.21 (1.04, 1.41)*	.86 (.70, 1.06)
BL had ADL disability (vs. no)	1.92 (1.72, 2.15)***	1.37 (1.15, 1.64)***	1.92 (1.72, 2.15)***	1.40 (1.17, 1.67)***	1.92 (1.71, 2.15)***	1.39 (1.16, 1.66)***
BL poor self-rated health (vs. good)	1.36 (1.23, 1.51)***	1.06 (.91, 1.24)	1.37 (1.23, 1.52)***	1.05 (.90, 1.23)	1.37 (1.23, 1.52)***	1.05 (.90, 1.23)
BL had chronic conditions (vs. no)	1.02 (.90, 1.14)	1.06 (.89, 1.25)	1.02 (.91, 1.15)	1.06 (.90, 1.26)	1.03 (.91, 1.15)	1.06 (.89, 1.26)
BL cognitive function	.96 (.95, .97)***	.97 (.96, .98)***	.96 (.95, .97)***	.97 (.96, .98)***	.96 (.95, .97)***	.97 (.96, .98)***
BL living arrangements (omitted: living alone)						
With spouse			.64 (.49, .84)**	.72 (.52, .99)*	.62 (.44, .86)**	.65 (.42, .99)*
With children	--	--	1.05 (.89, 1.24)	.85 (.67, 1.08)	1.03 (.79, 1.34)	.70 (.48, 1.04)
With spouse & children			.74 (.57, .95)*	.66 (.47, .93)*	.68 (.49, .94)*	.59 (.38, .92)*

	Model 1		Model 2		Model 3	
	Died	**Loss**	**Died**	**Loss**	**Died**	**Loss**
	OR (95% CI) [b]	***OR (95% CI)***	***OR (95% CI)***	***OR (95% CI)***	***OR (95% CI)***	***OR (95% CI)***
With others			.95 (.65, 1.40)	.72 (.40, 1.30)	1.47 (.78, 2.78)	.62 (.22, 1.78)
Institution			.85 (.64, 1.13)	.61 (.42, .89) *	.54 (.34, .84) **	.63 (.36, 1.10)
BL living arrangements × Gender						
With spouse × Female					1.07 (.55, 2.09)	1.09 (.53, 2.26)
With children × Female			--	--	1.04 (.74, 1.46)	1.34 (.82, 2.18)
With spouse & children × Female	--	--			1.42 (.77, 2.64)	1.18 (.53, 2.61)
With others × Female					.51 (.23, 1.13)	1.27 (.36, 4.48)
Institution × Female					2.18 (1.24, 3.86) **	.93 (.44, 1.95)
Model χ^2 (df)	2052.29 (24)		2085.96 (34)		2105.23 (44)	
ΔModel χ^2(df)	--		33.67 (10) ***		19.27 (10) *	

Note

[a] Mortality status is a 3-category variable: died, loss, re-interviewed at Wave 2. Re-interviewed at Wave 2 is the reference category.

[b] OR = odds ratio; CI = confidence interval.

* p < .05;

** p < .01;

*** p < .001.

Table 3

Multinomial Logistic Regression Models for ADL disability[a] at Wave 2 (N = 9,093)

	Model 1			Model 2		
	Had ADL disability	**Died**	**Loss**	**Had ADL disability**	**Died**	**Loss**
	***OR (95% CI)*[b]**	***OR (95% CI)***	***OR (95% CI)***	***OR (95% CI)***	***OR (95% CI)***	***OR (95% CI)***
Age	1.06 (1.05, 1.07)***	1.09 (1.08, 1.10)***	1.01 (.99, 1.02)	1.06 (1.05, 1.07)***	1.09 (1.08, 1.10)***	1.01 (.99, 1.02)
Female (vs. male)	1.20 (1.04, 1.39)*	.61 (.54, .69)***	1.28 (1.07, 1.53)**	1.19 (1.02, 1.38)*	.57 (.50, .65)***	1.21 (1.00, 1.45)*
Education	1.01 (.98, 1.03)	.99 (.97, 1.02)	1.10 (1.07, 1.12)***	1.01 (.98, 1.03)	.99 (.97, 1.02)	1.10 (1.07, 1.12)***
Urban (vs. rural)	1.31 (1.14, 1.50)***	1.05 (.92, 1.19)	1.99 (1.68, 2.36)***	1.29 (1.12, 1.48)***	1.06 (.94, 1.21)	2.05 (1.73, 2.43)***
High occupational status (vs. low)	.96 (.73, 1.28)	.62 (.47, .83)***	1.15 (.86, 1.53)	.98 (.74, 1.30)	.65 (.49, .87)**	1.16 (.87, 1.55)
Minority (vs. Han)	.58 (.45, .74)***	.68 (.55, .83)***	.36 (.24, .55)***	.57 (.45, .74)***	.67 (.54, .82)***	.35 (.23, .54)***
No. of children	.97 (.94, 1.01)	.93 (.90, .96)***	.98 (.94, 1.02)	.98 (.95, 1.02)	.95 (.91, .98)***	.98 (.94, 1.03)
Had children living nearby (vs. no)	.96 (.79, 1.15)	1.21 (1.02, 1.44)*	.85 (.68, 1.06)	.97 (.81, 1.18)	1.20 (1.01, 1.43)*	.84 (.67, 1.06)
BL had ADL disability (vs. no)	4.49 (3.83, 5.25)***	4.19 (3.63, 4.85)***	2.89 (2.37, 3.52)***	4.41 (3.76, 5.16)***	4.16 (3.59, 4.82)***	2.92 (2.40, 3.57)***
BL poor self-rated health (vs. good)	1.07 (.93, 1.22)	1.39 (1.23, 1.56)***	1.07 (.91, 1.27)	1.08 (.95, 1.24)	1.40 (1.24, 1.58)***	1.07 (.90, 1.26)
BL had chronic conditions (vs. no)	1.26 (1.10, 1.45)***	1.13 (1.00, 1.28)*	1.16 (.98, 1.38)	1.26 (1.10, 1.45)***	1.14 (1.01, 1.29)*	1.17 (.98, 1.39)
BL cognitive function	.98 (.97, .99)***	.95 (.94, .96)***	.96 (.95, .97)***	.98 (.97, .99)***	.95 (.94, .96)***	.96 (.95, .97)***
BL living arrangements (omitted: living alone)						
With spouse	--	--	--	1.15 (.84, 1.56)	.68 (.51, .90)**	.75 (.54, 1.05)
With children				1.33 (1.07, 1.66)*	1.16 (.96, 1.39)	.92 (.72, 1.19)
With spouse & children				1.25 (.92, 1.71)	.80 (.61, 1.06)	.71 (.50, 1.02)

	Model 1			Model 2		
	Had ADL disability	**Died**	**Loss**	**Had ADL disability**	**Died**	**Loss**
	OR (95% CI) [b]	***OR (95% CI)***	***OR (95% CI)***	***OR (95% CI)***	***OR (95% CI)***	***OR (95% CI)***
With others				2.12 (1.28, 3.49) **	1.37 (.86, 2.20)	1.02 (.54, 1.92)
Institution				1.59 (1.13, 2.23) **	1.01 (.73, 1.39)	.71 (.48, 1.05)
Model χ^2 (df)	3118.17 (36)			3164.84 (51)		
ΔModel χ^2(df)	--			46.67 (15) ***		

Note

[a] ADL disability is a 4-category variable: no ADL disability, had ADL disability, died and loss at Wave 2. No ADL disability at Wave 2 is the reference category.

[b] OR = odds ratio; CI = confidence interval.

* p < .05;

** p < .01;

*** p < .001.

Table 4

Multinomial Logistic Regression Models for Self-Rated Health[a] at Wave 2 (N = 9,093)

	Model 1			Model 2		
	Poor self-rated health	**Died**	**Loss**	**Poor self-rated health**	**Died**	**Loss**
	***OR (95% CI)*[b]**	***OR (95% CI)***	***OR (95% CI)***	***OR (95% CI)***	***OR (95% CI)***	***OR (95% CI)***
Age	1.00 (.99, 1.01)	1.07 (1.06, 1.08)***	.98 (.97, .99)*	1.00 (.99, 1.01)	1.06 (1.05, 1.07)***	.98 (.97, .99)**
Female (vs. male)	1.08 (.94, 1.23)	.59 (.51, .67)***	1.23 (1.03, 1.48)*	1.08 (.94, 1.24)	.55 (.48, .63)***	1.17 (.97, 1.42)
Education	.98 (.96, 1.01)	.98 (.96, 1.01)	1.09 (1.06, 1.11)***	.98 (.96, 1.01)	.99 (.96, 1.01)	1.09 (1.06, 1.11)***
Urban (vs. rural)	1.04 (.91, 1.18)	.93 (.82, 1.06)	1.81 (1.52, 2.15)***	1.01 (.89, 1.16)	.95 (.83, 1.08)	1.85 (1.56, 2.21)***
High occupational status (vs. low)	1.00 (.77, 1.29)	.64 (.48, .85)**	1.17 (.87, 1.57)	.99 (.76, 1.28)	.66 (.50, .88)**	1.17 (.87, 1.57)
Minority (vs. Han)	1.27 (1.02, 1.57)*	.97 (.78, 1.21)	.50 (.32, .76)**	1.28 (1.03, 1.59)*	.96 (.77, 1.20)	.50 (.32, .76)**
No. of children	.97 (.94, 1.00)	.93 (.90, .96)***	.97 (.93, 1.02)	.97 (.93, .99)*	.94 (.90, .97)***	.97 (.93, 1.02)
Had children living nearby (vs. no)	.87 (.72, 1.04)	1.15 (.96, 1.38)	.81 (.64, 1.01)	.90 (.75, 1.08)	1.15 (.96, 1.38)	.81 (.64, 1.02)
BL had ADL disability (vs. no)	1.14 (.97, 1.33)	2.06 (1.79, 2.37)***	1.46 (1.20, 1.78)***	1.16 (.99, 1.36)	2.07 (1.80, 2.39)***	1.51 (1.24, 1.84)***
BL poor self-rated health (vs. good)	1.89 (1.66, 2.15)***	1.91 (1.68, 2.17)***	1.47 (1.24, 1.75)***	1.87 (1.65, 2.12)***	1.91 (1.68, 2.17)***	1.45 (1.22, 1.72)***
BL had chronic conditions (vs. no)	1.28 (1.14, 1.44)***	1.16 (1.02, 1.32)*	1.20 (1.00, 1.43)	1.29 (1.14, 1.45)***	1.17 (1.03, 1.33)*	1.21 (1.01, 1.45)*
BL cognitive function	.98 (.97, .99)***	.95 (.94, .96)***	.96 (.94, .97)***	.98 (.97, .99)***	.95 (.94, .96)***	.96 (.94, .97)***
BL living arrangements (omitted: living alone)						
With spouse				.83 (.63, 1.08)	.58 (.43, .78)***	.65 (.46, .92)*
With children	--	--	--	.73 (.60, .89)**	.89 (.73, 1.09)	.72 (.56, .94)*
With spouse & children				.79 (.61, 1.04)	.65 (.48, .87)**	.59 (.41, .85)**

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	Model 1			Model 2		
	Poor self-rated health	**Died**	**Loss**	**Poor self-rated health**	**Died**	**Loss**
	OR (95% CI) [b]	***OR (95% CI)***	***OR (95% CI)***	***OR (95% CI)***	***OR (95% CI)***	***OR (95% CI)***
With others				.87 (.54, 1.39)	.88 (.55, 1.41)	.67 (.36, 1.28)
Institution				1.01 (.73, 1.39)	.86 (.61, 1.21)	.62 (.41, .94)*
Model χ^2 (df)	2309.51 (36)			2357.46 (51)		
ΔModel χ^2(df)	--			47.95 (15)***		

Note

[a] Self-rated health is a 4-category variable: good self-rated health, poor self-rated health, died and loss at Wave 2. Good self-rated health at Wave 2 is the reference category.

[b] OR = odds ratio; CI = confidence interval.

* p < .05;

** p < .01;

*** p < .001.