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A multi-level analysis of urban/rural and socioeconomic differences in functional health status transition among older Chinese

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ABSTRACT

The main purpose of the study is to assess urban versus rural differences in functional status transitions among older Chinese, aged 55+, and to examine how individual and community level socioeconomic indicators alter the rural/urban effects and themselves influence transitions. The study uses a hierarchical linear modeling approach that considers individual responses to be embedded within communities. Data come from the 2004 and 2006 rounds of the Chinese Health and Nutrition Survey. The study considers the functional transitions of 2944 individuals living across 209 communities in nine Chinese provinces. Functioning is measured at baseline as being able or not being able to conduct all of the following: walking, standing, climbing stairs, lifting, kneeling. Outcomes include having or not having a functional limitation, measured the same way, dying, or not responding. Outcomes are modeled adjusted for baseline functional status. Findings indicate urbanites have substantial advantages. They are less likely to have a limitation at follow-up and less likely to die over the study period. Some of this is explained by socioeconomic indicators measured at two levels. Cross-level interactions suggest education and having insurance operate differently in urban and rural areas. Community-level indicators are somewhat less predictive, and much of the urban advantage is unexplained. In conclusion, the study suggests differences in the influences of socioeconomic indicators in China versus what has been found in the past, and that place of residence in China is a particularly robust predictor of functional health transitions.

Introduction

This study uses hierarchical modeling to assess rural/urban differences in two-year functional status transitions among Chinese 55 and older and the degree to which individual and community level socioeconomic status (SES) determinants explain these differences. The focus on the older population is important given demographic change, fueled by declining levels of fertility, which means that China has one of the fastest growing elderly populations in the world. According to estimates, China's 55 + population, which at time of writing made up about 15% of the country's population, will grow to over 30% within 25 years (United Nations, 2009). The health of this population segment will have obvious implications for future formal and informal costs, an issue that is of great concern to Chinese policy makers (Riley, 2004).

While SES disparities in China have been studied (e.g., Beydoun & Popkin, 2005; Liang et al., 2000; Zeng, Poston, Vlosky, & Gu, 2008; Zhu & Xie, 2007) publications that focus on rural/urban differences is modest in number, and those that exist mostly concentrate on mortality (Fang, 1993; Li & Sun, 2003; Zimmer, Kaneda, & Spess, 2007). Zimmer et al. (2007) showed part of the rural disadvantage in mortality to be a function of a combination of community and individual SES. The current study extends upon this by considering a broader measure of health and employing cross-level hierarchical effects to test for community by individual level interactions. Functional status, and its counterpart disability, represents an increasingly important indicator of health for older populations, as is witnessed in a number of ways. Functional items are now routinely included in population-level surveys of older people around the globe (Borsch-Supan, Hank, & Jurges, 2005; National Institute on Aging, 2007). There is escalating dialogue on ways of measuring and linking aspects of functional status (Deeg, Verbrugge, & Jagger, 2003; Freedman & Martin, 2006). There is also increasing recognition of the connection between functional status and other quality of life outcomes in later years (Barberger-Gateau & Fabrigoule, 1997; Jiang, Tang, Futatsuka, & Zhang, 2004). Finally, the field of health and aging is witnessing growing interest in assessing functional status at population levels (Freedman, Martin, & Schoeni, 2002; Jagger et al., 2009). An important

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finding from this research is recognition of functional status as both dynamic and predictive, with improvements and deteriorations possible, and limitations being a predictor of mortality (Branch, Katz, Kneipmann, & Papsidero, 1984; Crimmins & Saito, 1993; Hardy & Gill, 2004; Rogers, Rogers, & Belanger, 1989). Thus, where data are available, research has emphasized transitions, defined as follow-up functional status adjusting for baseline status.

Like other health outcomes, indicators of SES have been considered vital to functional status transitions (Grundy & Glaser, 2000; Kaplan, Strawbrige, Camacho, & Cohen, 1993; Lantz et al., 2001). Specific reasons for the link have been difficult to pinpoint, especially given inconsistencies across developing and developed societies (Liang, Liu, & Gu, 2001; Zimmer, Liu, Hermalin, & Chuang, 1998), but explanations revolve around psychosocial advantages bestowed upon those with high SES. These include material pathways, such as the increase in health resources afforded by those with higher SES, and non-material pathways, such as greater ability to understand disease processes and act in adequate ways in response to illness, the associated link with behaviors, increased confidence and locus of control, and better social support and stronger networks (House, Kessler, Herzog, Mero, & Breslow, 1992; Marmot & Siegrist, 2004).

Theoretical and empirical research across various international settings has also considered the complimentary notion of community SES as a predictor of health outcomes including functional status (Glass & Balfour, 2003; Pickett & Pearl, 2001; Schootman et al., 2006; Wen, Browning, & Cagney, 2003; Wight et al., 2008). The community in which individuals live can influence health through mechanisms such as accessibility to health service and personnel, availability of amenities, infrastructure, communication and education, and factors that indirectly relate to individual SES such as community income and education. Thus far, however, findings concerning community SES have been more mixed than for individual SES. This seems particularly true among older adults. Some studies find no contextual influence of community SES on mortality in later life (Anderson, Sorlie, Backlund, Johnson, & Kaplan, 1997; Haan, Kaplan, & Camacho, 1987; Waitzman & Smith, 1998), while others report community effects net of individual variables (Ecob & Jones, 1998; Wen, Cagney, & Christakis, 2005). Previous literature has not clarified the precise sources of these empirical discrepancies. One possibility is that community SES effects are specific to local settings and sensitive to geographic definitions. It is also possible that community SES plays a weaker and less stable role in contributing to mortality because effects may depend upon complex moderating and intermediating variables that are more proximate to individual health.

Little research has considered communities in developing societies. If community influences health outcomes, China might be a setting where such differences are likely to emerge. Recent economic development in China has been accompanied by well documented inequalities by region, particularly rural/urban disparities that encompass health services (Anson & Sun, 2003; Beach, 2001; He, Sengupta, Zhang, & Guo, 2007; Tang et al., 2008). Rural communities have fared poorly, a reality that has prompted recent comment from government officials who have promised to focus on strategies aimed at reducing economic and health gaps between urban and rural areas (Kahn, 2004). As such, rural and urban communities in China are characterized by different levels of SES, which may influence and explain any advantage that urbanites have with respect to individual health outcomes.

Based on the past literature, the current study considers that SES can influence health outcomes on two levels. First, individuals living in urban areas may have different characteristics than those in rural areas. For instance, they may better access to health insurance. Second, the communities in which people live can differ. Urban communities may be better endowed with health related resources and infrastructure that promotes better health. Thus, our study asks several questions. Does the urban health advantage noticed in previous research in China translate into more favorable functional transitions for older urban residents? Do individual and community level SES characteristics influence these differences? What is the impact of having high individual level SES versus high community level SES? Finally, is it better to have high SES and live in a rural area or low SES and live in an urban area?

Method

Data

Data come from the China Health and Nutrition Survey (CHNS), a longitudinal panel study organized by the Carolina Population Center at the University of North Carolina in collaboration with the National Institute of Nutrition and Food Safety at the Chinese Center for Disease Control and Prevention (Chinese CDC). Based on a multistage random cluster process, the sample draws households from urban and rural areas within communities, which are the primary sampling units (PSU). While there are seven waves of data dating back to 1989, the current study employs the last two waves, with the baseline being 2004 and follow-up 2006. The 2004 baseline sampled 216 communities across 9 provinces (Guangxi, Guizhou, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Liaoning, and Shandong). The sample contains 14,478 individuals living in 3795 households. The last two survey waves were chosen for three reasons. First, detailed questions on functional status among older people, the outcome measure in this study, were not asked until later waves. Second, the time between surveys differs between different survey waves (e.g., 1997 and 2000; 2000 and 2004; 2004 and 2006). While different follow-up periods create difficulties in assessing transitions, research is also showing that longer intervals mean less reliable measures of transition (Wolf & Gill, 2007). Third, SES indicators, particularly on a community basis, are changing rapidly in China, and measures that go back in time may be inconsistent with those from more recent years.

The analysis uses data from two databases. The first is information about individuals obtained from household surveys. This includes demographic and SES indicators, as well as functional status items about all household members 55 and older. Our study is limited to the 55 and older population of which there was 3040 individuals in 2004 living in communities that were followed-up in 2006. Eliminating cases missing baseline functional status information or communities without complete community information reduces the sample size to 2944, 1052 of which live in urban communities and 1892 in rural communities. For the household survey, attempts were made to conduct face-to-face interviews with each member. When particular members were not available, information was collected from other members knowledgeable about the indexed individual.

The second is the community questionnaire, completed face-to-face by a knowledgeable respondent for each PSU. Communities were defined as per official administrative definitions, which divide the country into urban and suburban neighborhoods, considered urban places, versus towns and villages, or rural places. Urban and suburban areas are metropolitan places with populations of 100,000+. The 216 communities surveyed consist of 36 urban and 36 suburban neighborhoods, 36 towns and 108 villages. The knowledgeable community respondent was the official head of the community, such as village heads for villages or the official head of the neighborhood associations for urban areas. Although accuracy of this community data has not been specifically examined, recent

analyses have been conducted, particularly with respect to health care and availability items, and results are in line with expectations, suggesting the data have validity (Bredenkamp, 2009; Chen, 2009; Ng, Norton, & Popkin, 2009). The community database contains SES, demographic and infrastructure variables about the community. Of the 216 communities sampled in 2004, five are eliminated due to incomplete information and two due to outlier values on average wage for a normal male worker, which is a key independent variable. The result is 209 communities, 69 of which are urban and 140 rural. Limitations of the community data include reliance on a single respondent, length of the community survey, and a fair amount of missing data. But, in this study, we selected only those indicators that had limited missing observations.

There are no weights available for analysis of the CHNS as it is technically not a representative study of China's population. Despite this, the characteristics of the households and individuals surveyed have been extensively analyzed and have been shown to be comparable to nationally representative samples (Du, Lu, Zhai, & Popkin, 2002; Entwisle & Chen, 2002; Short, Ma, & Yu, 2000). Data, documentation, and details on sampling, representativeness and validity of data can be easily accessed through the Carolina Population Center website:

[http://www.cpc.unc.edu/projects/china].

At time of writing, the website listed over two hundred publications, most of which are in peer reviewed journals, but also dissertations, chapters and reports. Few publications focus on the older population and thus this is an underused resource for research questions related to elderly health transitions. Good examples of publications that provide information on the CHNS are available (Beydoun & Popkin, 2005; Entwisle & Chen, 2002; Wang, Bentley, Zhai, & Popkin, 2002).

Measures

Functional status transition

Individuals were asked to report difficulty performing physical functioning tasks based on bodily movements. At baseline (2004), an individual is considered to possess a functional limitation if they report difficulty with at least one of the following: walking 200 m, standing up from a sitting position, climbing a few stairs without pause, lifting a 5-k.g. bag, kneeling or bending down. About 42% reported a problem with at least one of these. The same items were repeated at follow-up (2006) and the outcome is whether or not a limitation is reported at follow-up. Respondents may have died during the inter-survey period, with the death being reported by a household member at follow-up. Death represents a third outcome category. Finally, 11.5% of respondents either did not respond at follow-up or the household in which they were living was not followed-up. These cases would be eliminated from the sample if non-response was random. However, non-response is weighted towards those with limitations at baseline (10% versus 14%) and urbanites (10% versus 14%). Therefore, we consider non-response a fourth outcome. At follow-up, 47% report no limitation, 39% report a limitation, 3% died and 11% were non-responders.

Community-level measures

All are measured at baseline in 2004. The key predictor is urban/rural residence, coded dichotomously. While community information included in the CHNS is broad, missing responses or interpretation difficulties limits the range of available indicators to those that allow us to meaningfully gauge the status of the community. First is number of amenities within the community, which is a sum of the following: telegraph office, telephone office, post office, daily newspaper, movie theatre, paved roads coming into the community, 24-h electricity, a gymnasium, recreational park, cellular phone service, internet service, fax service. Second is number of doctors within the community, which because of a skewed distribution is logged. Third is number of health facilities operating within the community minus those used solely for maternity. Fourth is estimated average wage per day for an ordinary male worker. Seventeen communities did not report this figure and we substitute the mean, but include a dichotomous covariate for multivariate equations indicating whether the value was reported. In order to adjust these SES indicators per capita, we also include a variable for population size of the community.

Individual-level measures

All of these are measured at baseline in 2004. There are four individual SES measures. First is wealth score. Technically, this is not an individual measure but represents wealth of the household. Nonetheless, we assume household wealth represents resources available to older household members. Wealth score is a composite constructed using 13 items that may be contained in the household: air conditioner, automobile, bicycle, camera, fan, microwave oven, motorbike, radio, refrigerator, rice cooker, sewing machine, television, washing machine. The index is constructed using a principal component and is normalized to have a mean of zero and standard deviation of one (Filmer & Prichette, 2001). The second is education, which has categories representing no formal, completed primary or less and more than primary. No education is used as the comparison. Third is health insurance, which is dichotomously coded as 1 if the individual reports having any type of health insurance and 0 if not. Last is cadre status. A cadre is a public official holding a responsible or managerial position in the party and government and is a person that may have access to privileges. Until the 2000 wave, the CHNS asked whether each household member is a cadre. Since most of the 2004 respondents are follow-ups from earlier surveys, we obtain cadre status from the 2000 survey. Cadres are coded as 1, while non-cadres and 174 individuals without cadre information are coded as 0.

Other baseline controls

A set of additional indicators all measured at baseline are incorporated as controls. Importantly, these include functional status at baseline. Individuals enter with or without functional limitations, and the chances of having a limitation or being deceased at follow-up should be strongly influenced by baseline status. By controlling for baseline status, the models adjust for having or not having a limitation at baseline. An alternate strategy would have been to run separate models for those with and without limitations at baseline, but this reduces number of cases in each group and limits the ability to make inferences from the results. Also included are age, being female versus male, being married versus not and household size. Household size is necessary in order to adjust for the relationship between size of household and the number of items contained in the household, which constitutes our measure of household wealth.

Analytical strategy

The research questions proposed earlier indicate that we are interested in examining whether there is an urban health advantage and whether individual- and community-level SES characteristics, and the combination and interaction of the two, influence this advantage. In order to address these questions, our analysis needs to simultaneously examine predictors that represent two levels. Each individual living within a community will have the same value for community-level measures, while the individual-level measures will differ across individuals within communities. Therefore, we use a hierarchical modeling strategy that considers

Table 1
Covariate descriptions by residence.

	Range		Means, standard deviations, and significance[a]		
	Min.	Max.	Total	Urban	Rural
Community variables					
Amenities	1	12	7.27 (3.04)	9.03 (2.53)	6.39 (2.90)**
Log of number doctors	.00	8.72	3.88 (2.50)	5.05 (2.27)	3.31 (2.42)**
Number facilities	0	8	2.29 (1.41)	2.83 (1.71)	2.02 (1.15)**
Wage per day[b]	8	50	22.98 (7.88)	24.8 (10.6)	22.1 (5.9)*
Population size in/1000	.13	87.96	5.05 (10.77)	6.78 (13.85)	4.20 (8.81) ^
Baseline variables					
Has functional limitations	0	1	.415 (.493)	.397 (.490)	.424 (.494)
Age	55	97	65.9 (8.1)	66.6 (8.2)	65.6 (7.9)**
Female	0	1	.524 (.499)	.531 (.499)	.521 (.500)
Married	0	1	.768 (.422)	.783 (.412)	.759 (.428)
Household size	1	11	3.65 (1.83)	3.36 (1.6)	3.80 (1.9)**
Socioeconomics					
Wealth score	−1.72	2.76	.00 (1.00)	.57 (1.03)	−.32 (.83)**
Education					
None	0	1	.285 (.452)	.229 (.420)	.317 (.465)**
Primary	0	1	.433 (.496)	.378 (.485)	.464 (.465)**
More than primary	0	1	.282 (.450)	.393 (.489)	.220 (.414)**
Has health insurance	0	1	.300 (.458)	.477 (.500)	.202 (.402)**
Is a cadre	0	1	.034 (.182)	.067 (.249)	.016 (.127)**

**$p < .01$
*$p < .05$
^ $p < .10$.
[a] Significance indicates rural areas are significantly different than urban based on $\chi 2$ or F-tests. Standard deviations are in parentheses.
[b] Seventeen missing cases coded at the mean.

individual responses embedded within communities (Raudenbush, 2000). In addition, the outcome measure for functional status transition has four possible non-ordered categorical responses including a group with no limitation at follow-up, a group with limitation at follow-up, a group that died by follow-up, and a group for those with missing responses at follow-up. Therefore our hierarchical regressions employ multinomial logistic outcomes.

In addition, we consider models that include several sets of interactions. A first is community level interactions that examine whether effects of community SES indicators differ across rural/urban areas. A second is cross-level interactions that consider random coefficients and examine whether effects of individual indicators differ across rural/urban areas. Finally, baseline status was interacted with other measures. These interactions suggested that baseline status did not significantly influence SES or rural/urban affects on transitions, confirming that a strategy of combining samples of those with and without limitations at baseline while controlling for baseline status is an adequate approach. All multi-level models are estimated using HLM 6.02 software (Raudenbush, Bryk, & Congdon, 2004).

Results

Table 1 provides descriptions for study covariates. Immediately evident is that SES indicators that describe both characteristics of people and communities vary. Urban communities have more amenities, doctors, medical facilities and a higher average daily wage. Urban communities are also significantly larger in population. Urban people have significantly more household wealth, higher levels of education, are more likely to have health insurance and to be categorized as a cadre.

Table 2 displays unadjusted transition probabilities. Those lost to follow-up are not included. There were 1558 individuals that reported no functional limitation at baseline, including 995 in rural and 563 in urban areas. The follow-up distribution indicates significantly more favorable transitions for urbanites. For instance, 73% of urbanites report remaining free of limitation at follow-up compared to about 66% of their rural counterparts. Urbanites are also more likely to survive the inter-survey period. There were 1046 with limitations at baseline, including 701 from rural and 345 from urban areas. Again, urbanites have more favorable transitions.

Table 3 presents hierarchical multinomial models. Model 1 considers baseline adjustments that do not include SES indicators or community population size. The impact of rural residence in predicting a limitation at follow-up or dying, in contrast to not having a limitation, is robust and significant. Having a limitation, and being older, results in less favorable transitions. Females are more likely to have a limitation but less likely to die, with the latter being non-significant. Those who are married have more favorable transitions, but this is non-significant. Those in larger households are more likely to die, which we do not interpret causally but rather as owing to the probability that older people who are ill and possibly near death are more likely to shift to living with other family who can provide care.

Table 2
Unadjusted transitions probabilities by limitation at baseline and residence.

	No functional limitations at baseline ($N = 1558$)[a]		Has functional limitations at baseline ($N = 1046$)[a]	
	Rural	Urban	Rural	Urban
Functional status				
N	995	563	701	345
No functional limitations at follow-up (%)	65.8	73.0	27.4	34.5
Has functional limitations at follow-up (%)	32.8	25.8	66.0	60.3
Did not survive to follow-up (%)	1.4	1.2	6.6	5.2
Total (%)	100	100	100	100
$\chi 2$	8.62** ($p < .01$)		5.80^ ($p < .10$)	

[a] Does not include missing cases.

Table 3
Hierarchical multi-level models for functional transitions[a].

	Model 1		Model 2		Model 3	
	Limitation vs. None	Died vs. None	Limitation vs. None	Died vs. None	Limitation vs. None	Died vs. None
Intercept	−1.046	−3.745	−1.011	−3.209	−1.200	−3.218
Community variables						
Rural residence	.443**	.492*	.328*	.360	.614*	.356
Amenities			.020	.003	.019	−.004
Log number doctors			.025	−.018	.022	−.024
Number facilities			−.050	−.038	−.047	−.047
Wage per day			.004	−.005	.005	−.001
Population size/1000			−.016*	−.023	−.016*	−.024
Baseline controls						
Has baseline limitation	1.021**	1.711**	.998**	1.708**	.996**	1.712**
Age	.095**	.127**	.094**	.122**	.095**	.122**
Female	.554**	−.093	.560**	−.285	.554**	−.278
Married	−.058	−.329	−.056	−.246	−.070	−.246
Household size	.031	.169**	.047^	.129*	.050^	.128*
Individual SES						
Wealth			−.153*	.208	−.160*	.203
Primary education			.017	−.242	.352	.118
More than primary			.028	−.516	.442	−.396
Has insurance			.039	−.582*	−.132	−1.407**
Is a cadre			−.255	−.758	−.287	−.599
Cross-level interactions						
Rural X primary education					−.468^	−.496
Rural X more education					−.601*	−.090
Rural X has insurance					.296	1.308*
Random effect variance	.438	.188	.433	.178	.430	.170
Significance of $\chi 2$ test	**	n.s.	**	n.s.	**	n.s.
ICC[b]	11.7%	5.4%	11.6%	5.1%	11.5%	4.9%

**$p < .01$.
*$p < .05$.
^ $p < .10$.
n.s. = not significant.
[a] Models include loss to follow-up and a missing wage predictor, but these results not shown.
[b] The inter-class correlation coefficient is a ratio of variance between neighborhood versus sum of variance between neighborhood and variance within neighborhood (Hedeker & Gibbons, 2006).

Model 2 adds community and individual SES variables, plus community population size. The advantage of urban residence is somewhat reduced, although coefficients remain sizeable. Rural residents in model 2 are shown to be significantly more likely to have a limitation at follow-up, all other things being equal. They are also more likely to die, although this is non-significant. The lack of significance of the transition to death is likely a result of a small percentage that died (see Table 2), which makes for large standard errors.

On balance, community variables in model 2 do not appear to have very strong effects on limitations. Community factors tend to act in expected directions and are somewhat larger in magnitude when predicting death, although effects do not reach statistical significance. As for individual SES effects, wealth reduces the likelihood of having a limitation at follow-up, while insurance substantially and significantly reduces the likelihood of death. Cadre status has a strong effect on both, but does not reach significance. It should be emphasized that a very small percent of the population are categorized as cadres (less than 4%) and results with large magnitudes may be unstable. Population size is also important in its own right, perhaps suggesting that size of population is picking up other amenities or favorable conditions not measured by community SES.

In further analyses, community variables were tested for interactions with rural residence, but none were significant. Therefore, effects of community SES can be said to be consistent across rural and urban communities. Individual level SES variables were tested for cross-level interactions using random coefficient models. Two interactions were significant and these are included in Model 3. This model indicates that the effect of education matters more in rural areas by enhancing the reduction in the probability of having limitations at follow-up. The cross-level interaction of rural by more than primary education is especially robust. The effect of insurance matters less for rural residents when it comes to dying. That is, while the effect of insurance is to greatly reduce the probability of dying in urban areas, combining the main and interaction effect negates most of the effect for rural residents.

Random effect variance components, $\chi 2$ tests of random effects, and intra-class correlation coefficients (ICC) are also presented (Hedeker & Gibbons, 2006). For the contrast of likelihood of developing limitation versus not developing no limitation after baseline limitation status is controlled for, about 11% of variance is explained at the neighborhood level and multi-level models exhibit significantly better goodness-of-fit compared to their single-level counterparts. Random effects are not significant for the death versus no limitation contrast.

Hierarchical multinomial models can be difficult to interpret intuitively. First, we have omitted the response category of loss to follow-up to keep the presentation parsimonious. Second, each health outcome is compared to a contrast category and the effects of covariates on this outcome can be difficult to see without additional models or calculations. Third, cross-level interaction random coefficients need to be considered in conjunction with main effects. Finally, the overall or total impact of rural residency and

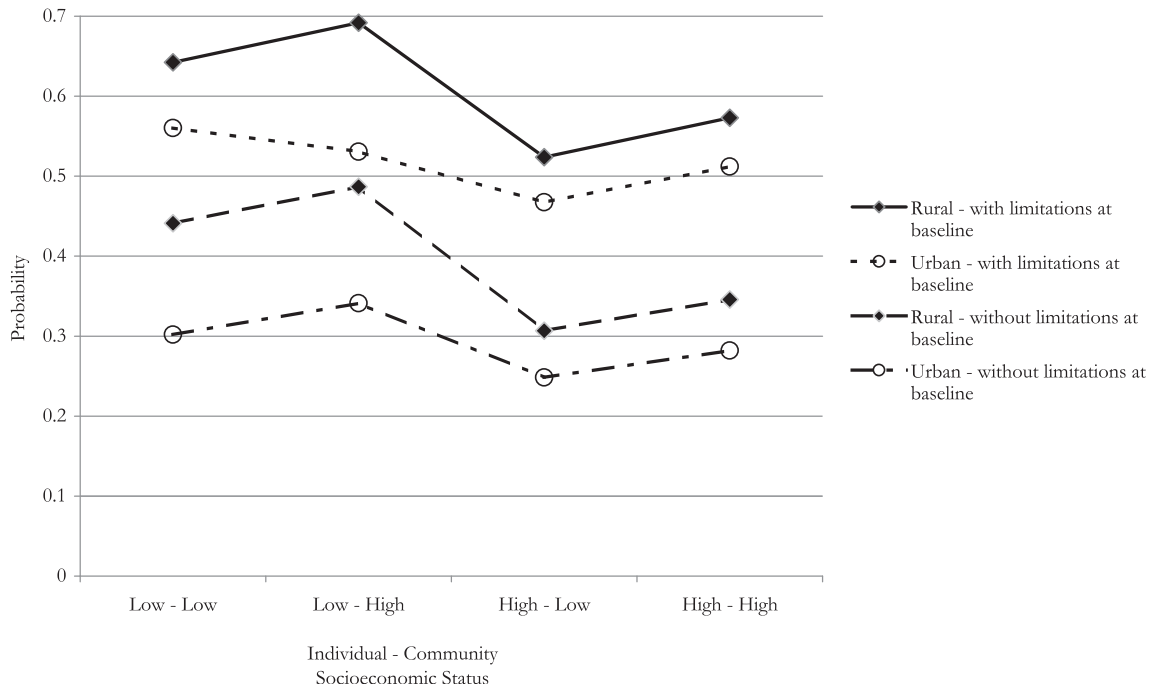

Fig. 1. Predicted probability of functional limitation by residence, limitation at baseline, and individual and community level SES. Based on Table 3 Model 3.

community and individual level SES covariates can be difficult to tease out given that some indicators predicting death are non-significant but coefficients are sizeable and may be worth considering. We therefore present Figs. 1 and 2, calculated from the results of Model 3 in Table 3, showing the predicted probability of having a limitation at follow-up (Fig. 1) and dying prior to follow-up (Fig. 2) for eight categories of people that combine low versus high individual-level SES, living in communities with low versus high SES, living in rural versus urban communities, and having and not having limitations at baseline. Levels for low and high SES are determined for heuristic purposes as follows: low SES individuals have no education, no insurance, are not cadres, and have wealth scores of one standard deviation below the overall mean. High SES individuals have more than primary education, insurance, are

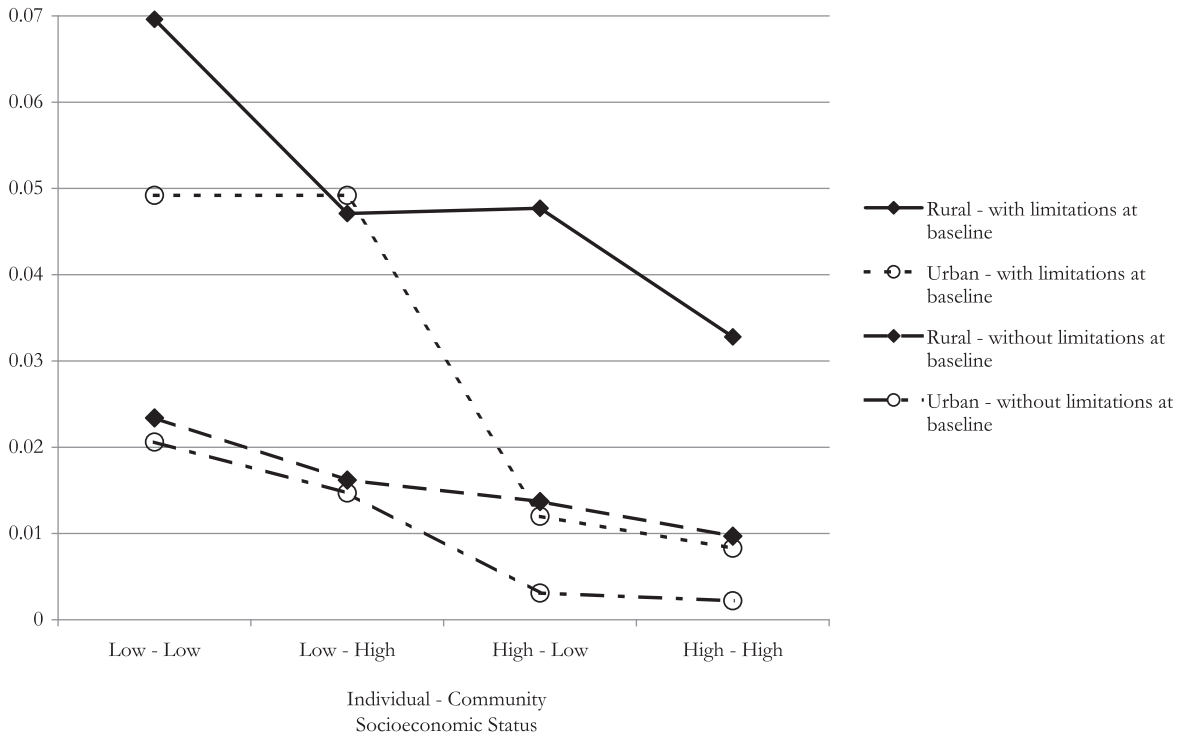

Fig. 2. Predicted probability of not surviving by residence, individual and community level SES, and limitation at baseline. Based on Table 3 Model 3.

cadres, and have wealth scores of one standard deviation above the mean. Communities with low SES score one standard deviation below the mean for each indicator, while communities with high SES score one standard deviation above the mean. Other variables are set at overall means.

Fig. 1 indicates that the probability of having a functional limitation at follow-up is higher for those with low individual SES and lower for those with high individual SES, with community effects not playing much of a role. The effect of rural residence narrows with increasing individual SES, the result of the cross-level impact of having more than primary education. Otherwise, urban residents have an advantage. Fig. 2 indicates the probability of dying prior to follow-up for the same eight scenarios. Rather than narrowing, the effect of area of residence widens with increasing SES, the result of the cross-level interaction of insurance, which helps urban people survive much more than it does rural residents. Also, unlike the transitions to having a limitation as seen in Fig. 1, both individual and community SES matter for transitions to death. For instance, an urban resident, without limitations at baseline, who has low individual and low community SES has a .021 probability of not surviving to follow-up, and this probability declines almost linearly to .002 for those that have high individual and community SES. For the rural resident, the comparable probabilities run from .023 to .010.

Discussion and conclusion

The current study concentrated on two kinds of determinants implicated as predictors of health, associating these with transitions in functional status among Chinese aged 55+. The first was place of residence. Despite much research documenting disadvantages in health care few studies have examined rural/urban differentiations in health outcomes in China. The current study suggested a disadvantage for the rural residents, who were found to be more likely to experience functional limitation and less likely to survive a two-year follow-up period. The second is SES. We proposed that if urban residents had health advantages, these might be explained by a combination of the individual SES advantages of urbanites and advantages they receive through the characteristics of the communities in which they live. While individual SES has certainly been shown to relate to health in a manner that some might say is consistent and persistent over time and space, community SES has been much less studied, particularly in China. On this, results were mixed. A robust urban advantage remained in place after adjusting for individual and community SES using a hierarchical modeling strategy, but much of this advantage remained unexplained. Individual indicators were more important and more likely to be statistically significant. Household wealth and having insurance were particularly robust. Cadre status had coefficients with sizeable magnitudes, although small numbers of cadres resulted in this variable being statistically insignificant. Community effects played a role in predicting mortality, although coefficients did not reach significance.

Through examination of random coefficients, we found cross-level interactions with education and having insurance. Education was found to have greater impact on preventing the transition to having a limitation among rural residents, while insurance was found to have little impact on rural residents in the case of preventing death. In contrast, insurance had a substantial effect on urban residents. Unfortunately, little can be done to raise the educational standing of today's elderly in rural areas. But, from a policy perspective, the provision of education might be considered as preventative, an issue that is of great importance given the aging of the rural Chinese population.

The sum of our results, which include predicted probability plots that ignore significance levels but include cross-level interactions, lead us to conclude that *it is better to have high individual SES than it is to live in a high SES community when it comes to functional health, while both individual and community SES are important for survival.* However, living in urban China is overall better than living in rural China. The best off when it comes to functional status are *urban residents with high individual SES.* The most likely to survive are *urban residents with high individual SES living in a high SES community.* We are left to speculate on why community SES might matter for mortality but not for functionality. It is possible that health problems that threaten life require services such as health facilities and doctors. These services may function to delay mortality. The delaying of functional disorder may be dependent on the life-long advantages accrued to those of higher SES over time, such as the long-term benefits of education (Ross & Wu, 1996).

The findings both parallel and contrast previous research. SES indicators proved poorer predictors of health, and reduced the urban advantage less, than might have been anticipated given studies from western societies (Robert & House, 2000). Still, the analysis actually supports a small but growing number of studies that suggest that Asian associations may differ in meaningful ways from the western experience (Liang et al., 2000; Zimmer et al., 1998). Given that SES and health in Asian societies has been a more recent concern and there are fewer studies than in western settings, the reasons for this inconsistency have not been isolated. One possibility is that the SES measures typically used to indicate status and class in western countries are less valid in non-western settings. Education, for instance, which tends to be highly related to health outcomes in the west, may not designate ones position on a class hierarchy as clearly in Asian societies. Another possibility may be the way health resources are distributed, which may not be linked as closely to SES in Asian societies than in the West.

To date, evidence on community SES effects on functioning and risk of disability is mixed. Balfour and Kaplan (2002) showed that residence in a multiple-problem neighborhood was associated with incident loss of physical function. In contrast, Robert (1998) found community SES was not associated with an index of functional disability after adjusting for individual SES. Some past research has appeared to link community contexts with health outcomes in China (Ali et al., 2007; Luo & Wen, 2002; Wen & Wang, 2009) but these studies are not necessarily focused on older people. As for mortality, some have documented weakened community SES effects on all-cause mortality among older people (Anderson et al., 1997; Haan et al., 1987; Waitzman & Smith, 1998). While our study indicates non-significant effects on mortality, it provides hints that community SES may be important in China. As such, the current study generally supports an earlier one using earlier waves of CHNS data that indicated robust rural/urban differences in mortality can be only partially explained by community SES indicators (Zimmer et al., 2007). Effects may become apparent in future research that includes larger sample sizes or in a longer period of follow-up. Indeed, some research has shown that community level characteristics may take a long time to manifest into health effects (Curtis, Southall, Congdon, & Dodgeon, 2004).

Finally, *our study did find place of residence itself to be a powerful and resilient predictor of function and survival* even after adjusting for SES measured on two levels. Health care differs enormously across rural and urban China. Differences in quality of care may certainly explain much of the urban advantage that remains even after controlling for individual- and community-level predictors. Therefore, unless inequalities in care itself are reduced, it is possible that differences in health between those living in urban and rural China may be slow to change.

There are several limitations. A small number of deaths limited our ability to affirm statistical significance with respect to predictors of mortality. Even fairly large rural/urban coefficients tended to be non-significant in models that controlled for individual and community level SES. Two years between observations may result in missed functional transitions. While death is not a problem, it is likely that a number of changes in functional status among survivors go unobserved. Many community characteristics are unmeasured. In particular, when it comes to China, environmental and health care quality factors come to mind. Because of availability of data, our functional status outcomes are based on self-reports rather than more objective physical performance tests. Previous research has indicated potential under-reporting of functional status limitations using self-reports in comparison to performance based measures (Karagiozis, Gray, Sacco, Shapiro, & Kawas, 1998). Further research examining differences in self-reported functional status across rural and urban areas of China would therefore be useful in order to determine whether there are biases that are patterned by places of residence.

In sum, the main message of the current study is that urbanites in China have much better functional transitions than do their rural counterparts, and that while some of this is accounted for by the SES position of individuals and the communities in which they live, the entire urban advantage is difficult to explain. There is certainly a need to better facilitate rural areas and to provide rural residents with education if equality in health is to be realized. But, the mixed ability of some of our SES indicators in predicting functional transitions or reducing the rural disadvantage suggests complexities in the Chinese case that require further study.

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