Moving beyond Living Arrangements: The Role of Family and Friendship Ties in Promoting Mental Health for Urban and Rural Older Adults in China

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ABSTRACT

Objective: This study examines the interplay among living arrangements, social networks, and depressive symptoms among Chinese older adults.

Methods: Data are derived from the 2014 baseline survey of the China Longitudinal Aging Social Survey (CLASS), **which provides a sample of older Chinese who had been married and had children** (N = 7,662). This study examines the association between living arrangements and depressive symptoms (measured as CES-D scale, 0-18) of older adults, and addresses the moderating role of social networks (measured as family ties and friendship ties, 0-15) on this perceived association.

Results: Our results show that older adults who live both with a spouse and adult children report superior mental health than those living alone (β = 1.240, $p < 0.001$), but no differences are seen from those living only with a spouse or children. Older adults living alone in rural areas are also more disadvantaged in comparison to those living alone in urban places (β = 0.535, $p < 0.05$). However, we find that the undesirable consequences associated with depression of older adults living alone can be reduced or even eliminated when older adults have strong friendship ties in rural China (β = -0.145, $p < 0.01$). We also find that for rural older adults living only with children, their mental health is highly contingent on their family ties, that is, they are extremely disadvantaged when having weak family ties, but benefit most significantly from strong family ties (β = -0.137, $p < 0.05$).

Conclusions: Associations between living arrangements and mental health in later life are contingent on older adults' social networks, and these moderating effects vary between rural and urban China.

Keywords: Living Arrangements; Mental Health; Social Networks; China

Introduction

The role of living arrangements in shaping individuals' mental health in later life has been widely discussed in both public and academic circles. Living alone is generally associated with inferior mental health among older adults, whereas living with a spouse and close family members can be beneficial in later life (Chou, Ho, & Chi, 2006; Do & Malhotra, 2012; Henning-Smith, 2016). In contexts where intergenerational ties are traditionally strong and formal social support systems for older adults remain underdeveloped, co-residing with adult children is often found to promote older adults' mental health (Chen & Short, 2008; Samantha, Chen, & Vanneman, 2015; Yamada & Teerawichitchainan, 2015). Indeed, existing research in settings where a family system of old age support dominates often emphasizes the importance of understanding the roles of co-residing family members, even when it is widely acknowledged that family relationships are not confined by the boundary of the household and that non-kinship ties can be crucial for older adults' well-being. It is still relatively uncommon for researchers to extend analysis beyond living arrangements and to examine how the larger social network (including family and friendship ties) and household context work together to influence older adults' mental health.

This study is set in China, a country with a traditional family system for old age support and strong expectations of adult children's filial responsibilities. As co-residence with children is undergoing a steady decline, might a strong kinship network and friendship ties compensate for the absence of adult children living in the household? In this study, we extend the existing line of literature by examining the moderating role of social networks in the mental health implications of living arrangements among older adults who had been married and had children. Previous literature on living arraignments have shown that by facilitating their continued independence,

active social engagement can help to reduce the disadvantages experienced by those living alone in comparison with those living with family members (Michael, Berkman, Colditz, & Kawachi, 2001; Russell, 2009). Also, despite living with family members is associated with an increasing probability of getting support when older adults experience negative life events (Do & Malhotra, 2012; Russell, 2009), they are also more vulnerable to the risk of conflicts with close family members and are more likely to experience adverse mental health outcomes as a consequence (Lin & Chen, 2018; Thomas, Liu, Umberson, & Suitor, 2017). To gain a better understanding of the complexities of the household context, a growing body of literature documents how older adults' social networks outside the household (e.g., friends, neighbors, relatives) may interact with living arrangements to influence their well-being (Chan, Malhotra, Malhotra, & Østbye, 2011; Leung et al., 2016; Stahl, Beach, Musa, & Schulz, 2017).

The close association between social networks and the mental health of older adults have been widely studied in gerontological research (Lei, Shen, Smith, & Zhou, 2015; Sicotte, Alvarado, León, & Zunzunegui, 2008). According to the social convoy model, individuals are surrounded by supportive others throughout the life course (Antonucci, Ajrouch, & Birditt, 2014). With respect to older adults, instead of being isolated with few social interactions, the large body of literature has documented supportive convoys of social relationships, and their protective effects on the well-being of individuals in later life (Ajrouch, Blandon, & Antonucci, 2005; Cheng, Lee, Chan, Leung, & Lee, 2009; Webster, Antonucci, Ajrouch, Abdulrahim, & Al, 2015). Therefore, even if the prevalence of coresidence with traditionally preferred family members is likely to decline, since older adults are surround by multidimensional convoys, they may be able to manage challenges of undesirable life events through their social ties.

Related to the convoy model, the stress-coping model has also emerged in the aging literature, and it suggests that older adults seek coping strategies in order to deal with challenges from negative life events (Kraaij, Arensman, & Spinhoven, 2002; Moos, Brennan, Schutte, & Moos, 2006). Through this process, they can cope by either acquiring the necessary resources in their environment or by adopting a positive reappraisal of the stressor (Holtfreter, Reisig, & Turanovic, 2017; Y. Lee, Jang, & Lockhart, 2018). In the case of living arrangements, living away from children can be considered a negative life condition in a context where intergenerational co-residence is traditionally preferred (Chen & Short, 2008; Ren & Treiman, 2015). We argue that older adults' social networks can act as important coping resources in later life and can play a direct and moderating role in modifying the association between undesirable living arrangements and mental health of older adults.

Consistent with previous studies on social networks among older adults (Chopik, 2017; Litwin & Shiovitz-Ezra, 2011), we distinguish older adults' social networks in terms of family ties and friendship ties. Studies from some Western countries have consistently shown that friendship interaction is positively related to self-esteem, morale and mental health among older adults, while family ties are not always beneficial, being dependent on the quality of the relationship (Chopik, 2017; Lee & Ishii-Kuntz, 1987; Lee & Shehan, 1989). Potential differences in the effects of family and friendship ties on emotional well-being in later life in non-Western contexts remain poorly studied on the whole, with a few exceptions (Lei, Shen, et al., 2015; T. Li & Zhang, 2015).

The Context of China

China is a country with a strong traditional culture of filial piety that emphasizes adult children's responsibilities to their aging parents (Lin & Pei, 2016; Pei, Luo, Lin, Keating, & Fast, 2017;

Silverstein, Cong, & Li, 2006). Co-residence with adult children is deemed as providing greater potential for older parents to receive financial, instrumental and emotional supports, promoting their mental health in consequence. However, owing to a combination of declining fertility rates and considerable internal migration, the living arrangements of older adults have shifted dramatically in recent decades. In 1982, nearly 75% of Chinese older adults lived with their adult children (Cartier, 1995). This proportion has declined substantially, with increasing number of older adults living only with their spouse or alone; by 2011, more than half of Chinese older adults lived away from adult children (Lei, Strauss, Tian, & Zhao, 2015; Ren & Treiman, 2015).

A large body of literature has examined wide rural-urban discrepancies with respect to health and health care sources among older adults (Wang, Chen, Shen, & Morrow-Howell, 2018; Zhu & Österle, 2017). Regarding the mental health, it is noted that depression is much more severe among older adults in rural China, and it may also lead to the higher rates of suicides among rural Chinese (Law & Liu, 2008; Li, Liu, Xu, & Zhang, 2016). As such, we examine rural-urban disparities in the implications of living arrangements for mental health in China. China has implemented a strict household registration system (*hukou*) since the 1950s, and this rural/urban dichotomy system has resulted in sharp social and economic disparities between rural and urban populations (Li et al., 2016). Rural older adults face limited access to a broad range of state-sponsored public goods and health care services, and less social support and participation in comparison with their urban counterparts (Li et al., 2016; Wang et al., 2018). Therefore, rural older adults in China primarily depend on their adult children in order to receive both financial and instrumental support when in need. Furthermore, rural areas are disadvantaged both in their social and physical environments, thus adding another layer of neighborhood stressors for older adults living therein (Wang et al., 2018). Evidence from the United States has shown that living

alone lead to greater levels of depression in low-quality neighborhoods (Stahl et al., 2017). In this study, we suggest that living without an adult child might be more detrimental to the well-being of rural older adults than those living in urban areas.

In sum, **using a nationwide survey of older Chinese**, we intend to answer the following research questions. First, compared with the traditional preference of living with both one's spouse and children, what are the implications for the mental health of Chinese older adults of other living arrangements, including living alone, living only with a spouse or children, and living only with others (e.g., siblings, roommates)? Second, does the relationship between living arrangements and mental health vary between rural and urban areas? Third, is this perceived association contingent on older adults' social networks (measured in terms of family and friendship ties), and do these moderating effects differ between rural and urban areas?

Methods

Data and Sample

We use data from the China Longitudinal Aging Social Survey (CLASS), conducted by a team of researchers at Renmin University of China (data and documentation are available at http://class.ruc.edu.cn). The baseline survey was conducted between July and December 2014. The CLASS applied a multi-stage stratified probability sampling method, with counties as the primary sampling units, villages/neighborhood committees as the secondary sample units, and people aged 60 and over living in households as the survey respondents. Only one older adult was randomly selected from each sampled household. The survey covered 28 provinces,

autonomous regions, and municipalities in mainland China, and collected information from 11,511 older adults living in 462 villages/neighborhood communities.

Given that the main purpose of this investigation is to examine the role of living with one's spouse and/or children in the mental health of older adults, all respondents who had never been married and who were childless were excluded. All respondents were initially asked to answer five cognition-related questions, and only those who answered correctly on at least three proceeded to the mental health and attitudinal questions. It is a widely used practice in clinical and epidemiological studies to use a standardized screening tool in order to decide whether respondents are cognitively suited to answering some self-reported questions, since serious questions can be raised about the validity of such self-reports (Wang, Chen, & Han, 2014). Approximately 25.6% of the sample (N = 2,907) were excluded in this study as a result. These cognitively impaired individuals were more likely to be women than men, to be living in rural than urban areas, and to have lower socioeconomic status (SES). Therefore, findings from this study may not be generalized to the cognitively impaired older population. In addition to the attrition of cognition impairment, we also excluded respondents with missing values on analytical variables (N = 839, 7.3%), resulting in 7,662 older adults, with 5,067 living in urban areas and 2,595 living in rural areas included in this study's analysis.

Measures

Dependent Variable

Depressive symptoms were measured by a subset (nine items) from the Center for Epidemiologic Studies-Depression (CES-D) scale (Radloff, 1977). Three items indicated feelings of positive affect (feeling happy, enjoying life, feeling pleasure), two items indicated feelings of negative

affect (feeling lonely, feeling upset), two items indicated feelings of marginalization (feeling useless, having nothing to do), and two items indicated somatic symptoms (having poor appetite, having trouble sleeping). We coded the frequency with which the participant had experienced each symptom in the past week as 0 (rarely or none of the time), 1 (some of the time), or 2 (most of the time). After the coding of positive affect items had been reversed, the nine items were summed, which produced a depressive symptom score ranging from 0 to 18, with a higher score indicating more depressive symptoms (Cronbach's α =0.755). The nine-item CES-D scale has been broadly used to assess mental health of older adults and also has been validated for studies of Chinse adults (Lin & Chen, 2018; Silverstein et al., 2006).

Independent Variables

One of our key independent variables is living arrangements. Based on the complete household roster, we categorized older adults into five distinct groups: 1) live with both spouse and children, 2) live alone, 3) live with a spouse, no children, 4) live with children, no spouse, and 5) live only with others (e.g., siblings, roommates).

Another key independent variable – residence type – was measured by a dichotomous variable indicating whether older adults were rural or urban residents at the time of interview. We used older adults' report of the official household registration (*Hukou*) status to classify them as rural or urban residents. **The *Hukou* system, first introduced in the 1950s, has been used to institutionalize China's agricultural/non-agricultural dual economy system (Kuang & Liu, 2012). People living in rural areas are considered under the agricultural segment and thus registered as the agricultural *Hukou* (i.e., rural *Hukou*), whereas those living in urban areas are registered as the non-agricultural *Hukou* (i.e. urban *Hukou*). One's *Hukou* status is inherited from one's parents and can only be converted through limited channels (e.g.,**

enrolled in higher education). *Hukou* is unique to the Chinese context and serves as a social boundary separating rural residents from urban residents (Song, 2014). It has also been generally used in the literature to study rural-urban disparities in various health conditions among Chinese older adults (Li et al., 2016; Zhu & Österle, 2017).

We used the *Lubben Social Networks Scale* (LSNS) (Lubben et al., 2006), an index that has been extensively used in the literature to assess social networks and social support for older adults (Chan et al., 2011; Leung et al., 2016), in order to measure the social networks of our sample of Chinese older adults. LSNS is constructed from a set of three questions evaluating family ties and a comparable three questions for friendship ties. The questions comprised: "How many relatives/friends do you see or hear at least once a month?", "How many relatives/friends do you feel at ease with to talk about private matters?", and "How many relatives/friends do you feel close to such that you could call on them for help?". We coded the number answered by the participants for each question as 0 (none), 1 (1), 2 (2), 3(3 or 4), 4 (5 through 8), or 5 (9 or more). The three items were summed into a scale ranging from 0~15 for (separately) family ties and friendship ties. The Cronbach's α coefficients were 0.742 for the subscale of family ties and 0.852 for the subscale of friendship ties.

We also controlled for a series of sociodemographic variables in the analysis, including gender, age, marital status (married or not), number of children, household size, presence of grandchild in the household, education (less secondary/secondary and above), number of chronic diseases, functional limitations (with an index of 0~30, the higher the worse), and annual personal income (logged).

Analytical Strategy

We conducted the analysis in two steps. The first set of analysis reported descriptive statistics of older adults' depressive symptoms, their living arrangements, social networks, and other variables included in the multivariate models by rural and urban subsamples. In the second set, we started with the total sample, using multivariate linear regression models to examine the associations between living arrangements and depressive symptoms, controlling for other independent variables. We then tested for whether the perceived associations among living arrangements, LSNS family and friendship ties subscales, and depressive symptoms could be moderated by residence type (rural/urban). We further tested for the moderating role of social network scales in the living arrangements-depressive symptoms link and whether it differs between urban and rural areas. Given that three way interactions (living arrangement x residence type x LSNS) could have become cumbersome to interpret, we conducted subsample analyses for urban and rural areas and tested for two-way interactions in each subsample (living arrangement x LSNS).

RESULTS

Descriptive Analysis

Table 1 presents the sample's characteristics and differences between rural and urban older adults. Consistent with previous studies, rural older adults in China exhibited higher levels of depressive symptoms than their urban counterparts (Li et al., 2016; Wang et al., 2018). In terms of living arrangements, more than half of the older adults (56.1%) lived away from their children, and the proportion of older adults living alone in rural areas (12.8%) was higher than that in urban areas (11.4%). Rural older adults reported weaker friendship ties compared to their

urban counterparts, but no significant differences in family ties were revealed between the two groups. As expected, rural older adults had much less education and income, more children, and reported a higher prevalence of chronic diseases and functional limitations than did urban older adults.

-Table 1 about here-

Table 2 further shows the mean values of family ties and friendship ties subscales across living arrangements in urban and rural areas. Older adults living with a spouse and children had the highest mean values of family ties, and those who lived alone had the lowest mean scores among both urban and rural subsamples. The variation of mean values of friendship ties by living arrangements were relatively smaller than that of family ties. Older adults living with a spouse and children had the highest mean value of friendship ties, but the differences were relatively modest, especially among urban older adults.

-Table 2 about here-

Multivariate Regression Analysis

Results from the regression analyses of the total sample are shown in Table 3. In Model 1a, having controlled for other covariates, living alone was associated with the highest level of depressive symptoms across all living arrangements (1.240 higher in CESD score, compared with those living with both a spouse and children). Living only with other non-spouse and non-children household members was also associated with a higher level of depressive symptoms than living with both a spouse and children (0.812). In Model 1b we added the interaction between residence type and living arrangements. Specifically, the positive association between living alone and depressive symptoms was stronger in rural areas (1.062+0.535=1.597), than

urban areas (1.062), suggesting that rural older adults living alone were further disadvantaged compared with their urban peers. In contrast, the adverse mental health outcome of living only with others was only statistically significant among rural older adults (0.381+1.565=1.946).

-Table 3 about here-

In Model 2a, we added the LSNS scale, including both family ties and friendship ties subscales. The results show that both family ties (-0.176) and friendship ties (-0.053) were negatively associated with older adults' depressive symptoms, with family networks playing a much stronger role than friendship networks. In Model 2b, we tested for the interaction between residence type and LSNS family and friendship ties subscales. We observe that the negative association between family ties and depressive symptoms was stronger among rural older adults, while friendship ties were more important among urban older adults, as shown in Figure 1. Furthermore, after controlling all variables including living arrangements, covariates, and LSNS (Model 2a), older adults living with a spouse (no children) show no statistically significant differences from those living with both a spouse and children.

-Figure 1 about here-

The above analyses established that the association among living arrangements, social networks, and depressive symptoms differed between urban and rural areas. We were also interested in testing whether the living arrangements-depressive symptoms link was moderated by social networks, whilst taking potential urban-rural differences into account. Instead of three-way interactions (living arrangements x residence type x LSNS), parallel regression analyses were conducted among rural and urban subsamples (Table 4). Consistent with the results from Table 3, Model 3a and Model 4a show that older adults' living alone was associated with the

poorest mental health and this association was stronger among rural subsamples (1.449 vs. 1.019). Moreover, family ties were negatively associated with depressive symptoms in both rural and urban areas, with a stronger association among rural subsamples (-0.217 vs. -0.150). As for the friendship ties subscale, we find it was significant only among urban subsamples (-0.067), and its magnitude was smaller than that of the family ties subscale.

-Table 4 about here-

In Model 3b and 4b we added interactions between living arrangements and LSNS subscales for urban and rural subsamples separately. Model 3b shows no statistically significant interactive relationships for urban older adults. Results of interactive relationships between living arrangements and LSNS subscales were somewhat different among rural older adults (Model 4b). In general, family ties were more closely associated with rural older adults' mental health for those living with children (no spouse), compared with those living with both children and a spouse. In contrast, friendship ties were significantly associated with mental health of older adults only for those living alone.

In order to aid interpretation, Figure 2 shows how the associations between social networks (family and friendship ties) and depressive symptoms vary by living arrangements. **For urban older adults, the associations between social networks and depressive symptoms were generally similar across different living arrangements, whereas for rural older adults these perceived associations varied significantly by certain living arrangements.** First, family ties were most considerably associated with depressive symptoms of older adults living with children without spouse (see its steepest slope in Figure 2). For those older adults, when family ties were weak, they exhibited the highest level of depressive symptoms. For example, their predicted CES-D was more than 8 when LSNS family ties subscale was equal to 0, compared with those

living with both children and a spouse (predicted CESD around 6). Interestingly, when family ties were strong, this group was no longer the most vulnerable. Indeed, we observe a convergence point when the LSNS family ties subscale was around 11. In other words, the gaps gradually closed amongst these different types of living arrangements when family ties became stronger. Second, we observe a very different pattern when it comes to friendship ties. The predicted regression lines of friendship ties were virtually flat for those living with family members. Strikingly, for rural older adults living alone, the strength of friendship ties was strongly associated with a reduction in depressive symptoms. In other words, when friendship ties were weak, there was a huge gap between older adults living alone and those who were living with a spouse and/or children. The former suffered from a much higher level of depression when the scale of friendship ties was zero, compared with those living with family members. When friendship ties were strong (LSNS friendship ties > 12), then small or even no difference across the various types of living arrangements could be identified.

-Figure 2 about here-

DISCUSSION

In the present study, we provide evidence of how the mental health of older adults **who had been married and had children** is associated with a combination of social networks (measured in terms of family ties and friendship ties) and the household context in China. By taking rural-urban differentials into account, we also study how the interplay among living arrangements, social networks, and depressive symptoms vary between rural and urban older adults.

Consistent with previous studies (Chen & Short, 2008; Chou et al., 2006; Zhou et al., 2018), living with family members is associated with better mental health of Chinese older adults' than those living alone. Our results also show that those living only with a spouse or children can enjoy the same level of advantages as those living both with a spouse and adult children. As intergenerational co-residence becomes decreasingly common in China due to declining fertility rates and increasing internal migration, "empty-nest" older adults (i.e., those living away from children) have become more prevalent than ever before. Surprisingly, many previous studies on "empty-nest" older adults have failed to differentiate between older adults living with a spouse and those living alone without a spouse. As shown in this study, "empty-nest" couples are not disadvantaged compared with those who live with their adult children, which suggests a significant role of the spouse in people's later life. To some extent, this finding indicates that the claim that having spouse is the "greatest guarantee of support in old age" made in some studies in Western contexts (Chappell, 1991; Hughes & Waite, 2002) applies to China as well, in spite of the fact that this cultural context has historically prioritized the parent-child relationship over the spousal relationship.

Those living alone remains the most disadvantaged group of Chinese older adults, especially among those in rural China. Older adults who live alone are more vulnerable to social isolation, to the detriment of their mental health, notably based on the dominant sense of filial obligation in Chinese society. This is especially true of rural older adults, who are more dependent on their family members owing to their limited access to formal support and relatively disadvantaged socioeconomic status compared with their urban counterparts. This finding is reinforced by the distinctive roles of family and friendship ties among rural and urban older adults: family ties play a relatively stronger role in mitigating rural older adults' depressive symptoms, while urban older

adults are more greatly implicated by friendship ties than are their rural peers. The role of family and friendship ties in promoting mental health of Chinese older adults is consistent with the social convoy model and also contribute to the existing literature in terms of pointing out differential implications of social networks for well-being in later life by networks types as well as across social contexts.

The association between living arrangements and the mental health of older adults does, however, vary across their perceived social networks. Although older adults living alone are the most disadvantaged group, we find that the living alone-depression relationship is likely to be contingent on the strength of their friendship ties. For older adults living alone with strong friendship ties, their psychosocial disadvantages are much smaller than those with weak friendship ties. This finding provides some support to the stress-coping model that friendship ties represent an important coping strategy that can help buffer the negative effects of stressful living arrangements (Kraaij et al., 2002; Moos et al., 2006). It is also possible that older adults with strong friendship ties are more likely to prefer living independently and thus do not suffer from living on their own. In contrast, the effect of family ties is notably greater for older adults living only with children. Older adults are more likely to coreside with adult children when they have greater needs for emotional, instrumental, and financial support due to loss of their spouse (widowhood, divorce, or separation) (Korinek, Zimmer, & Gu, 2011; Zhang, Gu, & Luo, 2014). Therefore, they are more sensitive to their family ties and either benefit most from them or are at the greatest risk of depression when these family ties are weak.

Certain limitations of this study are worth noting. First, this study is based on a cross-sectional design, and thus we are not able to determine the causality of relationships among living arrangements, social networks, and depressive symptoms of older adults. Future studies

could use longitudinal data to examine the causality of these associations in greater detail. Second, owing to the data limitations, we are unable to differentiate family ties within the household from those outside the household, among older adults living with family members. It is possible that the effect of family ties on older adults' mental health is contingent on their geographic proximity (e.g., Lin & Chen, 2018). Also, other relatives who are living in older adults' household may possibly contribute to the part of family networks. Although we have controlled for the household size in the multivariate analysis to account for the potential effects of live-in relatives, it does not eliminate the risk of endogeneity issues. Future studies should further develop these measurements to consider potential heterogeneities within family ties. Finally, data limitation also prevents us from including of several potentially important measures related to the living arrangements such as preferences for living arrangements.

Despites these limitations, this study has demonstrated the critical importance of extending beyond the boundary of the household in health disparity research. Yes, living arrangements still matter for Chinese older adults, but our analyses have shown that its implications for mental health are nuanced and varied, fundamentally contingent upon their larger family and social network. We interpret the findings as encouraging, given that the traditional model of old age support, facilitated mainly by coresidence with adult children is no longer sustainable in contemporary China. Intergenerational coresidence has been declining steadily and massive rural to urban migration has left millions of older adults behind. It is unlikely that these trends will be reversed in the foreseeable future. However, existing government policies have overwhelmingly placed the emphasis on adult children, re-asserting their filial responsibilities for older parents. Our study has highlighted another area where policy intervention could be effective, that is, to promote a stronger family and friendship network and more active social interaction in the local

communities. After all, social support comes in many different forms. It is neither feasible nor desirable to exclusively focus on the support provided by children. For better mental health outcomes, older adults ought to be able to benefit from different aspects of the larger social network, given that they are strong and well maintained.

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Figure 1. Predicted Depressive Symptoms by Lubben Social Networks Scales (Family and Friendship Ties Subscales) in Urban and Rural Areas (with 95% confidence intervals)

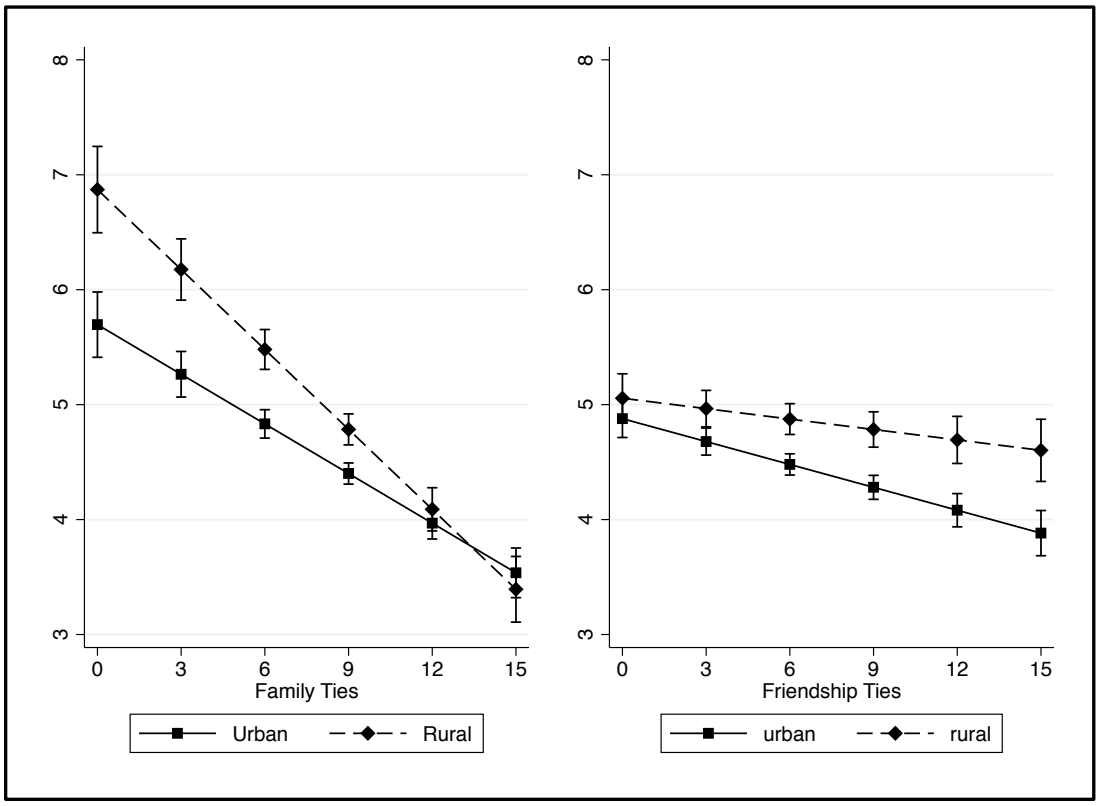
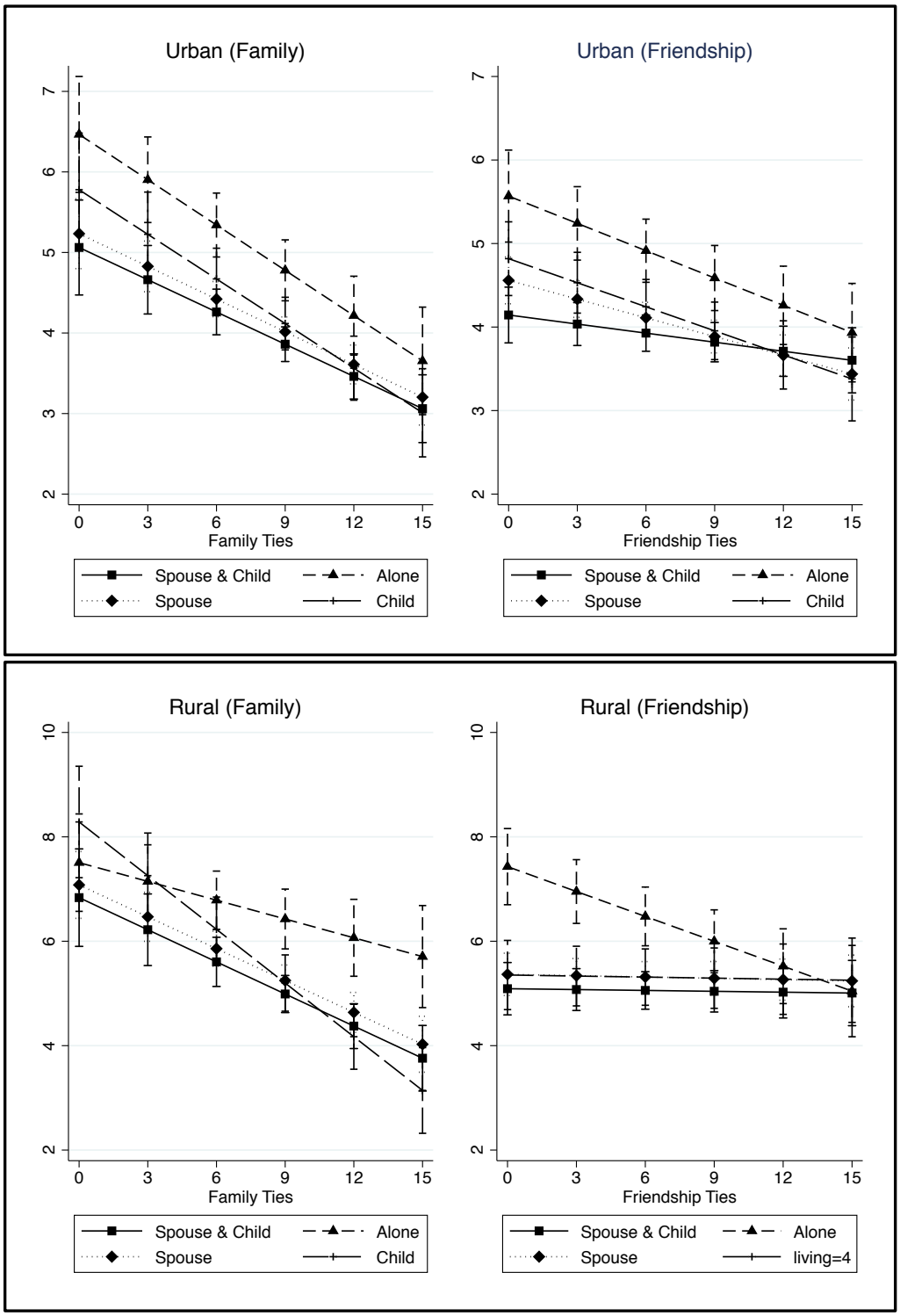


Figure 2. Predicted Depressive Symptoms by Lubben Social Networks Scales (Family and Friendship Ties Subscales) across Living Arrangements (with 95% confidence intervals)



Note. The category of "living only with others" was removed from figures because of its small sample size and nonsignificant results.

Table 1. Descriptive Statistics of Urban and Rural Older Adults, CLASS 2014

	Total	Urban	Rural
Depressive symptoms（0-18）	4.58	4.15	5.43*
	(3.58)	(3.36)	(3.82)
Living arrangements (%)			
Both spouse and children	25.3	25.5	24.7
Living alone	11.9	11.4	12.8
Spouse (no children)	41.9	41.9	41.8
Children (no spouse)	18.6	18.6	18.7
Only others	2.3	2.5	1.8
Age (60-113)	69.14	69.48	68.47*
	(7.51)	(7.67)	(7.14)
Female (%)	46.2	49.1	40.5*
Married (%)	71.1	71.6	70.3
Number of children(1-12)	2.76	2.51	3.23*
	(1.43)	(1.38)	(1.42)
Presence of grandchildren (%)	38.9	36.7	43.0*
Household size (1-17)	3.14	3.06	3.28*
	(1.78)	(1.70)	(1.91)
Secondary education or above (%)	44.1	56.5	20.0*
Annual personal income (in RMB)	20,715.21	26,849.25	8,737.86*
(0-550,000)	(23,187.75)	(23,958.06)	(15,809.61)
Number of chronic diseases	1.67	1.54	1.90*
(0-16)	(1.72)	(1.63)	(1.86)
Index of functional limitation	1.26	1.12	1.54*
(0-30)	(3.09)	(3.04)	(3.17)
LSNS family ties subscale	8.68	8.69	8.65
(0-15)	(3.12)	(3.06)	(3.25)
LSNS friendship ties subscale	6.49	6.71	6.07*
(0-15)	(4.66)	(4.55)	(4.83)
N	7,662	5,067	2,595

Note. Values for categorical variables are in percent. The mean values, followed by standard deviations in parentheses, are presented for all other variables.
*Indicates a significant difference ($p < 0.05$) between urban and rural older adults based on chi-square test or t-test.

Table 2. Lubben Social Networks Scales (Family and Friendship Ties Subscales) by Living Arrangements in Urban and Rural China, CLASS 2014

	Total			Urban			Rural		
	Family (0-15)	Friendship (0-15)	N	Family (0-15)	Friendship (0-15)	N	Family (0-15)	Friendship (0-15)	N
Both spouse and children	9.31 (3.00)	6.79 (4.72)	1,935	9.20 (2.98)	6.91 (4.66)	1,293	9.53 (3.02)	6.55 (4.85)	642
Living alone	7.65 (3.39)	6.30 (4.70)	911	7.74 (3.29)	6.67 (4.51)	578	7.50 (3.56)	5.66 (4.96)	333
Spouse (no children)	8.52 (3.09)	6.51 (4.60)	3,211	8.59 (3.02)	6.77 (4.48)	2,125	8.37 (3.22)	6.01 (4.79)	1,086
Children (no spouse)	8.96 (2.93)	6.20 (4.61)	1,428	8.90 (2.89)	6.39 (4.54)	942	9.08 (3.02)	5.84 (4.73)	486
Only others	7.67 (3.27)	6.12 (4.84)	177	8.00 (3.35)	6.08 (4.71)	129	6.77 (2.89)	6.23 (5.22)	48

Note. Family ties and friendship ties are significantly different among five types of living arrangements in both urban and rural samples based on one-way ANOVA tests.

Table 3. Linear Regression Models Predicting Depressive Symptoms of Chinese Older Adults, Total Sample, CLASS 2014

	Model 1a	Model 1b	Model 2a	Model 2b
Living arrangements (*ref*. Both spouse and children):				
Alone	1.240***	1.062***	1.205***	1.189***
	(0.244)	(0.262)	(0.239)	(0.239)
Spouse (no children)	0.142	0.086	0.202	0.199
	(0.134)	(0.147)	(0.131)	(0.131)
Children (no spouse)	0.343	0.344	0.298	0.285
	(0.197)	(0.210)	(0.193)	(0.193)
Only others	0.812**	0.381	0.654*	0.625*
	(0.308)	(0.342)	(0.302)	(0.301)
Rural	0.423***	0.239	0.404***	0.940***
	(0.090)	(0.161)	(0.088)	(0.229)
Age	0.083	0.079	0.065	0.074
	(0.084)	(0.084)	(0.083)	(0.082)
Female	-0.138	-0.132	-0.065	-0.069
	(0.079)	(0.079)	(0.077)	(0.077)
Married	-0.384*	-0.410*	-0.402*	-0.425*
	(0.187)	(0.188)	(0.183)	(0.183)
Number of children	0.033	0.033	0.116***	0.116***
	(0.031)	(0.031)	(0.031)	(0.031)
Presence of grandchild	-0.056	-0.081	-0.055	-0.067
	(0.126)	(0.126)	(0.123)	(0.123)
Household size	-0.070	-0.056	0.012	0.015
	(0.043)	(0.043)	(0.043)	(0.043)
Secondary education and above	-0.613***	-0.602***	-0.502**	-0.490***
	(0.086)	(0.087)	(0.085)	(0.085)
Log annual personal income	-0.464***	-0.462***	-0.398***	-0.397***
	(0.052)	(0.052)	(0.051)	(0.051)
Number of chronic diseases	0.440***	0.440***	0.422***	0.422***
	(0.022)	(0.022)	(0.022)	(0.022)
Index of functional limitations	0.252***	0.252***	0.237***	0.237***
	(0.013)	(0.013)	(0.013)	(0.013)
Rural * Alone		0.535*		
		(0.271)		
Rural * Spouse (no children)		0.236		
		(0.197)		
Rural * Children (no spouse)		-0.037		
		(0.238)		
Rural * Only others		1.565**		
		(0.568)		
Family ties subscale			-0.176***	-0.144***
			(0.013)	(0.016)
Friendship ties subscale			-0.053***	-0.066***
			(0.008)	(0.011)
Rural * Family ties subscale				-0.088**
				(0.025)
Rural * Friendship ties subscale				0.036*
				(0.017)
Constant	4.126	4.255	5.814*	5.316
	3.020	3.021	2.960	2.962
R^2	0.191	0.192	0.224	0.225
N	7,662	7,662	7,662	7,662

*** $p<.001$, ** $p<.01$, * $p<.05$ (two-tailed tests)

Table 4. Linear Regression Models Predicting Depressive Symptoms of Chinese Older Adults, Urban and Rural Subsamples, CLASS 2014

	Urban		Rural	
	Model 3a	Model 3b	Model 4a	Model 4b
Living arrangements (*ref*. Both spouse and children):				
Alone	1.019***	1.941***	1.449**	1.713*
	(0.284)	(0.487)	(0.438)	(0.700)
Spouse (no children)	0.160	0.345	0.273	0.354
	(0.154)	(0.349)	(0.245)	(0.542)
Children (no spouse)	0.276	1.073*	0.258	1.575*
	(0.224)	(0.464)	(0.371)	(0.734)
Only Others	0.271	-0.494	1.554*	3.617**
	(0.342)	(0.806)	(0.614)	(1.363)
Age	0.107	0.104	-0.023	0.003
	(0.094)	(0.094)	(0.168)	(0.168)
Female	-0.082	-0.077	-0.028	-0.028
	(0.091)	(0.091)	(0.144)	(0.143)
Married	-0.474*	-0.464*	-0.392	-0.347
	(0.215)	(0.215)	(0.345)	(0.345)
Number of children	0.166***	0.172***	0.032	0.032
	(0.039)	(0.039)	(0.054)	(0.054)
Presence of grandchild	-0.133	-0.124	0.011	-0.008
	(0.146)	(0.146)	(0.228)	(0.228)
Household size	0.028	0.027	0.007	0.028
	(0.052)	(0.053)	(0.074)	(0.075)
Secondary education and above	-0.415***	-0.411***	-0.550**	-0.556**
	(0.098)	(0.098)	(0.173)	(0.173)
Log annual personal income	-0.438***	-0.429***	-0.318***	-0.320***
	(0.063)	(0.063)	(0.087)	(0.087)
Number of chronic diseases	0.374***	0.375***	0.497***	0.496***
	(0.027)	(0.027)	(0.037)	(0.037)
Index of functional limitations	0.228***	0.228***	0.253***	0.253***
	(0.016)	(0.016)	(0.023)	(0.023)
Family ties subscale	-0.150***	-0.139	-0.217***	-0.210***
	(0.015)	(0.031)	(0.023)	(0.048)
Friendship ties subscale	-0.067***	-0.036	-0.028	-0.003
	(0.010)	(0.020)	(0.015)	(0.029)
Alone * Family ties subscale		-0.060		0.094
		(0.051)		(0.072)
Spouse (no children) * Family ties subscale		0.009		0.003
		(0.039)		(0.058)
Children (no spouse) * Family ties subscale		-0.046		-0.137*
		(0.047)		(0.070)
Only others*Family ties subscale		0.036		-0.153
		(0.087)		(0.196)
Alone * Friendship ties subscale		-0.064		-0.145**
		(0.036)		(0.049)
Spouse (no children) * Friendship ties subscale		-0.037		-0.006
		(0.025)		(0.037)
Children (no spouse)* Friendship ties subscale		-0.057		0.001
		(0.030)		(0.044)
Only others* Friendship ties subscale		0.085		-0.145
		(0.061)		(0.109)
Constant	4.345	4.095	9.070	7.774
	(3.384)	(3.396)	(5.978)	(5.978)
R^2	0.191	0.102	0.222	0.227
N	5,067	5,067	2,595	2,595

*** $p<.001$, ** $p<.01$, * $p<.05$ (two-tailed tests)