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Unmet long-term care needs and depression: the double disadvantage of community-dwelling older people in rural China

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Unmet Long-Term Care Needs and Depression: The Double Disadvantage of Community-Dwelling Older People in Rural China

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ABSTRACT

This study investigates the relationship between unmet long-term care needs and depressive symptoms among community-dwelling older people in China. The data come from a nationally representative sample of 1,324 disabled older people from the China Health and Retirement Longitudinal Survey (CHARLS) collected between 2013 and 2014. Regression analyses were conducted to examine the factors associated with unmet needs and the impacts of unmet needs on people's depressive symptoms. We found that disabled older people living in rural communities have a higher level of unmet needs than those in urban communities. Unmet needs cause more severe depressive symptoms among rural older people, but they do not have a significant impact among urban older people. Depressive symptoms are also affected by people's health conditions in rural China, and by household income in urban China. We argue that older people living in rural communities face a double disadvantage. The first disadvantage relating to unmet needs reinforces the second one relating to mental health. These findings highlight the urgent need for more investment by the Chinese central government in formal social care services and support for carers in rural areas.

Key words: Unmet long-term care needs, depressive symptoms, informal care, disability

What is known about this topic:

- In developed countries, older people living in remote rural areas have reduced access to health and formal social care services due to population dispersion, geographic isolation and transport inadequacy;
- The long-term care system in China relies almost exclusively on informal care;
- Older people living in rural China have reduced access to informal care due to rural to urban migration;
- Older people with unmet long-term care needs in the US have more severe depressive symptoms.

What this paper adds:

- Older people living in rural communities have on average a higher level of unmet needs than those in urban communities in China;
- The factors associated with the prevalence and the level of unmet needs are different;
- The detrimental effects of unmet needs on depressive symptoms are larger in rural China.

Introduction

Long-term care is crucial when older people have difficulties in carrying out basic activities of daily living due to the onset of disability, illness, or chronic conditions. As the number and proportion of older people keep rising across the world, meeting the long-term care needs of the older population is a serious challenge that faces developed and developing countries alike (United Nations, 2015).

Older people with long-term care needs but without access to formal social care or informal care have to cope with difficult situations in life on their own. It has been reported that older people with unmet needs face serious restrictions in life (e.g. not bathing as often as they want to, not eating when hungry, or not getting housework done) (Allen & Mor, 1997; Allen et al., 2014). In the longer term, unmet needs may lead to mental health problems (Choi & McDougall, 2009), acute care admission (Sands et al., 2006) or higher mortality rates (He et al., 2015; Zhen et al., 2015). In order to improve the health outcomes of older people, it is important for governments to identify those older people with unmet needs and alleviate their negative consequences.

The People's Republic of China (PRC) has seen its older population increasing rapidly in the past decades. In 2015, the number of older people aged 60 and over reached 222 million, accounting for 16% of the Chinese population (Ministry of Civil Affairs of the PRC, 2016). The long-term care system in China has two unique characteristics. First, the whole system relies almost exclusively upon informal care provided by family members. In the US and European countries, formal social care services provided by professional carers and unpaid care provided by family members join forces to meet older people's care needs (Bonsang, 2009; Houtven & Norton, 2004). In comparison, formal care is not a viable option in most

parts of China (Hu & Ma, 2016). In such a system, the unavailability of informal carers will directly lead to unmet needs for disabled older people.

Second, China is a country in which population ageing is coinciding with rapid urbanisation. Rural to urban migration and the industrialisation of cities are taking place at an unprecedented pace, and creating a great divide between rural and urban areas in relation to the demographic structure, social norms, economic development and social welfare, which is also known as rural-urban duality (Cai & Wang, 2009). Rural-urban differences in economic development and social values do exist in developed countries. However, the disparity in China is much more pronounced and can go to extremes in some regions of the country. Meanwhile, the scale of labour migration to cities is unparalleled across the world. This leads to a diversion of the labour force that could have been potential caregivers in rural areas. In this case, both the patterns of unmet needs and the mechanism through which unmet needs affect older people's mental health may be different from those observed in developed countries.

Against this backdrop, this study investigates the relationship between unmet needs and depressive symptoms among disabled Chinese older people living in rural villages or urban communities. Based on the analysis of a nationally representative sample, it aims to answer two research questions. First, what are the determinants of unmet needs in the older Chinese population? Does the level of unmet needs differ between rural and urban China? Second, do unmet needs affect older people's depressive symptoms in China? If so, does the impact differ between older people in rural and urban China?

Theoretical framework

Factors associated with unmet need in China

The level of unmet needs depends upon individuals' propensity to utilise long-term care. Anderson and Newman's (2005) care utilisation framework suggests that the propensity to receive care is affected by disposing, need and enabling factors. Empirical studies conducted in the US and in European countries have confirmed the validity of this framework (Jacobs et al., 2016; Murphy et al., 2014; Suanet et al., 2012). We expect that these factors will also play an important role in the Chinese context.

What sets China and developed countries apart is that population ageing in China is taking place amid the large scale rural to urban migration. Historically, the Chinese population was separated into rural and urban residents by the household registration system, also known as the *hukou* system, according to their place of birth. Migration from rural to urban areas was strictly forbidden (Hu & West, 2015). The institutional separation of the hukou system was relaxed in the 1980s. Since then a large number of rural residents have migrated to the cities each year. At present, there are 169 million migrant workers with a rural hukou doing non-agricultural work in cities, accounting for 22% of the labour force in China (National Bureau of Statistics of PRC, 2016).

Most of the migrants are working age adults who move to the cities to find better job opportunities or even want to settle down there. Rural to urban migration increases the dependency ratio and reduces the support resources available to older people in rural China. Guo et al. (2009) found that rural older people whose adult children migrate to the cities receive significantly less care. We do not hold the simplistic view that out-migration in rural China will immediately lead to unmet needs for rural older people. As reported by Liu (2014) in a qualitative study, when adult children migrate to the cities and are not available to help,

other family members may step up and provide care. But it is reasonable to argue that out-migration weakens the strength of the support network and heightens the risks of unmet needs for rural older people. This is especially the case for older people with multiple disabilities, because they may need informal care from several family members to fully meet their needs. Following this logic, we formulate the first hypothesis of this study as follows:

> Hypothesis 1: All other things being equal, disabled older people living in rural areas on average have a higher level of unmet needs than those in urban areas.

Activity restriction effect, stress coping and depression

Theoretically, there are two channels through which unmet needs affect older people's mental well-being. The first is the activity restriction effect. The activity restriction model (Williamson & Christie, 2009) suggests that physical disabilities or other health conditions impose constraints on older people's ability to carry out basic but much valued activities on a daily basis and thus contributes to the development of depressive symptoms. The main purpose of long-term care is to alleviate or compensate for the constraints imposed on older people by disability so that their restricted state of life becomes less unbearable for older people (Maisonneuve & Martins, 2013). In the absence of long-term care, disabled older people are fully exposed to the restriction effect of disability and are thus more likely to develop depressive symptoms. A higher level of unmet needs will result in more severe depressive symptoms.

The impact of unmet needs on depression also depends upon older people's response to unmet needs. The stress coping model (Folkman & Lazarus, 1988) suggests that older people, in the face of disabilities, will search for a solution to address this stressful event. The coping

strategy is influenced by both personal characteristics (e.g. age, gender, marital status, and socioeconomic status) and the social environment (Specht et al., 2011). Regarding the environmental factors, social norms and beliefs have a major impact on how older people respond to the onset of disability and unmet needs (Aldwin, 2007; Clarke & Smith, 2011). For those older people who expect family members to provide care, they will seek informal care as a coping strategy. If informal care is unavailable, unmet needs become an unsolved problem and make older people feel helpless, which contributes to the development of depressive symptoms. Older people with a lower expectation of help from family members prefer to cope by themselves where they can, and thus appraise unmet needs as a less stressful event. Successful coping with unmet needs by themselves will have a positive impact on their sense of independence and self-esteem, and provide a buffer for the development of depressive symptoms (Felton et al., 1984).

The rural-urban duality in China is characterised by the co-existence of a highly industrialised economy in the cities and a backward agricultural sector in the rural villages (Cai & Wang, 2009). Accompanying the economic duality is the social duality, which is reflected in the divergence in terms of family structure, inter-personal expectations, and social norms. Modernisation in the cities has contributed to the individualisation of urban residents and eroded the sense of filial piety of children towards their parents (Cheung & Kwan, 2009). There has been a sharp increase in the proportions of nuclear families and singleton households in the cities (Wang, 2014). In comparison, the social changes in rural China have been markedly slower. The traditional Chinese values, which are based on the Confucianism, have been relatively well preserved, and extended families are much more common in rural villages than in urban communities (Silverstein et al., 2006; Wang, 2014). A national survey conducted in 2014 found that 83% of rural older people expected to receive long-term care

from their children, whereas only 53% of urban older people reported such an expectation (National Survey Research Centre, 2014).

In the event of the onset of disability, rural older people are more likely to seek help from family members as a solution, whereas urban older people have a higher tendency to plan ahead, search for alternative solutions or manage on their own (Zhang & Goza, 2006). This means that the two groups of people appraise unmet needs differently: unmet needs are treated as a more stressful event by rural older people than urban older people. Therefore, we formulate the second hypothesis of this study as follows:

> Hypothesis 2: The detrimental effects of unmet long-term care needs on
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> depressive symptoms are larger for older people in rural China than in urban
>
> China.

Research methods

Data

The study sample comes from the China Health and Retirement Longitudinal Survey (CHARLS), which collects information on community-dwelling people aged 45 and over. The baseline survey was conducted in 2011, and the same participants were followed in the second wave study in 2013. Since the CHARLS 2011 and the CHARLS 2013 asked different questions relating to disability and unmet needs, our analyses draw on the information in the CHARLS 2013.

Following a multi-stage cluster sampling procedure, the CHARLS provides a nationally representative sample (Zhao et al., 2013). In total, 18,605 people aged 45 and over took part in the CHARLS 2013. Our analyses focus on the 1,324 older people aged 60 and over who

reported having disabilities (see definition below) and provided answers in the mental health module of the questionnaire.

Measurements

The key measurements of interest are unmet needs, depressive symptoms, and rural-urban residence. The CHARLS 2013 asked respondents whether they had difficulties in performing activities of daily living (ADLs) or instrumental activities of daily living (IADLs). The survey included five ADLs (eating, bathing, dressing, using a toilet, and getting in and out of bed) and five IADLs (cooking, shopping, doing housework, taking medication and managing money). For each ADL or IADL, the respondents were provided with four choices: 'I do not have any difficulty', 'I have difficulty but can do it', 'I need help', and 'I cannot do it'. Those older people who chose either of the last two choices for an ADL or IADL task were regarded as having a disability in this task.

The survey asked respondents whether they received informal help from family members for each ADL or IADL disability. Following Vlachantoni et al. (2011), we treated a respondent as having an unmet need if this person had a disability in a particular ADL or IADL task but did not receive informal help with the task. Adding up the number of unmet needs, we created a variable to measure the severity of unmet needs. The value of the variable ranges from 0 to 10. The survey also asked respondents whether they received paid help from a professional carer. The number of formal care recipients in our sample is tiny, and the impact of paid helpers on the analysis results is trivial.

Respondents' depressive symptoms were measured by the 10-item Centre for Epidemiologic Studies Depression Scale (CES-D Scale) included in the CHARLS 2013 questionnaire. The Scale contains 10 statements about depressive symptoms. Respondents were asked to rate the

frequency of each symptom on a metric of four scales including 'less than one day', 'one to two days', 'three to four days', and 'five to seven days'. For the eight negative statements (e.g. my sleep was restless), we scored the scales from 0 to 3, respectively. For the two positive statements (e.g. I felt hopeful), the scoring was reversed. We added up the scores and created a depression indicator ranging from 0 (no depressive symptoms) to 30 (severe depressive symptoms). It has been reported that the 10-item CES-D Scale in the CHARLS questionnaire has good validity and reliability (Chen & Mui, 2014).

The CHARLS 2013 recorded the type of community in which each respondent was living. Based on this information, we created a binary variable, which indicates an older person's location of residence. The variable was coded as 0 if an older person lived in a rural village, and 1 if an older person lived in an urban community. Among the 1,324 older people in our sample, 1,063 of them lived in 276 rural villages, and the rest (261 older people) lived in 110 urban communities.

Control variables

To test the two hypotheses in this study, the effects of the confounding factors needed to be controlled for, so that we could ascertain, all other things being equal, whether the variables of interest still have a significant impact. Based on the theoretical framework in the previous section and subject to information availability, we included three groups of control variables in the analysis: demographic factors, socioeconomic factors, and health conditions.

Demographic and socioeconomic factors affect the propensity to receive informal care (Andersen & Newman, 2005) and the way people appraise a stressful event (Aldwin, 2007). We investigated four demographic factors including age, gender, marital status and living arrangements. We investigated six socioeconomic factors including level of education,

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household income, housing tenure, receipt of financial transfer from adult children, receipt of pension insurance, and receipt of medical insurance.

Health conditions indicate older people's need to receive informal care (Andersen & Newman, 2005). They also affect depressive symptoms through the activity restriction effect (Williamson & Christie, 2009). Five health variables were examined: severity of disability, feeling pain, number of chronic conditions, receipt of outpatient care in the preceding month, and receipt of inpatient care in the preceding year. The disability variable has four categories: IADL disability only, one ADL disability, two ADL disabilities, and three or more ADL disabilities. A higher number of ADL disabilities indicates more severe disability. We examined 12 chronic diseases included in the survey: hypertension, dyslipidemia, diabetes, cancer, lung disease, liver disease, stroke, kidney disease, heart attack, stomach disease, arthritis, and asthma.

Regression analysis

We conducted regression analyses to test the two hypotheses. For the first hypothesis, the dependent variable is the number of unmet needs and the independent variable of interest is the rural-urban residence. Since the dependent variable is a count variable and heavily right-skewed, we built a two-part model, which is a generalisation of the Tobit model and provides greater modelling flexibility (Cameron & Trivedi, 2005). The first part is a probit regression model, which accounts for a large proportion of older people without unmet needs. The second part is a generalised Poisson regression model, which accounts for the unequal dispersion of the non-zero part of the dependent variable (Harris et al., 2012; Hilbe, 2014, Chapter 8). A two-part model also enabled us to distinguish between the prevalence rate and the level of unmet needs.

For the second hypothesis, the dependent variable is severity of depressive symptoms, and the independent variable of interest is the number of unmet needs. We stratified the sample by rural-urban residence so that we could examine the impacts of unmet needs on depressive symptoms for the two groups of older people separately. We built two-level regression models to account for community-level unobserved heterogeneity. Failing to capture the impacts of community-level heterogeneity would lead to biased coefficients (Wooldridge, 2010, pp. 281-285) or biased standard errors (Rabe-Hesketh & Skrondal, 2012, pp. 167-168). We tested both a two-level fixed-effects model and a two-level random-effects model. We used multiple imputation to impute the missing values in the dataset (Rubin, 2004). The regression results based on the imputed dataset do not differ systematically from those without imputation.

Results

Sample characteristics

Table 1 shows the sample characteristic of disabled older people living in rural (n=1063) and urban areas (n=261) in the CHARLS 2013. We report weighted results, which account for non-response in the survey (Zhao et al., 2013). The prevalence rates of unmet needs are 34.2% and 35.3% among disabled older people in rural and urban Chin, respectively. Conditional on the presence of unmet needs, rural older people have on average 1.3 unmet needs, whereas urban older people have 1.2 unmet needs. The average depressive symptom scores among older people living in rural villages and urban communities are 11.5 and 9.3, respectively.

Table 1 Characteristics of disabled older people in rural and urban China

	Entire sample	Rural villages	Urban communities	Univariate analysis[1]
	Weighted means or proportions			
Dependent variables				
Depressive symptoms score	10.9	11.5	9.3	z = 5.32***
Prevalence rates of unmet needs	34.4%	34.2%	35.3%	$\chi^2(1) = 0.11$
Number of unmet needs[2]	1.27	1.32	1.19	z = 2.54**
Demographic factors				
Age (years old)	70.6	69.9	72.4	z = -3.36***
Gender				$\chi^2(1) = 0.12$
Male	42.7%	42.7%	42.6%	
Female	57.3%	57.3%	57.4%	
Marital status				$\chi^2(1) = 0.58$
Single older people[3]	27.8%	26.9%	30.3%	
Married couples	72.2%	73.1%	69.7%	
Living arrangements				$\chi^2(1) = 4.50*$
Living alone	8.1%	7.3%	10.4%	
Living with others	91.9%	92.7%	89.6%	
Socioeconomic factors				
Education				$\chi^2(1) = 91.27***$
No formal education	66.0%	74.4%	42.5%	
With formal education	34.0%	25.6%	57.5%	
Household income (1000 Yuan per year)	21.5	15.9	37.3	z = -14.01***
Housing tenure				$\chi^2(1) = 2.21$
Owner	83.9%	85.7%	79.0%	
Renter	16.1%	14.3%	21.0%	
Financial transfer from children				$\chi^2(1) = 8.90**$
No	81.5%	79.7%	86.7%	
Yes	18.5%	20.3%	13.3%	
Receipt of pension insurance				$\chi^2(1) = 1.38$
No	11.0%	10.1%	13.5%	
Yes	89.0%	89.9%	86.5%	
Receipt of medical insurance				$\chi^2(1) = 3.19$
No	4.1%	3.6%	5.5%	
Yes	95.9%	96.4%	94.5%	
Health conditions				
Disability				$\chi^2(3) = 14.17**$
IADL disability only	62.7%	66.1%	53.5%	
One ADL disability	24.9%	21.5%	34.3%	
Two ADL disabilities	5.8%	5.7%	5.9%	
Three or more ADL disabilities	6.6%	6.7%	6.3%	
Feel of pain				$\chi^2(2) = 21.41***$
None	46.0%	42.5%	55.7%	
Mild pain	33.1%	33.4%	32.5%	
Severe pain	20.9%	24.1%	11.8%	
Number of chronic disease	1.9	1.8	2.3	z = -3.65***
Receipt of outpatient care				$\chi^2(1) = 0.05$
No	69.2%	69.6%	68.3%	
Yes	30.7%	30.4%	31.7%	
Receipt of inpatient care				$\chi^2(1) = 4.38*$
No	74.2%	76.4%	68.0%	
Yes	25.8%	23.6%	32.0%	
Sample size	1,324	1,063	261	

Notes

1. The univariate analyses compare the characteristics of rural and urban older population. For continuous variables, the Wilcoxon rank-sum (Mann-Whitney) tests were conducted. For categorical variables, the Pearson's chi-squared tests were conducted. *p < 0.05, **p < 0.01, and ***p < 0.001

2. This only relates to older people with unmet needs.

3. Single older people include those who have never been married or who are widowed, separated or divorced.

The average age of the disabled older people in rural and urban areas in the sample is 69.9 and 72.4 years old, respectively. The proportion of disabled older people who are single or live alone is higher in urban communities than in rural villages. Both the proportion of disabled older people with formal education and the average household income are twice as high in urban than in rural China.

Disabled older people in rural areas have a higher prevalence rate of IADL disability only, whereas disabled older people in urban areas have a higher prevalence rate of one ADL disability. The two groups have similar prevalence rates of two or more ADL disabilities. Compared with disabled urban older people, disabled rural older people have a higher prevalence rate of severe pain and a lower number of chronic diseases. The percentage of people receiving healthcare is slightly lower in rural areas than in urban areas.

Rural-urban residence and unmet needs

Table 2 shows the determinants of unmet needs on the basis of a two-part regression model. The first part is a probit regression model. The dependent variable is the dichotomised unmet need variable (i.e. with unmet needs vs without unmet needs). Holding other variables constant, disabled older people living in rural villages are more likely than those in urban communities to have unmet needs, but the difference does not have statistical significance. Marital status, living arrangements, and disability status are statistically significant variables. Disabled older people who are married or living with others in the same household are less likely than those who are single or live alone to have unmet needs. Older people with ADL disabilities are more likely than those with IADL disabilities only to have unmet needs. Both the Pearson and the Hosmer-Lemeshow goodness-of-fit tests show that the first part model has a good fit.

Table 2 Determinants of unmet long-term care needs (A two-part regression model)

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	First part Probit model	Second part Generalised Poisson Model
Independent variables[1]	Coefficient[4] (Robust standard error)	
Demographic factors		
Rural-urban residence		
Urban communities (reference)	0	0
Rural villages	0.004 (0.09)	0.31*** (0.07)
Marital status		
Single older people (reference)	0	0
Married older people	-0.32*** (0.10)	-0.01 (0.07)
Living arrangements		
Living alone (reference)	0	0
Living with others	-0.37* (0.15)	0.003 (0.09)
Socioeconomic factors		
Receipt of medical insurance		
No	0	0
Yes	0.27 (0.20)	-0.39* (0.16)
Health conditions		
Disability		
IADL disabilities only (reference)	0	0
One ADL disability	0.59*** (0.09)	0.33*** (0.06)
Two ADL disabilities	0.62*** (0.15)	0.58*** (0.09)
Three or more ADL disabilities	-0.15 (0.16)	1.29*** (0.12)
Joint significance test	p<0.001	p<0.001
Pseudo R-squared statistic	0.06	0.19
Pearson goodness-of-fit test[2]	p=0.49	
Hosmer-Lemeshow goodness-of-fit test	p=0.88	
Dispersion test[3]		δ =-0.47, p<0.001
Sample size	1,324	454

Notes:

1. Age, gender, household income, education, housing tenure, financial transfer, receipt of pension insurance, receipt of healthcare, feeling pain, and chronic conditions are not statistically significant in any of the models.
2. For the Pearson or the Hosmer-Lemeshow goodness-of-fit test, a large p-value (p>0.05) indicates that the model is well fitted.
3. A negative dispersion parameter (i.e. δ<0) indicates that the count data is under-dispersed. A small p-value of the dispersion test (p<0.05) indicates the dispersion parameter is significantly different from zero.
4. *p < 0.05, **p < 0.01, and ***p < 0.001

The second part is a conditional model. The dependent variable is the non-zero part of the unmet need variable. Rural-urban residence and disability status are statistically significant variables. Conditional on having unmet needs, older people living in rural villages have a significantly higher number of unmet needs than those living in urban communities. Older people with ADL disabilities have more unmet needs than those with IADL disabilities only.

Furthermore, older people with a higher number of ADL disabilities have more unmet needs. Unlike in the first part of the model, marital status and living arrangements are not statistically significant in the conditional model. The dispersion test shows that the dependent variable is under-dispersed, which means that the generalised Poisson model is the appropriate model.

Unmet needs and depressive symptoms

Table 3 shows the impacts of unmet long-term care needs on depressive symptoms among older people living in rural villages. We fitted a pooled OLS model, a fixed effects model and a random effects model to identify the model with the best fit. The unmet needs variable has a statistically significant impact in all three of the models. Rural older people with a higher number of unmet needs have more severe depressive symptoms. Both the F-test of fixed effects and the likelihood ratio test of random effects reported small p-values. This means that the overall levels of depression in different villages are highly heterogeneous, and thus the pooled OLS model is not an appropriate model. The Hausman test reported a large p-value, which means that the fixed effects model and the random effects model do not generate systemically different coefficients, and thus both models are appropriate. We investigated the possibility of reverse causality from depression to unmet needs by testing the endogeneity of the unmet needs variable. Various endogeneity tests consistently showed that the unmet needs variable is not endogenous (table 3). There seems to be a strong case to rule out the possibility of reverse causality.

Females have more severe depressive symptoms. Marital status and living arrangements do not have a significant impact on depression. Most of the health conditions variables have a significant impact. Disabled older people with more severe disability, more severe pain or more chronic disease have more severe depressive symptoms. None of the socioeconomic factors has a significant impact on depressive symptoms.

Table 3 The impact of unmet needs on depressive symptoms in rural villages

Independent variables[1]	Pooled OLS model	Fixed effects model	Random effects model
	Coefficient[5] (Robust standard error)		
Number of unmet needs	0.66* (0.26)	0.68* (0.31)	0.61* (0.26)
Demographic factors			
Age	-0.08** (0.03)	-0.05 (0.04)	-0.07* (0.03)
Gender			
Male (ref.)	0	0	0
Female	1.45*** (0.38)	1.86*** (0.42)	1.53*** (0.36)
Health conditions			
Disability			
IADL disabilities only (ref.)	0	0	0
One ADL disability	0.60 (0.49)	1.01 (0.57)	0.71 (0.5)
Two or more ADL disabilities	2.15*** (0.62)	2.01** (0.74)	2.16*** (0.61)
Feel of pain			
None (ref.)	0	0	0
Mild pain	2.25*** (0.44)	2.31*** (0.49)	2.26*** (0.44)
Severe pain	5.10*** (0.52)	4.64*** (0.6)	4.98*** (0.53)
Number of chronic disease	0.51*** (0.13)	0.56*** (0.14)	0.51*** (0.12)
Receipt of outpatient care			
No (ref.)	0	0	0
Yes	1.08** (0.42)	1.08 (0.58)	1.04* (0.46)
Joint significance test	p<0.001	p<0.001	p<0.001
R-squared statistic	0.19	0.19	0.19
F-test of fixed effects[2]		p<0.001	
LR test of random effects[2]			p<0.001
Hausman test[3]		p=0.48	
Endogeneity tests[4]			
Durbin test	p=0.334		
Wu-Hausman test	p=0.336		
Wooldridge's score test	p=0.358		
Robust regression test	p=0.356	p=0.263	p=0.306
Sample size	1,063		

Notes:
1. Marital status, living arrangements, education, household income, housing tenure, financial transfer, receipt pension and medical insurance, and receipt of inpatient care are not statistically significant in any of the models.
2. A small p-value of the F-test (p<0.05) indicates a significant impact of the fixed effects. A small p-value of the LR test indicates a significant impact of the random effects.
3. A large p-value of the Hausman test (p>0.05) indicates that the coefficients in a random effects model do not differ systematically from those in a fixed effects model.
4. The tests focus on the endogeneity of the unmet need variable. The two-stage least-squares method is used. The instrumental variables are marital status and living arrangements. The overidentification test shows that they are valid instrumental variables (p=0.53). A large p-value of the endogeneity tests (p>0.05) indicates the unmet needs variable is not endogenous.
5. *p < 0.05, **p < 0.01, and ***p < 0.001

Table 4 shows the factors affecting depressive symptoms among disabled older people in urban communities. The unmet needs variable is not statistically significant in any of the models, which means that unmet long-term care needs do not affect depressive symptoms

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among disabled urban older people. Both the F-test and the likelihood ratio test reported large p-values. This suggests that older people's depressive symptoms are not heterogeneous across different urban communities, and that the fixed effects model and the random effects model impose unnecessary constraints in the model. Thus, the pooled OLS model is the most appropriate model. The endogeneity tests showed that the unmet needs variable is not endogenous.

Table 4 The impact of unmet needs on depressive symptoms in urban communities

Independent variables[1]	Pooled OLS model	Fixed effects model	Random effects model
	Coefficient[4] (Robust standard error)		
Number of unmet needs	0.59 (0.52)	0.64 (0.39)	0.60 (0.47)
Demographic factors			
Age	-0.13** (0.05)	-0.16** (0.06)	-0.13** (0.05)
Gender			
Male (ref.)	0	0	0
Female	2.02** (0.76)	2.45* (1.02)	2.05* (0.81)
Socioeconomic factors			
Household income	-0.03* (0.01)	-0.06*** (0.02)	-0.03** (0.01)
Health conditions			
Feel of pain			
None (ref.)	0	0	0
Mild pain	1.54 (0.85)	0.73 (1.15)	1.40 (0.92)
Severe pain	2.83* (1.35)	3.81** (1.34)	2.84* (1.19)
Joint significance test	p<0.001	p<0.001	p<0.001
R-squared statistic	0.14	0.13	0.14
F-test of fixed effects[2]		p=0.09	
LR test of random effects[2]			p=0.18
Endogeneity tests[3]			
Durbin test	p=0.501		
Wu-Hausman test	p=0.508		
Wooldridge's score test	p=0.540		
Robust regression test	p=0.552	p=0.329	p=0.437
Sample size	261		

Notes:
1. Marital status, living arrangements, education, housing tenure, financial transfer, receipt of pension and medical insurance, disability, and receipt of healthcare are not statistically significant in any of the models.
2. A large p-value of the F-test (p>0.05) indicates an insignificant impact of the fixed effects. A large p-value of the LR test indicates an insignificant impact of the random effects.
3. The tests focus on the endogeneity of the unmet need variable. The two-stage least-squares method is used. The instrumental variables are marital status, living arrangements and disability. The overidentification test shows that they are valid instrumental variables (p=0.24). A large p-value of the endogeneity tests (p>0.05) indicates the unmet needs variable is not endogenous.
4. *p < 0.05, **p < 0.01, and ***p < 0.001

Like rural older people, urban older people with a younger age and females have more depressive symptoms. Marital status and living arrangements do not have a significant impact. Unlike rural older people, the depressive symptoms of urban older people are affected by their socioeconomic status. Those with a lower household income have more severe depressive symptoms. Most of the health conditions variables do not have a significant impact on depressive symptoms. The only exception is feeling pain. Urban older people who feel severe pain have more severe depressive symptoms than those who do not feel pain.

We pooled rural and urban older people together in one regression model and added an interaction term to further compare the impact of unmet needs between rural villages and urban communities. The coefficient of the interaction term between rural-urban residence and unmet needs is positive and statistically significant (table 5). This result further confirms that the impact of unmet needs on depressive symptoms is significantly larger among rural older people than among urban older people.

Discussion and conclusion

This paper used a nationally representative sample to investigate the relationships between unmet long-term care needs and depressive symptoms among older people in China. Before we dive into the discussion of the research findings, it is important to note that the study has two limitations. First, we have used all of the information and techniques available to reduce the endogeneity bias in our models. We did not detect strong evidence of endogeneity in our analyses results, but this possibility might not be entirely precluded with a cross-sectional dataset. Analyses based on longitudinal information in the future will help us further understand this issue. Second, confined by the sample size, we were not able to examine the number of unmet needs for ADLs or IADLs separately. Fortunately, this problem is alleviated by the fact that in our sample people with a lower number of unmet needs mostly have unmet

needs for IADLs and people with a higher number of unmet needs have unmet needs for both

ADLs and IADLs. In this sense, the number of unmet needs variable can be treated as a good

indicator of the severity of unmet needs.

Table 5 The impact of unmet needs on depressive symptoms with interaction effects

Independent variables[1]	Pooled OLS model	Fixed effects model	Random effects model
	Coefficient[4] (Robust standard error)		
Rural-urban residence			
Urban communities (ref)	0	n.a.	0
Rural villages	1.47*** (0.45)	n.a.	1.50** (0.49)
Number of unmet needs	0.02 (0.01)	0.03 (0.02)	0.02 (0.02)
Unmet needs × rural villages	0.65* (0.26)	0.60 (0.30)	0.59* (0.26)
Demographic factors			
Age	-0.09*** (0.02)	-0.07* (0.03)	-0.08*** (0.03)
Gender			
Male (ref.)	0	0	0
Female	1.59*** (0.34)	2.03*** (0.38)	1.65*** (0.32)
Health conditions			
Disability			
IADL disabilities only (ref.)	0	0	0
One ADL disability	0.25 (0.43)	0.95 (0.51)	0.39 (0.44)
Two or more ADL disabilities	1.85*** (0.56)	1.84** (0.62)	1.87*** (0.56)
Feel of pain			
None (ref.)	0	0	0
Mild pain	2.08*** (0.39)	2.10*** (0.46)	2.07*** (0.40)
Severe pain	4.87*** (0.48)	4.41*** (0.55)	4.75*** (0.49)
Number of chronic disease	0.39*** (0.11)	0.45*** (0.12)	0.40*** (0.11)
Receipt of outpatient care			
No (ref.)	0	0	0
Yes	1.01** (0.38)	1.01* (0.45)	0.97* (0.41)
Joint significance test	p<0.001	p<0.001	p<0.001
R-squared statistic	0.19	0.17	0.19
F-test of fixed effects[2]		p<0.001	
LR test of random effects[2]			p<0.001
Hausman test[3]		p=0.16	
Sample size	1,324		

Notes:

1. Marital status, living arrangements, education, household income, housing tenure, financial transfer, and receipt of inpatient care are not statistically significant in any of the models.
2. A small p-value of the F-test (p<0.05) indicates a significant impact of the fixed effects. A small p-value of the LR test indicates a significant impact of the random effects.
3. A large p-value of the Hausman test (p>0.05) indicates that the coefficients in a random effects model do not differ systematically from those in a fixed effects model.
4. *p < 0.05, **p < 0.01, and ***p < 0.001

Our analysis results have confirmed the two hypotheses of this study. First, we have found that older people living in rural villages have a higher level of unmet needs. The results remain statistically significant after we control for people's demographic characteristics, health conditions and socioeconomic status. These results seem consistent with those reported by Lu et al. (2015) and Zhu (2015). An important reason for such a rural-urban difference is that rural older people have a weakened informal care network or receive less informal care due to the out-migration of their adult children to the cities, which has been well-documented in the literature (Guo et al., 2009; Liu, 2014). Meanwhile, we also found that there is no statistically significant difference between rural and urban China in terms of the prevalence rate of unmet needs once the control variables are accounted for. A plausible explanation is that other family members will step up if adult children migrate to the cities and cannot provide informal care in rural China (Liu, 2014).

Second, this study has found that a higher level of unmet needs leads to more severe depressive symptoms. Such a result is consistent with Choi and McDougall's (2009) findings in the US. The contribution of our study is that unmet care needs have a significantly bigger impact on depressive symptoms among older people in rural areas than in urban areas. These results have confirmed our hypothesis that rural older people attach more importance to informal care than urban older people, and therefore are more detrimentally affected by the absence of informal care when they need it.

Putting these two strands of the findings together, we argue that, in the Chinese context, older people living in rural communities face a double disadvantage. A higher level of unmet needs further causes a decline in their mental health. It shows that different aspects of rural-urban inequality are inter-linked and cumulative: inequality in one aspect reinforces another. Informal care plays a central role in rural older people's life: it not only has the function of

meeting physical needs, but also is a manifestation of family bond and psychological attachment. Therefore, the absence of informal care causes a double 'deficit'. This is not to say that the psychological function of informal care is non-existent in urban China, but it is important to note that this function has been weakening due to increased individualisation in urban communities.

The findings in this study also contribute to the international literature on long-term care utilisation among community-dwelling older people. Studies conducted in developed countries have shown that Anderson & Newman's (2005) care utilisation framework is useful to understand the determinants of long-term care receipt (Jacobs et al., 2016; Murphy et al., 2014; Suanet et al., 2012). This study has found that this framework is equally valid for unmet needs research in the Chinese context. Furthermore, the results underscore the importance of distinguishing between the presence and the level of unmet needs. Marital status and living arrangements, the two demographic factors, affect the probability of having unmet needs, but do not affect the level of unmet needs, conditional on the presence of unmet needs. Disability, which reflects people's need for care, affects both the likelihood and the level of unmet needs. There is a positive relationship between severity of disability and level of unmet needs. The implication is that people with more disabilities have higher care needs, and it is more difficult to fully meet their needs.

Rural-urban inequality in care utilisation is a global issue. It has been reported in a number of countries (e.g. the UK, Ireland, Canada and the US) that older people in rural communities have reduced access to health and formal social care (Goodridge et al., 2010; Manthorpe et al., 2008; McAuley et al., 2009; Ryan-Nicholls, 2004; Walsh & O'Shea, 2008). In particular, people in remote rural areas face barriers to care utilisation due to population dispersion, geographic isolation and transport inadequacy. The challenges facing Chinese rural

communities are different from those in developed countries. Community-based formal social care is not available in most part of the country, so the issue of limited access to formal care affects urban and rural older people alike (Zhou & Walker, 2016). Moreover, inequality of social care in rural China is mainly reflected in reduced access to family care, and this takes place in the context of the large-scale rural to urban migration.

Some factors affect rural and urban older people's depressive symptoms differently. First, most of the health factors have a significantly negative impact on depressive symptoms among rural older people, which confirms the life restriction theory (Williamson & Christie, 2009). In contrast, feeling pain is the only significant health factor affecting depressive symptoms among urban older people, which seems to suggest that the life restriction effect is weaker for this group of people. Second, while none of the socioeconomic factors affects depressive symptoms among rural older people, lower household income has a significantly adverse impact among urban older people. These results seem to suggest that rural older people are more mentally troubled by their health conditions, whereas urban older people are more mentally troubled by their economic conditions.

Given the double disadvantage of older people in rural communities, more support should be provided to this particular group of older people to address their risks of unmet needs and depression. The experience in the US and European countries suggests that there are two possible solutions. The first relates to the direct provision of formal social care by the Chinese government to rural older people. Professional carers could share the caring responsibilities with informal carers and help to fill the gap in people's care needs. Second, the Chinese government may want to strengthen the support for informal carers. For example, financial support can be made available to caregivers to compensate for the opportunity costs of caregiving. Or training courses can be offered to family members to improve their caring

skills. Due to the economic disparity, rural governments may lack the financial resources to implement these policies. Thus, equally important is that more financial resources are invested by the Chinese central government in rural than in urban areas.

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