Gender-specific associations between activities of daily living disability and depressive symptoms among older adults in China: Evidence from the China Health and Retirement Longitudinal Study

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ABSTRACT

Purpose: To evaluate the associations between BADL/IADL disability and depressive symptoms from the perspective of gender among older adults in China.
Methods: This cross-sectional study used the data from the second wave of the China Health and Retirement Longitudinal Study (CHARLS). The sample included 3463 older adults aged 60 years and older across China. Multivariable logistic regression models were conducted.
Results: Among 3463 older adults, 1240 (35.8%) were classified as depressed, the prevalence of BADL and IADL disabilities were 756 (21.8%) and 1194 (34.5%), respectively. After controlling for covariates, BADL/IADL disability was significantly associated with an increased risk of depression prevalence both in men and women among older adults. Compared with IADL independent, IADL disability was about two times more likely to develop depressive symptoms in men (OR = 2.165, 95% CI = 1.661–2.822), which was much higher than that in women (OR = 1.748, 95% CI = 1.415–2.160). In contrast, the odds of being depressed for women with BADL disability (OR = 1.824, 95% CI = 1.447–2.299) were much higher than the odds for men with BADL disability (OR = 1.791, 95% CI = 1.348–2.379).
Conclusions: Older adults with BADL/IADL disability were more likely to have depressive symptoms both for men and women. However, the associations between depressive symptoms and BADL/IADL disability were different in gender. Our results suggest that differential institutional care service and appropriate strategies for improvement in mental health are required.

Introduction

Aging populations present an unprecedented challenge all over the world (Lee & Mason, 2014). The latest data showed that the percentage of people aged 60 years and over has jumped from 13.26% in 2000 to 16.70% in 2016 with 230 million Chinese older adults nationwide (National Bureau of Statistics of China, 2017). Demographic changes have brought renewed focus on the health of older adults, both physically and mentally. The World Health Organization (WHO, 2017) reported that > 300 million people are living with depressive symptoms now, an increase of > 18% between 2005 and 2015. Depressive

symptoms increased the perception of poor health, the utilization of medical services and healthcare costs.

Depressive symptoms are projected to be the leading cause of disability in the world (Murray & Lopez, 1997; WHO, 2017), and contributes considerably burden to the current mental health system (Hsieh & Qin, 2017; Mrazek, Hornberger, Altar, & Degtiar, 2014). Evidence suggests that gender differences in depressive symptoms are genuine, with women reporting a higher number of depressive symptoms than men (Acciai & Hardy, 2017; Piccinelli & Wilkinson, 2000). In China, it is estimated that about 23.6% of older adults have suffered from depressive symptoms with higher prevalence in women than men (22.2%

Table 1
Sample characteristics (N = 3463).

Variables	Total (N = 3463)	Male (N = 1554)	Female (N = 1909)	P	No depressive symptoms (N = 2223)	Depressive symptoms (N = 1240)	P
Age				0.004			0.105
60–64	1375 (39.7)	574 (36.9)	801 (42.0)		860 (62.5)	515 (37.5)	
65–69	927 (26.8)	408 (26.3)	519 (27.2)		592 (63.9)	335 (36.1)	
70–74	603 (17.4)	290 (18.7)	313 (16.4)		389 (64.5)	214 (35.5)	
75–79	376 (10.9)	190 (12.2)	186 (9.7)		264 (70.2)	112 (29.8)	
80 and above	182 (5.3)	92 (5.9)	90 (4.7)		118 (64.8)	64 (35.2)	
Gender				–			< 0.001
Male	–	–	–		1107 (71.2)	447 (28.8)	
Female	–	–	–		1116 (58.5)	793 (41.5)	
Marital status				< 0.001			0.002
Married or cohabited	2826 (81.6)	1377 (88.6)	1449 (75.9)		1851 (65.5)	975 (34.5)	
Never married/divorce/separated	49 (1.4)	33 (2.1)	16 (0.8)		25 (51.0)	24 (49.0)	
Widowed	588 (17.0)	144 (9.3)	444 (23.3)		347 (59.0)	241 (41.0)	
Chronic conditions				0.023			< 0.001
0	1084 (31.3)	519 (33.4)	565 (29.6)		767 (70.8)	317 (29.2)	
1	1050 (30.3)	473 (30.4)	577 (30.2)		680 (64.8)	370 (35.2)	
2 and above	1329 (38.4)	562 (36.2)	767 (40.2)		776 (58.4)	553 (41.6)	
Household register				0.872			0.005
Village	315 (9.1)	140 (9.0)	175 (9.2)		225 (71.4)	90 (28.6)	
Rural	3148 (90.9)	1414 (91.0)	1737 (90.8)		1998 (63.5)	1150 (36.5)	
Working				< 0.001			0.003
Yes	1798 (51.9)	893 (57.5)	905 (47.4)		1112 (61.8)	686 (38.2)	
No	1665 (48.1)	661 (42.5)	1004 (52.6)		1111 (66.7)	554 (33.3)	
Formal volunteering				0.399			0.346
Yes	32 (0.9)	12 (0.8)	20 (1.0)		18 (56.2)	14 (43.8)	
No	3431 (99.1)	1542 (99.2)	1889 (99.0)		2205 (64.3)	1226 (35.7)	
Caregiving				0.192			0.955
Yes	48 (1.4)	26 (1.7)	22 (1.2)		31 (64.6)	17 (35.4)	
No	3415 (98.6)	1528 (98.3)	1887 (98.8)		2192 (64.2)	1223 (35.8)	
Informal helping				0.911			0.542
Yes	361 (10.4)	161 (10.4)	200 (10.5)		237 (65.7)	124 (34.3)	
No	3102 (89.6)	1393 (89.6)	1709 (89.5)		1986 (64.0)	1116 (36.0)	
Caring for grandchildren				0.499			0.709
Yes	1329 (38.4)	606 (39.0)	723 (37.9)		848 (63.8)	481 (36.2)	
No	2134 (61.6)	948 (61.0)	1186 (62.1)		1375 (64.4)	759 (35.6)	
Education				< 0.001			< 0.001
Illiterate	1156 (33.4)	248 (16.0)	908 (47.6)		664 (57.4)	492 (42.6)	
Elementary school	1590 (45.9)	858 (55.2)	732 (38.3)		1034 (65.0)	556 (35.0)	
Middle school	454 (13.1)	272 (17.5)	182 (9.5)		331 (72.9)	123 (27.1)	
High school and above	263 (7.6)	176 (11.3)	87 (4.6)		194 (73.8)	69 (26.2)	
Log PCE				0.273			0.005
< Median	1687 (48.7)	741 (47.7)	946 (49.6)		1043 (61.8)	644 (38.2)	
> Median	1776 (51.3)	813 (52.3)	963 (50.4)		1180 (66.4)	596 (33.6)	
Depressive symptoms				< 0.001			–
Yes	1240 (35.8)	447 (28.8)	793 (41.5)		–	–	
No	2223 (64.2)	1107 (71.2)	1116 (58.5)		–	–	
BADL				0.012			< 0.001
BADL disability[a]	756 (21.8)	309 (19.9)	447 (23.4)		368 (48.7)	388 (51.3)	
BADL independent[b]	2707 (78.2)	1245 (80.1)	1462 (76.6)		1855 (68.5)	852 (31.5)	
IADL				< 0.001			< 0.001
IADL disability[c]	1194 (34.5)	426 (27.4)	768 (40.2)		611 (51.2)	583 (48.8)	
IADL independent[d]	2269 (65.5)	1128 (72.6)	1141 (59.8)		1612 (71.0)	657 (29.0)	

Note: log PCE: log of household per capita expenditure; BADL: basic activities of daily living; IADL: instrumental activities of daily living.
P values were obtained from the chi-square test.
[a] BADL score ≥ 1.
[b] BADL score = 0.
[c] IADL score ≥ 1.
[d] IADL score = 0.

vs 15.7%) (Li, Zhang, Shao, Qi, & Tian, 2014). The traditional family structure in China is experiencing great changes in recent years. The elderly living alone are increasing due to the increased divorce rates, less childcare by grandparents, and the phenomenon of the "empty nest", which may lead to higher prevalence of depressive symptoms in elderly (Yu, Li, Cuijpers, Wu, & Wu, 2012). In addition, prior study has reported that China had a life expectancy at birth of 75.0 years in men and 77.9 years in women (World Health Statistics, 2018). Longer life expectancies in women may imply that their later life years would experience widowed, which may increase the risk of depressive symptoms

(Wang, Hu, Xiao, & Zhou, 2017). Therefore, preventing women from depressive symptoms may be even more critical in China.

Disability in relation to activities of daily living (ADL), which was measured using the basic activities of daily living (BADL) and the instrumental activities of daily living (IADL), has been shown to both break older adults' daily routines and prevent them from performing their own social roles, affecting their physical and mental health (Gobbens, 2018). The Comprehensive Geriatric Assessment Study in China found that disability rate in elderly was 7% and increased with age (Ma et al., 2017). In addition, studies also revealed a gender

Table 2
Depressive symptoms in BADL/IADL by gender (N = 3463).

Variables	Total	Depressive symptoms prevalence (%)		χ^2	P-value
		Male	Female		
BADL disability	756	43.7	56.6	12.189	< 0.001
BADL independent	2707	25.1	36.9	43.967	< 0.001
IADL disability	1194	43.2	52.0	8.417	0.004
IADL independent	2269	23.3	34.5	34.685	< 0.001

Note: BADL: basic activities of daily living; IADL: instrumental activities of daily living.

difference of disability among older people, indicating the higher prevalence of disability for women than men (Auais et al., 2019; Murtagh & Hubert, 2004).

Emerging research has investigated the associations between disability and depression. A review pointed out that there was a reciprocal relationship between depression and disability in older adults (Bruce, 2001). The study by Jiang et al. also found that ADL disability may increase the risk of depressive symptoms among older adults (Jiang, Tang, & Futatsuka, 2002). And Haynie et al. found that disabled people are more likely to have a higher depressive scores (Haynie, Berg, Johansson, Gatz, & Zarit, 2001). A recent systematic review indicated that people with disabilities were more disadvantaged in their social relationships which may be harmful to mental health (Tough, Siegrist, & Fekete, 2017). Although previous studies found that ADL disability was associated with depressive symptoms, and there were gender differences both in depressive symptoms and disability, little is known about whether the association between BADL/IADL disability and depressive symptoms differs in gender. Thus, this study aimed to evaluate the associations between BADL/IADL disability and depressive symptoms from the perspective of gender among older adults in China.

The study was designed to answer the following research questions: (1) What are the associations between characteristics of respondents and depressive symptoms in older adults; (2) whether the association between BADL/IADL disability and depressive symptoms differs in gender. It was hypothesized that older adults with BADL/IADL disability would be more likely to have depressive symptoms, and there would be gender difference.

Methods

Study design

This study was a cross-sectional study conducted using the data from the second wave of the China Health and Retirement Longitudinal Study (CHARLS). The second wave of the CHARLS was conducted between July 2013 and January 2014, and involved 18,605 respondents. CHARLS is a nationally representative survey conducted every two years of middle-aged and older adults and their spouses in China. Samples of households with members aged 45 and above were chosen through multistage probability sampling. A total of 450 villages and urban communities from 30 provinces were selected, which included a mix of urban and rural settings and a wide range of levels of economic development. The design and detailed descriptions of the CHARLS have been published previously (Zhao, Hu, Smith, Strauss, & Yang, 2014).

In this study, we selected respondents aged 60 years and above who had completed the self-administered questionnaire on depressive symptoms. Finally, 3463 respondents were included in the study.

Ethical issues

The CHARLS was approved by the ethics review committee of Peking University. And the CHARLS data can be accessible to

researchers through its official website (http://charls.pku.edu.cn), and we have acquired the right to use the data.

Measures in CHARLS

Depressive symptoms

The 10-item Center for Epidemiologic Studies Depression Scale (CES-D 10) short form was used to measure depressive symptoms. The time frame for the CES-D questions refers to the week prior to the interview. Each item is rated on a four-point scale with answers ranging from "rarely or none of the time (< 1 day)" to "most or all of the time (5–7 days)." The CES-D 10 has shown good validity and reliability in the Chinese population (Chen & Mui, 2014; Huang, Wang, & Chen, 2015).

The CES-D 10 questionnaire consists of eight negatively oriented items and two positively oriented items. Eight negatively oriented items were scored from zero for rarely or none of the time to three for most of the time, while the remaining two positively oriented items were scored in reverse. The 10 items were summed for a respondent which ranged from 0 to 30. Previous studies have suggested that the cut-off point for depressive symptoms among older adults is 10 for the 10-item CES-D scale (Andresen, Malmgren, Carter, & Patrick, 1994). A score of 10 and above was used as the measure of depressive symptoms in our study.

BADL/IADL disability

This study referred to the BADL scale and Lawton functional scale (Katz, Ford, Moskowitz, et al., 1963; Lawton & Brody, 1969). The abilities to eat, take a bath, dress, get in and out of bed, use the toilet, and defecate were used to measure the BADL; whereas the abilities to do housework, shop, cook, make phone calls, take medicine, and take care of finances were used to measure the IADL. Each answer was divided into 4 responses as follows: (1) No, I do not have any difficulty; (2) I have difficulty but still can do it; (3) Yes, I have difficulty and need help; and (4) I cannot do it. Each item in BADL/IADL was recorded as 0 if the respondent did not report any problems with the activity, or as 1 if the respondent reported any difficulty with the activity or could not do the activity. The total scores of BADL/IADL are calculated by summing scores of the six items. In our study, the BADL/IADL was classified as: (1) BADL or IADL independent (BADL/IADL score = 0); (2) BADL or IADL disability (BADL/IADL score ≥ 1).

Covariates

Our study included age, gender, marital status, and household register as individual attributes. The household register system has been the legal division of rural and urban populations since the establishment of the People's Republic of China (Chan, 2009). We used respondents' report of current household register status to classify them as rural (agricultural) or urban (non-agricultural) residents. More recently, some areas have abolished household register differentiation and included both agricultural and non-agricultural household register as unified residency household register. We would use their prior household register status in this study if respondents had unified residency household register.

Two variables of socioeconomic status (SES) were used: level of education and household income. We classified level of education as illiterate, elementary school, middle school, and high school and above. For household income, income has much measurement error and relatively larger fluctuation ranges over the life-cycle, whereas expenditure tends to be measured with less error (Lee & Smith, 2009), so we used log of household per capita expenditure (log PCE) for the household resources. Because income impacts may be highly nonlinear, even while PCE was in logs, we used a linear spline around the median log PCE (Lei, Sun, Strauss, Zhang, & Zhao, 2014).

Chronic conditions and productive activities were also taken into consideration in our study. Chronic conditions were measured as the total number of diseases, from a list of 14 diseases, that respondents had

Table 3
Multivariable analysis of the associations between BADL/IADL and depressive symptoms by gender.

Variables	Male			Female		
	Model 1[a]	Model 2[b]	Model 3[c]	Model 4[a]	Model 5[b]	Model 6[c]
BADL disability	1.789 (1.358–2.357)***	1.741 (1.313–2.308)***	1.791 (1.348–2.379)***	1.850 (1.477–2.318)***	1.816 (1.442–2.288)***	1.824 (1.447–2.299)***
IADL disability	2.123 (1.654–2.725)***	2.114 (1.625–2.751)***	2.165 (1.661–2.822)***	1.762 (1.448–2.143)***	1.731 (1.402–2.137)***	1.748 (1.415–2.160)***
Age						
60–64		Ref	Ref		Ref	Ref
65–69		1.112 (0.833–1.484)	1.141 (0.853–1.526)		0.805 (0.636–1.018)	0.807 (0.637–1.024)
70–74		0.864 (0.621–1.201)	0.926 (0.660–1.298)		0.762 (0.574–1.010)	0.803 (0.599–1.077)
75–79		0.673 (0.452–1.001)*	0.770 (0.508–1.167)		0.502 (0.349–0.721)***	0.537 (0.368–0.784)***
80 and above		0.818 (0.489–1.367)	0.971 (0.564–1.671)		0.575 (0.356–0.931)*	0.629 (0.381–1.037)
Marital status						
Married or cohabited		Ref	Ref		Ref	Ref
Never married/divorce/ separated		1.941 (0.943–3.993)	1.980 (0.951–4.123)		1.401 (0.490–4.004)	1.388 (0.482–3.995)
Widowed		1.474 (0.998–2.177)	1.541 (1.041–2.282)*		1.507 (0.833–1.342)	1.080 (0.850–1.373)
Household register						
Village		Ref	Ref		Ref	Ref
Rural		1.093 (0.700–1.707)	1.012 (0.642–1.595)		1.046 (0.722–1.516)	0.991 (0.679–1.448)
Education						
Illiterate		Ref	Ref		Ref	Ref
Elementary school		1.295 (0.928–1.807)	1.313 (0.940–1.835)		0.793 (0.640–0.982)*	0.806 (0.650–0.999)
Middle school		1.128 (0.739–1.722)	1.172 (0.766–1.793)		0.554 (0.380–0.808)**	0.586 (0.400–0.858)**
High school and above		1.346 (0.833–2.176)	1.393 (0.858–2.261)		0.554 (0.325–0.946)*	0.593 (0.346–1.018)
Log PCE						
< Median		Ref	Ref		Ref	Ref
> Median		0.639 (0.503–0.812)***	0.675 (0.529–0.862)**		1.120 (0.919–1.365)	1.147 (0.939–1.401)
Chronic conditions						
0		Ref	Ref		Ref	Ref
1		1.142 (0.851–1.533)	1.161 (0.864–1.561)		1.281 (0.998–1.643)	1.273 (0.991–1.634)
2 and above		1.454 (1.099–1.923)**	1.510 (1.138–2.003)**		1.763 (1.393–2.232)***	1.772 (1.399–2.245)***
Working						
Yes			1.302 (1.000–1.696)*			1.281 (1.039–1.579)*
No			Ref			Ref
Formal volunteering						
Yes			2.851 (0.865–9.399)			1.345 (0.502–3.602)
No			Ref			Ref
Caregiving						
Yes			1.350 (0.572–3.187)			0.738 (0.287–1.892)
No			Ref			Ref
Informal helping						
Yes			0.814 (0.548–1.209)			0.973 (0.706–1.341)
No			Ref			Ref
Caring for grandchildren						
Yes			1.177 (0.920–1.505)			0.967 (0.787–1.187)
No			Ref			Ref

Note: BADL: basic activities of daily living; IADL: instrumental activities of daily living; log PCE: log of household per capita expenditure; CI: confidence interval; OR: odds ratio; Ref: reference.
* P < 0.05.
** P < 0.01.
*** P < 0.001.
[a] Model 1 and Model 4 adjusted for BADL and IADL.
[b] Model 2 and Model 5 adjusted for BADL, IADL, age, marital status, household register, education, log PCE and chronic conditions.
[c] Model 3 and Model 6 adjusted for BADL, IADL, age, marital status, household register, education, log PCE, chronic conditions, and productive activities.

been diagnosed with the number of chronic diseases was coded as 0, 1, 2 and above. Five types of productive activity were distinguished in this study: working, formal volunteering, caregiving, informal helping, and caring for grandchildren (Choi, Stewart, & Dewey, 2013; Liu & Lou, 2016).

Statistical analysis

The analyses were performed using the statistical package SPSS 20.0 (IBM Corp., Armonk, NY). First, the distribution of dependent and independent variables by gender was assessed by chi-square tests. Then,

we analyzed gender disparities in the prevalence of depressive symptoms. Finally, logistic regression models were used to examine the gender-specific associations between BADL/IADL disability and depressive symptoms among older adults. The dependent variables in models for depressive symptoms were as follows: 1 = Yes, 0 = No. Covariates were entered into logistic regression models in the following stages: the independent variables of BADL and IADL were entered (Model 1 and Model 4); adjusted for individual attributes, SES and chronic conditions (Model 2 and Model 5); adjusted for individual attributes, SES, chronic conditions, and productive activity (Model 3 and Model 6). The level of significance was set at 0.05.

Results

Sample characteristics

The characteristics of the sample by gender

The sample consisted of 3463 older adults, of whom 1909 (55.1%) were women. More than three quarters of the respondents were married or cohabited both in men (88.6%) and women (75.9%). Four-fifths (79.3%) of the respondents were illiterate or had elementary school. There were 893 (57.5%) men and 905 (47.4%) women still working. The prevalence of BADL disability and IADL disability among older adults were 756 (21.8%) and 1194 (34.5%), respectively. Moreover, women had a higher prevalence than men both in BADL disability (23.4%) and IADL disability (40.2%). About 36% of the respondents were classified as depressed, with higher prevalence in women than men. No significant differences were found in household register, formal volunteering, caregiving, informal helping, caring for grandchildren, or log PCE among gender disparities (Table 1).

The characteristics of the sample by depressive symptoms

The associations between characteristics of respondents and depressive symptoms were shown in Table 1. The prevalence of depressive symptoms was declined gradually with the increase of age, except for the age group of 80 years and above (35.2%). The more chronic diseases of the respondents had the higher prevalence of depressive symptoms occurred, which were 29.2%, 35.2%, and 41.6% with 0, 1, and 2 and more chronic diseases, respectively. Over 36.5% of the respondents with depressive symptoms were in rural, while 28.6% were in village. There were 388 (51.3%) and 583 (48.8%) of the respondents with BADL and IADL disabilities being depressed, respectively. Moreover, the respondents with BADL/IADL disability were more likely to have depressive symptoms. On a bivariate level, depressive symptoms were significantly associated with gender, marital status, chronic conditions, household register, working, educational levels, log PCE, and BADL/IADL.

Associations between BADL/IADL and depressive symptoms by gender

Table 2 showed the prevalence of depressive symptoms in older adults with BADL/IADL disability by gender. The prevalence of depressive symptoms was 43.7% in elderly men with BADL disability, and 56.6% in elderly women with BADL disability. The prevalence of depressive symptoms was 43.2% in elderly men with IADL disability, and 52.0% in elderly women with IADL disability. Significant associations were shown between BADL/IADL disability and depressive symptoms in the whole sample. Older adults with BADL/IADL disability had a higher likelihood of developing depressive symptoms than those with BADL/IADL independence for both gender.

Multivariate logistic regression models

As shown in Table 3, the results of logistic regression analyses for depressive symptoms in relation to BADL/IADL, showed that both BADL disability and IADL disability were significantly associated with an increased risk of depression prevalence both in men and women. When all confounding variables were adjusted, we found that BADL disability was significantly associated with an increased risk of depression prevalence among men (OR = 1.791, 95% CI = 1.348–2.379) and women (OR = 1.824, 95% CI = 1.447–2.299). In contrast, the odds of being depressed for men with IADL disability were approximately 42% higher than the odds for women with IADL disability (OR = 1.748, 95% CI = 1.415–2.160).

Table 3 also showed that the likelihood of depressive symptoms increased with the number of chronic diseases in both men and women. The respondents who were still working were more likely to suffer from depressive symptoms. Compared with the reference group of married or

cohabited, elderly men who were widowed had a higher likelihood of developing depressive symptoms (OR = 1.541, 95% CI = 1.041–2.282). The depressive symptoms decreased with the log PCE (OR = 0.675, 95% CI = 0.529–0.862). However, marital status and log PCE did not showed significant associations with depressive symptoms in elderly women. The age group of 75–79 years were less likely to be depressed compared with the age group of 60–64 years among women (OR = 0.537, 95% CI = 0.368–0.784). In addition, the odds of being depressed in women with middle school education were lower than those with illiterate (OR = 0.586, 95% CI = 0.400–0.858).

While adjusting productive activities, the odds ratios increased between BADL/IADL disability and depressive symptoms both in men and women. Moreover, working was the only factor significantly associated with depressive symptoms, and was considered a risk factor of depressive symptoms both in men (OR = 1.302, 95% CI = 1.000–1.696) and women (OR = 1.281, 95% CI = 1.039–1.579). Informal helping was discovered as a protective factor of depressive symptoms among productive activities in men, while caregiving, informal helping and caring for grandchildren were considered protective factors in women.

Discussion

Using the large-scale nationally representative survey data from CHARLS, the present study revealed the associations between BADL/IADL disability and depressive symptoms by gender among older adults in China. We found that after adjusting for individual attributes, SES, chronic diseases, and productive activities, older adults with BADL/IADL disability were more likely to be depressed than those with BADL/IADL independent both in men and women. IADL disability is related to much higher risk of developing depressive symptoms in elderly men than women. In contrast, BADL disability is related to higher risk of developing depressive symptoms in elderly women than in men.

Our results verified that there were, indeed, an association between disability and depressive symptoms. Many previous studies have indicated that disability was a risk factor for depression (Barry, Soulos, Murphy, Kasl, & Gill, 2013; Haynie et al., 2001; Rashid & Tahir, 2015; Zhao et al., 2018). Kim et al. and Wada et al. found that older adults with ADL disability were more likely to develop depression, which had a negative impact on the quality of life of elderly (Kim & Choi, 2015; Wada, Ishine, Sakagami, et al., 2005). The results of the national survey from England demonstrated that BADL/IADL disability was associated with an increased risk of depression, even after controlling physical ill health (Meltzer et al., 2012). In China, a longitudinal study suggested that ADL disability significantly increased the risk for subsequent depressive symptoms among older adults in a community of Beijing (Jiang et al., 2002).

In addition, several previous studies have claimed that women had a higher prevalence of depressive symptoms than men (Rashid & Tahir, 2015; Wada et al., 2005). And there were gender differences in disability, with more likelihood to have moderate and severe disability in women than men (Gill, Gahbauer, Lin, Han, & Allore, 2013). The findings of this study were consistent with prior researches. However, few studies have analyzed the associations between BADL/IADL disability and depressive symptoms from the perspective of gender in older adults, especially for China. Prior studies showed that females, older individuals, people living in villages, and people living in middle and western China were more likely to suffer from BADL/IADL disability (Liang, Song, Du, Guralnik, & Qiu, 2015; Ma et al., 2017). Since ADL is associated with the depressive symptoms, as well as the quality of life (Haghgoo, Pazuki, Hosseini, & Rassafiani, 2013; Qian & Ren, 2016), health-care professionals should pay more attention to improve the physical function and mental health among older adults, especially in women.

There were significant differences in the associations of BADL/IADL disability and depressive symptoms in older adults by gender in our study. We found that BADL/IADL disability might contribute to

depression in different level for men and women. Elderly women had a higher risk of BADL disability than elderly men, while elderly men had higher risk of IADL disability than elderly women. Previous studies revealed that women were more likely to be affected by disabilities in all age groups (Camargos, Machado, & Roberto, 2007; Newman & Brach, 2001). Our findings could be partly explained by a higher prevalence of nonfatal disabling conditions in women, including fractures, osteoporosis, back problems, and osteoarthritis, which contribute to greater BADL disability (Murtagh & Hubert, 2004). Our findings suggested that BADL/IADL disability might contribute to depression in different level for men and women. Therefore, we should pay more attention to the IADL disability in men, improve their abilities of doing housework, shopping and cooking. Further studies are warranted to investigate the mechanisms of the associations between the BADL/IADL disability and depressive symptoms to confirm the gender specificity.

Moreover, the associations between BADL/IADL disability and depressive symptoms were strengthened after adjusting for productive activities; only working was significantly associated with depressive symptoms as a risk factor both in men and women after controlling all other confounding variables. However, Choi et al. showed that paid work was associated with lower prevalence of depressive symptoms, and this effect was not preserved on older adults after adjusting for education and economic status (Choi et al., 2013). Liu and Lou found the evidence of gender disparities in older adults who were working or engaging caregiving activities, reporting more male older adults who were still working or caring for grandchildren than female (Liu & Lou, 2016). Butterworth et al. found that men of retirement age who were not working for pay had higher prevalence of depressive symptoms than paid workers (Butterworth, Gill, Rodgers, et al., 2006). When working becomes obligatory, particularly in late life that many peers are retiring, it may not be as positive an experience as in early life (McDonnall, 2011). Although working could promote the physical condition of older adults to some degree, it also may cause more frustration, dysphoria, feelings of depression or sadness than younger people.

Strengths and limitations

There are several strengths worth noting in our study. First, it was based on a national probability sample of older adults in China, and had a relatively large sample size at the individual level. Second, it was the first time to explore the associations between BADL/IADL disability and depressive symptoms from the perspective of gender. Third, we took productive activities into consideration which are theoretically relevant to older adults' mental health but have rarely been investigated in prior studies. However, some limitations of this present study should be mentioned. First, it was a cross-sectional analyses, caution should be taken when interpreting the findings. We cannot establish the causal conclusions between BADL/IADL disability and depressive symptoms. Second, our findings could be generalized only to the Chinese population aged 60 years and above, wider applicability should need further investigation. Third, although we have used multivariate analysis to explore the associations between BADL/IADL and the likelihood of developing depressive symptoms by gender, the constructs may not have been captured fully or precisely. Finally, recall bias can affect the study results. Although data were obtained through face-to-face interviews by trained interviewers, there was a potential endogenous error in the self-assessment questionnaire.

Conclusions

Our study revealed that BADL disability and IADL disability were significantly correlated with depressive symptoms by gender in China. Older adults with BADL/IADL disability were more likely to have depressive symptoms both for men and women in China. IADL disability is related to much higher risk of developing depressive symptoms in

elderly men than in women. In contrast, BADL disability is related to higher risk of developing depressive symptoms in elderly women than in men. Moreover, the associations between BADL/IADL disability and depressive symptoms were strengthened after adjusting for productive activities, in which working plays an important role. Therefore, possible intervention strategies, such as improving the awareness of health, protecting older adults from engaging in some productive activities, should be taken into account among older adults in China. More importantly, government should make different policies for different populations with respect to the gender disparities, and differential institutional care services may be required to improve their physical conditions.

Declaration of competing interest

None.

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