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Original Article

# Prevalence, Factors, and Health Impacts of Chronic Pain Among Community-Dwelling Older Adults in China

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ABSTRACT

*Background:* Chronic pain (CP) is prevalent among older adults in many Western countries and its prevalence, factors, and self-reported or objective measured health impacts have been well documented. However, there is limited information on these aspects among Chinese community-dwelling older adults.
*Aims:* Our aim was to assess the prevalence of CP and identify its associated factors as well as health impacts among older adults in China.
*Design:* Cross-sectional design.
*Settings:* Community settings.
*Participants/Subjects:* A total of 1219 community-dwelling adults aged 60 years or older.
*Methods:* Data on CP, sociodemographic characteristics, comorbidity, cognitive function, and physical activity, as well as self-reported outcomes (functional disability, depression, quality of sleep, and undernutrition) and objective measured physical function, were obtained.
*Results:* Among 1,219 participants, 41.1% reported CP, of whom 16.6% experienced moderate to severe pain. The risk of CP was higher among older women with comorbidity and with depression and lower among older adults with higher educational level as well as with adequate physical activity. CP had significant associations with inadequate physical activity, functional disability, depression, poorer quality of sleep, and undernutrition, as well as worsening physical performance, poorer standing balance, and chair stands.
*Conclusions:* CP is a common problem among Chinese community-dwelling older adults, particularly among the most vulnerable subgroups, and has substantial impacts on self-reported functional disability, depression, poor quality of sleep, and undernutrition, as well as objective measured physical function. Therefore it is relevant for older adults to develop effective CP management programs.


Chronic pain (CP) is particularly common among older adults, of whom 29%-83% experience CP (dos Santos, de Souza, Antes, & d'Orsi, 2015; Inoue et al., 2015; Zanocchi et al., 2008). Previous studies have found that higher prevalence of CP is associated with female sex and low socioeconomic and educational levels (Cabral, Bracher, Depintor, & Eluf-Neto, 2014; Dragioti, Larsson, Bernfort, Levin, & Gerdle, 2016; McCarthy, Bigal, Katz, Derby, & Lipton, 2009). Comorbidity, cognitive impairment, and depression are usually characterized as physical and psychological factors of CP (Cabral et al., 2014; Dominick, Blyth, & Nicholas, 2012; Dragioti et al., 2016; Patel, Guralnik, Dansie, & Turk, 2013). With respect to behavioral characteristics, physical activity has been found to enhance the descending pain inhibition modulatory function, and older adults with adequate physical activity are less likely to report CP (Landmark, Romundstad, Borchgrevink, Kaasa, & Dale, 2011; Naugle & Riley, 2014; Pinto et al., 2014). Western studies have particularly identified physical activity as an essential

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nonpharmacologic strategy of CP management (dos Santos et al., 2015; Naugle & Riley, 2014). Describing CP and understanding its determinants is the key to target interventions to older adults at high risk. However, the previous results mainly feature Western samples, and extensions are needed to determine whether they also remain persistent in non-Western contexts, especially in China, where the largest aging population lives. Additionally, these few Chinese studies on CP have been primarily conducted among specific subpopulations, such as specific old-old adults (Xue, Chu, Chen, & ZM, 2012), or in specific settings, such as in primary health care settings (Feng, Wang, Gao, & Lou, 2012) or in hospital (Wang, Xu, & Song, 2017), rather than among community-dwelling older adults.

CP causes substantial health impacts in older adults, including inadequate physical activity (Holden, Nicholls, Young, Hay, & Foster, 2015; Stubbs et al., 2013), disability in activities of daily living, depression, poor quality of sleep, and undernutrition (Eggermont et al., 2014; Morales-Espinoza et al., 2016; Shega, Weiner, et al., 2010). Specifically, Western researchers also have assessed the impact of CP on physical function using objective measures, such as grip strength, or lower extremity physical performance, such as gait speed, standing balance, and chair stands, which can capture a wide range of function (Patel et al., 2013) and strongly predict future disability, decreased mobility, institutionalization, and mortality in older adults (Cooper, Kuh, & Hardy, 2010; Studenski et al., 2011). However, Chinese studies have neglected the impact on objective functional outcomes and just have assessed the interference of CP with daily life using self-reported questionnaires (Hua, Shilong, & Lanxia, 2016; Wang et al., 2017; Xue et al., 2012), such as general activity, mood, and sleep. Therefore systematic assessment of health impacts using self-reported and objective measures is necessary among Chinese older adults with CP. This can guide public health policies and promote potent targeted interventions to minimize the impact of CP on the healthy aging process.

On the basis of the preceding overview, the aim of this study was to examine the prevalence and multidimensional factors of CP and its impact on self-reported and objectively measured outcomes in Chinese community-dwelling older adults.

## Methods

A cross-sectional study was conducted between July and December 2016 in Jinan City, Shandong Province, China. The target population was older adults living in communities with defined geographic borders. The study was approved by the Institutional Review Board of Shandong University, Jinan, China and all participants provided informed consent for participation.

### *Design*

Three steps were used in sampling. First, of nine districts in Jinan, three were selected according to stratification by socioeconomic status. Second, 22 communities were selected from these three districts. Last, adults aged 60 years or older in these selected communities were invited to their affiliated Community Residents Committees (Community Residence Committee is a committee designated by the government and is responsible for daily operation of the community) for closed-ended interviews and physical assessments. Participants with severe cognitive impairment were excluded because of the self-reporting nature of data.

A CP prevalence of 45.7% was expected based on a recent study conducted in China (Pan et al., 2015). A sample size of 1,144 participants was estimated according to the following formula: $Z^2_{\alpha/2}\, p(1\text{-}p)\, DEFF/d^2$ (where $\alpha = .05$, $Z_{\alpha/2} = 1.96$, $p = .457$, $DEFF$ [design effect] $= 3$, $d = 0.05$) (Gorstein, Sullivan, Parvanta, & Begin, 2007). This calculation is used to determine sample size in cross-sectional survey design.

### *Data Collection*

A pilot study was performed to test the study questionnaire before data collection. The 15 interviewers were trained before the survey and were required to follow a standardized, typewritten sequence of queries. Some measures were implemented to promote participation of older adults. For example, the staffs in the Community Residents Committees convened suitable adults aged 60 or older in the communities, introduced them to the research team, and coordinated and assisted the implementation of our survey, and we put up posters in the communities' bulletin boards. All participants received structured questionnaire interviews and objective physical performance measures in their affiliated community centers. The researchers asked the participants closed questions and recorded the answers. Objective physical performance measures were completed in a safe situation.

### *Chronic Pain*

CP was measured using two questions: (1) whether the participants had pain or not; and (2) a question about pain duration. Participants were defined as having CP if they answered positively to the first question and had pain duration of ≥3 months according to the International Association for the Study of Pain (Merskey et al., 1994).

The current pain intensity was measured by the FACES Pain Scale—Revised (FPS-R) (Hicks, von Baeyer, Spafford, van Korlaar, & Goodenough, 2001). The FPS-R is a visual scale consisting of six faces. The scores of FPS-R range from 0 to 10 (in increments of 2) with the faces representing "no pain" to "very much pain", respectively. Participants were asked to choose the face that best describes the current intensity of pain they were experiencing. Considering the large number of older adults who have attained less formal education in China, we chose this standardized, visual, and easier scale. Previous studies indicated that the FPS-R appeared to be the best scale for Chinese older adults to report their pain intensity (Li, Liu, & Herr, 2007). Pain intensity was categorized as mild (i.e., 2, 4), moderate (i.e., 6), and severe (i.e., 8, 10) (Huang et al., 2013).

### *Covariates*

*Sociodemographic Characteristics.* Sociodemographic characteristics included age, gender, marital status, educational level, and monthly income.

*Comorbidity.* Participants were asked if they had the following chronic diseases: hypertension, coronary heart disease, diabetes mellitus, congestive heart failure, chronic obstructive pulmonary disease, asthma, stroke, arthritis, kidney disease, and cancer. Participants with two or more chronic diseases were defined as having comorbidity (Marengoni et al., 2011; Valderas, Starfield, Sibbald, Salisbury, & Roland, 2009).

*Cognitive Function.* The Short Portable Mental Status Questionnaire (SPMSQ) was used to measure cognitive function (Pfeiffer, 1975). The total score ranges from 0 to 10, and cutoff scores for the SPMSQ are 0-2 (intact cognitive function), 3-4 (mild cognitive impairment), 5-7 (moderate cognitive impairment), and 8-10 (severe cognitive impairment). If the educational level of a participant was primary school or lower, the number of errors was allowed to be one more than the cutoff point; and if the educational level was high school or higher, the number of errors allowed was one less (Pfeiffer, 1975). Participants with severe cognitive impairment were excluded. Thus

participants with cognitive impairment in our data analyses were those with mild or moderate cognitive impairment. The α coefficient of SPMSQ in the study was .72.

*Health Impacts*

*Physical Function.* Grip strength was measured in kilograms by having participants squeeze a dynamometer as hard as they could. The maximum recorded strength from three trials was analyzed; if a participant was not able to squeeze three times, the single measurement value was recorded. Grip strength was stratified by gender and body mass index quartiles (Fried et al., 2001). Those who did not meet the criteria are considered as weak grip strength.

The Short Physical Performance Battery was used to assess the lower extremity physical performance, which comprises three tests of lower extremity function: standing balance, gait speed, and chair stands (Guralnik et al., 1994). Standing balance was assessed in three 10-second stands: standing with feet touching side by side, semi-tandem stand (the side of the heel of one foot touching the side of the big toe of the other foot), and full tandem (heel to toe) stand. Gait speed was assessed by asking participants to walk at their usual pace for a 4-meter course. The faster of two timed trials was recorded. Chair stands were assessed by asking participants to stand up and down from a chair five times as fast as possible with their arms folded in front of the chest.

For the gait speed and the chair stands, a score of 0 was assigned to a participant who was unable to complete the task. Those completing the tests were assigned a score of 1-4, according to cut points based on quartiles of the time needed to complete each task, with a point of four indicating the best performance (Guralnik et al., 1994). For the test of balance, it is considered as hierarchical in difficulty in assigning a single score of 0-4, with a point of four indicating the best balance performance (Guralnik et al., 1994). In the present study a score lower than four for each test was used to identify the slower gait speed, poorer performance of chair stands, and poorer standing balance.

The Short Physical Performance Battery score was calculated from the sum of categorical scores on the three tests, ranging from 0 to 12, with a higher score indicating better lower extremity function. Participants who scored eight or less were defined as having decreased physical performance (da Camara, Alvarado, Guralnik, Guerra, & Maciel, 2013). The tool has been widely used among older adults and has been reported to have good validity and reliability (Freire, Guerra, Alvarado, Guralnik, & Zunzunegui, 2012; Gomez, Curcio, Alvarado, Zunzunegui, & Guralnik, 2013).

*Physical Activity.* Physical activity was assessed using the International Physical Activity Questionnaire—Short Form (Stewart et al., 2001). According to the recommendations for older adults in the 2008 Physical Activity Guidelines for Americans (Royall, Troiano, Johnson, Kohl, & Fulton, 2008), for substantial health benefits, the elderly should do at least 150 minutes of moderate-intensity, or 75 minutes of vigorous-intensity physical activity a week, or an equivalent combination of moderate- and vigorous-intensity activity. Participants were considered to have adequate physical activity if they met these criteria (Carlson, Fulton, Pratt, Yang, & Adams, 2015).

*Functional Disability.* The Katz Index (Katz, Ford, Moskowitz, Jackson, & Jaffe, 1963) and the Lawton scale (Lawton & Brody, 1969) were used to assess functional disability in activities of daily living (ADLs) and instrumental activities of daily living (IADLs), respectively. ADL and IADL disabilities were defined as any difficulty in six different ADLs and eight IADLs, respectively. The α coefficients of ADL and IADL in the study were .52 and .86, respectively.

*Quality of Sleep.* To study the quality of sleep, participants were asked "How do you sleep every night?" and to rate on a 5-point scale (1 = very good, 2 = good, 3 = general, 4 = poor, 5 = very poor). Responses of 4 or 5 were recorded as "poor quality of sleep."

*Depression.* Depression was measured using the 5-item Geriatric Depression Scale (GDS-5), which was created based on the 15-item GDS, and has been identified as effective as the 15-item GDS for depression screening (Hoy et al., 1999; Rinaldi et al., 2003). Depression was indicated by the cutoff point ≥2 (Weeks, McGann, Michaels, & Penninx, 2003). The α coefficient of GDS-5 in the study was .62.

*Nutritional Status.* Nutritional status was measured by the Mini Nutritional Assessment—Short Form (MNA-SF) (Kaiser et al., 2009; Rubenstein, Harker, Salvà, Guigoz, & Vellas, 2001)

The MNA-SF consists of six questions on food intake, weight loss, mobility, psychological stress or acute disease, presence of dementia or depression, and body mass index, with scores ranging from 0 to 14. Scores of 0-11 points indicate that the individual was at risk of undernutrition; scores of 12-14 points indicate that the individual was well nourished (Kaiser et al., 2009).

*Statistical Analysis*

The data were analyzed in three stages. First, we used frequencies (percentages) and means (standard deviations) to describe participant characteristics for categorical and continuous variables, respectively. We used $\chi^2$ and $t$ tests to compare participant characteristics by CP status. Second, a multivariate logistic regression model was constructed to identify multidimensional factors (adjusted odds ratios [ORs]) associated with CP. Third, we used multiple logistic regression models to determine the adjusted associations of CP with each measured health outcomes (i.e., physical function, physical activity, functional disability, depression, quality of sleep, and undernutrition). CP and pain-related factors (sociodemographic characteristics, comorbidity, and cognitive function) were put into the models in the third stage. We excluded depression and physical activity from pain-related factors considering their interplay with pain. A $p$ value < .05 was taken as significant. All data were analyzed with SPSS Version 21.0 (IBM Corp., Armonk, NY, USA).

## Results

*Sample Characteristics*

Table 1 presents characteristics of participants. The participants' ages ranged from 60 to 97, the minority of whom were men (30.8%) and mateless (25.4%). The prevalence of comorbidity, depression, and cognitive impairment was 42.4%, 12.1%, and 4.9%, respectively. More than half of the participants (61.9%) had adequate physical activity.

*Characteristics of Chronic Pain*

Of the total sample, 41.1% of participants (n = 501) reported CP, and 6.2% (n = 75) reported acute pain. Among participants with CP, a median of 10 years of pain duration was found, and 29.9% reported more than 20 years. The prevalence of mild, moderate, and severe pain intensity was 56.4%, 9.0%, and 7.6%, respectively. Table 1 also shows that participants with CP were more likely to be female, mateless, and less educated and to have comorbidity, depression, and inadequate physical activity (all $p$ < .05).

**Table 1**
Sample Characteristics by Chronic Pain Status Among Community-Dwelling Older Adults

| Characteristics | Total Sample (N = 1219) | Nonchronic Pain (N = 718) | Chronic Pain (N = 501) | $t/\chi^2$ | *p* |
|---|---|---|---|---|---|
| Age (years) | 69.01 ± 6.69 | 68.89 ± 8.31 | 69.56 ± 6.70 | −1.57 | .117[†] |
| Female | 844 (69.2) | 465 (64.8) | 379 (75.6) | 16.42 | **<.001** |
| Mateless[*] | 309 (25.4) | 162 (22.6) | 147 (29.4) | 7.20 | **.007** |
| Highest education attainment[*] | | | | | |
| Primary school or lower | 422 (34.7) | 225 (31.4) | 197 (39.4) | 9.24 | **.010** |
| Middle school | 340 (27.9) | 204 (28.4) | 136 (27.2) | | |
| High school or higher | 455 (37.4) | 288 (40.2) | 167 (33.4) | | |
| Monthly income[*] < 3,200 CNY[‡] | 876 (73.5) | 507 (72.6) | 369 (74.7) | 0.63 | .427 |
| Comorbidity[*] (≥2 chronic diseases) | 516 (42.4) | 255 (35.6) | 261 (52.1) | 33.01 | **<.001** |
| Cognitive impairment[*] (SPMSQ ≥ 3) | 60 (4.9) | 35 (4.9) | 25 (5.0) | 0.01 | .921 |
| Depression (GDS-5 ≥ 2) | 148 (12.1) | 64 (8.9) | 84 (16.8) | 17.06 | **<.001** |
| Adequate physical activity (≥150 minutes/week) | 754 (61.9) | 466 (64.9) | 288 (57.5) | 6.88 | **.009** |

CNY = Chinese yuan; SPMSQ = short portable mental status questionnaire; GDS-5, 5-item Geriatric Depression Scale.
Statistical significant parameters were shown in bold.
[*] One missing datum was found for the variables comorbidity and cognitive status; two missing data were found for marital status and highest education attainment; 27 missing data were found for monthly income.
[†] Independent sample *t* tests.
[‡] CNY 3,200 (US$498.44) was the average of household per capita disposal income of Jinan, China, in 2014.

### *Correlates of Chronic Pain*

Table 2 shows the adjusted ORs for the factors associated with CP in the logistic regression model. Three independent risk factors for CP were identified, including female sex (OR = 1.59, 95% confidence interval [CI] = 1.19-2.13), comorbidity (OR = 1.77, 95% CI = 1.39-2.26), and depression (OR = 1.72, 95% CI = 1.20-2.48). Furthermore, an educational level of high school or higher (OR = 0.72, 95% CI = 0.53-0.98) and adequate physical activity (OR = 0.77, 95% CI = 0.60-0.99) were identified to be protective factors for CP. CP was not significantly associated with age, marital status, monthly income, or cognitive function.

### *Health Impacts of Chronic Pain*

Older adults with CP suffered higher percentages of all the measured adverse health impacts except weak grip strength than their counterparts. With adjustment for covariates, CP had higher risk of self-reported inadequate physical activity, ADL or IADL disability, depression, poor quality of sleep, and undernutrition, as well as all the objective measured physical functions (ORs = 1.33-1.85, $p < .05$) except weak grip strength and slow gait speed (ORs = 1.07-1.37, $p > .05$) (Table 3).

## Discussion

The prevalence of CP in this study was 41.1%, comparable to that in other studies (42%-50%) among community-dwelling older adults (Cabral et al., 2014; Inoue et al., 2015; Pan et al., 2015) but higher than among the general population (31.7%) (Bouhassira, Lanteri-Minet, Attal, Laurent, & Touboul, 2008). This indicates that CP is a common problem in older adults around the world. Consistent with other studies (Dragioti et al., 2016; McCarthy et al., 2009), women were more likely to report CP than were men. Although the accurate etiologic basis of gender difference regarding pain experience remains unknown, it is thought to be a complex interplay among biological, psychological, and social factors (Bartley & Fillingim, 2013). For example, with aging, changes in female sex hormones affect pain sensitivity of women, making their pain threshold lower than that of men (Rusu & Pincus, 2017). Additionally, older adults with lower levels of education were more likely to report CP, consistent with other studies reporting CP with a clear social gradient (Azevedo, Costa-Pereira, Mendonca, Dias, & Castro-Lopes, 2012; Cabral et al., 2014). Considering that education level has an important influence on access to information, this may reflect the cumulative effect of social advantage on health literacy over older adults' life course (Lacey, Belcher, & Croft, 2013). Individuals with lower health literacy have limited access to and use of appropriate treatment of CP, and they also have difficulties understanding how to engage in measures to relieve pain, resulting in undertreated CP (Cutler & Lleras-Muney, 2010).

We found that CP was positively associated with comorbidity. This corresponds to the findings in the previous studies that specific physical diseases (such as rheumatoid arthritis, osteoarthritis, heart disease, or gastrointestinal disorders) increased the risk of CP (Dominick et al., 2012; Tracey & Bushnell, 2009). Additionally, pain

**Table 2**
Logistic Regression Model Predicting Chronic Pain

| Variables | Adjusted OR | 95% CI | *p* |
|---|---|---|---|
| Age (years) | 1.00 | 0.98-1.02 | .991 |
| Female (ref. male) | **1.59** | **1.19-2.13** | **.002** |
| With mate (ref. mateless) | 0.92 | 0.69-1.23 | .558 |
| Education (ref. primary school or lower) | | | |
| Middle school | 0.79 | 0.58-1.08 | .144 |
| High school or higher | **0.72** | **0.53-0.98** | **.035** |
| Monthly income CNY ≥ 3,200 (ref. < 3,200)[*] | 1.23 | 0.90-1.67 | .194 |
| Comorbidity (ref. without comorbidity) | **1.77** | **1.39-2.26** | **< .001** |
| Depression (ref. no depression) | **1.72** | **1.20-2.48** | **.003** |
| Cognitive impairment (ref. intact cognition) | 0.85 | 0.48-1.51 | .579 |
| Adequate physical activity (ref. inadequate physical activity) | **0.77** | **0.60-0.99** | **.039** |

OR = odds ratios; CI = confidence interval; CNY = Chines yuan.
Statistical significant parameters were shown in bold.
[*] CNY 3,200 (US$498.44) was the average of household per capita disposal income of Jinan, China, in 2014.

**Table 3**
Adjusted* Odd Ratios and 95% CIs for the Adverse Health Impacts of Chronic Pain

| Adverse Health Impacts | Nonchronic Pain N (%) | Chronic Pain N (%) | Adjusted ORs | 95% CI | *p* |
|---|---|---|---|---|---|
| Inadequate physical activity (<150 minutes/week) | 252 (35.1) | 213 (42.5) | **1.33** | **1.04-1.71** | **.024** |
| ADL disability* (≥1 difficulty in ADLs) | 69 (9.6) | 88 (17.6) | **1.85** | **1.29-2.64** | **.001** |
| IADL disability* (≥1 difficulty in IADLs) | 109 (15.2) | 116 (23.2) | **1.44** | **1.03-2.01** | **.032** |
| Depression (GDS-5 ≥2) | 64 (8.9) | 84 (16.8) | **1.79** | **1.25-2.57** | **.002** |
| Poor sleep* (≥4) | 122 (17.0) | 124 (24.8) | **1.39** | **1.04-1.86** | **.028** |
| Undernutrition* (MNA-SF <12) | 71 (10.0) | 75 (15.1) | **1.59** | **1.10-2.29** | **.013** |
| Weak grip strength* (≤30 kg for men; ≤17.3 kg for women) | 275 (39.0) | 217 (43.9) | 1.07 | 0.83-1.37 | .608 |
| Slow gait speed* (score of gait speed <4) | 71 (10.2) | 74 (15.2) | 1.37 | 0.92-2.02 | .118 |
| Poor standing balance* (score of standing balance <4) | 134 (19.2) | 139 (28.3) | **1.41** | **1.03-1.92** | **.030** |
| Poor chair stands* (score of chair stands <4) | 261 (37.3) | 251 (51.2) | **1.56** | **1.21-2.01** | **.001** |
| Low SPPB* (SPPB ≤ 8) | 54 (7.7) | 72 (14.7) | **1.83** | **1.21-2.78** | **.004** |

OR = odds ratio; CI = confidence interval; ADL = activities of daily living; IADL = instrumental activities of daily living; GDS-5 = 5-item geriatric depression scale; MNA-SFG = mini nutritional assessment—short form; SPPB = short physical performance battery.
Statistical significant parameters were shown in bold.
* All the logistic models were adjusted for age, gender, marital status, highest education attainment, monthly income, comorbidity, and cognitive function. One missing datum was found for ADL disability, IADL disability, and poor sleep; 12 missing data were found for nutritional status; 20 missing data were found for grip strength; 27 missing data were found for gait speed; 29 missing data were found for standing balance; 30 missing data were found for the variables chair stands and SPPB.

and depression have a number of overlapping pathophysiologic mechanisms, such as common brain structure, the same neural circuitry, and activation of the same neurochemicals (e.g., serotonin, norepinephrine) (Goesling, Clauw, & Hassett, 2013). Therefore their relationship is not simply linear, but rather complex, circular, and interacting (Kroenke et al., 2011). This is also mirrored by the findings in our study, as well as in previous studies, that CP had a bidirectional relationship with depression; that is, depression had an adverse effect on CP and vice versa (Inoue et al., 2015). The findings imply that clinical care may be enhanced by joint attention to CP and depression rather than an either-or approach. For example, some treatments have been found to be effective for both conditions, such as cognitive-behavioral therapy (Wetherell et al., 2011).

Furthermore, we found that adequate physical activity was a protective factor for CP, similar to previous studies (dos Santos et al., 2015; Landmark et al., 2011). This may be explained by the mechanism that physical activity enhances the descending pain modulatory function (Naugle & Riley, 2014). Additionally, the safety of long-term physical activity in older adults has been confirmed (Quicke, Foster, Thomas, & Holden, 2015). Nevertheless, the level of physical activity among older adults with CP was lower than those without CP (Holden et al., 2015; Stubbs et al., 2013), which was also found in the present study. The reason may be that older adults with CP may reduce their daily activities and functional capacity to avoid the feeling of pain (Larsson, Ekvall Hansson, Sundquist, & Jakobsson, 2016). As a consequence, it is clearly important for health professionals to encourage older adults with CP to remain active and adopt physical activity as a main nonpharmacologic strategy in the management of CP.

We found that mild to moderate cognitive impairment was not associated with CP, similar to another community-based study (Shega, Paice, Rockwood, & Dale, 2010). Previous studies reported mixed results regarding the association of cognitive impairment with CP. Older adults with cognitive impairment reported less prevalent CP in some studies (Walid & Zaytseva, 2009), but more CP in other studies (Patel et al., 2013). Further studies are needed on cognitive function and pain reporting.

CP has substantial associations with health outcomes in older adults. Some studies have examined the self-reported interference of CP with daily functioning in Chinese older adults and found that older adults had the most interference with daily activities (e.g., eating, bathing), mood, and sleep (Hua et al., 2016; Wang et al., 2017; Xue et al., 2012). These results are mirrored by our findings that older adults with CP had higher risk of ADL and IADL disability, depression, and poor quality of sleep.

Strong association between CP and functional disability has been found extensively in Western studies (Eggermont et al., 2014; Shega, Weiner, et al., 2010). For example, CP contributes to progressive ADL and IADL disability over time in older adults (Eggermont et al., 2014). In line with prior studies, we found that older adults with CP were more likely to develop functional disability. An explanation may be that the experience of pain is associated with deficits of executive function, resulting in reduced functional independence (Glass et al., 2011; Hughes, Chang, Bilt, Snitz, & Ganguli, 2012). However, the ability to complete these daily functional activities is important for older adults' independent living. Therefore it is recommended that an assessment for functional disability should be part of the routine evaluation of older adults with CP.

As mentioned earlier, pain has a bidirectional relationship with depression because of some overlapping pathophysiologic mechanisms (Goesling et al., 2013). The study also identified a strong association of CP with sleep disturbance. This is because CP may lead to long-term functional changes in the neural systems that modulate both sleep and pain (Haack et al., 2012). Furthermore, CP, depression, and insomnia are interrelated because of some common neurobiological correlates, which may include structural changes in similar brain structures, dysregulation of the hypothalamic-pituitary-adrenal axis, and abnormal secretion of 5-hydroxytryptophan (Boakye et al., 2016). Additional studies are warranted to better understand the complicated interrelationship among these disorders.

We also found that older adults with CP were more likely to be undernourished. This may be explained by the finding that CP was associated with decreased appetite and food intake (Bosley, Weiner, Rudy, & Granieri, 2004). However, another study found that CP was not an independent factor in undernutrition. The reason may be that CP could affect older adults' mood and then cause depressive symptoms, which constitute an independent factor in poor nutritional status (Krzyminska-Siemaszko et al., 2016). To confirm this explanation that depressive symptoms may link CP with undernutrition, we further adjusted for depression and found that depression (OR = 22.17, 95% CI = 13.97-35.18, not shown) but not CP was significantly associated with undernutrition (OR = 1.28, 95% CI = 0.84-1.95, not shown). Our finding of the strong association between CP and depression, as mentioned earlier, further provided support for the explanation. Nevertheless, another study found that CP was still associated with poor nutrition status after adjusting for depression (Boulos, Salameh, & Barberger-Gateau, 2014). These results suggested that depression may fully or partially mediate the relationship between CP and undernutrition.

Importantly, we used objective measures to assess the upper and lower extremity functions that are relevant for older adults to maintain independent mobility (Pereira et al., 2014). In line with other Western studies (Eggermont, Bean, Guralnik, & Leveille, 2009; Eggermont et al., 2014), we found that older adults with CP were more likely to have decreased physical performance, poorer standing balance, and chair stands, indicating a decreased ability of mobility. It has been suggested that CP may cause behavioral and cognitive alterations and chemical changes in the brain (Sharma et al., 2011), so there may be multiple pathways through which pain affects the lower extremity function in older adults (Eggermont et al., 2009). And the fear of pain may result in avoidance of physical activities, leading to worsening performance (Larsson et al., 2016). These results strongly suggest that effective CP management interventions be developed to prevent functional decline in this large, vulnerable population. Longitudinal studies are needed to help understand the risk for lower extremity function decline related to pain in Chinese older adults.

Different from other studies, CP was not an independent predictor of gait speed. One possible explanation may be that the pain intensity was less severe in the present study, and the percentage of participants who reported moderate to severe pain intensity (16.6%) was lower than in other studies (30%) (Azevedo et al., 2012; Cabral et al., 2014). This explanation is supported by the threshold effect of pain intensity on gait speed, beyond which lower extremity function was significantly limited (Eggermont et al., 2009). In addition, we found that CP had no significant association with grip strength even in the univariate analysis. Different from our result, an American study suggested that older adults with pain had significantly weaker grip strength, the majority of whom (65.8%) reported pain in the upper body regions (shoulders, hands, wrists, head, or neck) (Patel et al., 2013). However, the most common locations of CP were lower extremity and low back among Chinese older adults (Feng et al., 2012; Hua et al., 2016; Pan et al., 2015). Therefore it is not surprising that CP had greater impacts on lower extremity performance than on grip strength in the present study. Further studies should be conducted to test the association among CP and gait speed and grip strength in Chinese older adults.

### *Limitations*

There are several limitations in our study. First, the cross-sectional design precludes a causal inference between CP factors and health outcomes. Second, pain assessment of duration and intensity did not provide an extensive profile of pain information such as source of pain, location, or treatment (medications and nonpharmacologic interventions). Therefore we were unable to analyze the causes and common sites of pain and could not determine whether differences in CP treatment could affect pain experiences of participants. Third, self-reporting of physical activity, ADLs, and IADLs may result in recall bias. Further studies could use objective measures to capture more accurate results. In addition, the sample came from one city in China, so the generalizability of results should be treated with caution.

## Nursing Implications

This study has several implications for CP management in older adults. First, effective health education about CP should be conducted among women with lower educational level or with comorbidities, to enrich their perceived health knowledge of CP and promote their management of chronic diseases. Second, the bidirectional relationship between CP and depression indicates that psychological treatment is important for CP interventions among older adults as well. Third, physical activity should be regarded as an effective nonpharmacologic strategy of CP. More attention should be paid to establishing individually tailored physical activity intervention programs for older adults with CP according to their capacity and health status, such as aerobic training (e.g., 30 minutes of walking at 50%-75% of maximal heart rate every day or fitness stationary cycling three times per week) (Landmark, Romundstad, Borchgrevink, Kaasa, & Dale, 2013); or strength training (e.g., 20-30 minutes of isokinetic, dynamic, or isometric resistance exercises targeting both the upper and lower extremity per day) (Golightly, Allen, & Caine, 2012); or 35-minute physical exercise programs that include 10 minutes of stretching, 15 minutes of strengthening, and 10 minutes of balance exercises (Cheng et al., 2017). It is worth noting that sometimes psychoeducational training is needed to enhance adherence to the programs (Nicolson et al., 2017). It is important for health professionals to prioritize this vulnerable population and to help them better manage CP and reduce its associated health impacts.

## Conclusions

This study indicates that CP is prevalent among Chinese community-dwelling older adults. Furthermore, the factors common in CP suggest that specific older adult subgroups of women with lower educational levels and with comorbidity and depression are at higher risk of CP, and adequate physical activity is protective of CP, underlining physical exercise as a targeted intervention in pain management. CP has evident negative impacts on objective measured physical function as well as self-reported outcomes and impedes older adults' ability to live independently in the future. Therefore it is relevant for older adults to develop effective CP management programs.

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