**Relationship between neighbourhood social participation and depression among older adults: A longitudinal study in China**

**ABSTRACT**

Previous research has found a negative linkage between neighbourhood social participation and depressive symptoms in Western countries, but the cross-sectional design of these studies limits the ability to infer causality. Little attention has been paid to socio-psychological pathways linking neighbourhood social participation to depressive symptoms among older adults in China. This study aimed to examine the impact of neighbourhood social participation on depressive symptoms among Chinese older adults. It further explored the mediating roles of physical activity, social contact among neighbours, and contact with own children in the relationship between social participation and depressive symptoms. Data obtained through three waves (2011, 2013, and 2015) of the China Health and Retirement Longitudinal Study were used. The sample consisted of 10,105 individuals aged 60 and above and 24,623 person-year records captured during these three waves. Depressive symptoms were assessed using the Center for Epidemiology Studies of Depression scale. Results show that respondents’ depression decreased with an increasing level of neighbourhood social participation, more time spent on physical activities, and a higher frequency of contact with neighbours and with own children. These factors were found to partly mediate the relationship between neighbourhood social participation and depression. The negative relationships between social contact and depression and contact with own children and depression were both strengthened by neighbourhood social participation. In conclusion, physical activity, social contact among neighbours, and contact with own children are mechanisms through which neighbourhood social participation lowers the risk of depression among older adults in China.

**Keywords:**

Neighbourhood social participation; Depression; Older adults; Longitudinal study; Mediating effect; China

**What is known about this topic**

* Depression is particularly problematic for older adults due to weaker social ties and poorer physical condition.
* Research has shown a positive association between neighbourhood social participation and mental health.

**What this paper adds**

* Neighbourhood social participation is associated with lower rates of depression.
* We found three potential pathways (physical activity, social contact and contact with children) linking neighbourhood social participation to depression.

**1. Introduction**

China has the largest ageing population in the world, with 209.2 million people aged 60 and over accounting for 14.4% of the total population in 2014 (Help Age International, 2015). Depression is a common mental health problem among older Chinese, with an estimated rate of 20.5% (Zhang et al., 2012). Depression is a serious public health issue in developing countries (Adjaye-Gbewonyo et al., 2018; Wang et al., 2018a; Wang et al., 2018b) and one of the top three diseases that lead to disability (Vos et al., 2016). Depression not only reduces life quality (Ruo et al., 2003) but also increases the risk of chronic physical illness (Farrokhi et al., 2014; Hare et al., 2014; Moussavi et al., 2007; Psaltopoulou et al., 2013; Van der Kooy et al., 2007). Preventing and reducing the risk of depression is therefore a key public health concern especially for older people (Niles and O'Donovan, 2018; Helbich et al., 2019; Wang et al., 2019b; Wang et al., 2019c). Compared to young people, older people spend more time in their neighbourhoods due to retirement and functional restriction (Liu et al., 2019; Wang et al., 2019a; [Wiles](https://scholar.google.com.hk/citations?user=CLtG0W8AAAAJ&hl=zh-CN&oi=sra) et al., 2009; [Wiles](https://scholar.google.com.hk/citations?user=CLtG0W8AAAAJ&hl=zh-CN&oi=sra) et al., 2012) and neighbourhood environment may play an important role in their daily life. There has been increasing interest in the role of neighbourhood social participation in health promotion for the elderly, since it reflects the ability of neighbourhoods to provide health-related resources (World Health Organization, 2007), including those impacting depression in older adults.

Neighbourhood social participation, such as participating in leisure, social, cultural and spiritual activities in the community, could provide opportunities for older people to continue to maintain or develop supportive and caring relationships (World Health Organization, 2007). It fosters social integration and act as one of the most important dimensions of neighbourhood social capital; and it has been found to have a positive effect on residents’ physical (Buck-McFadyen et al., 2018; Chaix et al., 2008; Cornwell and Laumann, 2015; Johnell et al., 2004; Kawachi et al., 1999; Lindström et al., 2003; Lindström et al., 2004; Sundquist et al., 2004) and mental health (Cornwell and Laumann, 2015; Luo et al., 2012; Niedzwiedz et al., 2016; Stafford et al., 2008). Previous literature has identified three main pathways to explain how neighbourhood social participation may influence residents’ health outcomes: (1) social norms which encourage people to adopt more healthy behaviours, such as engaging in physical activities; (2) increasing the social contact that could access the health-related information through contact within the neighbourhood; and (3) exerting unofficial social control on residents’ behaviour (e.g. contact with children) (Dassopoulos et al., 2011; Ellaway et al., 2007; Goll et al., 2015; Kawachi et al., 1999; Sundquist et al., 2004; Tobin et al., 2014). In addition, since neighbourhood social participation could influence one’s health outcomes by three main pathways, the accelerations of effects of healthy behaviours, social contact, and social control on one’s health outcomes could be different according different neighbourhood social participation; it is worth to investigate moderated relationships between healthy behaviours, social contact, and social control and neighbourhood social participation on one’s mental health.

Considering the first pathway, engaging in physical activity could reduce the risk of depression among older individuals (Lampinen et al. 2000; Strawbridge et al. 2002). However, older adults are more likely to have limited functional abilities, to be afraid of getting hurt during physical activities, and have difficulty finding a partner for sports activities, therefore staying at home with a sedentary lifestyle (Aylaz et al., 2012; Hughes et al., 2001; Nelson et al., 2007; Niedzwiedz et al., 2016). High levels of neighbourhood social participation may encourage people to adopt more healthy norms of behaviour such as engaging in physical activity (Kawachi et al., 1999; Lindström et al., 2001; McNeill et al., 2006). Through higher neighbourhood social participation, older adults can more easily get support and assistance from neighbours and thereby become more willing to engage in physical activities (Lindström et al., 2003; McNeill et al., 2006). Neighbourhoods with a higher level of social participation provide older adults with more opportunities to participate in finding partners for sporting activities (Lindström et al., 2001; Lindström et al., 2003; McNeill et al., 2006). Existing literature suggests that physical activity can balance hormone levels and reduce stress, potentially reducing older people’s depressive symptoms (Strawbridge et al., 2002). Neighbourhood social participation could therefore encourage physical activity and reduce depressive symptoms among elderly people.

In terms of the second pathway, neighbourhood social participation may increase older adults’ chances of being in contact with their neighbours (Ellaway and Macintyre, 2007; Kawachi et al., 1999; Tobin et al., 2014). Most older adults have retired from the labour market, leading to a loss of social ties and reduced opportunities for social contact. This could increase feelings of loneliness and lead to poorer mental health outcomes as compared to younger adults (Courtin et al., 2017; Heaven et al., 2013; Niedzwiedz et al., 2016). In neighbourhoods with higher social participation, older adults may have more chances to strengthen their social ties as they may have more opportunities for face-to-face interaction (Ellaway and Macintyre, 2007; Kawachi et al., 1999; Tobin et al., 2014). Kawachi et al. (1999) pointed out that activities building neighbourhood social capital, such as neighbourhood social participation, strengthens social ties and encourages residents to share health information among themselves. Strengthened social ties also encourage material support among neighbours. In neighbourhoods with high social capital, residents are more willing to maintain a harmonious environment as they believe that ‘a close neighbour is better than a distant relative’ (Goll et al., 2015; Heaven et al., 2013; Liu et al., 2017). Neighbourhood social participation may therefore benefit older adults’ mental health through the improvement of social contact, which encourages the sharing of and mutual support.

Regarding the third pathway, higher level of neighbourhood social participation may reinforce cultural norms and that these norms include filial piety and thus older people are more likely to be cared for by their children (Carpiano, 2006; Dassopoulos and Monnat, 2011; Kawachi et al., 1999). Contacting with their children, older adult’s health could be monitored more easily and the risk of negative responses to stressful events could also be reduced (Feng, 2018). In neighbourhoods with higher social participation, older adults are more likely to be active in neighbourhood which may strengthen social ties and reinforce cultural norms (Aw et al., 2017; Minagawa and Saito, 2015). Older adults would be more familiar with their neigbours and trust them, and they may feel more comfortable to get along with neighbours and be more active in neighbourhood affairs (Aw et al., 2017; Minagawa and Saito, 2015). On the other hand, strong social ties and reinforced cultural norms may make older adults realize that they are also an important part of the neighbourhood which encourage them to be more active in neighbourhood (Aw et al., 2017; Minagawa and Saito, 2015). It is likely that older adults would share their family affairs with each other in their community, and the filial piety (i.e. children contacts with their parents to show their respect and provide emotional and material support to their parents) as a form of cultural norms would be shaped and regulated by dsocial control by the whole neighbourhood (Chen and Silverstein, 2000; Lee and Xiao, 1998; Li and Shin, 2013; Silverstein et al., 2006; Zhang and Goza, 2006). In addition, social participation could also help older people to continue to maintain or establish supportive and caring relationships (WHO, 2007). In China, adult children are the main social support (emotional and material support) for older people. Having contact with their children can ensure older people get emotional and material support, and older people’s health can also be monitored by their children to prevent health become worse (Bordone, 2009; Feng, 2018). Older people living in neighbourhoods with higher social participation may also realise the benefits of having frequent contact with their children (Chen and Silverstein, 2000; Lee and Xiao, 1998; Li and Shin, 2013; Silverstein et al., 2006; Zhang and Goza, 2006). There are urban and rural differences in terms of neighbourhood social participation and contacting with children among older adults. Compared with urban older adults, rural older adults have more contact with their children, mainly due to the social structure of Chinese rural neighbourhoods often taking the form of ‘acquaintance societies’ where residents’ behaviour, such as providing support to parents, is more regulated by social control (Chen and Silverstein, 2000; Lee and Xiao, 1998; Li and Shin, 2013; Silverstein et al., 2006; Zhang and Goza, 2006). For example, Lee and Xiao (1999) found that rural residents in China have more frequent contact with their parents than urban residents, likely because neighbours may judge their behaviour harshly if they do not care for their older parents. Therefore, having contact with their children would have different effect on older people’s depressive symptoms according to different level of social participation in the neighbourhood.

Few studies have focused on how neighbourhood social participation influences older adults’ depression through different pathways, and the evidence is extremely limited in developing countries such as China. This study aimed to explore three pathways (physical activity, social contact, and contact with own children) between neighbourhood social participation and depression among older adults in the Chinese context. For this purpose, data from the China Health and Retirement Longitudinal Study (CHARLS) was used. The current study particularly aimed to examine to what extent physical activity, social contact, and contact with own children mediate the linkage between neighbourhood social participation and depression level. It also examined whether neighbourhood social participation moderated the relationship between physical activity, social contact, and contact with own children and the depression level.

This study contributes to extant literature in two respects. First, it makes a first attempt to systematically examine the association between neighbourhood social participation and depression in Chinese older adults. Second, it explores the mechanisms through which neighbourhood social participation exerts a protective effect on mental health in the Chinese context.

**2. Materials and methods**

**2.1 Data collection**

This study uses data from three waves of the CHARLS. The first wave was conducted in 2011, with follow-up data collected in 2013 (Wave 2) and 2015 (Wave 3). The CHARLS was conducted by the National Development Research Institute of Peking University, in cooperation with the China Social Science Research Center and the Youth League Committee of Peking University. Respondents were selected using a probability-proportional-to-size sampling technique. In the first stage, 150 city-level divisions from 28 provinces were randomly selected. In the second stage, 450 neighbourhoods from the city-level divisions were randomly selected. The sampling proportion of urban and rural neighbourhoods was 7:10 for the baseline survey (7,106 urban residents and 10,481 rural residents). We only selected respondents who were 60 and above during the survey year for this study. After excluding observations with missing information for any individual- or neighbourhood-level variables, the sample consisted of 24,623 person-year records (10,105 individuals aged 60 and above, collected over all three waves).

**2.2 Measures**

*Depressive symptoms*

Depressive symptoms were assessed using the Center for Epidemiology Studies of Depression (CES-D 10) scale (Radloff, 1977). The CES-D 10 is a 10-item Likert scale questionnaire to assess depressive symptoms during the past week. The CES-D 10 has been shown to have good validity and reliability for older adult populations (Andresen et al., 1994). Individual items represent respondents’ depression-related symptoms and include items on happiness, hopelessness, and so on. Each item is scored on a four-point scale, ranging from ‘rarely or none of the time’ to ‘most or all of the time’. To consider the entire range of depressive symptoms (i.e. from none to severe) and to avoid the problem of setting subjective cut-off points, we used the total score of the CES-D 10. The internal consistency of the CES-D 10 in this study was excellent (Cronbach’s α= 0.96).

*Neighbourhood social participation*

Social participation was measured by a combination of questionnaire items. The CHARLS asked how often the respondent engaged with various activities, includingplay mah-jong, chess, or cards; attend a community, sports, social or other club; participate in a community-related organisation; participate in voluntary or charity work; and attend any educational or training courses in the past 12 months. Older people could access opportunities to become involved in their community from their engagement in playing mah-jong, chess, or cards, sport or recreation clubs, or belonging to organizations, or other forms in terms of leisure, recreational, cultural, and spiritual activities (World Health Organization, 2007). The respondents were asked to rate the frequency of each social participation (*almost daily*, *almost every week*, *not regularly and* *never*). A binary variable was constructed with respondents who took part in any social participation taking the value of 1 (*almost daily*, *almost every week*, *not regularly*), and the rest taking the value 0 (*never*) (individual-level social participation). Following the methods of Johnell et al. (2004) and Kawachi et al. (1999), neighbourhood social participation was estimated as the proportion of persons in the neighbourhood who participated in any of the above activities (weighted according to the sample weight). We conducted a sensitivity analysis by measuring the level of neighbourhood social participation against the proportion of residents in the neighbourhood who participated in each of the above activities. Results (not shown here) were not substantively altered by using alternative measures of social participation.

*Mediators*

Three variables from the survey were used as potential mediators to represent three socio-psychological pathways linking neighbourhood social participation to residents’ health outcomes. The first mediator was people’s physical activity, measured by weekly physical exercise time in hours. We log-transformed this variable as it was non-normally distributed. The second mediator was concerned with social contact. This was measured using a self-reported four-level indicator (Fan et al., 2011; Maas et al., 2009). Respondents were asked how often they had contact or interacted with their neighbours over the past month (1= *never,* 2= *not regularly*, 3= *almost every week,* 4= *almost daily*). It was normally distributed and in order to conduct mediation analysis based on muti-level model, we treated it as continuous variable. The third mediator was contact with own children, represented by the frequency of contact with their children. Respondents were asked to indicate on a 10-point scale how often they had contact with each of their children (1= *never*, 2= *almost never*, 3= *once a year*, 4= *once every six months*, 5= *once every three months*, 6= *once a month*, 7= *every two weeks*, 8= *once a week*, 9= *2-3 times a week*, 10= *almost every day*). We measured respondents’ frequency of contact with their children by averaging the scores for all children. After averaging the scores, the variable changing from ordinal variable to continuous variable.

*Covariates*

Covariates included individual-level social participation, gender, age, educational attainment, marital status, household size (*number of persons*), annual household income per capita (*Chinese Yuan*), living area (*rural* or *urban neighbourhood*), smoking (*current smoker* or *non-smoker*), use of alcohol (*drinker* or *non-drinker*), physical health status (*physical illness* or *no physical illness*), and medical insurance. Functional ability was also used as a control variable and categorised into limitations or no limitations using the Activities of Daily Living scale (Pluijm et al., 2005). Descriptive statistics for all variables are presented in Table 1.

Table 1 about here

**2.3 Analysis**

The data has a hierarchical structure: measurements at different waves were nested within individual-level data, which were nested within neighbourhood-level data. We used multilevel models to examine the associations between neighbourhood social participation and individual depression (Raudenbush and Bryk, 2002). The full model including all predictors was estimated as follows:

$$CES-D\_{tij}=β\_{0}+β\_{1}Neighbourhood social participation\_{j}+β\_{2}Physical activities\_{tij}$$

$$+β\_{3}Social contact\_{tij}+β\_{4}Contact with own children\_{tij}+β\_{5}Covariates\_{tij}$$

$$+β\_{6}Covariates\_{ti}+ε\_{tij}+μ\_{ij}+φ\_{j}$$

where $t$ represents time, $i$ represents individuals, and $j$ represents neighbourhoods. $β\_{0}$ is the intercept.$Neighbourhood social participation\_{j}$$Neighbourhood social environment indicators\_{h}$$Neighbourhood social environment indicators\_{h}$represents the level of social participation in neighbourhood j during 2011. $Physical activities\_{tij}$, $Social contact\_{tij}$ and $Contact with own children\_{tij}$ were three mediators. $Covariates\_{tij}$ represents a vector of time-varying covariates, such as age. $Covariates\_{ti}$ represents a vector of time-invariant covariates such as gender. $ε\_{tij}$, $μ\_{ij}$$ε\_{ih}$$ε\_{ih}$ and $φ\_{j}$$μ\_{h}$$μ\_{h}$ represent the random errors within individuals, between individuals, and between neighbourhoods, respectively.

We used variance inflation factors (VIF<3) to quantify the severity of multicollinearity among the variables. The intra-class correlation coefficient (ICC) was 0.10 between neighbourhoods and 0.45 between individuals in the null model (i.e. the model without any predictor variables), indicating that depression scores were correlated to some extent within the same neighbourhood and same individual, which confirms the necessity of using a multi-level approach.

We used Baron and Kenny’s (1986) approach to test the existence of mediating effects. The first step was to regress independent variables on dependent variables and mediators. If the effects of independent variables on dependent variables and mediators were both significant, the next step was to regress independent variables on dependent variables, with mediators controlled. Sobel test (Sobel, 1982) was then used to test whether the coefficient of dependent variables decreased significantly after controlling mediators.

In this study, we first separately examined the relationship between the level of neighbourhood social participation and three mediators, time spent on physical activity, the frequency of contact with neighbours, and the frequency of contact with own children (Models 1 - 3). Second, Model 4was used to quantify the linkage between neighbourhood social participation and respondents’ depression (CES-D scores) without controlling mediators. Third, Models 5-7were used to examine the association between neighbourhood social participation and respondents’ CES-D scores, considering three mediators separately. Fourth, we fitted Model 8 to examine the association between neighbourhood social participation and respondents’ CES-D scores, controlling all mediators. The Sobel test and the method proposed by Preacher and Hayes (2008) were used to test significance of the mediating effect. Finally, cross-level interaction effects were added to Model 9 to test whether neighbourhood social participation moderated the relationship between physical activity, social contact, and contact with own children, and respondents’ CES-D scores. Analyses were performed in Stata 14.1.

**3. Results**

*The effect of neighbourhood social participation on physical activity, social contact, and contact with own children*

The results of Model 1 showed that the respondents’ physical activity increased with increased neighbourhood social participation (*Coef.*=0.417, *SE*=0.084). The results of Model 2 showed that respondents’ social contact increased with increased neighbourhood social participation (*Coef.*=0.219, *SE*=0.105). In addition, in Model 3, the respondents’ contact with own children increased with increased neighbourhood social participation (*Coef.*=0.362, *SE*=0.104).

Table 2 about here

*The relationship between neighbourhood social participation and depression and the mediating role of physical activity, social contact, and contact with own children*

Model 4 showed that higher neighbourhood social participation was significantly associated with lower depression (*Coef.*=-1.336, *SE*=0.434). (Table 2). Concerning physical activity (Model 5), respondents’ CES-D scores decreased with increased physical activity (log-transformed, *Coef.*=-0.040, *SE*=0.018). After running a Sobel test, the result showed that the logarithm of physical activity significantly mediated the relationship between neighbourhood social participation and respondents’ depression (*z*-score=-2.028, *p*-value=0.043). Concerning social contact (Model 6), respondents’ depression scores decreased with social contact (*Coef.*=-0.188, *SE*=0.031). A Sobel test showed that social contact significantly mediated the relationship between neighbourhood social participation and respondents’ depression (*z*-score=-1.972, *p*-value=0.049). Finally, concerning contact with own children (Model 7), respondents’ depression scores decreased with increased contact with own children (*Coef.*=-0.002, *SE*=0.001). A Sobel test showed that contact with own children significantly mediated the relationship between neighbourhood social participation and respondents’ depression (*z*-score=-1.999, *p*-value=0.046).

In Model 8, the relationship between neighbourhood social participation and depression was insignificant after physical activity, social contact, and contact with own children variables were added to the model (*z*-value=2.558, *p*<0.05). After applying Preacher and Hayes’ test, results confirmed that these three mediators together had a full mediation effect on the relationship between neighbourhood social participation and depression.

*Cross-level interaction effects*

Results from Model 9 showed that neighbourhood social participation moderated the relationship between social contact and depression, as well as between contact with own children and depression. The negative relationship between social contact and depression was strengthened by neighbourhood social participation. Additionally, results indicated that the negative association between contact with own children and depression was also strengthened by neighbourhood social participation. However, there was no evidence that neighbourhood social participation moderated the relationship between physical activity and depression (Table 2).

**4. Discussion**

This study explored the association between neighbourhood social participation and depression in older Chinese individuals and studied whether physical activity, social contact, and contact with own children mediated the effect of neighbourhood social participation on depression using multilevel models and mediation analysis. Respondents’ depressive symptoms were associated with neighbourhood social participation, and physical activity, social contact, and contact with own children jointly exerted a partly mediating effect on this relationship. The effects of social contact and contact with own children on respondents’ depressive symptoms were found to be moderated by neighbourhood social participation.

Findings suggest that mental health problems are less prevalent in neighbourhoods with higher neighbourhood social participation, which is consistent with previous studies (Cornwell and Laumann, 2015; Luo et al., 2012; Niedzwiedz et al., 2016; Stafford et al., 2008). The present study focused on older adults and found that both individual-level and neighbourhood-level social participation were significantly related to depressive symptoms. After controlling for individual-level social participation, the relationship between neighbourhood social participation and depressive symptoms was still significant, indicating that the findings are relatively robust for older adults in China.

The results of this study imply that neighbourhood social participation is related to older adults’ physical activity, social contact, and contact with own children, which may have contributed to a decrease in the respondents’ depressive symptoms. With respect to physical activity, living in neighbourhoods with higher social participation makes it more likely for older adults to join different sports clubs and engage in physical activities for older Chinese adults (e.g. square dancing) (Sun and Liu, 2006; Wu, 2012). According to social capital theory, residents living in neighbourhoods with higher neighbourhood social participation are more likely to unite to maintain their facilities and open spaces (Kawachi et al., 1999), so elderly Chinese living in neighbourhoods with higher social capital are also more likely to maintain their open spaces (Wu, 2012; Xu et al., 2010). Additionally, older adults living in neighbourhoods with higher neighbourhood social participation can more easily access support from others (Lindström et al., 2001; Lindström et al., 2003; McNeill et al., 2006), and will likely have less anxiety about getting assistance in case of an injury during physical activities (Wu, 2012; Xu et al., 2010).

As for social contact, results of this study show that social contact increases with neighbourhood social participation, which may also decrease older respondents’ depressive symptoms (Feng et al., 2019). Social capital theory suggests that living in neighbourhoods with higher neighbourhood social participation increases older adults’ possibilities for face-to-face contact with neighbours, strengthening social ties in such neighbourhoods (Kawachi et al., 1999; Palmer et al., 2011; Xu et al., 2010). Older adults are also more likely to get emotional support from neighbours when living in neighbourhoods with higher neighbourhood social participation (Luo et al., 2012; Yang and Victor, 2008). Older adults are at high risk of suffering from loneliness and subjective feeling of exclusion (Feng et al., 2018), but neighbourhood social participation may encourage them to communicate with and comfort each other, increasing their emotional support (Luo et al., 2012; Yang and Victor, 2008).

Neighbourhood social participation improves older respondents’ contact with their own children, which could also reduce their depressive symptoms. As social capital theory suggests that social capital encourages the spread of health-related knowledge (Kawachi et al., 1999), older Chinese adults who live in neighbourhoods with higher neighbourhood social participation are more likely to be aware that contact with their children may benefit their health and lead to increased support from their children. This could prompt them to be more pro-active in maintaining contact with their children (Lee and Xiao, 1998; Sun, 2002). Similarly, children of older adults who live in neighbourhoods with higher social cohesion may also be more pro-active in maintaining contact with their parents – likely due to informal social control mechanisms (Lee and Xiao, 1998; Sun, 2002). For example, older adults are likely to share their family affairs with their neighbours, and the knowledge of this may prompt adult children to contact their parents more frequently under the pressure of the neighbours’ opinions.

The cross-level interaction effects between neighborhood social participation and social contact, as well as between neighborhood social participation and contact with own children on the respondents’ depressive symptoms were significant. First, neighborhood social participation strengthened the beneficial effect of social contact on older adults’ depressive symptoms. According to social capital theory, neighbourhood social capital strengthens social ties (Kawachi et al., 1999; Lindström et al., 2003; Sundquist et al., 2004; Tobin et al., 2014), so with higher neighborhood social participation the social contact among older adults may go beyond being merely acquaintances. This would make it more likely for older adults to get useful health knowledge and support from these contacts, which in turn may benefit their depressive symptoms. Second, neighborhood social participation strengthened the beneficial effect of contact with own children on older adults’ depressive symptoms. With higher neighborhood social participation, older adults are more likely to get more social support according to social capital theory (Kawachi et al., 1999; Lindström et al., 2003; Sundquist et al., 2004; Tobin et al., 2014), so elder Chinese may get advice from their neighbors and know the benefits of being in contact with their children. On the other hand, neighborhood social participation in their parents’ neighborhood may also encourage adult children to be more pro-active in caring about their parents’ health through keeping contact in China, because keeping their parents healthy is important for their social status in the neighborhood. Thus, neighborhood social participation might transfer contact with own children into a useful resource for older adults in China.

Some research limitations ought to be paid attention to. First, we considered only three mediators; thus, certain topics related to health-related behaviours (e.g. various health treatments) remain to be further studied. Second, there might be self-selection problems related to the sample, because residents may choose to reside in a given neighbourhood based on their personal preferences, which would also influence their depressive symptoms (Wingate and Alexander, 2006). Third, the Modifiable Areal Unit Problem (MAUP) which means the definition of neighbourhood boundary may influence social participation-depression association could occur in this study (Kawachi et al., 2013), as we defined neighbourhoods using only administrative boundaries. Fourth, CHARLS did not provide neighbourhood information for 2013 and 2015, which constrained our ability to estimate the effect of neighbourhood social participation on the risk of depression using fixed-effect models.

**5. Conclusion**

We found evidence that living in neighbourhoods with a higher level of neighbourhood social participation is related to lower rates of depression among Chinese older adults. We also found that the association between neighbourhood social participation and older adults’ depression symptoms was significantly mediated by time spent on physical activity, frequency of contact with neighbours, and frequency of contact with own children. These mediating factors seem to play an important role when analysing the relationship between neighbourhood social participation and the risk of depression. In addition, neighbourhood social participation strengthens the beneficial effect of social contact among neighbours and contact with own children on older adults’ risk of developing depressive symptoms. Researchers are advised to be careful not to restrict future studies to direct effects. We urge policymakers to encourage people to participate in neighbourhood affairs in China, as this not only encourages elderly people to engage in health-promoting behaviours (e.g. physical activity, interacting with neighbours and contacting their own children), but also increases the protective effect of these behaviours on elderly people’s mental health.

**Availability of data and materials**

The dataset(s) supporting the conclusions of this article can be retrieved from <http://charls.pku.edu.cn/zh-CN>

**Consent for publication**

Not applicable.

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