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Longitudinal associations of depressive symptoms, subjective memory decline, and cognitive functioning among Chinese older adults: Between-person and within-person perspective

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ABSTRACT

Objectives: We examined between- and within-person associations between depressive symptoms and cognitive functioning among Chinese older adults (aged 60+) over time. Furthermore, we also investigated whether subjective memory decline (SMD) is uniquely associated with cognitive functioning above and beyond depressive symptoms for both between-person and within-person associations.
Methods: About 7385 older adults from the China Health and Retirement Longitudinal Study reported their demographic and health status, and completed self-report measures of depressive symptoms and SMD, as well as a battery of cognitive tests, every two years at three times between 2011 and 2015.
Results: There were significant between-person and within-person associations between depressive symptoms and cognitive functioning. Furthermore, SMD was uniquely associated with cognitive functioning for both within-person and between-person associations after controlling for depressive symptoms.
Conclusions: The results highlight the importance of careful screening and monitoring of depressive symptoms and SMD for the benefits of cognitive functioning among Chinese older adults. More importantly, SMD has practical implications for the care of Chinese older adults given significant cultural stigma attached to mental illness within Chinese culture.

1. Introduction

Cognitive functioning decline is an important health concern in older adults worldwide including China because it is related to quality of life, independent living, nursing home placement, and need for care (Ball et al., 2002; Valkanova, Ebmeier, & Allan, 2017). The comorbidity of depression and subjective memory decline (SMD) is common in older adults and is often indicative of cognitive impairment in later life (Kryscio et al., 2014; Valkanova et al., 2017). Older adults with depressive symptoms, SMD, and cognitive functioning decline often have functional limitations and require more care (Ball et al., 2002), which might make them more vulnerable to a loss of independence; this is among the most important concerns for older adults (Hillcoat-Nallétamby, 2014). Therefore, studies to understand the relationships among depression, SMD, and cognitive functioning are important to inform clinical practice in support of better quality of life for older adults (Ball et al., 2002).

Researchers claimed that the link between SMD, depression, and cognitive functioning tend to be complex. Theoretically, depression and SMD can be either preceded, coincide with, or follow the changes in cognitive functioning (Barnes, Alexopoulos, Lopez, Williamson, & Yaffe, 2006) and SMD can be the presentation or manifestation of depression (Bolla, Lindgren, Bonaccorsy, & Bleecker, 1991; Jonker, Geerlings, & Schmand, 2000; Reid & MacLullich, 2006; Schmand, Jonker, Geerlings, & Lindeboom, 1997). Given the major difficulty in establishing a causal relationship among these variables, the association therefore has significant clinical implications. In order to answer the complementary questions of which factor is a valid indicator of cognitive functioning, it is important to consider them together. Previous findings from cross-sectional and longitudinal studies about the relationships among depressive symptoms, SMD, and cognitive functioning in non-Chinese older adults are mixed and controversial. For example, some cross-sectional studies reported that SMD is significantly associated with cognitive decline (Burmester, Leathem, & Merrick, 2016; Lam, Lui, Tam, & Chiu, 2005) whereas other cross-sectional studies fail to observe these effects (Balash, Mordechovich, Shabtai, Merims, & Giladi, 2010;

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Jorm et al., 1994). Likewise, the controversy persists in the relationship between depressive symptoms and cognitive functioning (Barnes et al., 2006). Findings from these studies are difficult to interpret because one-time point measurement of depressive symptoms and SMD cannot capture the changes in these conditions that older adults experience over time (Kaup et al., 2016). In addition, of the studies focusing on cognitive functioning, only a few have simultaneously addressed both depressive symptoms and SMD (Reid & MacLullich, 2006). Studies using longitudinal data examining this topic by providing multiple time-sequential measures of relevant variables, but inconsistent results still remained (Reid & MacLullich, 2006). Although analyses from the Health, Aging, and Body Composition Study (Kaup et al., 2016) and the Gospel Oak Study (Tobiansky, Blizard, Livingston, & Mann, 1995) shown the baseline depressive symptoms or SMD appears to be predictive of future cognitive function decline, some other studies did not observe such an effect (Smith, Petersen, Ivnik, Malec, & Tangalos, 1996; Wang et al., 2000). The utility of depression and SMD as valid predictors of cognitive functioning remains uncertain.

Previous longitudinal studies predominantly focused on the between-person effects using different predictors. However, fewer studies have focused on the within-person effect, nor have considered depressive symptoms and SMD simultaneously in predicting cognitive functioning. Differentiating between within-person effect and between-person effect is important. Late adulthood is characterized by major changes in depressive symptoms, SMD, and cognitive functioning (Laukka, Dykiert, Allerhand, Starr, & Deary, 2018). Depressive symptoms, SMD, and cognitive functioning are time-varying covariates that include both between-person (inter-individual) variability and within-person (intra-individual) variability (Boker & Nesselroade, 2002). For example, an individual's depressive symptoms are sometimes worse than he or she is at other times (i.e., within-person variation). This represents a deviation from the specific mean associated with that individual. Moreover, some people tend to demonstrate greater depressive symptoms than others do (i.e., between-person variation). This represents the person-mean predictor across time (Hoffman & Stawski, 2009). Therefore, recent research calls for studies that systematically distinguish between within-person variation and between-person variation among time-varying covariates (Hülür, Hertzog, Pearman, Ram, & Gerstorf, 2014; Laukka et al., 2018) so that a better understanding of how cognitive functioning changes across time among older adults can be achieved (Hülür et al., 2014; Laukka et al., 2018).

Understanding the relationships among depression, SMD, and cognitive functioning is particularly important in support of quality of life for Chinese older adults because both depression and cognitive functioning impairment have a high prevalence rate but are underrecognized and undertreated (Woo & Mehta, 2017). In Chinese culture, older adults have culturally different perspectives on depressive symptoms, cognitive functioning impairment, and SMD than those in Western culture. Both depressive symptoms and cognitive functioning are culturally stigmatized and socially discriminated in comparison with SMD (Li, Jiao, & Zhu, 2018; Woo & Chung, 2018). For example, the Chinese term "chi-dai" ("痴呆") used to describe dementia is considered insulting, offensive, and discriminatory (Zou et al., 2017). Therefore, Chinese people with depressive symptoms or cognitive functioning impairment often deny their illness, disregard the symptoms, and seldom seek for professional help (Woo & Mehta, 2017). Even when they visit doctors, they tend to report somatic symptoms rather than psychological symptoms (Ryder et al., 2008), making diagnosis and treatment of depression and cognitive functioning impairment particularly difficult. In contrast, SMD is more culturally acceptable than depressive symptoms and dementia (Kundhal & Kundhal, 2003; Yeung, Chang, Gresham, Nierenberg, & Fava, 2004). This is especially true for those with lower levels of education (Zhou et al., 2014), which is the dominant category describing Chinese older adults' educational background (Li, Liu, Sun, Wu, & Zou, 2014) The main reason is that SMD is interpreted as a part of the normal aging process (Lineweaver & Hertzog, 1998), while depressive symptoms and cognitive functioning impairment are seen as "weakness of character" and hence are shameful in Chinese culture (Li et al., 2018; Woo & Mehta, 2017). Therefore, SMD can be an important predictor of cognitive functioning above and beyond depressive symptoms in the Chinese cultural context. Despite its importance, however, the utility of SMD in the prediction and diagnosis of cognitive functioning in Chinese older adults is uncertain and has not been studied.

Thus, the current study examined between-person and within-person associations among depressive symptoms, SMD, and cognitive functioning simultaneously to better understand how cognitive functioning changes across time among Chinese older adults (Hülür et al., 2014; Laukka et al., 2018). First, we examined between-person and within-person associations between depressive symptoms and cognitive functioning (research question 1). We hypothesized that cognitive functioning would be poorer for those with higher mean levels of depressive symptoms relative to peers (between-person effect) and at times when depressive symptoms were higher than an individual's own mean (within-person effect). Then, we examined whether SMD was uniquely associated with cognitive functioning above and beyond depressive symptoms for both between-person and within-person associations (research question 2). We expected that SMD would be uniquely associated with cognitive functioning for both within-person and between-person associations after accounting for depressive symptoms.

2. Methods

2.1. Data and sample

This study utilized data from the harmonized China Health and Retirement Longitudinal Study (CHARLS). We obtained harmonized CHARLS data (version C) produced by the University of Southern California Program on Global Aging, Health & Policy, and funded by the National Institute on Aging from the Gateway to Global Aging (G2G). G2G is the institution that facilitates cross-country aging studies by providing a digital library and creating harmonized data to improve easy use of data. The CHARLS is a national longitudinal study of Chinese community-dwelling adults aged 45+ conducted by Peking University (Zhao, Hu, Smith, Strauss, & Yang, 2014). The institutional review board at Peking University in China approved the original CHARLS study. Data are de-identified and openly accessible to researchers.

Older adult is defined as persons aged 60 years or older in China (Standing Committee of the National People's Congress, 2012). The current analysis only included individuals aged 60+ and completed three waves of data (1st wave in 2011, 2nd wave in 2013, and 4th wave in 2015) (n = 7385). The 3rd wave of data in 2014 was not analyzed because it only contained information of life history.

2.2. Measures

2.2.1. Subjective memory decline (SMD)

SMD was operationalized as respondents' self-perceived memory performance (Cook & Marsiske, 2006) and was assessed by asking participants "How would you rate your memory at the present time?" on a 5-point scale from 1 = "excellent" to 5 = "poor" with higher scores indicating worse self-rated memory.

2.2.2. Depressive symptoms

Depressive symptoms were measured using the 10-item Center for Epidemiologic Studies Depression Scale short form (CESD-10) with a 4-point scale ranging from 0 ("rarely or none of the time") to 3 ("most or all of the time"), with higher scores indicating higher levels of depressive symptoms (Chen & Mui, 2014). CESD-10 has been validated in Chinese older adults with an adequate factorial validity (Chen & Mui, 2014). Cronbach's alpha in the current study is 0.81.

2.2.3. Cognitive functioning

Three dimensions of cognitive functioning were assessed in the CHARLS, including orientation and attention measured by Telephone Interview of Cognitive Status (TICS), episodic memory measured by immediate and delayed word recall, and visuospatial functioning measured by figure drawing. TICS included serial subtraction of 7 from 100 (up to five times), and orientation of date (month, day, and year), day of the week, and season of the year. Regarding word recall, participants were given about two minutes to immediately recall as many words they could after interviewers read a list of 10 random words (immediate recall) and about four to ten minutes later, participants were asked to recall words again from the original word list (delayed word recall). Figure drawing was assessed by asking participants to draw a similar figure of two pentagons overlapped with each other. Following previous studies (Sha, Cheng, & Yan, 2018; Zuo et al., 2018), summary scores from these tests was computed to measure overall cognitive functioning (range 0–30) with a higher score indicating better cognitive performance.

2.2.4. Covariates

Additional covariates included age (years, grand mean centered), gender (−0.5 = *Male*, 0.5 = *Female*), marital status (−0.5 = *Separated, divorced, widowed, or never married*, .5= *Married or partnered*), and education (−0.5 = *Less than lower secondary*, 0.5= *Upper secondary & vocational training or tertiary*). Functional status was measured according to activities of daily living (ADLs), a 3-item summary score of bathing, dressing, and eating (Wallace & Herzog, 1995), ranged from 0 to 3, and was grand mean centered. The chronic conditions that were associated with cognitive functioning included stroke (−0.5=*No*, 0.5=*Yes*), hypertension (−0.5=*No*, 0.5=*Yes*), and diabetes (−0.5=*No*, 0.5=*Yes*) (Zuo et al., 2018).

2.3. Analytic plan

Multilevel modeling was conducted to examine within- and between-person variability in depressive symptoms alone (research question 1) or depressive symptoms and SMD simultaneously (research question 2) as they relate to cognitive functioning (Hoffman & Stawski, 2009; Hoffman, 2015). We followed guidelines for separating within-person and between-person effects (Hoffman, 2015) to better understand the effect of a person's fluctuations (intra-individual variability) in depressive symptoms alone or simultaneously with SMD on individual's cognitive functioning while accounting for this person's average level of depressive symptoms alone or simultaneously with SMD (individual variability).

Data from all three-time points were included in these models, with cognitive functioning at each time point predicted by depressive symptoms alone or depressive symptoms and SMD simultaneously at each time point. Equations for the multilevel models (research question 2) as an example) are listed below:

Level 1 (within-person):

$$\text{Cognitive functioning}_{ti} = \pi_{0i} + \pi_{1i}(\text{Depressive symptoms})_{ti} + \pi_{2i}(\text{SMD})_{ti} + \pi_{3i}(\text{age})_{ti} + \pi_{4i}(\text{Marital Status})_{ti} + \pi_{5i}(\text{ADLs})_{ti} + \pi_{6i}(\text{Stroke})_{ti} + \pi_{7i}(\text{Hypertension})_{ti} + \pi_{8i}(\text{Diabetes})_{ti} + r_{ti}$$

Level 2 (between-person):

$$\pi_{0i} = \beta_{00} + \beta_{01}(\text{Mean of depressive symptoms})_i + \beta_{02}(\text{Mean of SMD})_i + \beta_{03}(\text{Gender})_i + \beta_{04}(\text{Education})_i + r_{0i}$$

$$\pi_{1i} = \beta_{10}$$
$$\pi_{2i} = \beta_{20}$$
$$\pi_{3i} = \beta_{30}$$
$$\pi_{4i} = \beta_{40}$$
$$\pi_{5i} = \beta_{50}$$
$$\pi_{6i} = \beta_{60}$$
$$\pi_{7i} = \beta_{70}$$
$$\pi_{8i} = \beta_{80}$$

Depressive symptoms and SMD respectively were group (person) mean-centered at Level 1 and mean of depressive symptoms at Level 2 was each person's average CESD-10 score across the three time points (subscript *t* represented each wave in the study) and mean of SMD at Level 2 was each person's average SMD score across the three time points, which then was respectively grand mean-centered. The slope (β_{10}) represents the within-person depressive symptoms effect and the slope (β_{20}) represents the within-person SMD effect. β_{01} represents the between-person depressive symptoms effect and β_{02} represents the between-person SMD effect. All covariates were accounted for in all models. See Table 2 for full model results. All within- and between-person effects of depressive symptoms and SMD were estimated using the MIXED command in SPSS (version. 25; 2017) with a two-tailed alpha of 0.05. We used maximum likelihood (ML) estimation to handle missing data under the assumption of missing at random. The inclusion of covariates (i.e., age, gender, marital status, and education) helped to improve the performance of ML, yielding unbiased parameter estimates and standard errors (Graham, 2009; Schafer & Graham, 2002).

Table 1
Descriptive Statistics for All Study Variables (n = 7385).

	Time 1		Time 2		Time 3	
	Mean (SD)	Proportion	Mean (SD)	Proportion	Mean (SD)	Proportion
Age (years)	68.41(7.01)		70.00(6.70)		71.48(6.44)	
Female		.50		.50		.50
Married or partnered		.77		.76		.73
Education (upper secondary and vocational training or tertiary)		.07		.07		.07
Subjective memory decline	4.18(.84)	.	4.16(.83)		4.23(.80)	
Depressive symptoms	9.11(6.47)		8.12(5.82)		8.64(6.61)	
Cognitive functioning	12.34(5.32)		12.00(5.59)		10.78(5.73)	
ADLs	.25(.70)		.25		.31	
Stroke		.05		.05		.07
Hypertension		.35		.39		.46
Diabetes		.08		.10		.13

Notes: Covariates included age (years = grand centered), gender (−0.5 = *Male*, 0.5 = *Female*), marital status (−0.5 = separated, divorced, widowed, or never married and .5= *Married or partnered*), and education (−0.5 = *less than lower secondary*, 0.5= *upper secondary & vocational training* or *tertiary*). Functional status was measured according to activities of daily living (ADLs) (grand mean centered, a 3-item summary score of bathing, dressing, and eating (range 0–3) (Wallace & Herzog, 1995). The chronic conditions that are associated with cognitive function included stroke (−0.5=*No*, 0.5=*Yes*), hypertension (−0.5=*No*, 0.5=*Yes*), and diabetes (−0.5=*No*, 0.5=*Yes*).

3. Results

3.1. Sample characteristics

Table 1 presents descriptive statistics of the study variables across three waves. At baseline, the mean age of the participants was 68.41 years (SD = 7.01, range 60–103), 50% were women, 77% were married or partnered, and 7% had upper secondary and vocational training or tertiary, 5% had stroke, 35% had hypertension, and 10% had diabetes with an average of 0.25 (SD = .70) ADL limitations. The average score for depressive symptoms, SMD, and cognitive functioning was 9.11 (SD = 6.47), 4.18 (SD = .84), 12.34 (SD = 5.32), respectively. The average score of cognitive functioning decreased from 12.34 to 10.78 across the three time points. Depressive symptoms ($r = -0.24$, $p < .05$) and SMD ($r = -0.26$, $p < .05$) were negatively related to cognitive functioning.

3.2. Predicting cognitive functioning from depressive symptoms alone (research question 1) and depressive symptoms and SMD simultaneously (research question 2)

Table 2 (top half of the table) presents results of tests of within- and between-person associations between depressive symptoms and cognitive functioning. There were significant between-person associations between depressive symptoms and cognitive functioning. As expected, individuals who reported more depressive symptoms demonstrated poorer cognition relative to those who reported less depressive symptoms. There were also significant within-person associations between depressive symptoms and cognitive functioning, such that when an individual's depressive symptoms were higher than his or her own average, his or her cognitive functioning was lower. Table 2 (bottom half of the table) presents results of tests of within- and between-person associations for both depressive symptoms and SMD on cognitive functioning. We included both depressive symptoms and SMD in the model to examine whether SMD uniquely was associated with cognitive functioning above and beyond the depressive symptoms. We found that both depressive symptoms and SMD were uniquely associated with cognitive functioning for both within-person and between-person associations.

Table 2
Multi-Level Models Predicting Cognitive Functioning from Depressive Symptoms Alone (Top) or Depressive Symptoms and Subjective Memory Decline (SMD) Simultaneously (bottom) Over Three-Time Points between 2011 and 2015.

	Depressive symptoms Estimate (SE)
Intercept	13.00(.15)***
Within-person depressive symptoms	−.06(.01)***
Between-person depressive symptoms	−.19(.01)***
Age (years)	−.24(.01)***
Gender	−1.63(.11)***
Marital Status	.64(.12)***
Education	4.86(.20)***
ADLs	−.86(.11)***
Stroke	−.45(.22)*
Hypertension	−.04(.10)
Diabetes	.24(.16)
	Depressive symptoms and SMD Estimate (SE)
Intercept	12.83(.15)***
Within-person depressive symptoms	−.06(.01)***
Between-person depressive symptoms	−.11(.01)***
Within-person SMD	−.35(.06)***
Between-person SMD	−1.64(.08)***
Age (years)	−.24(.01)***
Gender	−1.53(.11)***
Marital Status	.74(.12)***
Education	4.43(.20)***
ADLs	−.82(.11)***
Stroke	−.42(.22)
Hypertension	.10(.10)
Diabetes	.25(.15)

Notes: Results were based on 7385 Chinese older adults. ADLs = activities of daily living. Coding of covariates was: age (grand mean centered), gender (−0.5 = *Male*, 0.5 = *Female*), marital status (−0.5 = *Separated, divorced, widowed, or never married*, .5 = *Married or partnered*), and education (−0.5 = *Less than lower secondary*, 0.5 = *Upper secondary & vocational training or tertiary*). Functional status was measured according to activities of daily living (ADLs), a 3-item summary score of bathing, dressing, and eating (Wallace & Herzog, 1995), ranged from 0 to 3, and was grand mean centered. The chronic conditions that were associated with cognitive functioning included stroke (−0.5 = *No*, 0.5 = *Yes*), hypertension (−0.5 = *No*, 0.5 = *Yes*), and diabetes (−0.5 = *No*, 0.5 = *Yes*).

* $p < 0.05$.

*** $p < .001$.

4. Discussion

This study is the first known to examine the between-person and within-person relationships between depressive symptoms and cognitive functioning alone, and between depressive symptoms, SMD, and cognitive functioning simultaneously using a representative sample of Chinese community-dwelling older adults. In the current analysis, we are able to answer the complementary question of whether depressive symptoms or SMD at within-person and between-person levels was predictive of cognitive functioning among Chinese older adults.

There are several important findings in the current study. First, we found significant negative between-person and within-person associations between depressive symptoms and cognitive functioning. Our findings on between-person association corroborates existing evidence from Western samples (Wilson et al., 2014), suggesting that the clinical importance of monitoring depressive symptoms for better cognitive functioning in old age extends to more diverse older adult populations. Furthermore, our new knowledge of the negative within-person effect of greater depressive symptoms on poor cognitive functioning suggests that person at times when he or she has worse depressive symptoms than usual might particularly impactful in his or her cognitive functioning, indicating fluctuations in depressive symptoms should be carefully monitored in Chinese older adults. This is a new contribution to the prior study, although on a different sample, in which both chronically high and continuously increasing depressive symptoms (Kaup et al., 2016) can put Western older adults especially at a high risk for cognitive decline. Our finding together with this evidence imply the nature of depression and its association with cognitive functioning may differ depending on the patterns of depressive symptoms that individual older adults experience over time. On the other hand, we also notice that the effect size of within-person depressive symptoms on cognitive functioning is small compared to that of between-person depressive symptoms. This suggests within-person depressive symptoms might not predict future cognitive functioning with substantial power but still deserve clinical attention given the substantial cultural barriers to the treatment of depression and cognitive functioning impairment in Chinese older adults, especially those with less education. As depressive symptoms are modifiable and amenable to treatment, we suggest that future studies need to examine whether the effective treatment of depressive symptoms can help prevent cognitive decline among Chinese older adults.

Second, we found that both depressive symptoms and SMD were significantly associated with cognitive functioning at both within-person and between-person levels when they were included in the same model. These results imply that both depressive symptoms and SMD uniquely predict cognitive functioning, and more importantly, between-person and within-person SMD add additional predictive power over between-person and within-person depressive symptoms on cognitive functioning. While earlier studies (Bolla et al., 1991; Jonker

et al., 2000; Zlatar et al., 2018) found that SMD was more related to depression than cognitive functioning or SMD appeared to be the reflection of older adults' perceptions of general health or depression rather than cognitive functioning (Cosentino, Devanand, & Gurland, 2018), our finding highlights the potential clinical utility of SMD in the prediction of cognitive functioning in Chinese older adult population. Given the under diagnosis and under treatment of depressive symptoms and cognitive functioning impairment in Chinese population (Kundhal & Kundhal, 2003; Yeung et al., 2004), SMD provides a unique opportunity for early treatment of these conditions in this population. Healthcare providers should not simply treat SMD as secondary to depressive symptoms or merely a reflection of depressive symptoms. When older adults report poorer memory than usual or report poorer memory compared to other people, healthcare providers should pay close attention to their cognitive functioning and perform a cognitive screening test. Future research is needed to clarify whether SMD is a symptom of depression, whether SMD is a reaction to cognitive functioning impairment, or whether SMD is a reflection of general health status in Chinese older adults.

Our study has several strengths, including a robust sample size, a representative sample of Chinese older adults, and disaggregation of within-person and between-person effects in longitudinal changes in cognitive functioning. However, there are limitations to consider. First, a single-item measure of SMD might lack sufficient psychometric properties, including reliability, which could reduce the statistical power. However, it is easy, quick, and flexible to administer as a screening tool in clinical settings. Second, our sample is community-based, rather than clinic-based. These participants might be relatively healthy than those in clinical settings and can differ in health seeking behaviors. Thus, results from the current study may not directly be translated into clinical patients.

To conclude, late adulthood is a crucial time to identify and prevent cognitive functioning decline. Given the challenges of early identification and diagnoses of cognitive impairment, the finding that depressive symptoms and SMD predicted cognitive functioning underscores the need for careful screening and monitoring of depressive symptoms and SMD to better support Chinese older adults at risk for cognitive functioning decline. More importantly, the finding that SMD uniquely predicted cognitive functioning in Chinese older adults has practical clinical implications given the prevalent stigma surrounding depression and cognitive functioning impairment within Chinese culture. We suggest Chinese older adults with SMD warrant a thorough cognitive functioning test.

Declaration of interest

None

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