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Perceived Stress and Cognitive Functions among Chinese Older Adults: The
Moderating Role of Health Status

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Abstract

Objective: The primary purposes of the present study are 1) to investigate the stress-cognition relationship among U.S. Chinese older adults; and 2) to examine the moderating role of health status on the stress-cognition relationship.

Method: Data were drawn from the Population Study of Chinese Elderly in Chicago (PINE), which investigated 3,159 Chinese adults over 60 years old living in Chicago. Participants reported health status and completed the Chinese Perceived Stress Scale. Cognitive functions were measured by the East Boston Memory Test, the Digit Span Backwards, the Symbol Digit Modalities Test, and Chinese Mini-Mental State Examination.

Results: Controlling for age, sex, education, and income, perceived stress was negatively associated with cognitive functions, whereas health status was positively associated with cognitive functions. In addition, older adults' health status interacted with stress such that the negative relationships between perceived stress and cognitive functions were more pronounced for those who had poor health than for those who had good health.

Conclusion: Findings suggest that physical health is a critical factor moderating the relationship between perceived stress and cognitive functions among U.S. Chinese older adults. Longitudinal research is needed to examine the complex relationships among stress, health, and cognitive functions of U.S. Chinese older adults.

Key Words: Perceived Stress, Cognitive Functions, Health, Chinese Aging Population

Perceived Stress and Cognitive Functions among Chinese Older Adults: The Moderating Role of Health Status

Introduction

Cognitive impairment and dementia are among major causes of morbidity and mortality among older adults and contribute substantially to health care expenditures around the world (Krueger, Onge, Saint, & Chang, 2011; Wimo, Jonsson, Bond, et al., 2013). Recent research suggests that stress can affect brain and cognitive functions profoundly (Lupien, McEwen, Gunnar, & Heim, 2009). The relationship between stress and cognition is, however, paradoxical because stress can either facilitate or impair cognitive functions (Joels, et al., 2006; Sandi, 2013). Reviewing hundreds of experiments with animals and humans, Sandi (2013) concludes that stress intensity is a major defining factor of the effects of stress on cognition. While mild stress tends to facilitate cognitive functions, high or sustained stress typically impair explicit memory (but improve implicit memory). In addition, the context where stress occurs matters. Stress promotes cognitive functioning if it is triggered by the cognitive task itself. In contrast, stress impairs cognitive functioning if it is triggered by the external environment (Sandi, 2013). Nevertheless, much evidence on the stress-cognition relationship is derived from experimental research. Very few population-based research has examined the stress-cognition relationship (Aggarwal, et al., 2014). Cognitive functions decline with increasing age (Salthouse, 1996). Thus, it is especially important to study the stress-cognition relationship among the older adult population. Using data from the Chicago Health and Aging Project, Aggarwal and colleagues (Aggarwal, et al.,

2014) found that increasing levels of perceived stress were related to lower cognitive functions among 6,207 black and white older adults.

No research so far has examined the stress-cognition relationship among U.S. Chinese older adults, despite the fact that Chinese older adults are the fastest growing segment of the aging population in the United States (U. S. Census, 2010). The Population Study of Chinese Elderly in Chicago (PINE) is the first population-based research that measured both perceived stress and cognitive functions of 3159 U.S. Chinese older adults (Chang & Dong, 2014; Zhang, Simon, & Dong, 2014). Thus, the first primary goal of the present study is to investigate the stress-cognition relationship among Chinese older adults, using the PINE data.

The relationship between stress and cognitive functions depends on a combination of factors related to both stress and cognitive functions (Sandi, 2013), such as the stress intensity and the context where stress occurs. Perceived stress, the psychological perception of whether environmental demands exceed an individual's coping resources, is important to study in relation to physical health (Cohen, et al., 1995; Lazarus & Folkman, 1987). Physical health declines with aging and is positively associated with cognitive functions and negatively associated with perceived stress among U.S. Chinese older adults (Chang & Dong, 2014; Chen, Peng, Ma, & Dong, 2017; Zhang, et al., 2014). U.S. Chinese older adults are susceptible to the double jeopardy of physical aging and acculturation stress (Chen, et al, 2017). It is estimated that more than 80% of the U.S Chinese older adults were born in foreign countries and 30% of them immigrated to the United States after the age of 60 (Dong, Wong, & Simon, 2014). Immigration is a highly stressful process, let alone immigration in late

adulthood. Compared to their White counterparts, U.S. Chinese older adults suffer from greater psychological distress and health disparity (Chen, et al., 2017).

However, there is a great paucity of data on cognitive functions of U.S. Chinese older adults. This is likely due to the absence of culturally and linguistically sensitive instruments (Chang & Dong, 2014). The PINE study used culturally and linguistically appropriate instruments and measured multiple cognitive functions, including episodic memory, working memory, and perceptual speed, among Chinese older adults (Chang & Dong, 2014). Based on the literature review on the stress-cognition relationship (Sandi, 2013), negative relationships between perceived stress and cognitive functions were hypothesized among U.S. Chinese adults for the following two reasons. First, the stress Chinese older adults encountered in the U.S. typically occurred during the acculturation process and originated from the context (Dong, et al., 2014). Second, the PINE study is a population-based study. In the Chicago Health and Aging Project (Aggarwal, et al., 2014), negative relationships between stress and cognitive functions were found for both White and Black older adults. Thus, we made the first hypothesis of the present study.

Hypothesis 1. The relationships between perceived stress and cognitive functions (i.e., episodic memory, working memory, and perceptual speed) would be negative among U.S. Chinese older adults.

Physical health decline is a major source of stress among older adults (Chen, Peng, Xu, O'Brien, 2017). According to the Socioemotional Selectivity Theory (SST; Carstensen, Isaacowitz, & Charles, 1999), older adults may conserve their cognitive resources and are more likely than younger adults to focus on health and well-being

because of their limited future time perspective. The Strength and Vulnerability Integration (SAVI) model (Charles, 2010; Charles, Leger, & Urban, 2016) further emphasizes the important role of physiological vulnerability on older adults' cognitive and emotional functioning. Similar to the SST (Carstensen, et al., 1999), the SAVI model (Charles, et al., 2016) suggests that older adults actively avoid exposure to situations that may elicit high levels of emotional distress to maintain their health and well-being. However, when older adults could not avoid stress exposure, they suffer from worse health consequences than younger adults due to their increased physiological vulnerabilities. Chinese older adults living in the United States typically experience high levels of acculturation stress that cannot be avoid, such as language barrier and racial discrimination (Chen, et al., 2017; Dong, et al., 2014). Thus, based on both the SST (Carstensen, et al., 1999) and the SAVI model (Charles, 2010), we expected that physical health status would moderate the negative relationship between perceived stress and cognitive functions among U.S. Chinese older adults. Specifically, for Chinese older adults who had good health status, the stress associated with aging and acculturation may not be perceived as demanding and therefore may have little impact on their cognitive functions. In contrast, perceived stress may be more pronounced for those older adults who had poor health and impair their cognitive functions. Thus, the second goal of the present study was to examine the moderating role of health status on the stress-cognition relationship among U.S. Chinese older adults.

Hypothesis 2. The negative stress-cognition relationships would be more pronounced for those who had poor health status than for those who had good health status.

Method

Population and Settings

The PINE is a community-engaged, population-based epidemiological study of U.S. Chinese older adults aged 60 and over living in the Greater Chicago area. The PINE study implemented culturally and linguistically appropriate community recruitment strategies guided by a community-based participatory research (CBPR) approach (Dong, et al., 2014). More than 20 social service agencies, community centers, health advocacy agencies, faith-based organizations, senior apartments, and social clubs served as study recruitment sites. Of 3,542 eligible older adults who were approached, 3,159 agreed to participate in the study, a response rate of 91.9%. All participants were consented and interviewed by trained bicultural research assistants in English or in a Chinese dialect, including Mandarin, Cantonese, Toishanese, and Teochow, according to participants' preference. Demographic characteristics of the PINE sample were comparable to those available from the 2010 U.S. Census and a random street-block census of the Chinese community in Chicago (Simon, Chan, Rajan, Welch, & Dong, 2014). The PINE study was approved by the Institutional Review Board of the Rush University Medical Center.

Measurements

Perceived Stress. The Chinese Perceived Stress Scale (PSS-10) was used to assess the degree to which life situations were perceived as stressful (Zhang, et al.,

2014). Participants were asked how often in the last month they had felt: 1) upset because of something that happened unexpectedly; 2) unable to control important things in life; 3) nervous and “stressed”; 4) confident about the ability to handle personal problems; 5) that things were going your way; 6) unable to cope with all the things had to do; 7) able to control irritations in life; 8) on top of things; 9) angered because of things that happened out of control; and 10) unable to overcome piled up difficulties. Respondents indicated answers to each question on a 5-point scale ranging from 0 = never to 4 = very often. Of the 10 items, four items (items 4, 5, 7, 8) were worded in a positive direction, so they were reversely coded as 0 = very often to 4 = never. The scores of all items were then summed. Total scores ranged from 0 to 40, with higher scores indicating greater psychological stress. The PSS-10 demonstrated good internal consistency reliability in the present study ($\alpha = .86$).

Cognitive Functions. A battery of five cognitive tests was administered during the Face-to-face interviews (Chang & Dong, 2014). Four of the five tests assessed three cognitive domains: Episodic memory, working memory, and perceptual speed. Episodic memory was a composite of the East Boston Memory Test-Immediate Recall (EBMT) and the East Boston Memory Test-Delayed Recall (EBDR) (Albert, Smith, & Scherr, 1991). Working memory was assessed by the Digit Span Backwards which was drawn from the Wechsler Memory Scale-Revised (Wechsler, 1987). Perceptual speed was measured by the Symbol Digit Modalities Test (SDMT), an 11-item test that required rapid perceptual comparisons of numbers and symbols in 90 seconds (Smith, 1982). Finally, the C-MMSE was adapted from the MMSE (Mini-Mental State Examination), a widely used tool in epidemiological studies to assess overall cognitive status (Folstein,

Folstein, & McHugh, 1975). The C-MMSE was validated in Chinese older adults in HongKong (Chiu, Lee, Chung, & Kwong, 1994). Higher scores represented better cognitive performance in all tests. Raw scores of all five tests were converted to z scores, using means and standard deviations of the distribution of the scores of all participants on the tests, to construct cognitive factors (three cognitive functions and C-MMSE). A composite score of global cognition was calculated by averaging the z scores of all five cognitive tests (Krueger, Wilson, Bennett, & Aggarwal, 2009). The composite score has the advantage of increasing power by reducing random variability present within tests and is approximately normally distributed (Chang & Dong, 2014).

Health Status. Participants' general health status was assessed by asking them to rate their health in general on a four point scale (1 = poor, 2 = fair, 3 = good, 4 = very good). Due to the skewed distribution, we dichotomized participants into two groups: 0 = poor or fair health and 1 = good or very good health.

Sociodemographic Covariates. Age, sex, education, and income were correlated to perceived stress and cognitive functions in previous PINE studies (Chang & Dong, 2014; Zhang, et al., 2014). Thus, they were controlled to examine the joint influence of perceived stress and health status on cognitive functions. Gender was coded as 1 = male, 0 = female. Participants' education was assessed by the years of formal education completed, ranging from 0 to 26 years. Participants' annual income was categorized into two groups: 0= less than \$10,000, 1= more than \$10,000.

Data Analysis

We first used descriptive statistics to describe the sample characteristics. Second, spearman correlations were used to describe the relationships between

perceived stress, health status, and sociodemographic variables with the global cognition, three specific cognitive functions, and C-MMSE. Finally, four linear regression models were performed on the global cognition as well as three specific cognitive functions (i.e., episodic memory, working memory, and perceptual speed) to test our hypotheses. First, Model 1 investigated the influence of the sociodemographic variables on cognitive functions. To test Hypothesis 1, Model 2 examined the influence of perceived stress and health status on cognitive functions, controlling for sociodemographic variables. Model 3 tested Hypothesis 2 by entering the interaction term between perceived stress and health status, controlling for sociodemographic variables. Listwise deletion was used to address missing data. All statistical analyses were undertaken using SAS, Version 9.2.

Results

Table 1 provided descriptive statistics of all variables under study. Specifically, it included age, sex, education, income, general health status, perceived stress, and z scores of cognitive functions (i.e., global cognition, episodic memory, working memory, perceptual speed, and C-MMSE).

Table 2 showed spearman correlations between cognitive functions and perceived stress, health status, and socio-demographic variables. Cognitive functions were positively related to education, income, and health status, but negatively related to age, sex (female), and perceived stress.

Regression Model 2 tested Hypothesis 1, the relationship between perceived stress and cognitive functions among U.S. Chinese older adults. Perceived stress had negative impact on the cognitive functions, after controlling for age, sex, education, and

income (see Table 3). For every unit increase of perceived stress, global cognition decreased by .13 [$t(3018) = -8.73, p < .001$], episodic memory decreased by .06 [$t(2986) = -3.51, p < .001$], working memory decreased by .09 [$t(2876) = -5.70, p < .001$] and perceptual speed decreased by .12 [$t(2781) = -6.10, p < .001$].

Regression Model 3 tested Hypothesis 2, the moderating role of health status on the stress-cognition relationship. Significant interactions between perceived stress and general health were found for global cognition [$\beta = .07, t(3017) = 2.97, p < .01$], episodic memory [$\beta = .07, t(2985) = 2.47, p < .05$], and working memory [$\beta = .06, t(2875) = 2.17, p < .05$], but not for perceptual speed [$t(2780) = .525, p = .60$]. Multicollinearity was tested by examining tolerance and the Variance Inflation Factor (VIF) for the variables. Overall, results indicated that multicollinearity was not a problem (VIFs < 3.2, Tolerance > 0.32).

To better understand the significant interaction effects, separate linear regressions of perceived stress on cognitive functions were performed for Chinese older adults who reported poor health status and those who reported good health status. After controlling for sociodemographic variables, the estimated slope of perceived stress on global cognitive function was $-.15 [t(1825) = -8.41, p < .001]$ for Chinese older adults who reported poor health status, and $-.06 [t(1188) = -2.58, p < .05]$ for those who reported good health status. For episodic memory, the estimated slope of perceived stress was $-.08 [t(1799) = -4.13, p < .001]$ for Chinese older adults who reported poor health status. In contrast, the effect of perceived stress on cognitive functions was not significant for those who reported good health [$t(1182) = .07, p = .95$]. Similar results were found for working memory. Perceived stress had an estimated slope of $-.12 [t$

(1731) = -6.06, $p < .001$] for those who reported poor health status. In contrast, perceived stress did not significantly predict working memory for those who reported good health status [$t(1140) = -1.31, p = .19$]. Figure 1 illustrated the interaction effect of perceived stress and health status on global cognition. Supporting Hypothesis 2, the figure shows that the negative stress-cognition slopes were steeper for those who had poor health status than for those who had good health status.

Discussion

The present study is the first population-based study that investigated the stress-cognition relationships among U.S. Chinese older adults. Perceived stress was found negatively related to multiple cognitive functions (i.e., episodic memory, working memory, and perceptual speed) among Chinese older adults. More importantly, Chinese older adults' health status moderated the negative relationships between perceived stress and cognitive functions. Perceived stress had more pronounced negative impacts on cognitive functions for Chinese older adults with poor health status than those with good health status. These findings add to our understanding of the complex relationships among stress, health, and cognitive functions among older adults.

The Stress-Cognition Relationship

The paradoxical relationships between stress and cognition have been frequently studied in experiments with animals, but rarely with humans (Sandi, 2013). Stress intensity and the context where stress occurs were two important factors influencing the stress-cognition relationships (Sandi, 2013). Our findings of the negative relationship between perceived stress and cognitive functions among U.S. Chinese older adults support the important role of context on the stress-cognition relationship. Individuals

perceive stress when environmental demands exceed their coping resources (Cohen, et al., 1995). Although the present study assessed the degree to which life situations were perceived stressful *in the last month*, it likely reflected an overall evaluation of stressful life situations of U.S. Chinese older adults. The double jeopardy of physical aging and acculturation stress may make Chinese older adults in the United States especially vulnerable to cognitive impairment (Chen, et al., 2017).

Few population-based studies examined the stress-cognition relationships due to the difficulty of measuring cognitive functions in large populations (Aggarwal, et al., 2014). One strength of the PINE data is the inclusion of multiple measures of cognitive functions, such as episodic memory, working memory, and perceptual speed. The present study is the first to discover the negative stress-cognition relationship in a population-based study of U.S. Chinese older adults (i.e., PINE). The stress-cognition relationship among Chinese older adults was similar to the relationships among White and Black older adults in another population-based research (i.e., Chicago Health and Aging Project; Aggarwal, et al., 2014).

The Moderating Role of Health Status

Under stressful situations, it is vital to have adequate coping resources (Carver, 2007; Cohen, et al., 1995). Physical health is an important coping resource. Our results suggested that when Chinese older adults had good health status, the negative impact of stress on global cognition were not as pronounced as those older adults who had poor health status. Furthermore, the negative stress-cognition relationships were not significant for episodic memory and working memory when Chinese older adults reported good health, but were significantly more negative when they reported poor

health. These findings support the SAVI model (Charles, 2010), which suggests that older adults may be more vulnerable to stressful situations and suffer worse cognitive and emotional consequences than younger adults due to their increased physiological vulnerabilities. Chinese older adults who reported poor health status were likely to have increased physiological vulnerabilities to stressful situations, and thus had impaired cognitive functions than those who reported good health status. Recent cognitive aging research calls for studies that advance our understanding of cognitive aging processes (Kremen, Lachman, Pruessner, Sliwinski, & Wilson, 2012). The recommendations include testing multiple mediators, examining moderation effects, and targeting interventions (Kremen, et al., 2012). Following these recommendations, we found that health status was a significant moderator of the stress-cognition relationship. Our findings extend current understanding of the mechanisms underlying the stress-cognition relationships.

Limitations and Future Direction

The findings of the present study should be interpreted with limitations in mind. First, although the PINE study was representative of Chinese older adults living in the Greater Chicago area, our findings may not be generalizable to other Chinese populations because of geographical variations, which may influence the regional variations on demography, immigration, acculturation, and social support network. More population-based research is needed to investigate Chinese older adults' stress and cognitive functions in different regions across the United States. Second, the interaction effects of stress and health status were found on episodic memory and working memory, but not on perceptual speed. Since the PINE only had these three

cognitive measures, it was difficult to speculate why. Future research may include more comprehensive cognitive assessments to test the interaction effects. Finally, the cross-sectional design cannot determine the causal directions of perceived stress and cognitive functions. Perceived stress may increase in response to cognitive impairments rather than cause it. Future studies with longitudinal designs are needed to better understand the complex relationships of stress, health, and cognitive functions among Chinese older adults.

Implications

This present study has important implications for researchers, health professionals, social workers, and policy makers. First, this study provided a basis for population-based research investigating the relationships between perceived stress and cognitive functions among U.S. Chinese older adults. Standardized cognitive scores in this sample can be compared to those in other older adult populations in the U.S. and China. For example, the cognitive functions of U.S. Chinese older adults can be compared to their White counterparts in the U.S. and Chinese older adults in China to estimate the normative age-related declines in cognitive functions due to physical aging versus acculturation stress unique to Chinese older adults living in the United States. Second, our findings can help health professionals, social workers, and policy makers identify the high-risk older adults for intervention purposes. The present study suggests that Chinese elderly who perceived high levels of stress and had poor health status is the most vulnerable group of cognitive impairments. It is essential to prioritize this high-risk group in clinical evaluations and interventions.

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Declare of Conflict of Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Reference

- Aggarwal, N. T., Wilson, R. S., Beck, T. L., Rajan, K. B., De Leon, C. F. M., Evans, D. A., & Everson-Rose, S. A. (2014). Perceived stress and change in cognitive function among adults aged 65 and older. *Psychosomatic medicine*, *76*(1), 80. doi: 10.1097/PSY.000000000000016
- Albert, M., Smith, L. A., Scherr, P. A., Taylor, J. O., Evans, D. A., & Funkenstein, H. H. (1991). Use of brief cognitive tests to identify individuals in the community with clinically diagnosed Alzheimer's disease. *International journal of Neuroscience*, *57*(3-4), 167-178. doi: 10.3109/00207459109150691
- Carver, C. S. (2007). Stress, Coping, and Health. In H. S. Friedman, R. C. Silver, H. S. Friedman, R. C. Silver (Eds.), *Foundations of health psychology* (pp. 117-144). New York, NY, US: Oxford University Press.
- Chang, E. S., & Dong, X. (2014). A battery of tests for assessing cognitive function in US Chinese older adults—Findings from the PINE Study. *Journals of Gerontology Series A: Biomedical Sciences and Medical Sciences*, *69*(Suppl_2), S23-S30. doi:10.1093/gerona/glu195
- Charles, S. T. (2010). Strength and vulnerability integration: A model of emotional well-being across adulthood. *Psychological Bulletin*, *136*(6), 1068-1091. doi:10.1037/a0021232
- Charles, S. T., Leger, K. A., & Urban, E. J. (2016). Emotional experience and health: What we know, and where to go from here. In A. D. Ong, C. E. Löckenhoff, A. D. Ong, C. E. Löckenhoff (Eds.), *Emotion, aging, and health* (pp. 185-204).

Washington, DC, US: American Psychological Association. doi:10.1037/14857-010

Carstensen, L. L.; Isaacowitz, D. M.; Charles, S. T. (1999). "Taking time seriously: A theory of socioemotional selectivity". *American Psychologist*. 54 (3): 165. PMID 10199217. doi:10.1037/0003-066X.54.3.165

Chiu, H. F., Lee, H. C., Chung, W. S., & Kwong, P. K. (1994). Reliability and validity of the Cantonese version of mini-mental state examination-a preliminary study. *Hong Kong Journal of Psychiatry*, 4(2), 25.

Chen, Y., Peng, Y., Ma, X., & Dong, X. (2017). Conscientiousness moderates the relationship between perceived stress and depressive symptoms among US Chinese older adults. *Journals of Gerontology Series A: Biomedical Sciences and Medical Sciences*, 72(suppl_1), S108-S112. doi: 10.1093/gerona/glw172

Chen, Y., Peng, Y., Xu, H., O'Brien, W. H. (2018). Age Differences in Stress and Coping: Problem-Focused Strategies Mediate the Relationship Between Age and Positive Affect. *International Journal of Aging and Human Development*, 86, 347-363. doi: 10.1177/0091415017720890

Cohen, S., Kessler, R. C., & Gordon, L. U. (1995). Strategies for measuring stress in studies of psychiatric and physical disorders. In S. Cohen, R. C. Kessler, L. U. Gordon (Eds.), *Measuring stress: A guide for health and social scientists*, 3-26. New York, NY, US: Oxford University Press.

- Dong, X., Wong, E., & Simon, M. A. (2014). Study design and implementation of the PINE study. *Journal of aging and health, 26*(7), 1085-1099. doi: 10.1177/0898264314526620
- Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). "Mini-mental state": a practical method for grading the cognitive state of patients for the clinician. *Journal of psychiatric research, 12*(3), 189-198.
- Joëls, M., Pu, Z., Wiegert, O., Oitzl, M. S., & Krugers, H. J. (2006). Learning under stress: how does it work? *Trends in cognitive sciences, 10*(4), 152-158. doi: 10.1016/j.tics.2006.02.002
- Kremen, W. S., Lachman, M. E., Pruessner, J. C., Sliwinski, M., & Wilson, R. S. (2012). Mechanisms of age-related cognitive change and targets for intervention: social interactions and stress. *Journals of Gerontology Series A: Biomedical Sciences and Medical Sciences, 67*(7), 760-765. doi: 10.1093/gerona/gls125
- Krueger, P. M., Saint Onge, J. M., & Chang, V. W. (2011). Race/ethnic differences in adult mortality: the role of perceived stress and health behaviors. *Social science & medicine, 73*(9), 1312-1322. doi: 10.1016/j.socscimed.2011.08.007
- Krueger, K. R., Wilson, R. S., Bennett, D. A., & Aggarwal, N. T. (2009). A battery of tests for assessing cognitive function in older Latino persons. *Alzheimer disease and associated disorders, 23*(4), 384. doi: 10.1097/WAD.0b013e31819e0bfc
- Lazarus, R. S., & Folkman, S. (1987). Transactional theory and research on emotions and coping. *European Journal of personality, 1*(3), 141-169. doi: 10.1002/per.2410010304

- Lupien, S. J., McEwen, B. S., Gunnar, M. R., & Heim, C. (2009). Effects of stress throughout the lifespan on the brain, behaviour and cognition. *Nature reviews neuroscience*, 10(6), 434-445. doi:10.1038/nrn2639
- Salthouse, T. A. (1996). The processing-speed theory of adult age differences in cognition. *Psychological Review*, 103, 403-428.
- Sandi, C. (2013). Stress and cognition. *Wiley Interdisciplinary Reviews: Cognitive Science*, 4(3), 245-261. doi: 10.1002/wcs.1222
- Simon, M. A., Chang, E. S., Rajan, K. B., Welch, M. J., & Dong, X. (2014). Demographic characteristics of US Chinese older adults in the greater Chicago area: assessing the representativeness of the PINE study. *Journal of aging and health*, 26(7), 1100-1115. doi: 10.1177/0898264314543472
- Smith, A. (1982). Symbol digit modalities test (SDMT) manual (revised) Western Psychological Services. *Los Angeles*.
- U.S.Census Bureau. *Census Demographic Profile.2011*. Washington, D.C.: U.S. Census Bureau; 2010.
- Wechsler, D. (1987). *Wechsler memory scale-revised manual*. San Antonio, TX: Psychological Corporation.
- Wimo, A., Jönsson, L., Bond, J., Prince, M., & Winblad, B. (2013). The worldwide economic impact of dementia 2010. *Alzheimer's & Dementia*, 9(1), 1-11. doi: 10.1016/j.jalz.2012.11.006

Zhang, M., Simon, M. A., & Dong, X. (2014). The prevalence of perceived stress among US Chinese older adults. *AIMS Medical Science*, 1(1), 40-56. doi: 10.3934/medsci.2014.1.40

Table 1. Descriptive Statistics for the Sociodemographic and Testing Variables

Variable	Total Number	Mean/n(%)	Std. Dev.	Range
Age		72.31	8.30	59-105
Sex:				
Male		1334 (42.3)	-	-
Female		1822 (57.7)	-	-
Education (years)		8.72	5.06	0-26
Income:				
Less than \$10,000		2656 (84.1)	-	-
More than \$10,000		465 (14.7)	-	-
Perceived Stress		10.07	6.54	0-39
General Health:				
Poor/Fair		1921 (60.8)	-	-
Good/Very good		1236 (39.2)	-	-
Global cognitive functions	3148	-.02	.79	-4.45-1.68
C-MMSE	3142	0	1	-5.08-1.03
Episodic memory	3097	0	1	-2.53-1.45
Working memory	2971	0	1	-2.31-2.76
Perceptual speed	2878	0	1	-1.46-2.83

Note: C-MMSE = Chinese Mini-Mental State Exam; C-MMSE, Episodic memory, working memory and perceptual speed were standardized prior to testing.

Table 2. Spearman Correlations between Cognitive Functions and Perceived Stress, Health Status, and Sociodemographic Variables

Variables	Age	Sex	Education	Income	Perceived Stress	General Health
1. Global Cognitive Function	-.32**	-.14**	.58**	.17**	-.16**	.10**
2. C-MMSE	-.30**	-.16**	.53**	.18**	-.20**	.08**
3. Episodic Memory	-.30**	-.08**	.46**	.15**	-.09**	.09**
4. Working memory	-.22**	-.20**	.51**	.12**	-.14**	.07**
5. Perceptual Speed	-.23**	-.08**	.41**	.11**	-.17**	.09**

Notes. C-MMSE = Chinese Mini Mental Status Exam; * $p < .05$, ** $p < .01$.

Table 3. Linear Regression Models on Cognitive Functions

Model	Global Cognitive Functions		Episodic Memory		Working memory		Perceptual Speed	
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>
Model 1								
Age	-.03***	.00	-.03***	.00	-.02***	.00	-.01***	.00
Sex	-.07**	.02	.00	.03	-.21***	.03	.02	.04
Education	.08***	.00	.08***	.00	.09***	.00	.04***	.00
Income	.10**	.03	.04**	.04	.04	.04	.04	.05
Adjusted R ²	.39		.28		.29		.40	
Model 2								
Age	-.03***	.00	-.03***	.00	-.02***	.00	-.01**	.00
Sex	-.06**	.02	.02	.03	-.19***	.03	.03	.04
Education	.08***	.00	.08***	.00	.09***	.00	.04***	.00
Income	.08**	.03	.11*	.04	.02	.04	.02	.05
Perceived Stress	-.02***	.00	-.01***	.00	-.01***	.00	-.02***	.00
General Health	.06*	.02	.11**	.03	.03	.03	.02	.04
Adjusted R ²	.41		.29		.30		.41	
Model 3								
Age	-.03***	.00	-.03***	.00	-.02***	.00	-.01**	.00
Sex	-.06**	.02	.02	.03	-.19***	.03	.03	.04
Education	.08***	.00	.08***	.00	.09***	.00	.04***	.00
Income	.08*	.03	.11*	.04	.02	.04	.02	.05
Perceived Stress	-.02***	.00	-.01***	.00	-.02***	.00	-.02***	.00
General Health	-.04	.04	.00	.06	-.07	.06	-.01	.07
Stress X Health	.01**	.00	.01*	.00	.01*	.00	.00	.01
Adjusted R ²	.41		.29		.30		.41	

Notes. * $p < .05$, ** $p < .01$, *** $p < .001$.

Figure 1. Interaction of Perceived Stress and Health Status on Global Cognition

