Self-reported and directly observed physical function and anxiety symptoms in community-dwelling US Chinese older adults: Findings from the PINE study.

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Abstract

Background: The association between physical function and anxiety symptoms has been widely discussed, but remains unclear. This study aims to examine the association between both self-reported and performance-based measures of physical function and anxiety symptoms in a community-dwelling population of Chinese older adults.

Methods: Data were derived from the Population Study of Chinese Elderly (PINE), a community-engaged, population-based epidemiological study of U.S. Chinese older adults aged 60 and above in the Greater Chicago area. Anxiety symptoms were measured by the anxiety subscale from the Hospital Anxiety and Depression Scale.

Results: Every one point higher in ADL impairment (OR: 1.23, 1.09-1.39), IADL impairment (OR: 1.17, 1.12-1.22), Index of Mobility scale (OR: 1.30, 1.19-1.42) and Index of Basic Physical Activities scale (OR: 1.09, 1.06-1.11), and lower levels of physical performance (OR: 1.13, 1.09-1.16) were associated with higher risk for anxiety symptoms.

Discussion: This study goes beyond prior studies by examining both self-reported and performance-based physical function and anxiety symptoms. The result suggests higher levels of self-reported physical function impairment and lower levels of physical performance are associated with higher risk of anxiety symptoms among community-dwelling U.S. Chinese older adults, which is contrary to studies in other culture. Cross-cultural research is needed to examine the association between physical function and anxiety symptoms under different contexts.

Introduction

Anxiety is a common mental illness and affecting up to 18% of community-dwelling older adults [1]. Anxiety refers to the general apprehension toward an unidentifiable source or uncertain future event [2,3]. Prior studies suggest that women, higher levels of physical function and quality of life were associated with greater levels of anxiety symptoms [4,5]. Physical function, in particular, is regarded as a significant predictor for anxiety among Canadian older adults, as health decline threatens to reduce the control they have over life [6]. Physical function decline usually leads to additional healthcare cost, which may intensify anxiety of older adults [7].

The association between physical function and anxiety has been widely discussed, but remains unclear. Some research

reported higher levels of physical function impairment were associated with greater risk of anxiety [6,8]. However, other studies found the association between physical function and anxiety was not significant [9]. One reason for the conflicting results in the association between physical function and anxiety is the various measures in physical function. Most prior studies adopted self-reported measures [9,10], while a few research used performance-based measures in physical function [11]. Additionally, these studies used a single item with a five-point response scale to assess physical function [9]. Older adults with high levels of anxiety may be biased to rate their physical function as poorer than those with low levels of anxiety [6]. The validity of physical function measures in early studies may explain some of the variabilities in study findings.

Early studies that examined the association between

physical function and anxiety mainly focused on anxiety disorders, which excluded older adults who were experiencing anxiety symptoms and didn't meet the requirements for anxiety disorder [9]. Older adults with anxiety symptoms were similar to those with anxiety disorders in terms of comorbidity and use of health services [12]. Studies on anxiety disorder may underestimate the association between physical function and anxiety. Research that focused on physical function and anxiety symptoms can better understand this issue among older adults.

The association between physical function and anxiety has rarely been examined in Chinese culture. Existing empirical studies investigated the association between physical function and anxiety among older adults in low- and middle-income countries and reported severe disability was significantly associated with having an anxiety syndrome in Cuba, Dominican Republic, Venezuela, Mexico and India, with the exception of Peru [8]. The association between physical function and anxiety may differ in Chinese culture [13]. In Chinese families, poorer physical function may not only evoke anxiety about aging, but also make them worry about adult children's behaviors due to a strong sense of filial piety expectation [14]. However, limited research investigated the association between physical function and anxiety in Chinese contexts.

To address these limitations in the literature, this study goes beyond previous research by adopting both self-reported and performance-based measures in physical function, and investigating the association between physical function and anxiety symptoms among Chinese community-dwelling older adults in the Greater Chicago Area. This study allowed us to test whether physical function was associated with anxiety symptoms and whether findings differed when using a self-reported measure of physical function compared with a performance-based measure of physical function.

Methods

Sample

The Population Study of ChINese Elderly in Chicago (PINE) is a community-engaged, population-based epidemiological study of U.S. Chinese older adults aged 60 and above in the Greater Chicago area. The PINE study is a representative of the Chinese aging population in the Greater Chicago area with a sample size of 3,159 [15,16]. Culturally appropriate community recruitment strategies guided by community-based participatory research (CBPR) approach were used to ensure community participation [17-20]. Face-to-face home interviews were conducted by trained multicultural and multilingual interviewers. Preferred language (English or Chinese) and dialect (e.g., Cantonese, Taishanese, Mandarin, and Teochew) for participants was used during the interview. The study has been approved by the Institutional Review Board of the Rush University Medical Center [21].

Measurements

Physical Function: Self-reported physical function and physical performance testing were used to collect information on physical function. Different measurements have been adopted to evaluate self-reported physical function, involving Katz activities of daily living (ADL) [22], Lawton instrumental activities of daily living (IADL) [23], Index of Mobility scale [24] and Index of Basic Physical Activities scale [25]. Higher scores of ADL, IADL, Index of Mobility scale and Index of Basic Physical Activities scale indicated higher levels of physical impairment. In this sample, ADL (Cronbach's alpha=0.92), IADL (Cronbach's alpha=0.90), Index of Mobility scale (Cronbach's alpha=0.80) and Index of Basic Physical Activities scale (Cronbach's alpha=0.80) had a good internal consistency.

As for physical performance testing, participants were asked to perform chair stand, tandem stand and timed walk, which has been employed in large-scale population studies, such as the Chicago Health and Aging Project [26,27]. Higher scores of physical performance testing were associated with lower levels of physical performance.

Anxiety Symptoms: Anxiety symptoms were measured by the anxiety subscale from the Hospital Anxiety and Depression Scale (HADS-A) [28]. Participants were asked if they currently had the following symptoms: (i) felt tense or wound up, (ii) had a frightened feeling as if something awful is about to happen, (iii) had worrying thoughts, (iv) sit at ease and feel relaxed, (v) had a frightened feeling like butterflies in the stomach, (vi) had feelings of restless, or (vii) had feelings of panic. Respondents indicated answers to each item on a 4-point scale ranging from 0 (not at all) to 3 (most of the time). The HADS-A has been tested in Chinese populations and has shown good interrater reliability [29]. In our study, the Cronbach's alpha of the anxiety subscale was 0.80.

Confounding Variables: Sociodemographic factors including age (in years), sex, education, annual income (in USD), number of children, living arrangement, years in the community, years in the U.S. and medical comorbidities were controlled in the models. Education was categorized into three groups: (i) elementary school and below; (ii) high school; and (iii) college and above. Self-reported annual income was divided into three groups: (i) $0–$4,999 per year; (ii) $5,000–$9,999 per year; and (iii) more than $10,000 per year. Medical comorbidities were evaluated by the presence of nine diseases: (i) heart disease, heart attack, coronary thrombosis, coronary occlusion, or myocardial infarction; (ii) stroke or brain hemorrhage; (iii) cancer, malignancy, or a tumor of any type; (iv) high cholesterol; (v) diabetes, sugar in the urine, or high blood sugar; (vi) high blood pressure; (vii) a broken or fractured hip; (viii) thyroid disease; or (ix) osteoarthritis or inflammation or problems with joints [30-32].

Data Analysis

To examine the association between physical function and anxiety symptoms, multivariate logistic regression models were employed to control for potential confounding factors. Model A was adjusted for basic sociodemographic characteristics, including age and sex. Model B added education and income. Number of children and living arrangement were added in Model C. In Model D, we added years in the community and years in the U.S.. Model E added medical comorbidities to the previous model. Additionally, all of the above models (Models A–E) were repeatedly using physical function with respect to anxiety symptoms outcomes. Odds ratios (ORs), 95% confidence intervals (CIs), and significance levels were reported for multivariate analyses. All statistical analyses were conducted using SAS, Version 9.2 (SAS Institute Inc., Cary, North Carolina).

Results

The older adults in the study sample had a mean age of 72.8 years (*SD*=8.3, range=60-105) and 58.9% were female. The majority of participants (78.9%) had equal or less than a high school education. Most of them (85.1%) had an annual income less than US$10,000. More than half of the participants (55.6%) averagely had 3 or more children. 21% of participants lived alone. 26.7% of the participants had been in the United States for less than 10 years and 57.5% had been in the community for less than 10 years. Details of the sample characteristics have been described elsewhere [14,33].

The association between physical function and anxiety symptoms were examined in Tables 1-5. Physical function was measured by ADL, IADL, Index of Mobility scale, Index of Basic Physical Activities scale and physical performance testing.

Table 1 showed ADL impairment was significantly associated with anxiety symptoms after controlling for age, sex, education, income, number of children, living arrangement, years in the community, years in the U.S. and medical comorbidities. Every one point higher in ADL impairment was associated with higher risk of anxiety symptoms (OR: 1.23, 1.09-1.39).

Table 2 suggested that greater levels of impairment in IADL were associated with higher risk of anxiety symptoms (OR: 1.17, 1.12-1.22). Table 3 showed that every one point higher in Index of Mobility scale was associated with higher risk of anxiety symptoms (OR: 1.30, 1.19-1.42). In Table 4, older adults with higher scores in Index of Basic Physical Activities scale were more likely to experience higher risk of anxiety symptoms (OR: 1.09, 1.06-1.11).

In Table 5, physical performance was found to be significantly associated with anxiety symptoms after controlling age, sex, education, income, number of children, living arrangement, years in the community, years in the U.S. and medical comorbidities. Lower levels of physical performance were associated with higher risk of anxiety symptoms (OR: 1.13, 1.09-1.16). Additionally, sex and living arrangement were significantly associated with anxiety symptoms consistently for all multivariable models. Older adults who were female and live with fewer people were more likely to experience higher levels of anxiety symptoms.

Discussion

The PINE study is the largest population-based epidemiological study to investigate the association between physical function and anxiety symptoms among U.S. Chinese older adults. This study confirmed that higher levels of self-reported physical function impairment and lower levels of physical performance were associated with higher risk of anxiety symptoms after controlling for age, sex, education, income, number of children, living

Table 1. Association between ADL and anxiety symptoms

	Model A	Model B	Model C	Model D	Model E
Outcome: Anxiety Symptoms					
			OR (95% CI)		
Age	1.00 (0.99, 1.01)	1.00 (0.99, 1.01)	1.00 (0.99, 1.01)	1.01 (0.99, 1.02)	1.00 (0.99, 1.01)
Female	1.65 (1.42, 1.91)***	1.68 (1.44, 1.96)***	1.66 (1.42, 1.93)	1.66 (1.42, 1.94)***	1.59 (1.36, 1.86)***
Education		1.01 (0.99, 1.03)	1.00 (0.99, 1.02)	1.00 (0.98, 1.02)	1.00 (0.98, 1.01)
Income		0.99 (0.93, 1.06)	0.98 (0.92, 1.05)	1.02 (0.95, 1.09)	1.02 (0.95, 1.09)
Number of Children			0.95 (0.90, 1.01)	0.95 (0.90, 1.00)	0.95 (0.90, 1.00)
Living Arrangement			0.94 (0.91, 0.98)**	0.94 (0.90, 0.98)**	0.94 (0.90, 0.98)**
Years in the Community				1.00 (0.99, 1.01)	1.00 (0.99, 1.01)
Years in the U.S.				0.99 (0.99, 1.00)	0.99 (0.98, 1.00)
Medical Comorbidities					1.10 (1.04, 1.17)***
ADL	1.25 (1.11, 1.40)***	1.25 (1.11, 1.41)***	1.25 (1.11, 1.41)***	1.25 (1.11, 1.41)***	1.23 (1.09, 1.39)***

*Note: * p<0.05, ** p<0.01, *** p<0.001*

Table 2. *Association between IADL and anxiety symptoms*

Outcome: Anxiety Symptoms					
	Model A	**Model B**	**Model C**	**Model D**	**Model E**
	OR (95% CI)				
Age	0.98 (0.97, 1.00)**	0.99 (0.97, 1.00)**	0.98 (0.97, 1.00)**	0.99 (0.98, 1.00)	0.99 (0.98, 1.00)*
Female	1.57 (1.35, 1.83)***	1.63 (1.39, 1.90)***	1.60 (1.36, 1.87)***	1.60 (1.37, 1.88)***	1.57 (1.34, 1.84)***
Education		1.02 (1.00, 1.03)*	1.01 (0.99, 1.03)	1.01 (0.99, 1.02)	1.00 (0.99, 1.02)
Income		1.00 (0.94, 1.07)	0.99 (0.93, 1.06)	1.03 (0.95, 1.10)	1.03 (0.96, 1.11)
Number of Children			0.94 (0.89, 1.00)	0.94 (0.89, 1.00)*	0.94 (0.89, 1.00)*
Living Arrangement			0.94 (0.90, 0.98)**	0.93 (0.89, 0.97)**	0.93 (0.89, 0.98)**
Years in the Community				1.00 (0.99, 1.01)	1.00 (0.99, 1.01)
Years in the U.S.				0.99 (0.99, 1.00)	0.99 (0.98, 1.00)
Medical Comorbidities					1.06 (1.00, 1.12)*
IADL	1.16 (1.12, 1.21)***	1.17 (1.13, 1.22)***	1.17 (1.13, 1.22)***	1.18 (1.13, 1.22)***	1.17 (1.12, 1.22)***

*Note: * p<0.05, ** p<0.01, *** p<0.001*

Table 3. *Association between Index of Mobility scale and anxiety symptoms*

Outcome: Anxiety Symptoms					
	Model A	**Model B**	**Model C**	**Model D**	**Model E**
	OR (95% CI)				
Age	0.99 (0.98, 1.00)	0.99 (0.98, 1.00)	0.99 (0.98, 1.00)	1.00 (0.98, 1.01)	0.99 (0.98, 1.01)
Female	1.58 (1.36, 1.83)***	1.61 (1.38, 1.88)***	1.59 (1.36, 1.86)***	1.59 (1.36, 1.86)***	1.55 (1.33, 1.82)***
Education		1.01 (0.99, 1.02)	1.00 (0.99, 1.02)	1.00 (0.98, 1.02)	1.00 (0.98, 1.01)
Income		1.00 (0.93, 1.06)	0.99 (0.93, 1.06)	1.02 (0.95, 1.09)	1.02 (0.95, 1.10)
Number of Children			0.95 (0.90, 1.01)	0.95 (0.89, 1.00)	0.95 (0.89, 1.00)
Living Arrangement			0.95 (0.91, 0.99)*	0.95 (0.91, 0.99)*	0.95 (0.91, 0.99)*
Years in the Community				1.00 (0.99, 1.01)	1.00 (0.99, 1.01)
Years in the U.S.				0.99 (0.98, 1.00)	0.99 (0.98, 1.00)
Medical Comorbidities					1.08 (1.02, 1.14)**
Index of Mobility Scale	1.33 (1.22, 1.45)***	1.33 (1.22, 1.45)***	1.33 (1.22, 1.45)***	1.32 (1.21, 1.44)***	1.30 (1.19, 1.42)***

*Note: * p<0.05, ** p<0.01, *** p<0.001*

Table 4. *Association between Index of Basic Physical Activities scale scale and anxiety symptoms*

Outcome: Anxiety Symptoms					
	Model A	**Model B**	**Model C**	**Model D**	**Model E**
	OR (95% CI)				
Age	0.99 (0.98, 1.00)*	0.99 (0.98, 1.00)	0.99 (0.98, 1.00)	0.99 (0.98, 1.01)	0.99 (0.98, 1.01)
Female	1.48 (1.28, 1.73)***	1.52 (1.30, 1.77)***	1.49 (1.28, 1.75)***	1.50 (1.28, 1.76)***	1.48 (1.26, 1.73)***
Education		1.01 (1.00, 1.03)	1.00 (0.99, 1.02)	1.00 (0.98, 1.02)	1.00 (0.98, 1.02)
Income		1.01 (0.95, 1.08)	1.00 (0.94, 1.07)	1.03 (0.96, 1.11)	1.03 (0.96, 1.11)
Number of Children			0.95 (0.90, 1.01)	0.95 (0.90, 1.01)	0.95 (0.90, 1.01)
Living Arrangement			0.95 (0.91, 0.99)*	0.94 (0.90, 0.98)	0.94 (0.90, 0.98)**
Years in the Community				1.00 (0.99, 1.01)	1.00 (0.99, 1.01)
Years in the U.S.				0.99 (0.98, 1.00)	0.99 (0.98, 1.00)
Medical Comorbidities					1.06 (1.00, 1.12)
Index of Basic Physical Activities	1.09 (1.07, 1.12)***	1.09 (1.07, 1.12)***	1.09 (1.07, 1.12)***	1.09 (1.07, 1.12)***	1.09 (1.06, 1.11)***

*Note. * p<0.05, ** p<0.01, *** p<0.001*

arrangement, years in the community, years in the U.S. and medical comorbidities.

Previous research found the health related changes would intensify the anxiety about aging in Chinese societies [5,8,34]. Additionally, with a strong sense of filial piety expectation in Chinese culture, older adults would expect their adult children to take care of them when they were

Table 5. Association between physical performance and anxiety symptoms

	Model A	Model B	Model C	Model D	Model E
Outcome: Anxiety Symptoms					
	OR (95% CI)				
Age	0.98 (0.97, 0.99)**	0.98 (0.97, 1.00)**	0.98 (0.97, 1.00)**	0.99 (0.98, 1.00)	0.99 (0.98, 1.00)
Female	1.54 (1.32, 1.79)***	1.60 (1.37, 1.87)***	1.58 (1.35, 1.85)***	1.58 (1.35, 1.85)***	1.54 (1.32, 1.81)***
Education		1.02 (1.01, 1.04)**	1.01 (1.00, 1.03)	1.01 (0.99, 1.03)	1.01 (0.99, 1.03)
Income		1.00 (0.94, 1.07)	0.99 (0.93, 1.06)	1.03 (0.96, 1.11)	1.03 (0.96, 1.11)
Number of Children			0.94 (0.89, 0.99)*	0.94 (0.88, 0.99)*	0.94 (0.88, 0.99)*
Living Arrangement			0.95 (0.91, 0.99)*	0.95 (0.91, 0.99)**	0.95 (0.91, 0.99)*
Years in the Community				1.00 (0.99, 1.01)	1.00 (0.99, 1.01)
Years in the U.S.				0.99 (0.98, 1.00)	0.99 (0.98, 1.00)*
Medical Comorbidities					1.06 (1.00, 1.12)*
Physical Performance	1.12 (1.09, 1.15)***	1.13 (1.10, 1.16)***	1.13 (1.10, 1.16)***	1.13 (1.10, 1.17)***	1.13 (1.09, 1.16)***

*Note: * p<0.05, ** p<0.01, *** p<0.001*

disabled. Thus, older adults with poor physical function worried about their health as well as their filial piety behaviors of their adult children [35]. With regard to U.S. Chinese older adults, their traditional social support system broke down [36], and the culture and language barriers inhibited their access to health care services [37-39]. Due to the vulnerability in a new country, poorer physical function was more likely to exacerbate their anxiety.

Some prior studies evaluated self-reported physical function by a single item and rated on a five-point response scale [9]. The reporting bias in physical function would influence the association between physical function and anxiety. This study provided a comprehensive measurement in self-reported physical function which included ADL, IADL, Index of Mobility scale and Index of Basic Physical Activities scale. And consistency in the association between self-reported physical function and anxiety symptoms was identified in the present study.

Early studies identified differences existed between self-reported and performance-based measures in physical function [40]. Assessing physical function in both self-reported and performance-based measures can decrease reporting bias in self-rated health [41]. Thus, it is necessary to examine the association between self-reported physical function and anxiety symptoms as well as performance-based physical function and anxiety symptoms to get a better understanding of the association between physical function and anxiety symptoms.

In contrast with previous research, this study found the greater levels of self-reported physical function impairment and lower levels of physical performance were associated with higher risk of anxiety symptoms. It may be explained by different culture. The research which targeted at older adults from entire black communities reported higher levels of self-reported physical function decline were associated with higher risk of anxiety but the association between performance-based physical function and anxiety was not significant [1]. Our study was conducted among U.S.

Chinese older adults and found the association between self-reported physical function and anxiety symptoms was consistent with the association between performance-based physical function and anxiety symptoms. This study provided cross-cultural comparisons between Chinese older adults and those in different culture context on the association between physical function and anxiety symptoms with both measures in physical function.

The association between physical function and anxiety has been examined in other population. For instance, the research on the association between objective physical function indicators and anxiety disorder has been conducted in middle-aged populations, and found women with anxiety disorders had poorer physical function in hand grip strength and lung function, however, men with anxiety disorders were associated with higher lung function [11]. In our research, older adults with poorer physical performance were more likely to have higher risk of anxiety symptoms compared with those with better physical performance. Future research is expected to test the moderating effect of gender in the association between physical function and anxiety in the ageing population.

The results showed that older adults who were female and live with fewer people were more likely to experience higher levels of anxiety symptoms. In consistent with prior studies, women had higher risk of anxiety symptoms [5,34]. Gender differences in anxiety symptoms may be explained by some predisposing factors. Some research also argued that women had stronger negative emotions as their emotional intensity was higher than men. Individuals with higher emotional intensity would experience stronger positive or negative feelings [42,43]. As for the association between living arrangement and anxiety, early studies found living alone was a significant predictor for anxiety of Chinese older adults [44,45]. Older adults living in a large household had the potential to receive more social support than their counterparts, and resulted in lower levels of anxiety.

The results of this study should be interpreted with cautions. First, this was a cross-sectional study and so the direction of causality would be strengthened by a longitudinal study. Second, the finding may not be generalizable to Chinese older adults in other geographic areas. Third, this study mainly focused on the association between physical function and anxiety symptoms. Future studies may focus on the association between physical function and more specific anxiety disorders, such as generalized anxiety disorder. Fourth, this study did not investigate risk and protective factors for anxiety symptoms of older adults [46]. Some factors that are very important for the anxiety symptoms of older adults in Chinese culture, such as gender of children, did not include in the present study. Future studies are expected to investigate the association between gender of children and anxiety symptoms of older adults.

Clinically, the findings suggest that clinicians should focus on the anxiety symptoms of U.S. Chinese older adults with poor physical function, since older adults with physical function impairment are more likely to experience anxiety symptoms. Anxiety is easily to be ignored by clinicians, as it is difficult to detect and diagnose in the ageing population [47]. Older adults with anxiety rarely receive adequately treatment due to under-recognition or misdiagnosis of this mental illness [48]. Our study confirms that physical function impairment could be one of the indicators for anxiety symptoms.

Conclusion

The higher levels of self-reported physical function impairment and lower levels of physical performance were associated with greater risk of anxiety symptoms among Chinese older adults in the Greater Chicago Area. Much remains unknown with regard to the mechanisms in physical function and anxiety symptoms. Longitudinal studies are expected to investigate the causal relationship between physical function and anxiety symptoms. Cross-cultural research is needed to examine the association between physical function and anxiety symptoms under different contexts.

Acknowledgement

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