

Association between both Self-Reported and Directly Observed Physical Function and Depressive Symptoms in a US Chinese Population: Findings from the PINE Study

Mengting Li¹, Xinqi Dong^{2*}

¹PhD, Post Doctoral Research Fellow; Rush Institute for Healthy Aging; Rush University Medical Center

²MD, MPH Professor of Medicine, Nursing, and Behavioral Sciences Director; Chinese Health, Aging and Policy Program Associate Director, Rush Institute for Healthy Aging, Rush University Medical Center

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***Corresponding author:** Xinqi Dong*, MD, MPH Professor of Medicine, Nursing, and Behavioral Sciences Director, Chinese Health, Aging and Policy Program Associate Director, Rush Institute for Healthy Aging, Rush University Medical Center; 1645 West Jackson Blvd, Suite 675, Chicago, IL60612. Tel.: +312-942-3350; Fax: +312-942-2861 E-mail: xinqi_dong@rush.edu

Abstract

Purpose: The association between physical function and depressive symptoms has been widely discussed in literature. However, the heterogeneity in measuring self-reported physical function has obfuscated the applicability of research findings while limited research investigated the association between performance-based physical function and depressive symptoms. This study aims to examine the association between both self-reported and performance-based physical function and depressive symptoms.

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. Self-reported physical function was measured by Katz activities of daily living (ADL), Lawton instrumental activities of daily living (IADL), Index of Basic Physical Activities scale and Index of Mobility scale. Performance-based physical function was measured by Short Physical Performance Battery (SPPB). Depressive symptoms and depression were assessed by the Patient Health Questionnaire-9 (PHQ-9).

Results: Every one point higher in ADL (OR: 1.29, 1.14-1.45), IADL (OR: 1.17, 1.13-1.22), Index of Basic Physical Activities scale (OR: 1.22, 1.19-1.26), Index of Mobility scale (OR: 1.52, 1.39-1.66), and SPPB (OR: 1.16, 1.12-1.19) was significantly associated with higher risk of depressive symptoms. In addition, both self-reported and performance-based physical function was significantly associated with depression.

Discussion: This study initially examined the association between both self-reported and performance-based physical function and depressive symptoms and it further identified physical function impairment was not only associated with depressive symptoms, but also depression. Our study suggests that health professionals should be aware of the depressive symptoms or depression in older adults with physical function impairment.

Keywords: physical function; depressive symptoms; depression; older adults; Chinese

Introduction

Previous research reported physical function impairment had a contemporaneous and strong effect on depressive symptoms among a young and middle-aged population [1]. Understanding the relationship between physical function and depressive symptoms is particularly important for populations with high risk of physical impairment, such as older adults [2]. Physical function impairment is one of the most common features associated with aging [3]. Many prior studies confirmed that depression is more prevalent among disabled older adults [2].

The reciprocal relationship between physical function and depressive symptoms has been well documented in literature [4-6]. Existing studies indicated the effect of physical function on depressive symptoms was faster and stronger than the lagged effect of depressive symptoms on physical function [1, 2]. Some longitudinal studies found that prior levels of physical impairment predicted changes in depressive symptoms, but there was no evidence of the reverse association [7]. Depression was also more reversible than physical impairment. Thus, this study pays more attention to the association between physical function and depressive symptoms.

Prior studies mainly focused on the association between self-reported physical function and depressive symptoms, while the association between performance-based physical function and depressive symptoms has been understudied. Early studies found lower levels of self-reported physical function, including ADL, IADL, and physical functioning and mobility (PFM), were associated with higher levels of depression among South African older adults [8]. Studies also reported that increasing number of self-reported physical impairment was associated with an increased prevalence of depression in Latin American countries [9].

As limited literature documented the association between performance-based physical function and depressive symptoms, this study aims to accumulate knowledge on the relationship between both self-reported and performance-based physical function and depressive symptoms in a largely community-dwelling US Chinese old population. If the association between physical function and depressive symptoms can be supported, we'd like to go further to test whether physical function is associated with depression.

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 3,157 [10, 11]. Culturally appropriate community recruitment strategies guided by community-based participatory research (CBPR) approach were used to ensure community participation [12-15]. 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 were used during the interview. The study has been approved by the Institutional Review Board of the Rush University Medical Center [16].

Measurements

Depressive Symptoms and Depression. Depressive symptoms were measured by the Patient Health Questionnaire-9 (PHQ-9) [17]. Participants were asked if they had the following symptoms in the last 2 weeks: (i) changes in sleep; (ii) changes in appetite; (iii) fatigue; (iv) feelings of sadness or irritability; (v) loss of interest in activities; (vi) inability to experience pleasure, feelings of guilt or worthlessness; (vii) inability to concentrate or making decisions; (viii) feeling restless or slowed down; and (ix) suicide thoughts. The response on each item had four categories ranging from 0 = not at all to 3 = nearly every day. Any "yes" response was defined as having depressive symptoms. The total score of PHQ-9 ranges from 0 to 27, with a score of 5 and more indicating depression. The Cronbach's alpha of PHQ-9 in the PINE study was 0.82 [18, 19].

Physical Function. We collect information on physical function of older adults by both self-report and physical performance testing. Self-reported physical function measures include Katz activities of daily living (ADL) [20], Lawton instrumental activities of daily living (IADL) [21], Index of Basic Physical Activities scale [22] and Index of Mobility scale [23]. For each self-reported physical function measures, the total score in each scale was used to present physical function. Higher scores of ADL, IADL, Index of Basic Physical Activities scale and Index of Mobility scale indicated higher levels of physical impairment. In this sample, ADL (Cronbach's alpha = 0.92), IADL (Cronbach's alpha = 0.90), Index of Basic Physical Activities scale (Cronbach's alpha = 0.80) and Index of Mobility scale (Cronbach's alpha = 0.80) had a good internal consistency.

With respect to physical performance testing, the Short Physical Performance Battery (SPPB) was used to collect information. Participants were asked to perform chair stand, tandem stand and timed walk. The SPPB has been validated among Chinese Americans and has good inter-rater reliability [24, 25]. Higher scores of physical performance testing indicated higher levels of physical impairment.

Confounding Variables. Socio-demographic factors were controlled in data analysis, including age (in years), gender, education, annual income, marital status, living arrangement, number of children, years in the U.S. and medical comorbidities. 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 [26-28].

Data Analysis

Chi-square and t-test were used to compare the differences in socio-demographics and physical function of older adults with depressive symptoms and without depressive symptoms. Chi-square and t-test were also applied to test the differences in socio-demographics and physical function of older adults with depression and without depression. Multivariate logistic regression models were employed to test the association between physical function and depressive symptoms/depression. Model A was adjusted for age and gender. Model B added education, income and marital status. Number of children, living arrangement and years in the U.S. were added in Model C. Model D added medical comorbidities to the previous model. In addition, all of the above models (Models A-D) were repeatedly using physical function with respect to depressive symptoms/depression 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. 71.3% of participants were married, while 24.5% were widowed. 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. Details of the sample characteristics have been described elsewhere [29, 36].

This study found self-reported physical function and performance-based physical function differed significantly by depressive symptoms (**Table 1**). Older adults with depressive symptoms were more likely to have higher scores in ADL (M: 0.29 vs. 0.08, $p < .001$), IADL (M: 2.24 vs. 1.18, $p < .001$), Index of Basic Physical Activities scale (M: 4.40 vs. 1.73, $p < .001$), Index of Mobility scale (M: 0.92 vs. 0.45, $p < .001$), and SPPB (M: 5.30 vs. 3.87, $p < .001$) compared with those without depressive symptoms, illustrating that older adults with depressive symptoms are more likely to have poorer self-reported and performance-based physical function.

Similarly, self-reported physical function and performance-based physical function differed significantly by depression (**Table 2**). Older adults with depression were more likely to have higher scores in ADL (M: 0.51 vs. 0.13, $p < .001$), IADL (M: 3.21 vs. 1.46, $p < .001$), Index of Basic Physical Activities scale (M: 6.45 vs. 2.50, $p < .001$), Index of Mobility scale (M: 1.36 vs. 0.58, $p < .001$), and SPPB (M: 6.45 vs. 4.28, $p < .001$) than their counterparts without depression.

Table 3 showed ADL, IADL, Index of Mobility scale, Index of Basic Physical Activities scale and physical performance testing were significantly associated with depressive symptoms after controlling for age, gender, education, income, marital status, living arrangement, number of children, years in the U.S. and medical comorbidities. As for self-reported physical function, every one point higher in ADL impairment was associated with higher risk of depressive symptoms (OR: 1.29, 1.14-1.45). Greater levels of impairment in IADL were associated with higher risk of depressive symptoms (OR: 1.17, 1.13-1.22). Every one point higher in Index of Basic Physical Activities scale was associated with higher risk of depressive symptoms (OR: 1.22, 1.19-1.26). Older adults with higher scores in Index of Mobility scale were more likely to experience higher risk of depressive symptoms (OR: 1.52, 1.39-1.66). With regard to performance-based physical function, SPPB was significantly associated with depressive symptoms (OR: 1.16, 1.12-1.19) after controlling for all covariates. Specifically, every one point greater in tandem stand (OR: 1.33, 1.22-1.44), timed walk (OR: 1.23, 1.16-1.30) and chair stand (OR: 1.24, 1.18-1.31) was associated with higher risk of depressive symptoms.

In **Table 4**, we tested the association between physical function and depression. Consistently, both self-reported and performance-based physical function was significantly associated with depression. With respect to self-reported physical function and depression, every one point higher in ADL (OR: 1.32, 1.21-1.44), IADL (OR: 1.26, 1.21-1.31), Index of Basic Physical Activities scale (OR: 1.24, 1.21-1.28) and Index of Mobility scale (OR: 1.85, 1.69-2.04) was associated with higher risk of depression. As for performance-based physical function and depression, every one point higher in SPPB (OR: 1.23, 1.19-1.27) was associated with higher risk of depression. Every one point greater in tandem stand (OR: 1.35, 1.25-1.46), timed walk (OR: 1.41, 1.30-1.53) and chair stand (OR: 1.46, 1.36-1.57) was associated with higher risk of depression.

Table 1. Physical Function of PINE Study Participants with Any Depressive Symptoms

	Yes (n=1423; 45.3%)	No (n=1716; 54.67%)	p-value
Self-reported Physical Function			
ADL	0.29 (±1.09)	0.08 (±0.57)	< .001
IADL	2.24 (±2.87)	1.18 (±2.07)	< .001
Index of Basic Physical Activities Scale	4.40 (±4.44)	1.73 (±2.87)	< .001
Index of Mobility Scale	0.92 (±1.13)	0.45 (±0.87)	< .001
Performance-based Physical Function			
SPPB (reversely coded)	5.30 (±3.51)	3.87 (±2.73)	< .001
Tandem Stand (reversely coded)	0.74 (±1.35)	0.34 (±0.89)	< .001
Walk (reversely coded)	2.28 (±1.45)	1.83 (±1.42)	< .001
Chair (reversely coded)	2.33 (±1.57)	1.73 (±1.42)	< .001
Notes. Values are presented as n (%) or mean ± SD. ADL, IADL, Index of Basic Physical Activities scale, Index of Mobility scale, SPPB, Tandem stand, Walk and Chair were continuous variables. SPPB, Tandem stand, Walk and Chair were reversely coded, with higher scores indicating lower physical performance			

Table 2. Physical Function of PINE Study Participants with Depression

	Yes	No	p-value
Self-reported Physical Function			
ADL	0.51 (±1.49)	0.13 (±0.70)	< .001
IADL	3.21 (±3.33)	1.46 (±2.30)	< .001
Index of Basic Physical Activities Scale	6.45 (±4.79)	2.50 (±3.49)	< .001
Index of Mobility Scale	1.36 (±1.22)	0.58 (±0.96)	< .001
Performance-based Physical Function			
SPPB (reversely coded)	6.45 (±3.83)	4.28 (±2.99)	< .001
Tandem Stand (reversely coded)	1.05 (±1.61)	0.45 (±1.04)	< .001
Walk (reversely coded)	2.65 (±1.46)	1.96 (±1.43)	< .001
Chair (reversely coded)	2.83 (±1.62)	1.89 (±1.46)	< .001
Notes. Values are presented as n (%) or mean ± SD. ADL, IADL, Index of Basic Physical Activities scale, Index of Mobility scale, SPPB, Tandem stand, Walk and chair were continuous variables. SPPB, Tandem stand, Walk and Chair were reversely coded, with higher scores indicating lower physical performance.			

Discussion

This study found both self-reported and directly observed physical function was significantly associated with depressive symptoms after controlling for age, gender, education, income, marital status, living arrangement, number of children, years in the U.S. and medical comorbidities. In addition, both self-reported and performance-based physical function was significantly associated with depression.

Our study found self-reported physical function was significantly associated with depressive symptoms. To be

Table 3. Association between Physical Function and Depressive Symptoms				
	Model A	Model B	Model C	Model D
OR (95% CI)				
Age	1.02 (1.01,1.02)*	1.02 (1.01,1.03)*	1.02 (1.01,1.03)#	1.02 (1.00,1.03)*
Female	1.52 (1.31,1.75)#	1.52 (1.30,1.78)#	1.52 (1.30,1.79)#	1.41 (1.20,1.66)#
Education		1.01 (0.99,1.02)	1.00 (0.98,1.02)	0.99 (0.98,1.01)
Income		0.85 (0.80,0.91)#	0.86 (0.80,0.93)#	0.87 (0.81,0.93)#
Married		0.96 (0.80,1.15)	0.96 (0.79,1.15)	0.98 (0.81,1.18)
Living Arrangement			1.00 (0.96,1.04)	1.01 (0.97,1.05)
Number of Children			0.93 (0.88,0.98)+	0.93(0.88,0.98)*
Years in the U.S.			1.00 (0.99,1.00)	1.00 (0.99,1.00)
Medical Comorbidities				1.24 (1.17,1.31)#
ADL	1.34 (1.19,1.51)#	1.33 (1.18,1.50)#	1.32 (1.17,1.48)#	1.29 (1.14,1.45)#
Age	1.00 (0.99,1.01)	1.00 (0.99,1.01)	1.00 (0.99,1.02)	1.00 (0.99,1.01)
Female	1.40 (1.21,1.63)#	1.42 (1.21,1.67)#	1.42 (1.21,1.67)#	1.33 (1.13,1.57)#
Education		1.02 (1.00,1.03)	1.01 (0.99,1.02)	1.00 (0.98,1.02)
Income		0.86 (0.80,0.92)#	0.86 (0.80,0.93)#	0.87 (0.81,0.94)#
Married		0.93 (0.77,1.13)	0.93 (0.76,1.12)	0.94 (0.77,1.14)
Living Arrangement			1.00 (0.96,1.05)	1.01 (0.97,1.06)
Number of Children			0.92 (0.86,0.97)+	0.92 (0.87,0.97)+
Years in the U.S.			1.00(0.99,1.00)	0.99 (0.99,1.00)
Medical Comorbidities				1.21 (1.14,1.28)#
IADL	1.20 (1.15,1.24)#	1.19 (1.15,1.24)#	1.20 (1.15,1.24)#	1.17 (1.13,1.22)#
Age	0.99 (0.98,1.00)+	0.99 (0.98,1.00)*	0.99 (0.98,1.01)	0.99 (0.98,1.00)
Female	1.18 (1.01,1.38)*	1.23 (1.04,1.45)*	1.24 (1.05,1.46)*	1.20 (1.01,1.42)*
Education		1.02 (1.00,1.03)*	1.01 (0.99,1.03)	1.00 (0.99,1.02)
Income		0.88 (0.82,0.94)#	0.89 (0.82,0.95)*	0.89 (0.82,0.96)*
Married		1.04 (0.86,1.27)	1.04 (0.85,1.26)	1.04 (0.85,1.27)
Living Arrangement			1.01 (0.96,1.05)	1.01 (0.97,1.06)
Number of Children			0.93 (0.88,0.99)*	0.93 (0.88,0.99)*
Years in the U.S.			1.00 (0.99,1.00)	1.00 (0.99,1.00)
Medical Comorbidities				1.13(1.07,1.19)#
Index of Basic Physical Activities Scale	1.24 (1.21,1.28)#	1.22 (1.19,1.26)#	1.24 (1.21,1.27)#	1.22 (1.19,1.26)#
Age	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	1.41 (1.21,1.63)#	1.43 (1.22,1.68)#	1.43 (1.22,1.68)#	1.35 (1.15,1.59)#
Education		1.01 (0.99,1.02)	1.00 (0.98,1.02)	0.99 (0.98,1.01)
Income		0.85 (0.79,0.91)#	0.86 (0.80,0.93)#	0.86 (0.80,0.93)#
Married		1.00 (0.83,1.20)	0.99 (0.82,1.20)	1.00 (0.82,1.21)
Living Arrangement			1.01 (0.97,1.06)	1.02 (0.98,1.06)
Number of Children			0.92 (0.87,0.97)+	0.92 (0.87,0.98)+
Years in the U.S.			1.00 (0.99,1.00)	1.00 (0.99,1.00)
Medical Comorbidities				1.19 (1.13,1.26)#
Index of Mobility Scale	1.58 (1.45,1.72)#	1.59 (1.46,1.73)#	1.59 (1.46,1.73)#	1.52 (1.39,1.66)#
Age	0.99 (0.98,1.00)	0.99 (0.98,1.00)	1.00 (0.99,1.01)	1.00 (0.99,1.01)
Female	1.38 (1.19,1.60)#	1.44 (1.22,1.69)#	1.44 (1.22,1.69)#	1.36 (1.16,1.61)#
Education		1.03 (1.01,1.04)+	1.01 (1.00,1.03)	1.01 (0.99,1.03)
Income		0.86 (0.80,0.92)#	0.88 (0.81,0.94)#	0.88 (0.82,0.95)#
Married		0.99 (0.82,1.20)	0.98 (0.81,1.19)	1.00 (0.82,1.21)
Living Arrangement		1.17 (1.14,1.21)#	1.01 (0.97,1.05)	1.02 (0.97,1.06)
Number of Children			0.91 (0.86,0.97)+	0.91 (0.86,0.97)*
Years in the U.S.			0.99 (0.99,1.00)	0.99 (0.99,1.00)*
Medical Comorbidities				1.18 (1.12,1.25)#
SPPB	1.16 (1.13,1.19)#	1.17 (1.14,1.21)#	1.18 (1.14,1.21)#	1.16 (1.12,1.19)#

Age	1.00 (1.00,1.01)	1.00 (0.99,1.02)	1.01 (1.00,1.02)*	1.01 (1.00,1.02)
Female	1.48 (1.28,1.71)#	1.49 (1.27,1.75)#	1.50 (1.28,1.76)#	1.40 (1.19,1.65)#
Education		1.01 (1.00,1.03)	1.01 (0.99,1.02)	1.00 (0.98,1.02)
Income		0.85 (0.79,0.91)#	0.86 (0.80,0.92)#	0.86 (0.80,0.93)#
Married		0.95 (0.79,1.15)	0.95 (0.78,1.14)	0.96 (0.80,1.17)
Living Arrangement			1.01 (0.97,1.05)	1.02 (0.98,1.06)
Number of Children			0.93 (0.88,0.98)+	0.93 (0.88,0.98)+
Years in the U.S.			1.00 (0.99,1.00)	0.99 (0.99,1.00)
Medical Comorbidities				1.21 (1.15,1.28)#
Tandem Stand	1.35 (1.25,1.46)#	1.37 (1.26,1.48)#	1.37 (1.27,1.49)#	1.33 (1.22,1.44)#
Age	1.01 (1.00,1.02)	1.01 (1.00,1.02)	1.02 (1.01,1.03)*	1.01 (1.00,1.02)*
Female	1.47 (1.27,1.70)#	1.51 (1.29,1.77)#	1.51 (1.29,1.77)#	1.41 (1.20,1.65)#
Education		1.02 (1.00,1.04)*	1.01 (0.99,1.03)	1.00 (0.99,1.02)
Income		0.85 (0.80,0.91)#	0.87 (0.81,0.94)#	0.88 (0.82,0.94)#
Married		0.98 (0.82,1.18)	0.97 (0.80,1.17)	0.99 (0.82,1.20)
Living Arrangement			1.01 (0.97,1.05)	1.02 (0.98,1.06)
Number of Children			0.90 (0.85,0.95)#	0.91 (0.86,0.96)#
Years in the U.S.			0.99 (0.99,1.00)	0.99 (0.99,1.00)*
Medical Comorbidities				1.22 (1.16,1.29)#
Walk	1.21 (1.15,1.28)#	1.23 (1.16,1.30)#	1.26 (1.19,1.33)#	1.23 (1.16,1.30)#
Age	1.00 (0.99,1.01)	1.00 (0.99,1.01)	1.01 (1.00,1.02)*	1.01 (1.00,1.02)
Female	1.42 (1.23,1.64)#	1.44 (1.22,1.69)#	1.44 (1.23,1.69)#	1.36 (1.16,1.60)#
Education		1.01 (1.00,1.03)	1.00 (0.99,1.02)	1.00 (0.98,1.01)
Income		0.87 (0.81,0.93)#	0.88 (0.81,0.94)#	0.88 (0.82,0.95)#
Married		0.98 (0.82,1.19)	0.98 (0.81,1.19)	1.00 (0.82,1.21)
Living Arrangement			1.00 (0.96,1.05)	1.01 (0.97,1.05)
Number of Children			0.93 (0.88,0.98)+	0.93 (0.88,0.98)*
Years in the U.S.			1.00 (0.99,1.00)	0.99 (0.99,1.00)
Medical Comorbidities				1.20 (1.13,1.27)#
Chair	1.28 (1.22,1.35) #	1.28 (1.22,1.35)#	1.28 (1.21,1.35)#	1.24 (1.18,1.31)#

Notes. Model A adjusted age and gender; Model B adjusted Model A + education, income, marital status; Model C adjusted Model B + living arrangement, number of children, years in the U.S.; Model D adjusted Model C + medical comorbidities.

*p<0.05, *p<0.01, #p<0.001

specific, the present study confirmed that US Chinese older adults with poorer report in ADL, IADL, Index of Basic Physical Activities scale and Index of Mobility scale were more likely to be associated with higher levels of depressive symptoms. Our results were consistent with early studies conducted in South Africa and Latin Americans that reported higher levels of impairment in self-reported physical function were associated with higher risk of depression [8, 9].

Our study goes beyond previous research by investigating the association between performance-based physical function and depressive symptoms. We found that US Chinese older adults with poorer performance in SPPB were more likely to be associated with higher risk of depressive symptoms. In addition, each item in SPPB (i.e. tandem stand, walk and chair) was significantly associated with depressive symptoms. Our study enables the comparison between both self-reported and directly observed physical function with depressive symptoms.

This study initially examined the association between both self-reported and performance-based physical function and depression. The results show higher scores in ADL, IADL, Index of Basic Physical Activities scale, Index of Mobility scale and SPPB

were all significantly associated with higher levels of depression. This result indicates physical function impairment was not only associated with depressive symptoms, but also depression. Physical impairment is a risk factor for the psychological well-being of older adults.

These findings should be interpreted with cautions. First, we didn't use clinical diagnosis for depression. In our study, depression was measured by PHQ-9, with a score of 5 and more indicating depression. Second, although we tested the association between physical function and depressive symptoms, the reverse association may also exist. The mutual effects or causal effects were difficult to be proved in a cross-sectional study.

This study has significant research implications. First, the heterogeneity in measuring physical function has obfuscated the applicability and comparability of research findings. Our study provides insight into research on physical function and depressive symptoms by using different measures of self-reported and directly observed physical function. Second, this study also allows the comparison between physical function and both depressive symptoms and depression.

Table 4. Association between Physical Function and Depression

	Model A	Model B	Model C	Model D
OR (95% CI)				
Age	1.01 (1.00,1.03) *	1.01 (1.00,1.02)	1.01 (0.99,1.03)	1.01 (0.99,1.02)
Female	1.48 (1.22,1.80) #	1.45 (1.17,1.79) #	1.44 (1.16,1.78) #	1.35 (1.08,1.68) +
Education		1.02 (1.00,1.04)	1.01 (0.99,1.03)	1.01 (0.99,1.03)
Income		0.86 (0.77,0.96) +	0.86 (0.77,0.96) +	0.87 (0.78,0.97) *
Married		0.82 (0.65,1.04)	0.83 (0.66,1.05)	0.85 (0.67,1.08)
Living Arrangement			0.97 (0.92,1.03)	0.97 (0.91,1.04)
Number of Children			0.97 (0.91,1.04)	0.98 (0.93,1.03)
Years in the U.S.			1.00 (0.99,1.01)	1.00 (0.99,1.01)
Medical Comorbidities				1.21 (1.13,1.29) #
ADL	1.34 (1.23,1.47) #	1.35 (1.23,1.47) #	1.34 (1.23,1.47) #	1.32 (1.21,1.44) #
Age	0.98 (0.97,1.00) +	0.98 (0.96,0.99) +	0.98 (0.97,1.00) *	0.98 (0.96,1.00) *
Female	1.34 (1.09,1.65) +	1.31 (1.05,1.64) *	1.31 (1.04,1.64) *	1.26 (1.01,1.58) *
Education		1.03 (1.01,1.05) +	1.02 (1.00,1.04)	1.02 (0.99,1.04)
Income		0.87 (0.78,0.97) *	0.87 (0.78,0.98) *	0.88 (0.78,0.99) *
Married		0.79 (0.62,1.01)	0.81 (0.63,1.03)	0.82 (0.64,1.05)
Living Arrangement			0.97 (0.91,1.03)	0.97 (0.92,1.03)
Number of Children			0.95 (0.88,1.03)	0.95 (0.89,1.03)
Years in the U.S.			1.00 (0.99,1.01)	1.00 (0.99,1.01)
Medical Comorbidities				1.13 (1.06,1.21) #
IADL	1.27 (1.22,1.32) #	1.27 (1.23,1.33) #	1.28 (1.23,1.33) #	1.26 (1.21,1.31) #
Age	0.98 (0.97,0.99) +	0.98 (0.97,0.99) +	0.98 (0.96,0.99) +	0.98 (0.96,0.99) +
Female	1.06 (0.86,1.31)	1.09 (0.86,1.37)	1.09 (0.86,1.37)	1.07 (0.85,1.35)
Education		1.03 (1.01,1.05) +	1.03 (1.01,1.05) *	1.03 (1.00,1.05) *
Income		0.91 (0.81,1.01)	0.90 (0.81,1.02)	0.91 (0.81,1.02)
Married			0.89 (0.69,1.15)	0.90 (0.70,1.15)
Living Arrangement			0.97 (0.91,1.03)	0.97 (0.92,1.03)
Number of Children			0.99 (0.92,1.06)	0.99 (0.92,1.06)
Years in the U.S.			1.00 (0.99,1.01)	1.00 (0.99,1.01)
Medical Comorbidities				1.06 (0.98,1.13)
Index of Basic Physical Activities Scale	1.25 (1.22,1.28) #	1.25 (1.22,1.28) #	1.25 (1.22,1.28) #	1.24 (1.21,1.28) #
Age	0.99 (0.97,1.00) *	0.99 (0.97,1.00) *	0.99 (0.97,1.00)	0.99 (0.97,1.00)
Female	1.33 (1.09,1.63) +	1.31 (1.05,1.63) *	1.30 (1.04,1.63) *	1.26 (1.00,1.57) *
Education		1.02 (1.00,1.04)	1.01 (0.99,1.03)	1.01 (0.99,1.03)
Income		0.86 (0.77,0.96) +	0.87 (0.77,0.97) *	0.87 (0.78,0.98) *
Married			0.85 (0.66,1.08)	0.86 (0.68,1.10)
Living Arrangement			1.00 (0.94,1.06)	1.00 (0.95,1.06)
Number of Children			0.97 (0.90,1.04)	0.97 (0.90,1.04)
Years in the U.S.			1.00 (0.99,1.01)	1.00 (0.99, 1.01)
Medical Comorbidities				1.12 (1.05,1.20) #
Index of Mobility Scale	1.90 (1.74,2.08) #	1.91 (1.75,2.10) #	1.91 (1.74,2.10) #	1.85 (1.69,2.04) #
Age	0.98 (0.97,0.99) +	0.98 (0.96,0.99) +	0.98 (0.97,1.00) *	0.98 (0.97,1.00) *
Female	1.29 (1.05,1.58) *	1.30 (1.04,1.63) *	1.29 (1.03,1.62) *	1.25 (0.99,1.56)
Education		1.04 (1.02,1.06) #	1.04 (1.01,1.06) +	1.03 (1.01,1.05) +
Income		0.87 (0.77,0.97) +	0.89 (0.79,1.00) *	0.89 (0.79,1.00) *
Married		0.81 (0.64,1.04)	0.81 (0.64,1.04)	0.83 (0.65,1.05)
Living Arrangement			0.99 (0.93,1.04)	0.99 (0.94,1.05)
Number of Children			0.97 (0.90,1.04)	0.97 (0.90,1.04)
Years in the U.S.			0.99 (0.99,1.00)	1.00 (0.98,1.00)
Medical Comorbidities				1.13 (1.05,1.21) #
SPPB	1.23 (1.19,1.27) #	1.24 (1.20,1.29) #	1.24 (1.20,1.29) #	1.23 (1.19,1.27) #

Age	1.00 (0.99,1.01)	1.00 (0.99,1.01)	1.00 (0.99,1.02)	1.00 (0.98,1.01)
Female	1.42 (1.16,1.74) #	1.38 (1.11,1.72) +	1.38 (1.11,1.71) +	1.30 (1.05,1.63) *
Education		1.02 (1.00,1.05) *	1.02 (1.00,1.04)	1.02 (0.99,1.04)
Income		0.86 (0.77,0.95) +	0.86 (0.77,0.97) *	0.87 (0.78,0.98) *
Married		0.78 (0.62,0.99) *	0.79 (0.62,1.00) *	0.81 (0.63,1.03)
Living Arrangement			0.99 (0.93,1.04)	0.99 (0.94,1.05)
Number of Children			0.98 (0.92,1.06)	0.98 (0.92,1.06)
Years in the U.S.			1.00 (0.99,1.01)	1.00 (0.99,1.01)
Medical Comorbidities				1.18 (1.10,1.26) #
Tandem Stand	1.38 (1.28,1.48) #	1.39 (1.29,1.50) #	1.39 (1.29,1.50) #	1.35 (1.25,1.46) #
Age	1.00 (0.99,1.02)	1.00 (0.99,1.02)	1.01 (0.99,1.02)	1.00 (0.99,1.02)
Female	1.40 (1.15,1.70) #	1.42 (1.15,1.77) +	1.41 (1.13,1.75) +	1.33 (1.06,1.65) *
Education		1.04 (1.02,1.06) #	1.03 (1.01,1.05) +	1.02 (1.00,1.05) *
Income		0.85 (0.67,1.07) +	0.88 (0.78,0.99) *	0.88 (0.79,0.99) *
Married			0.85 (0.67,1.07)	0.86 (0.68,1.09)
Living Arrangement			0.99 (0.93,1.04)	0.99 (0.94,1.05)
Number of Children			0.94 (0.87,1.01)	0.94 (0.87,1.01)
Years in the U.S.			0.99 (0.98,1.00)	0.99 (0.98,1.00)
Medical Comorbidities				1.18 (1.11,1.26) #
Walk	1.38 (1.28,1.48) #	1.42 (1.31,1.53) #	1.44 (1.33,1.56) #	1.41 (1.30,1.53) #
Age	1.00 (0.98,1.01)	0.99 (0.98,1.01)	0.99 (0.98,1.01)	0.99 (0.98,1.01)
Female	1.34 (1.09,1.64) +	1.31 (1.05,1.63) *	1.30 (1.04,1.62) *	1.25 (0.99,1.56)
Education		1.02 (1.00,1.04)	1.01 (0.99,1.04)	1.01 (0.99,1.03)
Income		0.89 (0.80,0.99) *	0.90 (0.80,1.00) *	0.90 (0.80,1.01)
Married		0.82 (0.65,1.05)	0.83 (0.65,1.06)	0.84 (0.66,1.07)
Living Arrangement			0.98 (0.93,1.04)	0.98 (0.93,1.04)
Number of Children			0.98 (0.91,1.06)	0.98 (0.91,1.06)
Years in the U.S.			1.00 (0.99,1.01)	1.00 (0.99,1.01)
Medical Comorbidities				1.14 (1.06,1.22) #
Chair	1.49 (1.39,1.60) #	1.50 (1.40,1.61) #	1.50 (1.40,1.60) #	1.46 (1.36,1.57) #

Notes. Model A adjusted age and gender; Model B adjusted Model A + education, income, marital status; Model C adjusted Model B + living arrangement, number of children, years in the U.S.; Model D adjusted Model C + medical comorbidities.

*p<0.05, +p<0.01, #p<0.001

In policy practice, our study suggests health professionals should be aware of the depressive symptoms or depression in older adults with physical function impairment. We found various kinds of physical impairment were significantly associated with depressive symptoms and depression. Poorer report in ADL, IADL, Index of Basic Physical Activities scale, Index of Mobility scale and poorer performance in SPPB were associated with higher risk of depressive symptoms and depression. Health professionals are suggested to pay more attention on older adults with physical impairment and conduct preventions for them when needed.

In future research, the causal effects of self-reported and performance-based physical function on depressive symptoms may be strengthened by longitudinal research. Studies on testing the combined effects of self-reported and performance-based physical function on depressive symptoms are expected. Future research can also examine the association between cognitive impairment and depressive symptoms.

Conclusion

This study shows both self-reported and directly observed

physical function were significantly associated with depressive symptoms after controlling for age, gender, education, income, marital status, living arrangement, number of children, years in the U.S. and medical comorbidities. The result for the association between physical function and depression is consistent with the association between physical function and depressive symptoms. Future research may focus on the causal effects of self-reported and performance-based physical function on depressive symptoms.

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