Research article

The Prevalence of Neurological Symptoms among Chinese Older Adults in the Greater Chicago Area

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Abstract: Background: Neurological symptoms influence health and well-being among older adults. However, Chinese older adults are underrepresented in most studies on neurological symptoms. This study aims to examine the prevalence of neurological symptoms among U.S. Chinese older adults. **Methods:** Data were drawn from the PINE study, a population-based survey of U.S Chinese older adults in the greater Chicago area. Guided by a community-based participatory research approach, a total of 3,159 Chinese older adults aged 60 and above were surveyed. Clinical review of system (ROS) was used to assess the presence of dizziness, syncope/fainting, fall, seizures, weakness, numbness, tingling, tremor, and stiffness. **Results:** Neurological symptoms were commonly experienced by U.S Chinese older adults (50.6%). Symptoms as dizziness (31.0%), numbness (19.0%), and falls (14.8%) were commonly reported. Participants were more likely to report any neurological symptom if they were older , less educated, low income, with poorer self-perceived health status, poorer quality of life, and worsened health change over last year. **Conclusions:** Neurological symptoms are common among Chinese older adults in the U.S. Future longitudinal research is needed to examine risk factors and health outcomes associated with neurological symptoms.

Keywords: population studies; older adults; neurological symptom; Chinese aging

1. Introduction

The presence of symptoms is important indicator to assess individual's overall health status and quality of life [1]. Neurological symptoms are associated with physical discomfort, impairment of motor function, poor cognitive abilities, and socially dysfunction [2,3]. However, many onset neurological symptoms are often intractable to recognize or manage: one third of the outpatients in neurology clinics have symptoms poorly explained by organic disease [4]; Moreover, older adults

with neurological symptoms are likely not actively seeking for medical attention [5]. Therefore, a systematic overview of the prevalence of cross-disease neurological symptoms is necessary so as to offer a more apposite evaluation of the health burden caused by neurological symptoms.

Older adults are particularly at risk of suffering from the negative health consequences of neurological symptoms, some of which are expected as part of the normal aging process and others are abnormal signs of neurological disorders and other health risks [6]. Despite the increased risk of suffering from negative symptoms caused by neurological disorders while aging [7–9], some neurological symptoms, for instance, dizziness and falls, were commonly considered syndromes because they are multifactorial and caused by pathology within as well as beyond the nervous system [10]. We followed the organization of the Review of System, and included those syndromes in our analysis because these syndromes often have strong implications on the function of the neurological system. Similar as other neurological symptoms, the presence of those syndromes can be the early signs of neurological deficiency or indicating negative outcomes projected on the neurological functioning. For example, fall and dizziness may cause brain injuries, and render negative impact on neurological system.

The presence of above-mentioned neurological symptoms and syndromes elicited negative influence on the physical and mental well-being of older adults [11–13]. Given that more than half of the older adults are with one or more chronic conditions [14], it is more than important to identify the presence of neurological symptoms and alleviate relevant health burden among older adults in the management of multiple chronic diseases. However, insufficient efforts have been made on evaluating the overall health burden based on a systematic assessment of neurological symptoms whereas a great number of studies have evaluated the prevalence of diagnosed neurological disorders. Most existing studies examined a single neurological disease [7–9], or a single neurological syndrome or symptom, including dizziness, fainting, falls, weakness, etc [5,15–18].

Older adults from Asian communities are often under-represented in most research and are consistently treated as a homogeneous group, which failed to acknowledge differences in cultural beliefs, health behaviors, and genetic inherence among diverse subgroups [19]. Only based on diagnosed neurological disease or diseases sets can render the potential bias of under-diagnose, for instance, there being inconsistent findings with regards to Chinese older adults' risk of having dementia compared to Caucasians [20–22]. While a few studies assessed neurological symptoms among certain Chinese population, such as printing workers and persons with schizophrenia [23,24], little is known in regards to the prevalence of neurological symptoms among the community-dwelling Chinese population domestically or globally.

The Chinese community is the oldest and largest Asian American subgroup in the U.S [25]. Older adults constitute a large segment of the general Chinese population in the U.S, of whom 15.4% are aged 65 or older [25]. More than 80 % of Chinese older adults were foreign-born, and approximately 30 % of them immigrated to the U.S. after the age of 60 [25]. Psychological, social, and environmental changes associated with immigrating to U.S may have great influence on the presence and development of neurological disorders [26]. However, the vast intra-group diversity in language, education level, socioeconomic status, and degree of acculturation among U.S. Chinese older adults have resulted in limited evidence-based research targeting this group [27]. Prior studies suggested Chinese older adults are disproportionally burdened from co-morbidity, and cardiopulmonary and musculoskeletal symptoms [28–30]. To build upon the social and health issues documented in previous research with U.S. Chinese older adults [31–33], there is a particular need to

assess the presence of clinical symptoms experienced by this population.

In this study, we aim to 1) evaluate the prevalence of neurological symptoms within the context of a large population-based cohort of U.S. Chinese older adults; 2) examine the correlations between the prevalence of neurological symptoms and socio-demographic characteristics; and 3) examine the correlations between the prevalence of neurological symptoms and self-reported health and quality of life measures.

2. Materials and Method

2.1. Population and settings

The Population Study of Chinese Elderly in Chicago (PINE) is a population-based epidemiological study of U.S. Chinese older adults aged 60 and over in the greater Chicago area. The purpose of the PINE study is to collect community-level data of U.S. Chinese older adults to examine the key cultural determinants of health and well-being. The project was initiated by a synergistic community-academic collaboration among Rush Institute for Healthy Aging, Northwestern University, and many community-based social services agencies and organizations throughout the greater Chicago area [34].

In order to ensure study relevance to the well-being of the Chinese community and enhance community participation, the PINE study implemented culturally and linguistically appropriate community recruitment strategies strictly guided by a community-based participatory research (CBPR) approach [35]. Over twenty social services agencies, community centers, health advocacy agencies, faith-based organizations, senior apartments and social clubs served as study recruitment sites. Eligible participants were approached during routine social service and outreach efforts serving Chinese Americans families in the Chicago city and suburban areas. All participants were consented and interviewed by trained bicultural research assistants in English or Chinese dialects, including Mandarin, Cantonese, Toishaness, and Teochow, according to respondents' preference. Out of 3,542 eligible participants, 3,159 agreed to participate in the study, yielding a response rate of 91.9 %.

Based on the available census data drawn from U.S. Census 2010 and a random block census project conducted in the Chicago's Chinese community, the PINE study is representative of the Chinese aging population in the greater Chicago area with respect to key demographic attributes, including age, sex, income, education, number of children, and country of origin [36]. The study was approved by the Institutional Review Boards of the Rush University Medical Center.

2.2. Measurements

2.2.1. Socio-demographics

Basic demographic information was collected, including age (in years), sex, education level, annual income (in USD), marital status, number of children, living arrangement, and country of origin. Immigration data relating to participants' years in the U.S. and years residing in the current community were also collected. Education level was assessed by asking participants the years of highest educational level completed. We created a dichotomous variable using "China" and "other" to distinguish respondents who were born in mainland China from those who were born in other

countries. Living arrangement was assessed by asking participants how many people live in their household besides themselves and was categorized into four groups: 1) living alone; 2) living with 1–2 persons; 3) living with 2–3 persons; and 4) living with 4 more persons. Self reported annual income was categorized into four groups: 1) $0–$4,999 per year; 2) $5,000–$9,000 per year; 3) $10,000–$14,999 per year; and 4) more than $15,000 per year.

2.2.2. Overall health status, quality of life, and health changes over the last year

Overall health status was measured by "In general, how would you rate your health?" on a four point scale (1 = poor; 2 = fair; 3 = good; 4 = very good). Quality of life was assessed by asking "In general, how would you rate your quality of life?" on a four point scale (1 = poor, 2 = fair, 3 = good, 4 = very good). Health change in last year was measured by the question "Compared to one year ago, how would you rate your health now?" on a five point scale (1 = much worse; 2 = somewhat worse; 3 = about the same; 4 = somewhat better; 5 = much better than one year ago). Health changes were then categorized into three groups: 1) improved health; 2) same health; and 3) worsened health.

2.3. Data Analysis

Descriptive univariate statistics were used to summarize socio-demographic characteristics and the prevalence of neurological symptoms. In bivariate analyses, Chi-squared tests were used to compare socio-demographic characteristics between persons with and without neurological symptoms. The prevalence of each neurological symptom was calculated. Pearson Correlation coefficients were used to examine the correlations between socio-demographic and self-reported health variables and neurological symptoms. All statistical analyses were conducted using SAS, Version 9.2 (SAS Institute Inc., Cary, NC).

2.3.1. Neurological Symptoms.

We used the Review of Systems (ROS) to assess the neurological symptoms among our participants [37]. ROS is a list of questions organized by organ systems used by health-care providers for eliciting a medical history from a patient. Neurological system was assessed by asking whether participants have had following symptoms in the past: 1) dizziness, 2) syncope/fainting, 3) falls, 4) seizures, 5) weakness, 6) numbness, 7) tingling, 8) tremor, and 9) stiffness.

The organization of Review of System is recognized by the Centers for Medicare and Medicaid Services. Content validity was assessed by a group of bilingual and bicultural study researchers with expertise in Chinese cultural issues, health, and aging. The original English versions of the instruments were first translated into Chinese by a bilingual research team. Due to the vast linguistic diversity of our study population, the Chinese version was then back translated by bilingual and bicultural investigators fluent in dialects including Mandarin and Cantonese to confirm consistency in the meaning of the Chinese version with the original English version. Both written scripts (traditional and simplified Chinese characters) were subsequently examined. The community advisory board (CAB) led by an experienced bilingual and bicultural geriatrician then went over the wording of the Chinese versions to ensure validity.

3. Results

3.1.1. Sample Characteristics

Of the 3,159 participants enrolled in the PINE study, 58.9% were women, 71.3% were married, and 85.1 % had an annual income below $10,000. The mean age of participants was 72.8 (SD = 8.3) and the mean years of education completed was 8.7 (SD = 5.1).

Approximately half of the participants (N = 1597) reported having at least one neurology symptom. Significant differences were presented between participants with and without neurological symptoms in regards to age ($p < 0.001$), gender ($p < 0.001$), education($p < 0.001$), income ($p < 0.001$), marital status ($p < 0.001$), living arrangement ($p < 0.01$), years in U.S and community ($p < 0.05$), overall health status ($p < 0.001$), quality of life ($p < 0.001$), and health changes over last year ($p < 0.001$) (Table 1).

Table 1. Characteristics of Study Participant by Any Neurological Symptom

	Any Symptom (N = 1597)	No Symptom (N = 1562)	χ^2, d.f.	p-value
Age group, Number (%)				
60–64	303 (19.0)	378 (24.2)		
65–69	284 (17.8)	359 (23.0)		
70–74	318 (19.9)	288 (18.4)		
75–79	295 (18.5)	262 (16.8)		
80-84	226 (14.2)	170 (10.9)		
85 and over	171 (10.7)	105 (6.7)	43.8, 5	< 0.0001
Sex, Number (%)				
Male	541 (33.9)	756 (48.4)		
Female	1056 (66.1)	806 (51.6)	68.8,1	< 0.0001
Education level, Number (%)				
0 year	128 (8.1)	67 (4.3)		
1–6 years	613 (38.6)	566 (36.5)		
7–12 years	510 (32.1)	593 (38.2)		
13–16 years	299 (18.8)	277 (17.9)		
More than 17 years	39 (2.5)	48 (3.1)	28.5,4	< 0.0001
Income, Number (%)				
$0–$4,999	540 (34.1)	501 (32.6)		
$5,000–$9,999	873 (55.1)	744 (48.4)		
$10,000–$14,999	127 (8.0)	183 (11.9)		
$15,000–$19,999	26 (1.6)	42 (2.7)		
Over $20,000	19 (1.2)	68 (4.4)	52.5, 4	< 0.0001
Marital Status, Number (%)				
Married	1049 (66.0)	1188 (76.7)		
Separated	35 (2.2)	22 (1.4)		
Divorced	43 (2.7)	31 (2.0)		
Widowed	462 (29.1)	307 (19.8)	44.3, 3	< 0.0001

Number of Children (%)				
0	65 (4.1)	63 (4.1)		
1–2	636 (39.9)	635 (40.8)		
3+	893 (56.0)	859 (55.2)	0.3, 2	0.8792
Living Arrangement, Number (%)				
Living Alone	384 (24.1)	295 (18.9)		
With 1 person	646 (40.5)	672 (43.1)		
With 2–3 persons	220 (13.8)	260 (16.7)		
With 4 or more	347 (21.7)	334 (21.4)	15.4, 3	0.0015
China Born				
Yes	1491 (93.4)	1440 (92.2)		
No	106 (6.6)	122 (7.8)	1.6, 1	0.2027
Years in US				
0–10	398 (25.1)	442 (28.4)		
11–20	521 (32.8)	448 (28.8)		
21–30	391 (24.6)	376 (24.2)		
31+	278 (17.5)	290 (18.6)	8, 3	0.0455
Years in Neighborhood				
0–10	939 (59.0)	872 (56.0)		
11–20	382 (24.0)	358 (23.0)		
21–30	171 (10.8)	217 (13.9)		
31+	99 (6.2)	111 (7.1)	9.1, 3	0.0286
Overall Health Status, Number (%)				
Very Good	30 (1.9)	110 (7.0)		
Good	382 (23.9)	715 (45.8)		
Fair	721 (45.2)	599 (38.4)		
Poor	464 (29.1)	138 (8.8)	334.3, 3	<0.0001
Quality of Life, Number (%)				
Very good	90 (5.6)	126 (8.1)		
Good	640 (40.1)	743 (47.6)		
Fair	798 (50.0)	659 (42.2)		
Poor	68 (4.3)	33 (2.1)	38.7, 3	<0.0001
Health Status Changes Over the Last Year, Number (%)				
Improved	135 (8.5)	142 (9.1)		
Same	578 (36.2)	957 (61.3)		
Worsened	882 (55.3)	463 (29.6)	224.0, 2	<0.0001

3.1.2. Presence of Neurological Symptoms

The prevalence of nine neurology symptoms was presented in Table 2. Dizziness was the most commonly reported neurological symptom (31.0%), followed by numbness (19.0%), and falls (14.8%). With regards to other symptoms, stiffness (9.8%), weakness (6.9%), syncope/ fainting (5.9%), tremor (5.9%), tingling (5.3%), and seizures (0.5%) were less commonly experienced among

study participants.

Table 2. Percentage of Neurological Symptoms

	N	%
Dizziness	980	31.0
Syncope/Fainting	185	5.9
Fall	467	14.8
Seizures	16	0.5
Weakness	217	6.9
Numbness	600	19.0
Tingling	168	5.3
Tremor	187	5.9
Stiffness	308	9.8

3.1.3. Prevalence of Neurological Symptoms by Socio-Demographic Characteristics

Neurological symptoms were more prevalent among the older age groups (Table 3). The prevalence of neurological symptoms was 44.5% among older adults aged 60–64, 44.2% among older adults aged 65–69, 52.5% among older adults aged 70–74, 53.0% among older adults aged 75–79, 57.1% among older adults aged 80–84, and 62.0% among the older adults aged 85 and over. Females are more like to report neurological symptoms than males (56.7% vs. 41.7%).

Table 3. Prevalence of Neurological Symptoms by Socio-demographic

Age	60–64 (N = 681)		65–69 (N = 643)		70–74 (N = 606)		75–79 (N = 557)		80–84 (N = 396)		85 and over (N = 276)	
	N	%	N	%	N	%	N	%	N	%	N	%
	303	44.5	284	44.2	318	52.5	295	53.0	226	57.1	171	62.0
Sex	Male (N = 1297)				Female (N = 1862)							
	N		%		N		%					
	541		41.7		1056		56.7					
Education	0 year (N = 195)		1–6 years (N = 1179)		7–12 years (N = 1103)		13–16 years (N = 576)		17 and over (N = 87)			
	N	%	N	%	N	%	N	%	N	%		
	128	65.6	613	52.0	510	46.2	299	51.9	39	44.8		
Income	$0–$4,999 (N = 1041)		$5,000–$9,999 (N = 1617)		$10,000–$14,999 (N = 310)		$15,000–$19,999 (N = 68)		$20,000 and over (N = 87)			
	N	%	N	%	N	%	N	%	N	%		
	540	51.9	873	54.0	127	41.0	26	38.2	19	21.8		

With regards to education level, the highest prevalence of any neurological symptom (65.6%) was reported by participants with 0 years of education. In contrast, older adults with 17 or more years of education completed presented the lowest prevalence of neurological symptoms (44.8%). Moreover, higher prevalence of neurological symptoms was reported by participants with lower income. The prevalence of neurological symptom was 51.9% and 54.0% among the two groups with annual income lower than $10,000, and 41.0% among participants with annual income $10,000 –$14,999, 38.2% among participants with annual income $15,000–$19,999, and 21.8% among participants with annual income $20,000 or over.

3.1.4. Prevalence of Neurological Symptoms by Health Status

Overall, neurological symptoms were less likely to be reported by participants who perceived their health status as very good (21.4%) or good (34.8%), comparing to older adults perceiving their health status as fair (54.6%) or poor (77.1%) (Table 4). Similar trend was presented with regards to quality of life: participants who perceived their quality of life as very good (41.7%) or good (46.3%) were less likely to reported neurological symptoms compared with participants with fair (54.8%) or poor quality of life (67.3%). In addition, a larger proportion of older adults with worsened health status over the past year (65.6%) reported neurology symptom than those with no health change (37.7%) and improved health (8.5%)

Table 4. Prevalence of Neurological Symptoms by Health Status

Overall Health Status	Very Good (N = 140)		Good (N = 1097)		Fair (N = 1320)		Poor (N = 602)	
	N	%	N	%	N	%	N	%
	30	21.4	382	34.8	721	54.6	464	77.1
Quality of Life	Very Good (N = 216)		Good (N = 1383)		Fair (N = 1457)		Poor (N = 101)	
	N	%	N	%	N	%	N	%
	90	41.7	640	46.3	798	54.8	68	67.3
Health Status Changes Over the Last Year	Improved (N = 277)		Same (N = 1535)		Worsened (N = 1345)	
	N	%	N	%	N	%
	135	8.5	578	37.7	882	65.6

Table 5. Correlations between Socio-demographic and Any Neurological Symptom

	Age	Sex	Edu	Income	MS	Children	Living	Yrs in U.S.	Yrs in Com	Origin	OHS	QOL	HC	Neu
Age	1.00													
Sex	0.01	1.00												
Education	−0.12***	−0.21***	1.00											
Income	0.05**	0.00	0.01	1.00										
MS	−0.33***	−0.32***	0.22	−0.03	1.00									
Children	0.32***	0.09***	−0.38***	0.00	−0.13***	1.00								
Living	−0.35***	−0.07***	0.02	0.16***	0.24***	−0.07***	1.00							
Yrs in U.S	0.35***	0.03	−0.10***	0.35***	−0.20***	0.15***	−0.13***	1.00						
Yrs in Com	0.23***	0.02	−0.11***	0.24***	−0.13***	0.10***	0.05**	0.66***	1.00					
Origin	0.04*	−0.01	−0.08***	−0.20***	0.05**	0.04*	−0.05**	−0.20***	−0.15***	1.00				
OHS	0.08***	0.06**	−0.06***	−0.12***	−0.05**	0.00	0.00	0.01	−0.05***	0.03	1.00			
QOL	−0.06***	−0.05**	−0.09***	−0.08***	0.03	−0.04*	0.01	0.00	0.02	0.04*	0.32***	1.00		
HC	0.11***	0.03	−0.02	−0.05**	−0.07***	0.02	−0.01	0.04*	−0.03	0.00	0.35***	0.15***	1.00	
Neu	0.12***	0.15***	−0.07***	−0.11***	-0.11***	0.04*	−0.02	0.00	−0.05**	0.02	-0.32***	-0.11***	-0.24***	1.00

3.1.5.   Correlation of Neurological Symptoms and Socio-Demographics and Health Status

Older age ($r = 0.12$, $p < 0.001$), female gender ($r = 0.15$, $p < 0.001$), lower education ($r = −0.07$, $p < 0.001$), lower income ($r = −0.11$, $p < 0.001$), being unmarried ($r = − 0.11$, $p < 0.001$), having more children ($r = 0.04$, p<0.05), and residing fewer years in community ($r = −0.05$, $p < 0.01$), were associated with more neurological symptoms (Table 5). In addition, poorer overall health status ($r = −0.32$, $p < 0.001$), poorer quality of life ($r = −0.11$, $p < 0.001$), and worsened health status changes over the past year ($r = −0.24$, $p < 0.001$) were correlated with higher prevalence of neurological symptoms.

4.   Discussion

As the first population-based study of neurological symptoms among U.S. Chinese older adults, we found that neurological symptoms were common among U.S. Chinese older adults. Dizziness was the most commonly presented neurological symptoms, followed by numbness and falls. Participants were more likely to report neurological symptoms if they were older, female, with lower education and income level, unmarried, having more children, residing fewer years in the community, with poorer health status, quality of life, and worsened health change over the last year.

Our study indicates that neurological symptoms were more prevalent among participants with an older age. The aging of the nervous system and muscles can result in inevitable structural and functional deterioration that associated with the decline of the cognitive and motor function [38,39]. An older age also indicates worsened health and a reduced capability to recover from not only neurological disorders but also a wide range of preconditions that lead to neurological symptoms, for instance stroke [40]. Moreover, despite the biological changes associated with aging, age accompanied psychological and behavioral change should also be taking into account in explaining the higher prevalence of neurological symptoms among the oldest-old. Aging accompanied stress, for instance, is shown to have deleterious neurological effects on the health of older adults [41].

We estimated the prevalence of neurological symptoms systematically while prior studies often examine limited symptoms, such as weakness, dizziness, fall, seizure, and fainting [3,5,15–18]. However, the variations in study design and sample require caution in making comparisons and drawing valid conclusions. For instance, in our study, the prevalence of falls was 14.8% while the prevalence ranged from 137 to 690 falls per 1000 persons per year in previous studies [42–44]. The prevalence of numbness and tingling in our study participants was 19.0% and 5.3%. In contrast, a prior research suggested that the prevalence of numbness and tingling or pain was 28.2 % and 26.8% among individuals with diabetes, respectively, compared with15.7% and 22.8% among individuals without diabetes [45]. In sum, our study provided an overall estimate of the prevalence neurological symptoms among community-dwelling Chinese older adults.

Dizziness is the most common neurological symptom in our study reported by 31.0% of Chinese older participants. A prior population-based study among older adults identified the prevalence of dizziness ranged from 27% to 34% r [46]. Previous studies also recognized the multifactorial nature of dizziness and falls as geriatric syndromes resulted from the impairment of one or multiple systems ranged from mild to severe [47,47]. Given that the dizziness and falls are commonly experiences among U.S older adults, our study points to the need of applying multifactorial strategies to incorporate all the potential contributing factors into consideration in

healthcare practice, including sensory balance, blood pressures, intake medications, gait impairment, depression and anxiety, etc [47]. This holistic approach to assess geriatric syndrome was proved to be effective in reducing falls, the third most prevalent symptom identified in our study among U.S Chinese older adults [48].

Our study observed that compared with men, U.S older females were more likely to report neurological symptoms. Our finding was supported by previous research indicating that older females are 1.3 to 2.2 times more likely to fall and 2.03 times more likely to experience dizziness [5,46]. Moreover, females with neurological disorders may be prone to certain neurological symptoms [49–51]. For instance, although men are believed to have a higher prevalence of Parkinson's disease, a recent study suggested women with Parkinson's disease are more likely to report tremor [52]. As an increasing number of the studies documented the gender differences on the aging effect on human brain and other neurological system mechanism [53], our study provides important insight onto the gender disparity on the explicit presence of neurological symptoms among U.S Chinese older adults.

Our research suggests that U.S. Chinese older adults with lower education and income level are more likely to experience neurological symptoms. Although it is not well-documented on the variation of neurological symptoms by education or income, it is suggested that the education and income may influence many behavioral risk factors which can contribute to the normal function of the neurological system in the aging process. Better-educated older adults are more likely to engage in cognitively stimulating activities, have better economic circumstances, eat healthier, spend more time to participate in physical activities, less stressed, and less likely to expose to environmental hazards [54–56]. Consequently, it is noted that lowered educated are of higher risk to diseases such as dementia, stroke and heart diseases, mental health disorders [57–60], all of which could increase their vulnerability to a number of neurological symptoms.

Our intriguing finding also indicates that older adults are more likely to report neurological symptoms if they live in the community for fewer years. The experiences of immigrating to the U.S may have life-changing influences on the health and well-being of older adults. Chinese older adults residing in U.S may encounter many language and cultural barriers of adjusting their lives in the U.S. Living in the community for a shorter period of time may indicate inefficient social support in the resettled environment, higher risk of exposure to daily life stressors, less experiences in acculturating to westernized lifestyle, and lack of access to community and healthcare resources. All of those factors can contribute to the higher prevalence of neurological symptoms. However, years of living in the community may interact with other factors, such as age, income level, and educational level. Future analysis is needed utilizing mixed methodology to identify risk factors of the prevalence of neurological symptoms.

Our study reveals that U.S Chinese older adults perceive themselves with poorer health status, poorer quality of life, and worsened health change over last year if they have neurological symptoms. Prior study estimated that dizziness, the most prevalent symptom in our study, was associated with greater disability measures [61], and have detrimental influence on all quality of life dimensions among older adults [11]. Falls and other sensory symptoms are among the most important indicators for quality of life among persons with Parkinson's disease [13]. Our findings may indicate a series of psychophysical changes along with the presence of symptoms: experiencing neurological symptoms may negatively influence the psychological well-being of the older adults; the psychological burden can reversely add on the likelihood of neurological symptoms. For instance, prior study indicates

falls, even the fear of falling can greatly contribute to the lowered quality of life [12,62]. In any case, our finding highlights that experiencing neurological symptoms influence the universal health outcomes of the U.S Chinese older adults.

The findings of this study have limitations. First, the generalizability of the findings to other Chinese populations is uncertain since our study was only representative of Chinese older adults in the Greater Chicago area. Future studies are needed to explore the risk factors and impact of neurological symptoms in diverse Chinese populations. In addition, recall bias might exist since we asked participants to self report their experience of neurological symptoms in the past year. The prevalence of neurological symptoms could likely to be underreported. Moreover, our measure of neurological symptoms was based on subjective self-reported data and not verified by medical history records so that we were not able to attribute those symptoms to a certain disorder. The cross-sectional design is limited in assessing the development process of neurological symptoms and limited in establishing causal relationships. Furthermore, the data we collected are unable to assess the severity or frequency of symptoms as well as those who experience multiple symptoms. Future studies applying mixed research strategies and longitudinal design are needed to better understand the neurological risks and the adverse health outcomes among Chinese older adults.

Nonetheless, this study has wide implications for researchers and practice. First, this study calls for collaborative efforts of an inter-disciplinary research team to investigate neurological symptoms and syndromes, linking the presence of those symptoms to clinical diagnose. The multifactorial nature of the neurological symptoms requires clinical healthcare practitioners to gain an overall estimate on the underlying mechanism of onset neurological symptom before developing the treatment plan. Second, while many older adults in community generally perceive those symptoms as part of the normal aging process, it is important to raise community awareness that the presence of neurological symptoms can be early signs of neurological disorders and other health risks. Healthcare professionals need to proactively inquiry the presence of neurological symptoms within the high risk subgroups of Chinese older adults, including the oldest-old, women, less-educated, and low income, whereas patients also need to actively seek for professional medical care and report neurological symptoms to their physicians. In light of the traditional tabooed cultural belief of talking about having those symptoms will link to potential of developing diseases, culturally sensitive interventions and educations are needed to alleviate stress and anxiety associated with self-reporting neurological symptoms.

Third, considering the negative impact of the neurological symptoms on Chinese older adults' lives, culturally and linguistically appropriate health education programs should be developed to promote healthy lifestyle and prevent risk factors in Chinese older adults. Also, workshops and other health communication opportunities should be provided to older adults with neurological symptoms to train them with necessary coping skills in a holistic perspective. For instance, older adults need to learn about fall prevention, as well as how to cope with the fear of falling and the physical injuries after they fell. Fourth, the caregivers of older adults with neurological symptoms need also be trained to perform proper support to deal with those symptoms. On the policy level, our finding advocates for an integrated diseases management healthcare system to foster better communication between clinical practitioners and patients with neurological symptoms, and to offer additional social support for several subgroups of older adults who are at higher risk of suffering from neurological symptoms.

5. Conclusion

In sum, this study indicates that neurological symptoms are common among Chinese older adults in the U.S, and dizziness is the most common symptom. Our findings call for further investigations on several subgroups of Chinese older adults who reported higher prevalence of symptoms, including the oldest-old, lower educated, and low income. Future longitudinal studies are needed to improve our understanding of the outcomes and functional mechanism underlying the neurological symptoms among Chinese aging populations.

Acknowledgments

Conflict of Interest

Authors report no conflict of interest.

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