Research article

The Prevalence of Musculoskeletal Symptoms among Chinese older Adults in the Greater Chicago Area—Findings from the PINE Study

Xinqi Dong *, E-Shien Chang, and Stephanie Bergren

Rush Institute for Healthy Aging, Rush University Medical Center, Chicago, IL 60612, USA

* Correspondence: xinqi_dong@rush.edu; Tel: +1-312-942-3350; Fax: +1-312-942-2861.

Abstract: Musculoskeletal disorders affect many older adults and are a major public health concern due to rising prevalence. However, there is a paucity of research regarding the prevalence of musculoskeletal symptoms in minority older adults, especially in older Chinese adults in the U.S. This study aims to provide an overall estimate on the prevalence of musculoskeletal symptoms among Chinese older adults in the U.S. and examine the correlations between sociodemographic characteristics, self-reported health measures, and musculoskeletal symptoms. Data was collected through the Population Study of Chinese Elderly in Chicago (PINE) study. This community-based participatory research study surveyed a total of 3,159 Chinese older adults aged 60 and above. Review of Systems (ROS) was used to assess individual perceptions of musculoskeletal symptoms. We found 67% of participants experience musculoskeletal symptoms. Muscle or joint pain (55.3%) and back pain (34.5%) were the most prevalent types of symptoms. Being female ($r = 0.18$), having lower education ($r = 0.15$), living fewer years in the community ($r = 0.05$), having a lower overall health status ($r = 0.22$), and having a lower quality of life ($r = 0.08$) were all significantly correlated with reporting musculoskeletal symptoms. Our findings show that musculoskeletal symptoms are a common health concern among Chinese older adults, and that certain subsets of the population, related to sociodemographic factors, are more likely to experience these symptoms. Future longitudinal studies should be conducted to determine causality as well as changes in musculoskeletal symptoms burden.

Keywords: musculoskeletal; Chinese aging; older adults; prevalence; health; population studies

1. Introduction

The musculoskeletal system, comprised of muscles, bones, joints, connective tissues, etc., is an

important organ system which supports the human body, enables movement, and protects vital organs. Diseases related to the musculoskeletal system are very common and include over 150 different diseases and syndromes [1], which often result in motion deficit or functional disorders [2]. Furthermore, the pain and discomfort accompanied with musculoskeletal disorders interfere with the daily life activities and may contribute to permanent disability [3]. Based on self-reported pain, musculoskeletal conditions affect up to 20% of all adults [3]. These symptoms are more prevalent in older adults due to their vulnerability and other associated health issues [4–6]. Older women in particular suffer from a higher prevalence of musculoskeletal symptoms [3]. Furthermore, there is no cure for many musculoskeletal disorders, and treatment includes prolonged management of the symptoms [7]. Therefore, increased attention to issues concerning musculoskeletal symptoms, like prevalence and causation, is necessary in order to mitigate their effects.

In particular, minority aging groups disproportionately suffer from musculoskeletal disorders. This disparity is the result of many contributing factors, of which include: genetic differences, socio–economic status (SES), environmental exposure, access to healthcare and/or treatment, occupation, and cultural barriers [8]. Most research on minority health disparities in the U.S. targets African American and Hispanic populations and few focus on the Asian population in the U.S. Considering more than half of hip fractures worldwide are expected to occur in Asia by 2050 [3], the scarcity in relevant research is alarming. Moreover, the U.S Asian populations are consistently treated as a homogeneous group, which fails to recognize differences in cultural beliefs, health behaviors, and genetic inherence between and within ethnicities that affect health outcomes [9–11].

The Chinese community is the oldest and largest Asian American subgroup in the U.S [12]. Chinese older adults constitute a large segment of the general Chinese population in the U.S, of whom 15.4% aged 65 or older [13]. More than 80% of Chinese older adults are foreign-born, and approximately 30% immigrated to the U.S. after the age of 60. Researchers suggest Chinese older adults are disproportionately affected by some musculoskeletal system diseases due to their former occupations and continued high physical activity compared to older U.S. Caucasian adults [14]. Furthermore, studies have shown specific musculoskeletal disorders, like knee osteoarthritis, are more prevalent in Chinese women than in white American women [14].

Due to the intra-group diversity of language, educational level, SES, as well as the aforementioned characteristics, there is limited evidence-based research targeting U.S. Chinese older adults and research that addresses their health needs [15]. Chinese older adults face multiple cultural and linguistic barriers in accessing healthcare [15]. For example, there are many ways to conceptualize pain within the Chinese context; a traditional Confucian belief is that pain is a necessary component of life and should not be reported until the pain becomes unbearable [16]. Current treatments for musculoskeletal symptoms may also only be available through medical visits, and many seniors rely on children for transportation and translation; their perceived burden on their children may deter Chinese older adults from seeking treatment [15,17–19]. The importance of this cultural nuance and its effects on musculoskeletal research needs to be examined, as it may complicate results. In order to ascertain a more robust picture of U.S. Chinese older adult health, research needs to focus on the prevalence of various symptoms, including those regarding the musculoskeletal system.

To provide an overall estimate on the prevalence of musculoskeletal symptoms among Chinese older adults in U.S, this study aims to 1) evaluate the prevalence of musculoskeletal symptoms, 2) examine the correlations between musculoskeletal symptoms, sociodemographic characteristics, and

self-reported health and quality of life measures.

2. Methods

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.

In order to ensure study relevance to the well community-based 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. A community advisory board (CAB) provided useful perspectives for research conduct and sustaining community partnerships [20]. This board worked extensively with our research staff not only to examine the cultural and linguistic appropriateness of study instruments, but also to conduct outreach programs and focus group discussions. The development of study instruments were chosen based on input from CAB for relevant domains to the population. Research staff then conducted thorough research to find best-fit measurement instruments for these domains. If no instruments were available, CAB and our research staff developed questions together. Survey materials were translated into traditional and simplified Chinese characters.

Over twenty social services agencies, community centers, health advocacy agencies, faith-based organizations, senior apartments and social clubs serving as study recruitment sites, where eligible participants were approached during routine social service and outreach efforts serving Chinese Americans families in the Chicago city and suburban areas. All participants consented and were interviewed by trained bicultural research assistants in English or Chinese dialects, including Mandarin, Cantonese, Toisanese, 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 [21], including age, sex, income, education, number of children, and country of origin. Further details are available in our existing publications [20]. The study was approved by the Institutional Review Boards of the Rush University Medical Center. The IRB number is 10090203-IRB02.

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 living in the U.S. and years residing in the current community were also collected. Education level was assessed by asking participants the highest educational level completed in years. We created a dichotomous country of origin variable by categorizing respondents into the "China" group if they were born in mainland China and "other" group for other countries and regions. Living arrangement was assessed by asking participants how many people live in their household besides themselves and was categorized into three groups: (1) living alone; (2) living with 1–2 persons; (3) living with 2–3 persons; (4) living with 4 more persons. Self reported annual income included income from all sources, such as wages, salaries, social security or retirement benefits, help from relatives, rent from property, etc. Annual income was categorized into four groups: (1) $0–$4,999 per year; (2) $5,000–$9,999 per year; (3) $10,000–$14,999 per year; (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; and 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.

2.2.3. Musculoskeletal symptoms

We used the Review of Systems (ROS) to assess the musculoskeletal symptoms among our participants. ROS is a list of questions organized by organ systems used by health–care providers for eliciting a medical history from a patient. Musculoskeletal system was assessed by asking participants whether they had these symptoms in the past: 1) Muscle or joint pain; 2) Back pain; 3) Stiffness; 4) Redness of joints; 5) Swelling of joints; and 6) Trauma. Content validity was assessed by a group of bilingual and bicultural study researchers with expertise in Chinese cultural issues, health, and aging. The Cronbach's alpha for the 6-item scale is 0.53.

2.3. Data analysis

Descriptive univariate statistics were used to summarize sociodemographic characteristics and the presence of prevalence of musculoskeletal symptoms among the sample population. The prevalence of each symptom was calculated. Chi-squared tests were used to compare the bivariate sociodemographic differences between no musculoskeletal symptoms group and any musculoskeletal symptoms group and between no musculoskeletal symptoms group and any musculoskeletal symptoms group. The Pearson Correlation coefficients were used to examine the correlations between sociodemographic variables and the prevalence of any musculoskeletal symptoms. Statistical analyses were conducted using SAS, Version 9.2 (SAS Institute Inc., Cary, NC).

3. Results

3.1. Sample Characteristics

Among 3,159 participants enrolled in the PINE Study, 58.9% were female, 71.3% were married, and 85.1% had an annual income below $10,000. Over two-thirds (67%) of participants reported any musculoskeletal symptoms as shown in Table 1. Highest prevalence of any musculoskeletal symptoms was also exhibited if they were female (65.2%, $P < 0.001$), had 1–6 years of education (40.5%, $P < 0.001$), were married (69.0%, $P < 0.001$) and were born in China (94.1%, $P < 0.001$). Individuals with any musculoskeletal symptoms in comparison to those without any symptoms perceived a higher rate of poor overall health status (22.0% vs. 13.0%, $P < 0.001$), fair or poor quality of life (52.0% vs. 44.2%, $P < 0.001$), and worsened health status (49.1% vs. 29.4%, $P < 0.001$).

Table 1. Characteristics of study participant by any musculoskeletal symptom.

	Any symptoms ($N = 2116$)	No symptoms ($N = 1043$)	χ^2	d.f	P
Age group, N (%)					
60–64	468 (22.1)	213 (20.4)			
65–69	402 (19.0)	241 (23.1)			
70–74	399 (18.9)	207 (19.9)			
75–79	389 (18.4)	168 (16.1)			
80–84	274 (13.0)	122 (11.7)			
85 and over	184 (8.7)	92 (8.8)	10	5	0.07
Sex, N (%)					
Male	736 (34.8)	561 (53.8)			
Female	1380 (65.2)	482 (46.2)	104.3	1	< 0.001
Education level, N (%)					
0 year	157 (7.5)	38 (3.7)			
1–6 years	854 (40.5)	325 (31.5)			
7–12 years	707 (33.6)	396 (38.3)			
13–16 years	347 (16.5)	229 (22.2)			
More than 17 years	42 (2.0)	45 (4.4)	61.8	4	< 0.001
Income, N (%)					
$0–$4,999	693 (33.1)	348 (33.9)			
$5,000–$9,999	1116 (53.2)	501 (48.8)			
$10,000–$14,999	193 (9.2)	117 (11.4)			
$15,000–$19,999	48 (2.3)	20 (2.0)			
Over $20,000	46 (2.2)	41 (4.0)	14.5	4	< 0.01

Marital status, *N* (%)					
Married	1453 (69.0)	784 (76.0)			
Separated	40 (1.9)	17 (1.7)			
Divorced	46 (2.2)	28 (2.7)			
Widowed	567 (26.9)	202 (19.6)	21.1	3	< 0.001
Number of children, *N* (%)					
0	84 (4.0)	44 (4.2)			
1–2	831 (39.4)	440 (42.3)			
3+	1195 (56.6)	557 (53.5)	2.8	2	0.25
Living arrangement, *N* (%)					
Living Alone	489 (23.1)	190 (18.2)			
With 1 person	851 (40.2)	467 (44.8)			
With 2–3 persons	324 (15.3)	156 (15.0)			
With 4 or more	452 (21.4)	229 (22.0)	11.4	3	0.01
China born, *N* (%)					
Yes	1991 (94.1)	940 (90.1)			
No	125 (5.9)	103 (9.9)	16.4	1	< 0.001
Years in US, *N* (%)					
0–10	545 (25.6)	295 (28.4)			
11–20	679 (32.2)	290 (27.9)			
21–30	521 (24.7)	246 (23.7)			
31+	361 (17.1)	207 (19.9)	9.2	3	0.03
Years in neighborhood, *N* (%)					
0–10	1234 (58.5)	577 (55.5)			
11–20	496 (23.5)	244 (23.5)			
21–30	249 (11.8)	139 (13.4)			
31+	130 (6.2)	80 (7.7)	4.9	3	0.18
Overall health status, *N* (%)					
Very good	54 (2.6)	86 (8.3)			
Good	609 (28.9)	488 (46.8)			
Fair	987 (46.6)	333 (31.9)			
Poor	466 (22.0)	136 (13.0)	182.1	3	< 0.001

Quality of life, N (%)				
Very good	130 (6.2)	86 (8.3)		
Good	887 (41.9)	496 (47.6)		
Fair	1023 (48.4)	434 (41.7)		
Poor	75 (3.6)	26 (2.5)	18.9	3	< 0.001
Health status changes over the last year, N (%)				
Improved	163 (7.7)	114 (10.9)		
Same	913 (43.2)	622 (59.6)		
Worsened	1038 (49.1)	307 (29.4)	110.5	2	< 0.001

3.2.   Presence of Musculoskeletal Symptoms

The prevalence of various musculoskeletal symptoms is presented in Table 2. Muscle or joint pain was the most common symptoms experienced by participants (55.3%). Back pain was present among 34.5% of participants, followed by the feeling of stiffness in muscles or joints in 13.1% of individuals. Swelling of joints occurred in 8.8% and trauma-related symptoms in 6.0% of the sample pool.

Table 2. Percentage of participants with musculoskeletal symptoms.

	N	%
Muscle or joint pain	1746	55.3
Back pain	1089	34.5
Stiffness	415	13.1
Redness of joints	107	3.4
Swelling of joints	279	8.8
Trauma	188	6.0

3.3.   Prevalence of Musculoskeletal Symptoms by Sociodemographic Characteristics

The categorization of musculoskeletal symptoms by sociodemographic characteristics is presented in Table 3. A majority of participants in each age group reported at least one musculoskeletal symptom; 68.7% of participants ages 60–64, 62.5% of participants ages 65–69, 65.8% of participants ages 70–74, 70.0% of participants ages 75–79, 69.0% of participants ages 80–84, and 66.7% of participants ages 85 and older reported musculoskeletal symptoms. More women (65.2%) than men (56.7%) reported symptoms. The prevalence of musculoskeletal symptoms decreased as the educational level increased, with the presence of musculoskeletal symptoms being greatest in 80.5% of those with 0 years of education in comparison to 48.3% of those with more than 17 years of education.

Table 3. Prevalence of musculoskeletal symptoms by social-demographic characteristics.

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	%
	468	68.7	402	62.5	399	65.8	389	70.0	274	69.0	184	66.7
Sex	Male (N = 1,297)						Female (N = 1,862)					
	N		%				N		%			
	736		56.7				1380		65.2			
Education	0 year (N = 195)		1–6 years (N = 1,179)			7–12 years (N = 1,103)		13–16 years (N = 576)		17 and over (N = 87)		
	N	%	N	%		N	%	N	%	N	%	
	157	80.5	854	72.4		707	64.1	347	60.2	42	48.3	
Income	$0–$4,999 (N = 1,041)		$5,000–$9,999 (N = 1,617)			$10,000–$14,999 (N = 310)		$15,000–$19,999 (N = 68)		$20,000 and over ($N$ = 87)		
	N	%	N	%		N	%	N	%	N	%	
	693	66.6	1116	69.0		193	62.3	48	70.6	46	52.9	

3.4.   Prevalence of Musculoskeletal Symptoms by Health Status

Further analysis in the prevalence of any musculoskeletal symptoms was defined by self-reported health status in Table 4. The presence of at least one musculoskeletal symptom increased as overall health status decreased, with the greatest prevalence of symptoms among 77.4% of participants who self-reported their overall health status as poor in comparison to 38.6% of those who deemed their health as very good. Likewise, more musculoskeletal symptoms appeared in 74.3% of those who rated their quality of life as poor in comparison to 60.2% of those with very good quality of life. In addition, 77.2% of participants with worsened health status change over the last year experienced significantly more musculoskeletal symptoms than 58.8% of those with improved health and 59.5% of those with no change in health over the past year.

Table 4. Prevalence of musculoskeletal symptoms by health status.

Overall health status	Very good (N = 140)		Good (N = 1097)		Fair (N = 1320)		Poor (N = 602)	
	N	%	N	%	N	%	N	%
	54	38.6	609	55.5	987	74.8	466	77.4
Quality of life	Very good (N = 216)		Good (N = 1383)		Fair (N = 1457)		Poor (N = 101)	
	N	%	N	%	N	%	N	%
	130	60.2	887	64.1	1023	70.2	75	74.3
Health status changes over the last year	Improved (N = 277)		Same (N = 1535)				Worsened (N = 1345)	
	N	%	N		%		N	%
	163	58.8	913		59.5		1038	77.2

3.5. *Correlation of Sociodemographic Factors and Musculoskeletal Symptoms*

Factors including sex, education, income, marital status, years in neighborhood, country of origin, overall health status, quality of life, and health changes over the last year were significantly correlated with musculoskeletal symptoms, shown in Table 5. Being female ($r = 0.18$, $P < 0.001$), having less education ($r = 0.15$, $P < 0.001$), lower income ($r = 0.05$, $P < 0.05$), not married ($r = 0.07$, $P < 0.001$), having fewer years in community ($r = 0.05$, $P < 0.001$), and being born in China ($r = 0.07$, $P < 0.001$) were associated the presence of at least one musculoskeletal symptom. Furthermore, overall health status ($r = -0.22$, $P < 0.001$), quality of life ($r = -0.08$, $P < 0.001$), and health status changes over the last

year (r = -0.18, P < 0.001) were negatively associated with the presence of any musculoskeletal symptoms. In contrast, number of years in the U.S. in relationship to the presence of any musculoskeletal symptoms was not significant.

Table 5. Correlations between sociodemographic and any musculoskeletal symptoms.

	Age	Sex	Edu	Income	MS	Children	Living	Yrs in U.S.	Yrs in com	Origin	OHS	QOL	HC	Any
Age	1.00													
Sex	0.01	1.00												
Edu	-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	
Any	0.02	0.18***	-0.15***	-0.05*	-0.07***	0.02	-0.02	-0.03	-0.05**	0.07***	-0.22***	-0.08***	-0.18***	1.00

Edu = Education; MS = Marital status; Living = Living arrangement; Yrs in U.S. = Years in the US; Yrs in com = Years in community; Origin = Country of origin; OHS = Overall health status; QOL = Quality of life; HC = Health changes over last year; Any = Any musculoskeletal symptoms. *P < 0.05 **P < 0.01 ***P < 0.001.

4. Discussion

As the first population-based study that reported the prevalence of musculoskeletal symptoms among U.S Chinese older adults, this study indicates that musculoskeletal symptoms are commonly experienced among Chinese aging population in greater Chicago area (67.0%). Muscle or joint pain is the mostly commonly presented musculoskeletal symptoms (55.3%), followed by back pain (34.5%). As reported, participants are more likely to experience any musculoskeletal symptoms if they are female, less educated, with lower income, unmarried, with fewer years living in their community, born in China, with poorer self-perceived health status and quality of life, and with negative health changes over last year.

Previous literatures have found prevalence of musculoskeletal symptoms exists in a majority of the population, suggesting that 59% of U.S. older adults 65 and older, and 69% of U.S. older adults 75 and older reported musculoskeletal symptoms [5,22]. A review of literature regarding musculoskeletal disorders has not determined a consensus on precise estimates of prevalence, but indicates these disorders are overwhelmingly prevalent in the elderly population [23]. Our study's results regarding prevalence of musculoskeletal symptoms, at 67% of our study population, align with existing literature. Further, previous literature has found back pain and muscle or joint pain to be the most prevalent forms of musculoskeletal symptoms [23,24], similar to our study.

Our finding that women have a higher prevalence experiencing musculoskeletal symptoms is consistent with previous literatures [23,25]. Various studies have proposed explanations such as sexes,-different pain thresholds, exposure to risks in the work environment, differences in muscle strength, as well as psychosocial risk factors like low social support [26–28]. Furthermore, researchers suggest life-long management of pain differs between men and women, possibly exacerbating genetic predispositions with psychosocial factors [29]. This implies that the relative complexity of causes of musculoskeletal pain for women compared to men at least partially explains the low, rate of rehabilitation or management of pain by women. Previous studies have not collected sufficient data on the occupations of Chinese older adults; further research regarding psychosocial or occupational factors needs to be done to evaluate if these characters play a role in the higher musculoskeletal symptoms prevalence among subgroups.

Our study indicates that age is not associated the prevalence of musculoskeletal symptoms. In a WHO data review of risk factors associated with major musculoskeletal conditions worldwide and across all age groups, age was listed as indicator of prevalence for all major musculoskeletal disorders, due to the general deterioration of the body over time [3]. However, a random sample study of older Chinese adults age 70 and over in Hong Kong did not report an age related increase in prevalence of musculoskeletal complaints [30]. Further research should be conducted to determine the influence of age on the prevalence and specific symptoms of musculoskeletal pain.

Consistent with previous research regarding education level and generalized health concerns our research suggests better-educated older Chinese in U.S are less likely to experience musculoskeletal symptoms [31]. Level of education has been found to be a strong socioeconomic predictor of health behavior [32,33]. Higher education is linked to higher income and lower rates of poverty, which greatly decreases the likelihood of poor health. However, the benefits of education extend beyond economic prosperity and influence behaviors which may lead to healthier lives [33]. Education may develop abilities that help individuals not only acquire a concept of good health, but also encourages and enables a healthy lifestyle [34]. More research is needed to specifically ascertain the causation

between level of education, related lifestyle characteristics/behavior, and level of health in the older Chinese adult population.

Furthermore, our bivariate analysis finds that Chinese older adults who have higher rates of musculoskeletal symptoms are likely to have lived fewer years in their community. Other studies regarding musculoskeletal symptoms, overall health, and social deprivation have also found clear associations between prevalence of pain and social isolation [35,36]. This prevalence of musculoskeletal pain may be determined not only by demographic factors related to sex, age, etc, but also social factors, like familiarity with their community, may carry significant weight.

Our study reveals that U.S. Chinese older adults perceive poorer health status and quality of life if they are experience higher rates of musculoskeletal symptoms, which is consistent with existing literature about the impact of pain on self rated health [37]. Moreover, older adults are more likely to report musculoskeletal symptoms if they perceive their health status to worsen over the past year. The pain, discomfort, and disability which accompany the prevalence of musculoskeletal symptoms can influence participants' perception of health status. On the other hand, people may report a poor health status if they suffer from illnesses, such as musculoskeletal disorders. Our study finds a correlation between perceived health status and reported symptoms, but further research needs to be completed to determine causality.

The findings of this study have limitations. First, this study is representative of Chinese older adults in the greater Chicago and its findings should not be generalized to other Chinese populations in the U.S. or in Asia, due to intra-group variety. While this study may be used as an indicator that musculoskeletal symptoms are an area of concern for Chinese communities, it would be shortsighted to directly apply our findings to the diverse Chinese populations. Also, future studies are needed to explore the prevalence of musculoskeletal symptoms and possible correlations and causations of these symptoms among Chinese populations around world. Moreover, due to an in-person interview design of the PINE study, recall bias indicates that the musculoskeletal symptoms are likely to be underreported. In addition, this study only collected data on musculoskeletal symptoms. We are unable to establish the causal relationship between symptoms and diagnosed musculoskeletal disorders. Its cross-sectional design is limited in assessing the development of musculoskeletal symptoms with aging. Future studies applying mixed research strategies and a longitudinal design are needed to better understand the experience of musculoskeletal symptoms and its adverse health outcomes among Chinese older adults. In addition, future reports are also needed to investigate the correlation among the prevalence of each study to provide detailed clinical implications.

Nonetheless, this study has wide implications for researchers, health professionals, social workers, and policy makers. First, this study points to the need of improving investigations on musculoskeletal prevalence among Chinese older adults. A multidisciplinary team composed of experts in biomedicine, pathology and epidemiology, in addition to health clinical practitioners, is needed to further understand aging and musculoskeletal prevalence in order to elucidate possible risk factors and causation. Physicians should pay special attention to screen subgroups that are more like to experience musculoskeletal symptoms including those who are women, are less educated, are not married, have lived fewer years in their community, and were born in China.

Research should be focused on collecting more data regarding musculoskeletal symptoms prevalence along with socio-demographic, psychosocial, and occupational characteristics. There are strong suggestions in other literature that physical exertion and routine during working years is an indicator of musculoskeletal symptoms prevalence [28]. Since current research about older Chinese

adults does not include data regarding work history, it is difficult to determine if their occupation or activity level at younger ages is a relevant indicator for the prevalence of musculoskeletal pain. However, there are likely multiple factors that influence prevalence of musculoskeletal symptoms and things like psychosocial stress and other demographic characteristics are important to survey as well. Longitudinal studies tracking the prevalence of musculoskeletal symptoms would be helpful in determining changes and possible causations for those changes.

In addition, it is important to raise community awareness to those musculoskeletal symptoms as early signs to detect the musculoskeletal disorders. The CBPR approach we used in the PINE Study could be a potential model for future research regarding health issues, particularly those mitigated by cultural practices, and has been detailed elsewhere [20,38–43]. Successful studies in Chinese communities may hinge upon the employment of CBPR approaches due to an overall reluctance to participate in research [38].

Though causality between musculoskeletal symptoms and overall health has not been determined, the relationship between musculoskeletal symptoms and health suggests treating musculoskeletal symptoms may affect perceptions of overall health status. In light of the traditional tabooed cultural belief of talking about the potential risks of developing diseases, culturally sensitive interventions and educations are needed to alleviate stress and anxiety associated with self-reporting early symptoms. The PINE Study elucidated cultural issues like differing expectations of medicine, Confucian and Daoist beliefs, which impede mutual understanding between the Chinese older adult and health professionals [39]. Our approach of humility and compassion as a clinical tool is a helpful model for health professionals, especially for improving access and use of biomedical treatment [40,44,45]. Our findings support changes in policies which advance culturally and linguistically-sensitive preventative care and increase access to medical resources for minority older adults.

5. Conclusion

In sum, this study indicates that musculoskeletal symptoms are common among Chinese older adults in the U.S. Our findings call for further investigations on several subgroups of Chinese older adults who reported higher prevalence of symptoms, including women, lower educated and newer to the community. Future longitudinal studies are needed to improve our understanding of the outcomes and functional mechanisms underlying the musculoskeletal symptoms among Chinese aging populations.

Acknowledgments

Conflict of Interest

Authors report no conflict of interest.

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