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Original Research

Relationship between Social Support, Sarcopenia, and Cognitive Impairment in Chinese Community-Dwelling Older Adults

D. Bian[1,2], X. Li[1], Y. Xiao[1], K. Song[1], L. Wang[3], J. Shen[4], M. Aimaiti[4], X. Ma[4], C. Shi[5], G. Li[1]

1. School of Public Health, Shanghai Jiao Tong University School of Medicine, Shanghai, China; 2. Department of Clinical Nutrition, Ruijin Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China; 3. Department of Geriatrics, Medical Center on Aging of Shanghai Ruijin Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China; 4. Department of Nutrition, College of Health Science and Technology, Shanghai Jiao Tong University School of Medicine, Shanghai, China; 5. Center for Health Technology Assessment, China Hospital Development Institute, Shanghai Jiao Tong University, Shanghai, China

Corresponding Author: C. Shi, Center for Health Technology Assessment, China Hospital Development Institute, Shanghai Jiao Tong University, Shanghai, China, chenshu@winkingworks.com; G. Li, School of Public Health, Shanghai Jiao Tong University School of Medicine, Shanghai, China, guohongli@sjtu.edu.cn.

Abstract

BACKGROUND: Cognitive impairment and sarcopenia have become important challenges for the growing aging population. Social support has been shown to protect against cognitive impairment, but its impact on sarcopenia remains unknown. The purpose of this study was to explore the correlation between social support, sarcopenia, and cognitive impairment in Chinese older adults.

METHOD: A multi-stage whole group sampling method was used to conduct a cross-sectional survey of 720 community-dwelling older people in Shanghai. The definition of sarcopenia was in accordance with the criteria of the Asian Working Group for Sarcopenia (AWGS) 2019. Cognitive impairment was evaluated using a computerized neuropsychological assessment device that had been previously validated. Social support was assessed using the Social Support Rate Scale. Logistic regression analyses were conducted to explore the relationship between social support cognitive impairment and sarcopenia, fully adjusting for all potential confounding factors.

RESULTS: Our study found that 230 (31.94%) of the participants had cognitive impairment and 97 (13.47%) of the participants had sarcopenia. The mean social support score was 35.10 ± 7.54. Besides, the results showed that cognitive impairment was associated with sarcopenia (OR:1.650, 95% CI: 1.048, 2.596, P=0.030) after adjusting for confounding factors. Older adults with high level social support had the lowest risk of cognitive impairment (OR: 0.297, 95% CI: 0.115, 0.680, P=0.021) and sarcopenia (OR: 0.113, 95% CI: 0.031, 0.407, P=0.001), respectively.

CONCLUSION: Our analysis revealed that high level social support was negatively associated with sarcopenia and cognitive impairment. These findings provide strong support for the health promotion effect of social networks against sarcopenia and cognitive impairment in Chinese community-dwelling older adults, with important implications for healthcare policy makers.

Key words: Cognitive impairment, sarcopenia, social support, community-dwelling older adults.

Introduction

With economic progress and urbanization, human living conditions and healthcare are constantly improving. Population aging has become a global trend and poses a serious challenge to human society worldwide. China, a country with a huge population, is also undergoing a major demographic shift into an aging society (1). At the end of 2022, there were 280 million people aged 60 or older in China, accounting for 19.8% of the total population. Among them, 209 million people were aged 65 and above. Health is a necessary condition for quality of life for adults in their later years. Zeng et al. showed that although death rates have substantially decreased among older adults in China, their cognitive impairment rate has increased and their physical performance capacity has decreased (2).

Aging plays an important role in the development of sarcopenia and cognitive impairment, which have become major challenges in countries with aging populations. Cognitive impairment ranges from mild cognitive impairment to dementia. Globally, approximately 47 million people live with dementia, and this number is projected to increase to 131 million by 2050 (3). In China, among people aged 60 and older, 15.07 million are living with dementia and 38.77 million people are living with mild cognitive impairment (4). Cognitive impairment can place a heavy socioeconomic burden on families and society; for example, the annual socioeconomic cost per Alzheimer's disease patient is US$19,144.36 (5). "Sarcopenia" refers to the age-related progressive decline of muscle mass accompanied by impaired muscle strength and/or muscle function (6). The disorder is associated with higher rates of falls, decreased function, higher mortality rates, and an increased probability of hospitalization (6). The global prevalence of sarcopenia ranges from 10% to 27%, which presents an issue of growing concern (7). A meta-analysis reported that the pooled prevalence of sarcopenia was 12.9% in men and 11.2% in women in community-dwelling Chinese older adults aged 60 years and over (8). Several recent epidemiological and review studies have reported an association between sarcopenia and cognitive decline (9-11), although their findings have not been replicated in other research (12). Inconsistent diagnoses of sarcopenia and cognitive impairment and differences in study design and study populations may have contributed to these inconsistent results (13).

Research has indicated that 90.7% of Chinese elderly individuals prefer home-based care services (14). In recent decades, the "4-2-1" (four grandparents, two parents, one child)

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family structure resulting from China's one-child policy has created several challenges, due to the rise of elderly empty-nest families (1). Against this cultural background, social support plays an important role in the well-being of China's elderly population today (15). Social support comprises material and/or spiritual support from various people and organizations, including family members, friends, neighbors, colleagues, and governmental and non-governmental organizations (16). Accumulating evidence has shown that social support protects against cognitive decline in older adults (17-19). However, few studies have investigated the correlation between social support and sarcopenia.

The purpose of this study was to examine the relationship between social support, cognitive impairment, and sarcopenia in a population-based sample with participants aged over 65. We also examined the association between diagnostic parameters of sarcopenia and cognitive impairment.

Methods

Participants

This cross-sectional study was conducted from March 2022 to November 2022 and was designed to investigate the prevalence of sarcopenia and cognitive impairment among Chinese community-dwelling older adults. The sampling method was as follows. First, we randomly selected three districts in Shanghai according to their geographical location and level of economic development. Second, we randomly selected one town in each district, giving a total of three towns. Third, we selected two or three communities from each town. The inclusion criteria for participants were as follows: (i) aged 65 years and above, (ii) able to complete relevant tests and assessments independently, and (iii) able and willing to provide informed consent. The exclusion criteria were as follows: (i) affected by loss of speech, (ii) severely impaired in daily living activities, and (iii) the presence of metal implants (such as cardiac pacemakers). We assessed the validity of the sampling approach in estimating the prevalence of sarcopenia and cognitive impairment in community-dwelling older adults. Assuming a prevalence of cognitive impairment of 21.5%, with an error rate of 3% and a confidence interval of 95%, the minimum sample size was calculated to be 720 community-dwelling older adults. We initially recruited 799 community-dwelling older adults for this cross-sectional study. However, 56 of the older adults who participated in this study were excluded due to incomplete data, such as missing demographic information and baseline disease information. Another 23 older adults were excluded because they were unable to complete the body composition analysis. The final sample used for analysis comprised 720 community-dwelling old adults. The study was approved by the Human Ethics Research Committee of the School of Public Health at the Shanghai Jiao Tong University School of Medicine (no. SJUPN202008). Written informed consent was obtained from all of the participants before the study began.

Assessment of Sarcopenia

The diagnosis of sarcopenia is based on a combination of low muscle mass and low muscle function (either strength or performance), in accordance with the 2019 consensus of the Asia Working Group on Sarcopenia (AWGS) (20). Muscle mass was measured using a multifrequency bioelectrical impedance method (Inbody 770, Biopace Co., Ltd., Seoul, Korea). Low muscle mass was identified by bioelectrical impedance analysis as an appendicular skeletal muscle index (ASMI) of < 7.0 kg/m2 for men and < 5.7 kg/m^2 for women.

Low muscle strength was diagnosed as handgrip strength of < 28 kg for men and < 18 kg for women. The handgrip strength measurement method was described in detail in our previous study (21). The results were measured three times on the dominant side (either the left or the right hand) at 30-second intervals, with the maximum value taken as the result. The results were expressed in kilograms of force (kg). According to the AWGS (2019) (20), the various possible criteria for low muscle performance are as follows: a 6 m walking speed (gait speed) of < 1.0 m/s, a 5-times sit–stand chair test time score of ≥ 12 seconds (a surrogate for gait speed), and a Short Physical Performance Battery (SPPB) score of ≤ 9.

Assessment of Cognitive impairment

We assessed cognitive impairment in the participating community-dwelling older adults using a pre-developed and validated computerized neuropsychological assessment device, "Memory Guard", which was described in detail in a previous study (21). Memory Guard is an immersive game task that measures the cognitive dimensions of an elderly individual's attention, recall, orientation, and calculation by simulating a hospital visit scene in which the elderly person randomly selects a character for hospital registration, consultation, and prescription dispensing tasks. Memory Guard includes 38 features (17 features for option score, 20 features for time score, and 1 demographic feature). The ordering of the correct answers to the items and the content of some items (i.e. numbers, color, direction) were randomly generated, to ensure that they were not repeated in subsequent tests. Memory Guard has an accuracy of 93.75% and an AUC of 0.923, with a sensitivity of 91.67% and a specificity of 95.45 compared with MoCA. In this study, Memory Guard was presented in the form of an app and operated by mobile phones or tablets with a touch screen using the Android or IOS system. It took approximately 20 minutes to complete the entire test system. The computerized tool automatically identifies whether older adults are at risk of cognitive impairment.

Social Support Assessment

Social support was assessed using the Social Support Rate Scale (SSRS), which was designed to determine how much support respondents receive from their family, friends, and various social contexts. The SSRS consists of three subscales: subjective support (including the number of friends who have

Table 1. Demographic and health-related characteristics of subjects

Demographic characteristics	Total	Ctrl	Cognitive impairment	Sarcopenia	Cognitive impairment & Sarcopenia	P value
N	720	435	188	55	42	
Age	70.92±4.73	70.91±4.68	70.69±4.91	71.78±4.49	70.95±4.75	0.519
Female, n (%)	428	250	113	36	29	0.380
Living alone, n (%)	48	24	16	6	2	0.285
Education level, n (%)						
Illiterate	6	5	0	1	0	0.322
Primary school	39	21	8	7	3	
Secondary school	472	280	134	30	28	
College and above	203	129	46	17	11	
Chronic conditions						
Hypertension	332	191	97	27	17	0.277
Diabetes	133	75	38	12	8	0.745
Coronary heart disease	85	55	22	3	5	0.489
Cancer	16	11	3	1	1	0.902
GDS score	1.73±2.04	1.69±1.96	1.62±1.98	2.03±2.17	2.26±2.72	0.190
Morse score	33.55±11.03	33.05±10.46	33.83±10.96	34.18±11.42	36.67±15.60	0.209
Annual household income, RMB						0.163
≤ 30,000	66	40	16	7	3	
30,000 - 90,000	543	321	150	43	29	
90,000 - 240,000	104	70	21	5	8	
> 240,000	7	4	1	0	2	
BMI, kg/m^2	23.84±8.15	24.26±2.72	24.30±3.22	21.46±2.32	20.52±3.90	0.004*
Fat mass, kg	18.29±5.95	18.50±5.92	19.15±6.14	19.15±6.14	15.08±5.49	0.000*
ASMI, kg/m^2	6.85±1.19	6.98±0.93	7.13±1.56	5.74±0.76	5.74±0.75	0.000*
Handgrip strength, kg	26.11±8.43	27.35±8.56	26.54±8.09	20.32±5.35	18.89±4.33	0.000*
SSRS score	35.10±7.54	35.72±7.42	34.62±7.49	33.87±8.06	32.50±7.71	0.017*
SPPB score	11.14±1.42	11.24±1.31	11.18±1.36	10.67±1.55	10.43±2.19	0.000*
Sarcopenia	97	0	0	55	42	0.000*
Cognitive impairment	230	0	188	0	42	0.000*

* P < 0.05. Data are presented as mean ± SD for continuous variables and n for categorical variables. ANOVA was conducted for continuous variables and chi-square tests were conducted for categorical variables.

offered assistance, relationships with neighbors, relationships with colleagues, and the level of support from family members), objective support (problem-solving channels in emergencies and sources of psychological comfort in circumstances where participants may face pressure or resistance), and support utilization (how a participant expresses themselves when in trouble, how they seek help when in trouble, and how willing they are to participate in group activities). The total SSRS score is the sum of these three subscale scores (ranges from 12 to 66), with higher scores indicating a higher level of social support (22). SSRS have been widely used with a high reliability and validity. The total SSRS score is categorised as follows: scores <22 indicates low level of social support, total score between 23-44 indicates medium level of social support, then total score range from 45-66 indicates high level of social support (23, 24).

Covariates

The following sociodemographic and health-related characteristics were included in the analyses: age, sex, educational level, marriage status, family average income, diabetes, hypertension, coronary heart disease and cancer.

A Chinese version of the Geriatric Depression Scale (GDS-15) was used to measure geriatric depression. The total score for the GDS-15 is calculated as the sum of the scores for the scale's 15 items, with higher scores corresponding to a greater degree of depression. Depressive disorders were defined using the cutoff points for community-dwelling older adults: < 5, normal; 5–9, minor depressive disorder; ≥ 10, moderate and severe depressive disorder (25).

Fall risk was assessed using the Morse Fall Scale. This scale consists of six items reflecting risk factors for falls. These comprise history of falls, secondary diagnosis, ambulatory aids, intravenous therapy, type of gait and mental status. The total

score ranges from 0 to 125, with a cut-off score of ≥ 45. In this study, we defined ≥ 45 as indicative of high fall risk, 25–45 as indicative of moderate fall risk, and < 25 as indicative of low fall risk (26).

Statistical Analysis

Categorical data were expressed as a percentage of occurrence; continuous data were expressed in the form of mean and standard deviation (SD). Analysis of variance (ANOVA) or t-tests were conducted for continuous variables, while chi-squared tests were used for categorical variables. Logistic regression models were used to explore the relationship between cognitive impairment and sarcopenia. Several confounders, such as age, sex, educational level, living alone, family average income, BMI, diabetes, hypertension, coronary heart disease, and cancer, were controlled in multivariable regression models, because these factors have been reported to be associated with cognitive impairment (4, 27). Furthermore, we investigated the potential mediating effect of sarcopenia, including its individual components, on the association between social support and cognitive impairment. Statistical significance was set at a two-sided $P < 0.05$. All of the statistical analyses were performed using R studio software programs and IBM SPSS Statistics 26.

Results

Demographic and Health-related Characteristics of Participants

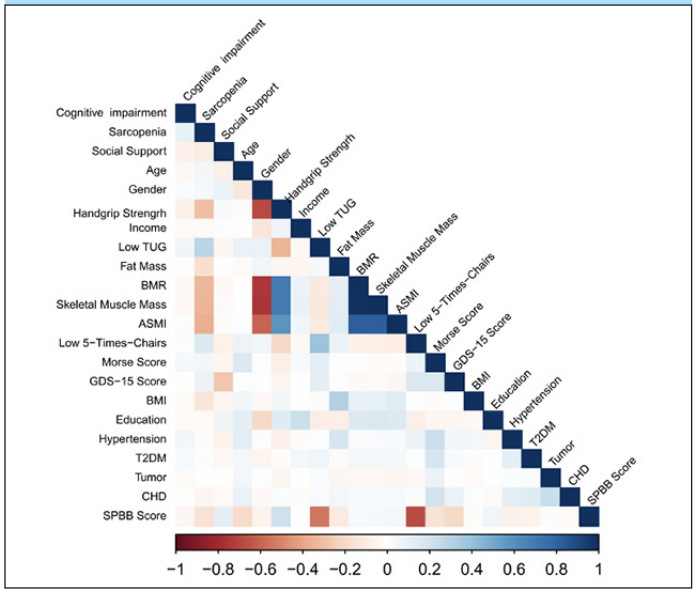
Of the 720 participants, 289 (40.14%) were male and 431 (59.86%) were female, with a mean age of 70.92 ± 4.73 years. Two hundred and thirty (31.94%) of the participants had cognitive impairment and 97 (13.47%) of the participants had sarcopenia. The mean social support score was 35.10 ± 7.54.

As shown in Table 1, there were significant differences in BMI, ASMI, fat mass, SPPB and SSRS scores between the groups (P<0.05). In addition, we found that patients with sarcopenia combined with cognitive impairment had the lowest BMI, ASMI, fat mass, SSRS and SPPB scores. However, we did not find statistically significant differences in BMI, ASMI, SPPB and SSRS scores in sarcopenia and sarcopenia combined with cognitive impairment (P>0.05). We conducted correlation analysis on each pair of variables, such as the subjects' basic characteristics, sarcopenia and its components, cognitive impairment, and social support. The results are shown in the heat map in Fig. 1.

Relationship between sarcopenia, including its components, and cognitive impairment

In the unadjusted model, the risk of cognitive impairment was 1.767 times higher in older adults with sarcopenia. After adjusting for potential confounders, we found that cognitive impairment was associated with sarcopenia (OR: 1.668, 95% CI: 1.064, 2.617, p: 0.026). We further analyzed the relationship between cognitive impairment and the diagnostic components of sarcopenia. We observed that cognitive impairment was significantly associated only with low handgrip strength (OR: 1.442. 95% CI: 1.003, 2.073) in model 3 (Table 2).

Figure 1. Heat map of the relationships between cognitive impairment, sarcopenia and its components, social support, and other health-related variables



Association of social support with cognitive impairment and sarcopenia

Table 3 presents the associations of different level of social support with cognitive impairment and sarcopenia among community-dwelling older adults. According to the scoring criteria of SSRS, 37 (5.13%) older adults had low social support, 603 (83.75%) had medium social support, and 80 (11.11%) had high social support. In the unadjusted model, the risk of sarcopenia was 0.169 times lower in older adults with high level of social support, compared with older adults with low level of social support (OR: 0.169, 95% CI: 0.057, 0.497, P=0.001). After controlling for confounding factors (Model 3), the older adults with high level of social support were negatively related to sarcopenia (OR: 0.113, 95% CI: 0.031, 0.407, P=0.001), compared with the older adults with low level social support. We also explored the relationship between cognitive impairment and social support. After controlling for confounding factors (Model 3), we found that older adults with high level of social support had the lowest risk of cognitive impairment (OR: 0.297, 95% CI: 0.115, 0.680, P=0.021).

Discussion

Throughout the world, populations are ageing more rapidly than in the past. The large increase for the elderly population will greatly increase the burden of disease and the demand for medical care for the whole society (28). The UN General Assembly recently published an action plan "Decade of healthy

Table 2. Associations of cognitive impairment with sarcopenia and cognitive impairment in logistic regression analysis

Variables	Model 1		Model 2		Model 3	
	OR (95%CI)	P	OR (95%CI)	P	OR (95%CI)	P
Sarcopenia	1.767 (1.142, 2.734)	0.011*	1.759 (1.129, 2.740)	0.013*	1.650 (1.048, 2.596)	0.030*
Low handgrip strength	1.516 (1.064, 2.159)	0.021*	1.517 (1.061, 2.169)	0.022*	1.439 (1.002, 2.066)	0.049*
Low ASMI	1.476 (1.024, 2.128)	0.037*	1.458 (1.007, 2.111)	0.046*	1.432 (0.980, 2.093)	0.064
Low SPPB	1.299 (0.797, 2.117)	0.295	1.358 (0.822, 2.242)	0.232	1.295 (0.778, 2.158)	0.320
Low gait speed	1.301 (0.910, 1.860)	0.149	1.316 (0.914, 1.893)	0.140	1.297 (0.895, 1.878)	0.170
Low 5-times sit-stand chair test	1.095 (0.715, 1.677)	0.676	1.104 (0.717, 1.700)	0.654	1.077 (0.691, 1.680)	0.743

* P< 0.05. Odds ratios and 95% confidence intervals were estimated by logistic regression models with different levels of adjustment, as follows. Model 1: unadjusted. Model 2: adjusted for gender, age, education, BMI, and living alone. Model 3: adjusted for gender, age, education, BMI, income, Morse score, GDS-15, living alone, hypertension, diabetes, cancer, CHD, and social support level.

Table 3. Association of social support with cognitive impairment and sarcopenia

Model	Low-level (n=37)	Medium-level (n=603)	High-level (n=80)	P
Sarcopenia				
Model 1	1(Ref)	0.314 (0.152, 0.650) *	0.169 (0.057, 0.497) *	0.001*
Model 2	1(Ref)	0.260 (0.115, 0.590) *	0.104 (0.030, 0.353) *	0.001*
Model 3	1(Ref)	0.270 (0.112, 0.649) *	0.113 (0.031, 0.407) *	0.002*
Cognitive impairment				
Model 1	1(Ref)	0.385 (0.197, 0.752) *	0.322 (0.143, 0.726) *	0.020*
Model 2	1(Ref)	0.378 (0.189, 0.753) *	0.312 (0.134, 0.730) *	0.022*
Model 3	1(Ref)	0.336 (0.162, 0.694) *	0.279 (0.115, 0.680) *	0.021*

* P < 0.05. Odds ratios and 95% confidence intervals were estimated by logistic regression models with different levels of adjustment, as follows. Model 1: unadjusted. Model 2: adjusted for gender, age, education, BMI, and living alone. Model 3: adjusted for gender, age, education, BMI, living alone, annual household income, Morse, GDS-15, hypertension, diabetes, cancer, CHD.

aging 2020–2030", highlighting the importance of policymakers around the world focusing their policies on improving the lives of older adults today and in the future. Cognitive impairment and sarcopenia will exert an increasingly important influence on the quality of life of older adults in the future. To examine the association between these factors, we conducted a cross-sectional survey. We used a stringent sampling design and standardized methods to ensure the reliability of the findings. In our study, the prevalence of cognitive impairment in community-dwelling Chinese older adults aged 65 and above was 31.94%. This figure for prevalence was slightly higher than that reported in previous research (4), which may have been due to the restriction of our survey population to 65 years and older. We also found that 13.47% of the older adults in our study had sarcopenia. Our results were similar to those of a previous review, in which the pooled prevalence of sarcopenia in older adults worldwide was reported to be ranged from 10% to 16% (29). Hence, our study showed that cognitive impairment was significantly related to sarcopenia. Previous studies have explored the relationship between cognitive impairment and sarcopenia. A recent meta-analysis across 10 cross-sectional and 3 cohort studies, including 27,428 patients, showed that sarcopenia was associated with mild cognitive impairment (pooled OR = 1.46, 95% CI: 1.31–1.62) (9). Similarly, data from the China Health and Retirement Longitudinal Study suggested that mild cognitive impairment was associated with sarcopenia in Chinese older adults, but the diagnosis of mild cognitive impairment and sarcopenia was not performed according to stringent criteria (30). We further analyzed the correlation between the diagnostic components of sarcopenia and cognitive impairment, and we found only that grip strength was significantly associated with cognitive impairment. Inflammation is a known risk factor for sarcopenia, low muscle strength and cognitive impairment (31-33). Besides, sarcopenia may contribute to the reduction of muscle mass and muscle strength, leading to an imbalance in the secretion of myokines, such as inflammatory cytokine, apelin, brain-derived neurotrophic factor, and chemokines. Subsequently, imbalanced myokine secretion leads to memory impairment by upregulating proinflammatory cytokine production through the blood–brain barrier (BBB) crossing (34, 35).

Our study found that the average score of social support for the community-dwelling older adults was 35.10±7.54 and 83.75% older adults had medium level of social support, which is consistent with other results regarding the older adults population (24, 36). Furthermore, we found that social support emerged as a significant correlate of cognitive impairment. This finding was consistent with the Women's Health Initiative Memory Study, which found that perceived social support, emotional or information support and positive social interaction were associated with incident mild cognitive impairment and/or dementia in American older adults (37). Recently, the

Chinese Longitudinal Healthy Longevity Survey showed that visits from children were consistently associated with a lower incidence of cognitive impairment among older adults (38). In traditional Chinese culture, the family is at the core of social support. Thus, older adults have relatively few social contacts in the aging community; instead, relationships with spouses and family members play the most important role in their social network (39). Social isolation, which also represents a lower level of social support, is linked to higher systemic, low-grade, chronic inflammation markers, such as C-reactive protein (CRP) and interleukin 6 (40-42). Furthermore, a study in the United States showed that chronic inflammation mediated the association between social isolation and cognitive decline (42).

In particular, our study found a correlation between social support and sarcopenia. A few studies have focused on the effects of social support on muscle mass or muscle function. A Japanese study found that social frailty exacerbated the development of osteoporosis and sarcopenia (43). The researchers' definition of social frailty included socioeconomic status, social resources, social behaviors, and social needs; as such, it was generally similar to the item measuring social support in this study. A Kashiwa cohort study found that social engagement had the potential to decrease sarcopenia risk by influencing multidimensional factors such as physical activity, oral function, and psychological and nutritional status (44). A meta-analysis revealed that social support was significantly related to lower levels of inflammation. By acting on the vagus nerve or the BBB (among other mechanisms), proinflammatory cytokines can signal the brain to alter neural sensitivity to the social environment, leading to increases in sensitivity to social threat and social connection (45). Thus, social support may attenuate or exacerbate the development of sarcopenia and cognitive impairment by altering the level of inflammation.

Therefore, social support may be a prevention and treatment measure for sarcopenia and cognitive impairment. Social support involves the companionship and assistance provided by family, friends, neighbors, and colleagues, providing them with a sense of belonging. Older adults are particularly likely to experience changes such as retirement and bereavement. These can exacerbate social isolation and social disengagement among the older adults, as well as reduced social support (46). Humans are fundamentally social (47), those with a stronger sense of belonging are likely to have better health and well-being (48). The US Centers for Disease Control and Prevention suggested that people's relationships and interactions with family, friends, coworkers, and community members can have a significant impact on their health and well-being. Healthy People 2030 focuses on helping people get the social support they need where they live, work, learn and play (49). Holt-Lunstad suggested that policy makers should consider prioritizing social connection (concluding social support) within public health agendas (47). In addition, we should propose feasible practice and policy to increase social support for older adults, according to the cultural backgrounds of different countries and the specific needs of older adults.

This study also has some limitations. First, it was a cross-sectional investigation. Therefore, the findings could not confirm the causal relationship between social support, sarcopenia and cognitive impairment in community-dwelling older adults. Future longitudinal cohort studies are needed to further confirm the findings. Second, chronic disease information and data on depression and fall risk were obtained from self-reported questionnaires, which should be treated with caution, although all of the data in the questionnaires were validated. Third, all of the participants in this study were recruited from Shanghai; therefore, the results may not be applicable to older adults in other Chinese provinces, although we implemented a stringent sampling strategy. Fourth, we did not examine inflammatory indicators or cognitive-related biomarkers, such as CRP and APOE4. Future biomarker-based measurements are needed to further confirm the findings of this study.

Conclusion

Our study further identified a correlation between sarcopenia, especially grip strength, and cognitive impairment. Furthermore, after adjusting for confounding factors, social support showed a negative association with sarcopenia and cognitive impairment. This study provides strong evidence of a health promotion effect of social networks against sarcopenia and cognitive impairment in Chinese community-dwelling older adults.

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References

1. Fang EF, Xie C, Schenkel JA, Wu C, Long Q, Cui H, Aman Y, Frank J, Liao J, Zou H, Wang NY, Wu J, Liu X, Li T, Fang Y, Niu Z, Yang G, Hong J, Wang Q, Chen G, Li J, Chen HZ, Kang L, Su H, Gilmour BC, Zhu X, Jiang H, He N, Tao J, Leng SX, Tong T, Woo J. A research agenda for ageing in China in the 21st century (2nd edition): Focusing on basic and translational research, long-term care, policy and social networks. Ageing Res Rev. 2020 Dec;64:101174. doi: 10.1016/j.arr.2020.101174.
2. Zeng Y, Feng Q, Hesketh T, Christensen K, Vaupel JW. Survival, disabilities in activities of daily living, and physical and cognitive functioning among the oldest-old in China: a cohort study. Lancet. 2017 Apr 22;389(10079):1619-1629. doi: 10.1016/S0140-6736(17)30548-2.
3. Arvanitakis Z, Shah RC, Bennett DA. Diagnosis and Management of Dementia: Review. JAMA. 2019 Oct 22;322(16):1589-1599. doi: 10.1001/jama.2019.4782
4. Jia L, Du Y, Chu L, Zhang Z, Li F, Lyu D, Li Y, Li Y, Zhu M, Jiao H, Song Y, Shi Y, Zhang H, Gong M, Wei C, Tang Y, Fang B, Guo D, Wang F, Zhou A, Chu C, Zuo X, Yu Y, Yuan Q, Wang W, Li F, Shi S, Yang H, Zhou C, Liao Z, Lv Y, Li Y, Kan M, Zhao H, Wang S, Yang S, Li H, Liu Z, Wang Q, Qin W, Jia J; COAST Group. Prevalence, risk factors, and management of dementia and mild cognitive impairment in adults aged 60 years or older in China: a cross-sectional study. Lancet Public Health. 2020 Dec;5(12):e661-e671. doi: 10.1016/S2468-2667(20)30185-7. PMID: 33271079.
5. Jia J, Wei C, Chen S, Li F, Tang Y, Qin W, Zhao L, Jin H, Xu H, Wang F, Zhou A,

Zuo X, Wu L, Han Y, Han Y, Huang L, Wang Q, Li D, Chu C, Shi L, Gong M, Du Y, Zhang J, Zhang J, Zhou C, Lv J, Lv Y, Xie H, Ji Y, Li F, Yu E, Luo B, Wang Y, Yang S, Qu Q, Guo Q, Liang F, Zhang J, Tan L, Shen L, Zhang K, Zhang J, Peng D, Tang M, Lv P, Fang B, Chu L, Jia L, Gauthier S. The cost of Alzheimer's disease in China and re-estimation of costs worldwide. Alzheimers Dement. 2018 Apr;14(4):483-491. doi: 10.1016/j.jalz.2017.12.006

6. Cruz-Jentoft AJ, Sayer AA. Sarcopenia. Lancet. 2019 Jun 29;393(10191):2636-2646. doi: 10.1016/S0140-6736(19)31138-9. Epub 2019 Jun 3. Erratum in: Lancet. 2019 Jun 29;393(10191):2590. PMID: 31171417.
7. Petermann-Rocha F, Balntzi V, Gray SR, Lara J, Ho FK, Pell JP, Celis-Morales C. Global prevalence of sarcopenia and severe sarcopenia: a systematic review and meta-analysis. J Cachexia Sarcopenia Muscle. 2022 Feb;13(1):86-99. doi: 10.1002/jcsm.12783. Epub 2021 Nov 23. PMID: 34816624; PMCID: PMC8818604.
8. Chen Z, Li WY, Ho M, Chau PH. The Prevalence of Sarcopenia in Chinese Older Adults: Meta-Analysis and Meta-Regression. Nutrients. 2021 Apr 24;13(5):1441. doi: 10.3390/nu13051441. PMID: 33923252; PMCID: PMC8146971.
9. Yang Y, Xiao M, Leng L, Jiang S, Feng L, Pan G, Li Z, Wang Y, Wang J, Wen Y, Wu D, Yang Y, Huang P. A systematic review and meta-analysis of the prevalence and correlation of mild cognitive impairment in sarcopenia. J Cachexia Sarcopenia Muscle. 2023 Feb;14(1):45-56. doi: 10.1002/jcsm.13143. Epub 2022 Dec 18. PMID: 36529141; PMCID: PMC9891948.
10. Peng TC, Chen WL, Wu LW, Chang YW, Kao TW. Sarcopenia and cognitive impairment: A systematic review and meta-analysis. Clin Nutr. 2020 Sep;39(9):2695-2701. doi: 10.1016/j.clnu.2019.12.014. Epub 2019 Dec 17. PMID: 31917049.
11. Liu X, Hou L, Xia X, Liu Y, Zuo Z, Zhang Y, Zhao W, Hao Q, Yue J, Dong B. Prevalence of sarcopenia in multi ethnics adults and the association with cognitive impairment: findings from West-China health and aging trend study. BMC Geriatr. 2020 Feb 17;20(1):63. doi: 10.1186/s12877-020-1468-5. PMID: 32066390; PMCID: PMC7027212.
12. van Kan GA, Cesari M, Gillette-Guyonnet S, Dupuy C, Vellas B, Rolland Y. Association of a 7-year percent change in fat mass and muscle mass with subsequent cognitive dysfunction: the EPIDOS-Toulouse cohort. J Cachexia Sarcopenia Muscle. 2013 Sep;4(3):225-9. doi: 10.1007/s13539-013-0112-z. Epub 2013 Jul 26. PMID: 23888380; PMCID: PMC3774918.
13. Salinas-Rodríguez A, Palazuelos-González R, Rivera-Almaraz A, Manrique-Espinoza B. Longitudinal association of sarcopenia and mild cognitive impairment among older Mexican adults. J Cachexia Sarcopenia Muscle. 2021 Dec;12(6):1848-1859. doi: 10.1002/jcsm.12787. Epub 2021 Sep 17. PMID: 34535964; PMCID: PMC8718052.
14. Cai Min, Zhang Yaoguang, Xie Xueqin, Wu Shiyong. Elserly people's pension willingness and influencing factors of choosing home-based care of population aged 60 and above. Chinese Journal Of Hospital Statistics, 2021, 28(4): 351-356.
15. Fan Z, Lv X, Tu L, Zhang M, Yu X, Wang H. Reduced social activities and networks, but not social support, are associated with cognitive decline among older chinese adults: A prospective study. Soc Sci Med. 2021 Nov;289:114423. doi: 10.1016/j.socscimed.2021.114423. Epub 2021 Sep 23. PMID: 34597879.
16. Li B, Guo Y, Deng Y, Zhao S, Li C, Yang J, Li Q, Yan Y, Li F, Li X, Rong S. Association of social support with cognition among older adults in China: A cross-sectional study. Front Public Health. 2022 Sep 26;10:947225. doi: 10.3389/fpubh.2022.947225.
17. Yin S, Yang Q, Xiong J, Li T, Zhu X. Social Support and the Incidence of Cognitive Impairment Among Older Adults in China: Findings From the Chinese Longitudinal Healthy Longevity Survey Study. Front Psychiatry. 2020 Apr 7;11:254. doi: 10.3389/fpsyt.2020.00254
18. Salinas J, O'Donnell A, Kojis DJ, Pase MP, DeCarli C, Rentz DM, Berkman LF, Beiser A, Seshadri S. Association of Social Support With Brain Volume and Cognition. JAMA Netw Open. 2021 Aug 2;4(8):e2121122. doi: 10.1001/jamanetworkopen.2021.21122.
19. Posis AIB, Yarish NM, McEvoy LK, Jain P, Kroenke CH, Saquib N, Ikramuddin F, Schnatz PF, Bellettiere J, Rapp SR, Espeland MA, Shadyab AH. Association of Social Support with Mild Cognitive Impairment and Dementia Among Older Women: The Women's Health Initiative Memory Study. J Alzheimers Dis. 2023;91(3):1107-1119. doi: 10.3233/JAD-220967IF: 4.160 Q2 . PMID: 36565123; PMCID: PMC9905323.
20. Chen LK, Woo J, Assantachai P, Auyeung TW, Chou MY, Iijima K, Jang HC, Kang L, Kim M, Kim S, Kojima T, Kuzuya M, Lee JSW, Lee SY, Lee WJ, Lee Y, Liang CK, Lim JY, Lim WS, Peng LN, Sugimoto K, Tanaka T, Won CW, Yamada M, Zhang T, Akishita M, Arai H. Asian Working Group for Sarcopenia: 2019 Consensus Update on Sarcopenia Diagnosis and Treatment. J Am Med Dir Assoc. 2020 Mar;21(3):300-307.e2. doi: 10.1016/j.jamda.2019.12.012. Epub 2020 Feb 4. PMID: 32033882.
21. Xiao Y, Jia Z, Dong M, Song K, Li X, Bian D, Li Y, Jiang N, Shi C, Li G. Development and validity of computerized neuropsychological assessment devices for screening mild cognitive impairment: Ensemble of models with feature space heterogeneity and retrieval practice effect. J Biomed Inform. 2022 Jul;131:104108. doi: 10.1016/j.jbi.2022.104108. Epub 2022 Jun 1. PMID: 35660522.
22. Zhan J, Chen C, Yan X, Wei X, Zhan L, Chen H, Lu L. Relationship between social support, anxiety, and depression among frontline healthcare workers in China during COVID-19 pandemic. Front Psychiatry. 2022 Sep 14;13:947945. doi: 10.3389/fpsyt.2022.947945. PMID: 36186880; PMCID: PMC9516096.
23. Yue C, Liu C, Wang J, Zhang M, Wu H, Li C, Yang X. Association between social support and anxiety among pregnant women in the third trimester during the coronavirus disease 2019 (COVID-19) epidemic in Qingdao, China: The mediating effect of risk perception. Int J Soc Psychiatry. 2021 Mar;67(2):120-127. doi: 10.1177/0020764020941567. Epub 2020 Jul 9. PMID: 32643510; PMCID: PMC7348553.
24. Shen Z, Ding S, Shi S, Zhong Z. Association between social support and medication literacy in older adults with hypertension. Front Public Health. 2022 Nov 7;10:987526. doi: 10.3389/fpubh.2022.987526. PMID: 36419989; PMCID: PMC9677095.
25. Han K, Yang S, Jia W, Wang S, Song Y, Cao W, Wang J, Liu M, He Y. Health-Related Quality of Life and Its Correlation With Depression Among Chinese Centenarians. Front Public Health. 2020 Oct 30;8:580757. doi: 10.3389/fpubh.2020.580757. PMID: 33194985; PMCID: PMC7661682.
26. Bao G, Liu Y, Zhang W, Luo Y, Zhu L, Jin J. Accuracy of self-perceived risk of falls among hospitalised adults in China: an observational study. BMJ Open. 2022 Dec 22;12(12):e065296. doi: 10.1136/bmjopen-2022-065296. PMID: 36549717; PMCID: PMC9791387.
27. Cong L, Ren Y, Wang Y, Hou T, Dong Y, Han X, Yin L, Zhang Q, Feng J, Wang L, Tang S, Grande G, Laukka EJ, Du Y, Qiu C. Mild cognitive impairment among rural-dwelling older adults in China: A community-based study. Alzheimers Dement. 2023 Jan;19(1):56-66. doi: 10.1002/alz.12629. Epub 2022 Mar 9. PMID: 35262288; PMCID: PMC10078715.
28. Behr LC, Simm A, Kluttig A, Grosskopf Großkopf A. 60 years of healthy aging: On definitions, biomarkers, scores and challenges. Ageing Res Rev. 2023 Jul;88:101934. doi: 10.1016/j.arr.2023.101934. Epub 2023 Apr 13. PMID: 37059401.
29. Yuan S, Larsson SC. Epidemiology of sarcopenia: Prevalence, risk factors, and consequences. Metabolism. 2023 Jul;144:155533. doi: 10.1016/j.metabol.2023.155533. Epub 2023 Mar 11. PMID: 36907247.
30. Hu Y, Peng W, Ren R, Wang Y, Wang G. Sarcopenia and mild cognitive impairment among elderly adults: The first longitudinal evidence from CHARLS. J Cachexia Sarcopenia Muscle. 2022 Dec;13(6):2944-2952. doi: 10.1002/jcsm.13081. Epub 2022 Sep 4. PMID: 36058563; PMCID: PMC9745544.
31. Stenholm S, Sallinen J, Koster A, Rantanen T, Sainio P, Heliövaara M, Koskinen S. Association between obesity history and hand grip strength in older adults--exploring the roles of inflammation and insulin resistance as mediating factors. J Gerontol A Biol Sci Med Sci. 2011 Mar;66(3):341-8. doi: 10.1093/gerona/glq226
32. Tuttle CSL, Thang LAN, Maier AB. Markers of inflammation and their association with muscle strength and mass: A systematic review and meta-analysis. Ageing Res Rev. 2020 Dec;64:101185. doi: 10.1016/j.arr.2020.101185. Epub 2020 Sep 26. PMID: 32992047.
33. Bradburn S, Murgatroyd C, Ray N. Neuroinflammation in mild cognitive impairment and Alzheimer's disease: A meta-analysis. Ageing Res Rev. 2019 Mar;50:1-8. doi: 10.1016/j.arr.2019.01.002. Epub 2019 Jan 2. PMID: 30610927.
34. Jo D, Yoon G, Kim OY, Song J. A new paradigm in sarcopenia: Cognitive impairment caused by imbalanced myokine secretion and vascular dysfunction. Biomed Pharmacother. 2022 Mar;147:112636. doi: 10.1016/j.biopha.2022.112636. Epub 2022 Jan 17. PMID: 35051857.
35. Scisciola L, Fontanella RA, Surina, Cataldo V, Paolisso G, Barbieri M. Sarcopenia and Cognitive Function: Role of Myokines in Muscle Brain Cross-Talk. Life (Basel). 2021 Feb 23;11(2):173.
36. Wang J, Pang M, Kong F. Association between self-reported oral health and life satisfaction among China's migrant elderly following children: The mediating effect of social support. Front Public Health. 2023 Feb 14;11:950942. doi: 10.3389/fpubh.2023.950942. PMID: 36866087; PMCID: PMC9971942.
37. Posis AIB, Yarish NM, McEvoy LK, Jain P, Kroenke CH, Saquib N, Ikramuddin F, Schnatz PF, Bellettiere J, Rapp SR, Espeland MA, Shadyab AH. Association of Social Support with Mild Cognitive Impairment and Dementia Among Older Women: The Women's Health Initiative Memory Study. J Alzheimers Dis. 2023;91(3):1107-1119.
38. Yin S, Yang Q, Xiong J, Li T, Zhu X. Social Support and the Incidence of Cognitive Impairment Among Older Adults in China: Findings From the Chinese Longitudinal Healthy Longevity Survey Study. Front Psychiatry. 2020 Apr 7;11:254. doi: 10.3389/fpsyt.2020.00254. PMID: 32317993; PMCID: PMC7154048.
39. English T, Carstensen LL. Selective Narrowing of Social Networks Across Adulthood is Associated With Improved Emotional Experience in Daily Life. Int J Behav Dev. 2014 Mar 1;38(2):195-202. doi: 10.1177/0165025413515404. PMID: 24910483; PMCID: PMC4045107.
40. Cudjoe TKM, Selvakumar S, Chung SE, Latkin CA, Roth DL, Thorpe RJ Jr, Boyd CM. Getting under the skin: Social isolation and biological markers in the National Health and Aging Trends Study. J Am Geriatr Soc. 2022 Feb;70(2):408-414. doi: 10.1111/jgs.17518. Epub 2021 Oct 26. PMID: 34698366; PMCID: PMC8821117.
41. Glei DA, Goldman N, Ryff CD, Lin YH, Weinstein M. Social relationships and inflammatory markers: an analysis of Taiwan and the U.S. Soc Sci Med. 2012 Jun;74(12):1891-9. doi: 10.1016/j.socscimed.2012.02.020. Epub 2012 Mar 16. PMID: 22483707; PMCID: PMC3348237.
42. Qi X, Ng TKS, Wu B. Sex differences in the mediating role of chronic inflammation on the association between social isolation and cognitive functioning among older adults in the United States. Psychoneuroendocrinology. 2023 Mar;149:106023. doi:

10.1016/j.psyneuen.2023.106023. Epub 2023 Jan 2. PMID: 36603408; PMCID: PMC10105626.
43. Inoue T, Maeda K, Satake S, Matsui Y, Arai H. Osteosarcopenia, the co-existence of osteoporosis and sarcopenia, is associated with social frailty in older adults. Aging Clin Exp Res. 2022 Mar;34(3):535-543. doi: 10.1007/s40520-021-01968-y. Epub 2021 Sep 7. PMID: 34491548; PMCID: PMC8421463.
44. Tanaka T, Son BK, Lyu W, Iijima K. Impact of social engagement on the development of sarcopenia among community-dwelling older adults: A Kashiwa cohort study. Geriatr Gerontol Int. 2022 May;22(5):384-391. doi: 10.1111/ggi.14372. Epub 2022 Mar 23. PMID: 35322539.
45. Eisenberger NI, Moieni M, Inagaki TK, Muscatell KA, Irwin MR. In Sickness and in Health: The Co-Regulation of Inflammation and Social Behavior. Neuropsychopharmacology. 2017 Jan;42(1):242-253. doi: 10.1038/npp.2016.141
46. Santini ZI, Jose PE, York Cornwell E, Koyanagi A, Nielsen L, Hinrichsen C, Meilstrup C, Madsen KR, Koushede V. Social disconnectedness, perceived isolation, and symptoms of depression and anxiety among older Americans (NSHAP): a longitudinal mediation analysis. Lancet Public Health. 2020 Jan;5(1):e62-e70. doi: 10.1016/S2468-2667(19)30230-0. PMID: 31910981.
47. Holt-Lunstad J. Social Connection as a Public Health Issue: The Evidence and a Systemic Framework for Prioritizing the "Social" in Social Determinants of Health. Annu Rev Public Health. 2022 Apr 5;43:193-213. doi: 10.1146/annurev-publhealth-052020-110732. Epub 2022 Jan 12. PMID: 35021021.
48. Birditt K.S., Newton N.J. Theories of Social Support and Aging. In: Pachana N.A., editor. Encyclopedia of Geropsychology. Springer; Singapore: 2015. pp. 1–7
49. Healthy People 2030. Social determinants of health. Fact Sheet, Off. Dis. Prev. Health Promot., Washington, DC. https://health.gov/healthypeople/objectives-and-data/social-determinants-health

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