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ORIGINAL ARTICLE

SOCIAL RESEARCH, PLANNING AND PRACTICE

Associations of social frailty with loss of muscle mass and muscle weakness among community-dwelling older adults

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Aim: The present cross-sectional study examined the associations of social frailty status with loss of muscle mass and weakness among community-dwelling older adults.

Methods: Data from 353 older adults (74.8% women) who had participated in a community-based health check survey (Tarumizu Study) were analyzed. Social frailty was defined using responses to five questions (going out less frequently, rarely visiting friends, feeling unhelpful to friends or family, living alone and not talking with someone every day). Participants with two or more components were considered socially frail. We assessed appendicular skeletal muscle mass using bioelectrical impedance analysis and calculated appendicular skeletal muscle index. Dominant handgrip strength was assessed. Loss of skeletal muscle mass (appendicular skeletal muscle index <7.0 kg/m^2 for men, <5.7 kg/m^2 for women) and muscle weakness (handgrip strength <26 kg for men, <18 kg for women) were determined based on the Asian Working Group for Sarcopenia criteria.

Results: The prevalence of social frailty was 14.7%. A higher prevalence of muscle weakness and loss of skeletal muscle mass in participants with social frailty was shown than in those without (muscle weakness 44.2% *vs* 23.6%, $P \leq 0.05$; loss of skeletal muscle mass 59.6% *vs* 46.2%, $P = 0.07$). Social frailty was independently associated with muscle weakness (odds ratio 2.04, 95% confidence interval 1.06–3.95), but not with loss of skeletal muscle mass (odds ratio 1.47, 95% confidence interval 0.78–2.76) after adjusting for covariates.

Conclusions: Social frailty status could be associated with muscle weakness, though not a loss of skeletal muscle mass. **Geriatr Gerontol Int 2019; 19: 76–80.**

Keywords: aged, frailty, muscle weakness, shrinking.

Introduction

Frailty is a state commonly used to describe the condition of poor resolution of homoeostasis after a stressful event[1] and increased risk of adverse health outcomes, such as falling, disability and death.[2] Although many studies focusing on frailty among older adults have examined physical functioning, the concept of frailty includes not only the physical domain, but also psychological and social spheres.[3,4]

Social frailty, such as maintaining fewer social networks and having poor social activity involvement and other participation, might be a significantly increased risk factor for disability incidence among community-dwelling older adults.[5] In addition, "social role" is one of the domains of a late-life functional assessment index.[6] The loss of a particular social role might occur sooner than a decline in an independent instrumental activity of daily living or intellectual mobility.[7] It might be important to consider strategies to prevent the decline of physical function among older adults living in the community. Social frailty is thought to be one of several risk factors for developing a disability; thus, social frailty status might affect physical functioning levels in older adults. However, few studies have examined the effects of social frailty on physical function, and it is particularly unclear whether frailty in the social domain is related to muscle mass and muscle strength.

The assessment of muscle weakness and loss of muscle mass in older adults is essential to identify their increased risk of disability, such as sarcopenia. Decline in the physical domain, including muscle weakness and loss of muscle mass, might have greater impacts on the development of functional disability than does social frailty.[8,9] However, social frailty can lead to disability and accelerates decline in physical functioning among older adults. Although social factors, such as living alone, frequency of going out and social relations (which are included in social frailty), are related to increased risk of disability, it is unclear whether the state of social frailty assessed using those social components is associated with muscle function including muscle weakness and loss of muscle mass.[10–12] A better understanding of the association between social frailty and muscle function would allow the refinement of community-based interventions to prevent disability in older adults. We hypothesize that older adults with social frailty might have decreased muscle function, including muscle weakness and decreased muscle mass.

Defenses against social frailty could have positive impacts on the maintenance of physical functioning, especially on muscle strength and muscle mass. Therefore, the present cross-sectional study was carried out to examine the association of social frailty status with the loss of muscle mass and weakness as a first step to show that social frailty occurs before impairment in physical function among community-dwelling older adults.

Methods

Participants

The present cross-sectional study used data from the Tarumizu Study 2017, which was carried out in cooperation with Kagoshima University (Faculty of Medicine), Tarumizu City Office and Tarumizu Chuo Hospital, and held in November and December 2017 as a community-based health check survey. Individuals selected for participation in the Tarumizu Study 2017 were chosen from among the older people living in Tarumizu City, a local city of Kagoshima, Japan. Participants were recruited through local newspapers and campaigns in community events. A total of 452 older individuals were enrolled in the Tarumizu Study 2017; 380 of them participated in the study. In this study, we included participants who were living in Tarumizu City and aged ≥65 years. Participants aged <65 years (n = 1, the survey was undertaken before the participant's 65th birthday), with a history of diagnosis of dementia (n = 6), missing data on social frailty assessments (n = 5), body composition measures (e.g. heart pacemakers; n = 10) and grip strength measure for those with unsafe conditions (e.g., systolic blood pressure ≥180 mmHg) were excluded (n = 5). Finally, data from 353 community-dwelling older adults (aged ≥65 years, mean age 75.4 years, 74.8% women) were analyzed (Fig. 1). Informed consent was obtained from all participants before their inclusion in the study, and the ethics committee of the Faculty of Medicine, Kagoshima University approved the study protocol (ref no. 170103).

Measures

Social frailty

We operationalized social frailty using five questions, including going out less frequently compared with last year (yes), sometimes visiting friends (no), feeling helpful toward friends or family (no), living alone (yes) and talking with someone every day (no) in face-to-face interviews. Participants were classified into the socially frail (two or more characteristics), pre-frail (one characteristic) and non-frail groups.[9]

Loss of skeletal muscle mass and weakness

We assessed appendicular skeletal muscle mass by a multifrequency bioelectrical impedance analysis using the InBody 430 (InBody Japan, Tokyo, Japan). The InBody 430 uses a tetrapolar, eight-point tactile electrode system that separately measures impedance of the arms, trunk and legs at three different frequencies (5, 50 and 250 kHz) for each segment. The surface of the hand electrode was placed in contact with each of the five fingers, while the participant's heels and forefoot were placed on the circular-shaped foot electrode. Participants held out their arms and legs so that they would not contact any other body parts during the measure. Appendicular skeletal muscle mass (ASM) was derived as the sum of the muscle mass of the four limbs, and the ASM index (ASMI; kg/m^2) was calculated. We categorized participants as those with a loss of muscle mass or without, in order to describe the prevalence of muscle mass loss for clinical interpretation. Loss of skeletal muscle mass was determined based on the Asian Working Group for Sarcopenia criteria for sarcopenia; ASMI <7.0 kg/m^2 for men and <5.7 kg/m^2 for women.[13]

Dominant handgrip strength was assessed using a Smedley-type handheld dynamometer (GRIP-D; Takei, Niigata, Japan). Participants were divided into those with muscle weakness or without, similar to the categorization with the loss of skeletal muscle mass. Muscle weakness was determined based on the Asian Working Group for Sarcopenia criteria for sarcopenia; handgrip strength <26 kg for men and <18 kg for women.[13]

Covariates

Age (years), education (years), total medications used (n/day) and physical activity (≤4 days/week) were assessed and included as covariates. Licensed doctors or nurses interviewed the participants regarding their medical condition, including their history and medication used. Physical activity levels were assessed using a simple question. Self-reported physical activity frequency (amount of activity per week) was classified into 7 days, 5–6 days, 2–4 days, 1 day and never.

Statistical analysis

Student's t-tests and Pearson's χ^2-tests were used to test differences in characteristics, muscle mass and handgrip strength between participants with social frailty and those without. The comparisons of the prevalence of loss of skeletal muscle mass and weakness in participants with social frailty and those without were tested using Pearson's χ^2-tests. The associations of social frailty status with the muscle weakness and loss of skeletal muscle mass were examined using a multiple logistic regression analysis. The adjusted model in the multiple logistic regression analysis included age, education, number of prescribed medications and physical activity levels (≤4 days/week) as covariates. Adjusted odds ratios (OR) were computed for social frailty, with 95% confidence intervals (95% CI). All analyses were carried out using IBM SPSS Statistics 24.0 (IBM Japan, Tokyo, Japan). The level of statistical significance was set at $P < 0.05$.

Results

Characteristics of participants

Participants' characteristics and comparisons between participants with social frailty and those without are shown in Table 1. Of 353 participants, 52 (14.7%) showed social frailty. There were no significant differences on the prevalence of social frailty between men (11.2%) and women (15.9%; P = 0.282). Participants with social frailty showed significantly lower education levels (P = 0.048) and higher medication used (n = 0.033) than those without social frailty.

Associations of social frailty with muscle mass and strength

Participants with social frailty showed significantly lower muscle mass (ASMI) compared with those without social frailty (P = 0.021). Significantly lower grip strength was found in participants with social frailty than in those without social frailty (P = 0.006; Table 1). A higher prevalence of loss of skeletal muscle mass and weakness was found in participants with social frailty than in those without (loss of skeletal muscle mass 59.6% *vs* 46.2%, P = 0.002; muscle weakness 44.2% *vs* 23.6%, P = 0.002; Table 1). Associations of subitems of social frailty with muscle mass and strength are represented in Table 2. Living alone showed significant associations with the loss of skeletal muscle mass ($P < 0.001$) and muscle weakness (P = 0.024). Answering "no" to the subitem of talking with someone every day was significantly related with muscle weakness (P = 0.006).

Results of multiple logistic regression analyses are represented in Table 3. On the crude models, social frailty was found to be significantly associated with muscle weakness (odds ratio 2.57, 95% confidence interval 1.40–4.72), but not with loss of skeletal muscle mass (odds ratio 1.72, 95% confidence interval 0.95–3.13). In the adjusted models including age, education, number of prescribed medications and physical activity levels as covariates, social frailty was independently associated with muscle weakness (odds ratio 2.04, 95% confidence interval 1.06–3.95), but not with loss of skeletal muscle mass (odds ratio 1.47, 95% confidence interval 0.78–2.76).

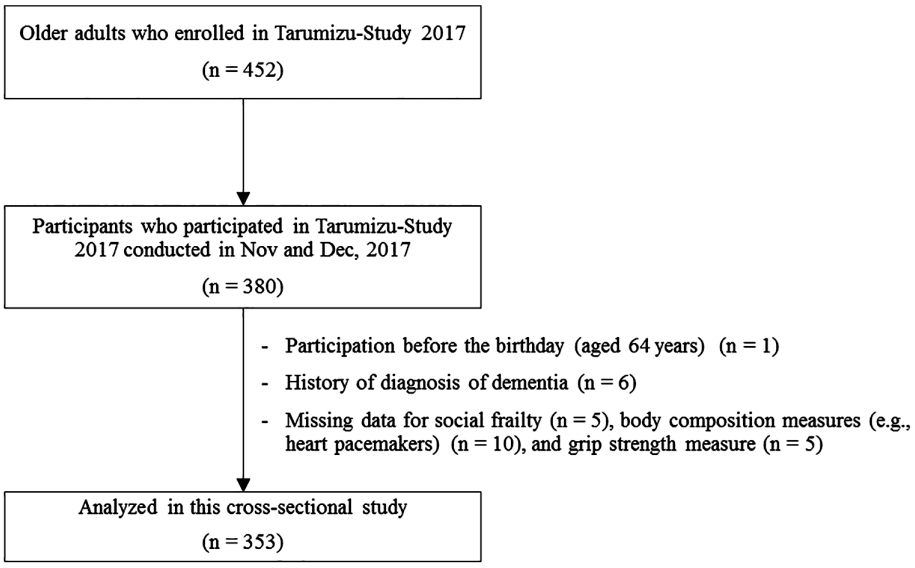

Figure 1 Participant inclusion criteria flow diagram.

Table 1 Characteristics of the participants

Variable	Over all (n = 353)	Participants without social frailty (n = 301)	Participants with social frailty (n = 52)	P^*
Age (years)	75.4 ± 6.5	75.0 ± 6.4	77.6 ± 6.8	0.010
Women, *n* (%)	264 (74.8%)	222 (73.8%)	42 (80.8%)	0.282
Education (years)	10.8 ± 2.0	10.9 ± 2.0	10.4 ± 1.7	0.048
Medical history, *n* (%)†				
Hypertension	162 (46.6%)	134 (45.1%)	28 (54.6%)	0.196
Diabetes mellitus	43 (12.3%)	38 (12.7%)	5 (9.6%)	0.530
Osteoporosis	72 (20.5%)	58 (19.4%)	14 (26.9%)	0.215
Arthritis	41 (11.9%)	32 (10.8%)	9 (17.6%)	0.160
Medications (*n*/day)	3.8 ± 3.9	3.6 ± 3.9	4.8 ± 4.1	0.033
Muscle mass				
ASMI (kg/m^2)	6.09 ± 0.93	6.14 ± 0.93	5.82 ± 0.91	0.021
Loss of skeletal muscle mass, *n* (%)	170 (48.2%)	139 (46.2%)	31 (59.6%)	0.073
Strength				
Grip strength (kg)	23.3 ± 7.0	23.8 ± 6.8	20.9 ± 7.4	0.006
Muscle weakness, *n* (%)	94 (26.6%)	71 (23.6%)	23 (44.2%)	0.002

Data shown as the mean ± SD or percentage. *Student's *t*-test for continuous measures and Pearson's χ^2-test for proportions. †Missing values on hypertension (n = 5), diabetes mellitus (n = 2), osteoporosis (n = 2) and arthritis (n = 5). ASMI, appendicular skeletal muscle mass index.

Discussion

The present cross-sectional study shows that a higher prevalence of muscle weakness and loss of skeletal muscle mass exists in participants with social frailty than in those without. In particular, social frailty is independently associated with muscle weakness, even after controlling for age, education, number of prescribed medications and physical activity levels.

Recent studies assessed social frailty status using questionnaires including social relationships, social support, infrequent contact and living situation (e.g. living alone).[9,14] Social frailty status can have a negative impact on disability incidence.[9,14] Muscle weakness and age-related changes in body composition (e.g. loss of muscle mass) are factors that increase the risk of disability.[8,13] The negative impacts of social factors on disability incidence risk, as shown in previous studies, might be through those age-related changes in physical function (i.e. muscle weakness and changes in body composition). Previous studies reported that social factors were related to a decline in physical function, but to our knowledge the role of social factors in age-related changes of body composition among older adults is unclear.[15,16] The results of the present study suggest that the association of social frailty with muscle weakness is stronger than with loss of muscle mass.

Living situations might affect the risks of physical functioning changes in older adults. Being alone was associated with more rapid motor decline,[17] and living alone increased the risk of disability incidence among older adults.[10] In contrast, older adults living alone are required to manage all household roles in order to be independent. Therefore, high levels of instrumental activities of daily living and complex independent instrumental activities of daily living tasks are required for older adults living alone. Some previous studies took a positive perspective on living alone among older adults, such as the participants not always being lonely and having health problems, along with positively self-rated health and enjoyment.[18,19] More discussions regarding the advantages and disadvantages of older adults living alone are required.

Going outdoors might play an important role in physical and psychological health. In community-dwelling older populations, objectively-measured outdoor time was related to physical and psychological function.[20] Interestingly, a previous study examining the effects of physical activity on muscle function and muscle mass showed that physical activity was associated with handgrip strength and gait speed, but not with muscle mass in the general population, including young-to-middle-aged and older community-dwelling adults.[21] Less frequent participation in social activities was associated with a more rapid rate of motor function

Table 2 Associations of subitems of social frailty with muscle mass and strength

	Going out less frequently compared with last year			Sometimes visiting friends			Feeling helpful toward friends or family			Living alone			Talking with someone everyday		
	No (n = 313)	Yes (n = 40)	P*	Yes (n = 317)	No (n = 36)	P*	Yes (n = 327)	No (n = 26)	P*	No (n = 243)	Yes (n = 110)	P*	Yes (n = 337)	No (n = 16)	P*
Age, years	75.2 ± 6.5	76.8 ± 6.4	0.151	75.5 ± 6.3	75.0 ± 8.3	0.710	75.2 ± 6.4	78.1 ± 6.8	0.030	74.3 ± 6.4	77.8 ± 6.1	<0.001	75.3 ± 6.5	76.8 ± 7.3	0.378
Women, %	73.2%	87.5%	0.049	78.2%	44.4%	<0.001	74.9%	73.1%	0.835	69.1%	87.3%	<0.001	74.2%	87.5%	0.231
Loss of skeletal muscle mass, %	48.6%	45.0%	0.671	48.3%	47.2%	0.906	46.8%	65.4%	0.068	41.6%	62.7%	<0.001	47.2%	68.8%	0.092
Muscle weakness, %	26.2%	30.0%	0.608	25.6%	36.1%	0.174	26.3%	30.8%	0.620	23.0%	34.5%	0.024	25.2%	56.3%	0.006

Data shown as the mean ± SD or percentage. *Student's t-test for continuous measures and Pearson's χ^2-test for proportions.

decline.[22] The present cross-sectional study showed that muscle weakness was significantly associated with social frailty, but muscle mass was not. The social domains of frailty might have greater impacts on muscle function and performance than on muscle mass. Muscle strength measures could be better than muscle mass parameters in predicting health-related outcomes in older people.[23] Results of the present study suggest that interventions to prevent social frailty might be particularly beneficial for community-dwelling older adults for maintaining physical health.

Social frailty assessment in the present study included subitems of frequently going outdoors and maintaining social relationships, such as visiting and talking with friends/someone. Going outdoors less frequently is related to an increased risk of disability.[24] Social relationships provide protection against disability by reducing the risk of developing disability.[11] Therefore, interventions to increase activities that involve going outdoors and social relationships have been recommended for physical health, as well as mental health.[25,26] The results of the present study also emphasize the importance of guarding against social frailty for maintaining muscle function, especially strength.

The results of associations of social frailty subitems with muscle mass and strength indicated that participants who lived alone and spoke less with others showed a relatively higher prevalence of skeletal muscle mass loss and muscle weakness. Although causal relationships are unclear and confounding factors should be considered, these social factors (living alone and not talking with others) could have a greater impact on muscle strength and muscle mass among older adults. The current study showed negative impacts of living alone on muscle mass and muscle strength. However, a previous study examining the effects of living arrangements showed positive impacts on mental and functional health for older adults living alone.[27] Participants who lived alone in the present study were older than those who did not, thus advancing age also played a role in their declining muscle function. Participants who answered "no" to the subitem regarding talking with someone every day might indicate social isolation and homebound status, both of which are associated with an increased risk of muscle function decline. Further studies including a large sample and longitudinal design are required to clarify these relationships.

We described not only the value of grip strength and ASMI, but also the prevalence of muscle weakness and loss of muscle mass for clinical interpretation. Approximately half of the participants (48.2%) in the present study showed a loss of muscle mass, and one-quarter of them (26.6%) showed muscle weakness. Both symptoms were more prevalent in participants with social frailty than in those without, which indicates that social frailty might impact the loss of muscle mass and muscle weakness. However, we need to state that the impact of social frailty on clinical cut-off points for loss of muscle mass and muscle weakness among community-dwelling older people was interpreted carefully, and that we considered the likelihood of cohort bias.

Several limitations should be noted. Although some previous studies suggested negative impacts of social factors on future decline in physical function using a longitudinal design, the current cross-sectional study could not discuss the longitudinal associations of social frailty with muscle weakness and loss of muscle mass. Identifying the frailty status using multidimensional assessments and a multidisciplinary approach is recommended.[4] Social frailty is recognized as an important aspect of frailty; however, the roles of cognitive and psychological domains were not considered in the present study. In addition, other potential covariates, such as nutritional, lifestyle and hormonal factors,[28–30] that would be related to strength and muscle mass, should be considered. We should note the representativeness of the population samples. In the present study, 452 older individuals (which represented approximately 10% of potential participants in the city) were enrolled. Furthermore, they were not selected randomly. Future longitudinal studies are required to accumulate adequate evidence in this field.

Table 3 Odds ratios for loss of skeletal muscle mass and muscle weakness according to social frailty

	Dependent value: loss of skeletal muscle mass (OR, 95% CI)		Dependent value: muscle weakness (OR, 95% CI)	
	Crude	Adjusted model	Crude	Adjusted model
Socially frail	1.72, 0.95–3.13	1.47, 0.78–2.76	2.57, 1.40–4.72**	2.04, 1.06–3.95*

*$P < 0.05$; **$P < 0.01$. Adjusted model: adjusted for age, education, number of prescribed medications and physical activity levels (>5 days/week).

In conclusion, social frailty status could be associated with muscle weakness, but not loss of skeletal muscle mass, which then might have a greater impact on muscle weakness. Maintenance of social non-frail status through increased social activities and social network could be one of potential strategies for maintenance of muscle function among community-dwelling older adults.

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Disclosure statement

The authors declare no conflict of interest.

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