findings, we discussed our observations and results separately, detailing each KCL domain and linking it to the participants' sociodemographic and lifestyle characteristics.

According to the KCL domains, we observed differences regarding the mean scores in IADL ($P < 0.001$) and physical ($P = 0.047$) domains among the three groups; however, such differences failed to remain statistically significant when we dichotomized them according to the cut-off points to determine frailty. A similar pattern was observed in the nutritional domain; no group showed a significantly different risk level to develop frailty. Although no differences were found in the physical and nutritional domains among the groups, we can discuss the significant difference observed in BMI ($P < 0.001$), especially because BMI is an important indicator of physical and nutritional status, and an increased BMI could be an alarming sign of imminent frailty evaluated by both domains. In the present study, the Brazilian participants were more obese (BMI 28.1 ± 5.39 kg/m^2) than the other groups. Although the KCL considers low bodyweight to be a frailty symptom, epidemiological studies show that both overweight and underweight are negative health outcomes associated with a greater risk for morbidity and mortality.[15]

There are some data showing that the Brazilian environment might pose a risk for developing obesity compared with the Japanese environment; a study verified that the risk for developing central obesity was 2.8-fold higher among Japanese Brazilians living in Brazil.[8] Although that study did not include Brazilian natives, there is evidence supporting concurrent increases in obesity in Brazil.[16]

Furthermore, we found that Brazilian participants were threefold more likely to be frail in terms of oral health (eating domain) than the Japanese group (OR 3.18, 95% CI 1.47–6.85, $P = 0.003$). In this case, the educational level of the participants seems to be related to their poor oral condition; considering the evidence that older adults who received elementary school level education had a significantly larger number of missing teeth and significantly fewer healthy gingival units compared with those who received higher than elementary school level education.[17] Another study showed that not only educational level, but also living arrangement influenced the participants' oral health; concluding that poorly educated and divorced women had fewer remaining teeth than better-educated and married women.[18] In the present study, the most favored group in terms of educational and living arrangement conditions was the Japanese cohort that were also more concerned about dehydration (consuming liquids, especially tea, as one of the Japanese habits), another included aspect in the oral domain.

Regarding the socialization domain, the Brazilian participants also showed a greater risk for becoming frail compared with the Japanese participants (OR 9.15, 95% CI 3.53–23.7, $P < 0.001$). A study showed that a partner relationship, such as marriage, might impact women's health status in numerous ways and could confer health-related benefits, such as providing nurturing conditions and socialization through a spouse,[19] and building a network with the partner's family.[20] Furthermore, a relationship possibly includes access to material resources and other social support.[21] These privations could lead Brazilian women to a poorer condition not only in the seclusion domain, but also in the mood domain, as the study concluded that individuals who lack social connections or report frequent feelings of loneliness tend to suffer higher rates of depression as well.[22]

Although the older Brazilian women showed a higher life satisfaction ($P = 0.002$), they presented a higher risk for being frail in terms of depression (OR 6.63, 95% CI 2.74–16.0, $P < 0.001$) than the Japanese group. Evidence showed that living alone or with other(s) than a partner could lead to depression and anxiety disorders in women.[23]

Finally, the results that we found in the memory domain did not differ from those aforementioned. The Brazilian participants were threefold more likely to be frail compared with the Japanese group (OR 3.87; 95% CI 1.93–7.75, $P < 0.001$). It is widely recognized that low education is one of the conditions that affect cognitive performance, especially phonological verbal fluency, calculation and working memory[24,25] that are required when processing the tasks assessed by the KCL cognitive domain. Another factor that might be related to the lowest scores achieved by Brazilian women in the memory domain is their highest number of medication use (Brazilian participants 2.9 ± 2.1 *vs* Japanese participants 2.1 ± 1.5, $P = 0.028$). Although we did not investigate the drug classes, the cognitive impairment is repeatedly reported to be a side-effect among medications prescribed for the elderly.[26,27]

We discerned that the majority of the differences in the present study were shows between Japanese and Brazilian natives. However, we must emphasize that an improved condition in terms of frailty was observed in the Brazilian Japanese descendants. This result might be linked to their higher educational level that predicts a higher-level financial status and better living conditions, which might in turn reflect a better health education, as they showed the lowest total KCL score ($P < 0.001$), and also the lowest mean KCL score in physical strength ($P = 0.047$), eating ($P = 0.001$) and mood ($P < 0.001$) domains.

We emphasize that the native Brazilian participants might be more vulnerable and frail because of the sociodemographic disadvantages that they are exposed to and their adopted lifestyle. However, such conditions are reversible; and an early detection of the frail aspects

is essential to reverse it in older adults. For this purpose, the KCL was designed to monitor the health conditions and to detect negative health outcomes at the earliest stage, thereby assuring prompt prevention or rehabilitation interventions, being an accurate, cheap, easy and fast diagnostic tool.

The present study had several limitations: (i) the present study was a cross-sectional design, which did not enable us to determine a cause–effect relationship; (ii) the present study was carried out in only one Brazilian and one Japanese region, which did not allow us to extend our findings to the national level; and finally, (iii) we only analyzed older women with heterogeneous characteristics, which complicated our comparisons. We recommend prospective studies to include a greater sample size, with male participants recruited from several regions of Brazil and Japan, and that future studies investigate important aspects that could be related to frailty, such as the financial situation of the participants.

In summary, we found that Brazilian natives were more frail than Japanese natives, but not Brazilian Japanese descendants. In addition to the environment, we believe that the lifestyle and the sociodemographic conditions could reflect the frailty of older Brazilian women in the present study. Hence, we recommend the dissemination of general health education among these older adults, including incentives for regular engagement in physical activity and a well-balanced diet, the principles of oral health safety and social and cognitive approaches to warrant a healthy aging process.

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Disclosure statement

The authors declare no conflict of interest.

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Original Study

Differential Association of Frailty With Cognitive Decline and Sarcopenia in Community-Dwelling Older Adults

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A B S T R A C T

Objectives: Frailty in older adults is a serious problem because of various adverse health outcomes in many countries with aging populations, such as Japan. The purpose of this study was to determine whether frailty and pre-frailty are associated with cognitive decline and sarcopenia in community-dwelling older adults.
Design: This is a cross-sectional study.
Setting: Japan.
Participants: The participants were 273 Japanese community-dwelling older women aged 65 years and older.
Measurements: We used the frailty criteria developed by the Cardiovascular Health Study to define physical frailty. We divided the cohort into nonfrail, prefrail, and frail according to frailty scores. Cognitive decline and memory decline were defined by using the Mini-Mental State Examination and Scenery Picture Memory Test, respectively. Sarcopenia was defined according to the diagnostic algorithm recommended by the Asian Working Group for Sarcopenia.
Results: In the multivariate logistic regression analysis by using non-frail participants as the reference, pre-frail elderly individuals were significantly more likely to have sarcopenia than non-frail elderly individuals [odds ratio (OR): 2.77, 95% confidence interval (CI): 1.05–9.26], but not cognitive decline or memory decline. Frail elderly individuals were significantly more likely to have cognitive decline (OR: 5.76, 95% CI: 1.20–27.6), memory decline (OR: 5.53, 95% CI: 1.64–18.7) and sarcopenia (OR: 19.1, 95% CI: 3.73–98.0) than non-frail elderly individuals.
Conclusions: Sarcopenia was associated with pre-frailty and frailty, whereas cognitive decline was associated only with frailty.

Frailty in older adults is a serious concern in countries with aging populations, such as Japan. In general, frailty is defined as a vulnerable state that places older adults at high risk for adverse health outcomes, such as falls, hospitalization, and mortality.[1,2] Using the frailty criteria developed by the Cardiovascular Health Study, the overall prevalence of frailty in community-dwelling adults aged 65 or older in the United States has been found to range from 7% to 12% and was greater in women than in men.[1] In Japanese, the prevalence of frailty in community-dwelling adults aged 65 or older was 11.3%, and it increased with aging.[3] Frail older adults are considered to have a substantially increased risk of disability, dependency, and need for long-term care insurance. Therefore, prevention and early detection of frailty is important for addressing age-related health care issues.

The causes of frailty are not clearly defined, but it has been suggested that age-related physical changes are the main causes of frailty.[4] Sarcopenia, defined as progressive loss of skeletal muscle mass, strength, and physical function, is regarded as a key component of physical frailty.[5,6] The Interventions on Frailty Working Group assessed various methods for screening, recruiting, evaluating, and

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retaining frail elderly individuals in clinical trials.[7] They reported that most researchers focused on the following domains when identifying physical frailty: mobility, such as lower-extremity performance and gait abnormalities; muscle weakness; poor exercise tolerance; unstable balance; and factors related to body composition, such as weight loss, malnutrition, and muscle loss.[7] Age-dependent loss of skeletal muscle mass is a multifactorial process; contributing factors include physical inactivity, malnutrition, oxidative stress, changes in endocrine function, and increases in inflammatory cytokines.[5] Thus, the domains of frailty overlap with the factors related to sarcopenia, and both frailty and sarcopenia mutually result in adverse health outcomes.[5,6]

Of note, some definitions of frailty include cognitive function and dementia.[4,8] Several cross-sectional studies have reported an association between physical frailty and cognitive function.[1,7,9,10] In addition, longitudinal studies have revealed that a higher level of physical frailty is associated with increased risk of incident Alzheimer's disease (AD)[11] and mild cognitive impairment.[12] It has been indicated that frailty is associated with AD pathology[13] and its biological mechanisms.[14] However, not all dementia patients become frail; therefore, the association between frailty and cognitive impairment warrants further study.

Frailty is associated with sarcopenia and cognitive decline. Furthermore, frailty has been considered to include other aspects, such as psychosocial issues and comorbidities.[15] However, it is unclear whether the associations between frailty and cognitive decline as well as between frailty and sarcopenia are different according to the level of frailty. Therefore, the purpose of this study was to determine whether frailty and prefrailty are associated with cognitive decline and sarcopenia in community-dwelling older adults.

Methods

Participants

Participants for this study were recruited through the local press; 273 Japanese women aged 65 years and older (mean age 73.0 ± 5.4 years) responded. We included community-dwelling older adults who were independent in activities of daily living. Participants were interviewed and excluded if they met any of the following criteria: severe cardiac, pulmonary, or musculoskeletal disorders; severe neurologic disorders, such as Parkinson disease and stroke; and participation in Japan's long-term care service. The following data were collected from each participant: age, height, weight, and number of medications being consumed.

Written informed consent was obtained from each participant in accordance with the guidelines approved by the Kyoto University Graduate School of Medicine and the Declaration of Human Rights, Helsinki, 1975. The study protocol was approved by the ethical committee of the Kyoto University Graduate School of Medicine.

Assessment of Frailty

We measured physical frailty domains determined in a previous study.[3] As in that study, we considered the frailty phenotype to be characterized by limitations in the following 5 domains by using frailty criteria developed by the Cardiovascular Health Study[1]: slowness, weakness, exhaustion, low activity, and shrinking. To measure slowness, each participant's 10-m normal walking speed (m/s) was calculated, and a slow walk was defined as <1.0 m/s. To measure weakness, low grip strength was established according to a sex-specific cutoff of the average grip strength in each arm (women: <17 kg). Exhaustion was assessed via self-report by using the Geriatric Depression Scale[16] (ie, exhaustion was defined as a negative ["no"] answer to the question "do you feel full of energy?)" We evaluated the role of physical activity by asking the following questions about time spent engaged in sports and exercise: (1) "Do you engage in moderate levels of physical exercise or sports aimed at health?" and (2) "Do you engage in low levels of physical exercise aimed at health?" If a participant answered "no" to both of these questions, then we considered their physical activity to be low. Shrinking was established according to self-reports of weight loss in response to the following question: "In the past 2 years, have you lost more than 5% of your body weight irrespective of intent to lose weight?" If a participant answered "yes" to this question, then we considered them to have shrunk. We calculated the number of affected domains and classified participants as follows: prefrailty = 1 or 2, frailty ≥3.[1]

Measurement of Cognitive Function

Participants' cognitive function was measured by using 2 neuropsychological tests: the Mini-Mental State Examination (MMSE)[17] and the Scenery Picture Memory Test (SPMT).[18]

Global cognitive function was assessed by using the MMSE, a standard test in cognitive aging research to assess mental status. The MMSE tests 5 areas of cognitive function: orientation, registration, attention and calculation, recall, and language. It has 11 questions and a possible maximum score of 30. We divided the participants into a normal or a cognitive decline group based on a cut-off of 23/24 as the MMSE score.[19]

The SPMT is a simple memory test that assesses visual memory combined with verbal responses. This test uses a line drawing of a living room in a house with 23 objects commonly observed in daily life on an A4 piece of paper. The examinee is instructed to look at the picture for 1 minute and remember the items. After this encoding period, participants are distracted by completing a brief digits forward test. Participants are then asked to recall the objects in the picture without a time limitation. The recall usually takes approximately 2 minutes. The number of items recalled is the score for the SPMT. We divided the participants into a normal or memory decline group based on a cut-off of 9/10 as the SPMT score.[18]

Definition of Sarcopenia

We defined sarcopenia by using the diagnostic algorithm recommended by the Asian Working Group for Sarcopenia, which assesses the presence of both low muscle function (low physical performance or low muscle strength) and low muscle mass.[20] A bioelectrical impedance data acquisition system (Inbody 430; Biospace Co, Ltd, Seoul, Korea) was used to perform bioelectrical impedance analysis.[21] This system uses electrical current at multiple frequencies (5, 50, 250, 500, and 1000 kHz) to directly measure the amount of extracellular and intracellular water. Participants stood on 2 metallic electrodes and held metallic grip electrodes. Using segmental body composition, appendicular skeletal muscle mass was determined and used for further analysis. Skeletal muscle mass index (SMI) was calculated by dividing muscle mass by height squared in meters (kg/m^2). This index has been used in several epidemiological studies.[22,23] If a participant had both low muscle function (slow walking speed, ≤0.8 m/s; low grip strength for women, ≤18 kg) and low SMI (low muscle mass for women, ≤5.7 kg/m^2), then they were defined as having sarcopenia.[20]

Statistical Analysis

Prior to the analysis, we classified participants into the following 3 groups according to their frailty score: nonfrailty, prefrailty, and frailty. Differences in the demographic variables, MMSE, SPMT, and

Table 1
Demographic Differences According to Frailty Scores

	Total (n = 273)	Frailty Level			*P* for Trend	Post-hoc
		Nonfrailty (n = 89)	Prefrailty (n = 155)	Frailty (n = 57)		
Age (y)	73.0 ± 5.4	73.1 ± 4.6	72.3 ± 5.6	76.6 ± 5.1	<.001†	a, b
BMI (kg/m^2)	22.5 ± 3.2	22.2 ± 3.0	22.7 ± 3.3	21.9 ± 3.8	.291	–
Medications	2.32 ± 2.24	2.18 ± 2.35	2.23 ± 2.10	3.27 ± 2.55	.072	–
Walking speed (m/s)	1.40 ± 0.20	1.43 ± 0.18	1.41 ± 0.20	1.21 ± 0.20	<.001†	a, b
Grip strength (kg)	22.4 ± 4.0	23.4 ± 3.4	22.6 ± 3.8	18.3 ± 4.1	<.001†	a, b
Cognitive decline (n)	18 (6.56%)	4 (4.49%)	9 (5.81%)	5 (8.77%)	.047*	
Memory decline (n)	20 (7.33%)	6 (6.74%)	4 (2.58%)	10 (17.5%)	<.001†	
Sarcopenia (n)	22 (8.06%)	2 (2.25%)	9 (5.81%)	11 (19.3%)	<.001†	

AWGS, Asian Working Group for Sarcopenia; BMI, body mass index.
Nonfrailty was defined as frailty score of 0, prefrailty was score 1 or 2, frailty was score 3 or greater.
Cognitive decline was defined as the cut-off of MMSE score (23/24).
Memory decline was defined as the cut-off of SPMT score (9/10).
Sarcopenia was defined by using the AWGS-recommended diagnostic algorithm.
a, significant difference between frailty and nonfrailty ($P < .01$).
b, significant difference between score frailty and prefrailty ($P < .01$).
*$P < .05$.
†$P < .01$.

SMI among the 3 groups were examined by using the analysis of variance. When a significant effect was found, differences were determined with the Tukey-Kramer post-hoc test. Differences in the prevalence of cognitive decline, memory decline, and sarcopenia among the 3 groups were evaluated by using the χ^2 test. In addition, multivariate logistic regression analyses, adjusted for age, body mass index, and medications, were performed to determine whether physical frailty was associated with cognitive decline, memory decline, or sarcopenia. For this analysis, cognitive decline, memory decline, and sarcopenia were dependent variables, whereas the 3 frailty groups (dummy coded with non-frailty group as the reference group) were independent variables. Subsequent multivariate logistic regression analyses were performed to determine the independent association between each level of frailty and the risk of cognitive decline or sarcopenia. In these subsequent analyses (adjusted for age and medications), the frailty groups were the dependent variables, and cognitive decline and sarcopenia were independent variables. Odds ratios (ORs) with 95% confidence intervals (CI) were presented. Statistical analyses were carried out by using SPSS Statistics for Windows, version 20.0 (SPSS Inc, Chicago, IL), with a significance threshold of 0.05.

Results

Demographic data for participants stratified by frailty group are shown in Table 1. There were 89 participants (32.6%) in the nonfrailty group, 155 participants (56.8%) in the prefrailty group, and 29 participants (10.6%) in the frailty group. Analysis of variance showed that there were significant differences in age, walking speed, and grip strength among the 3 groups (Table 1). In the χ^2 test, there were

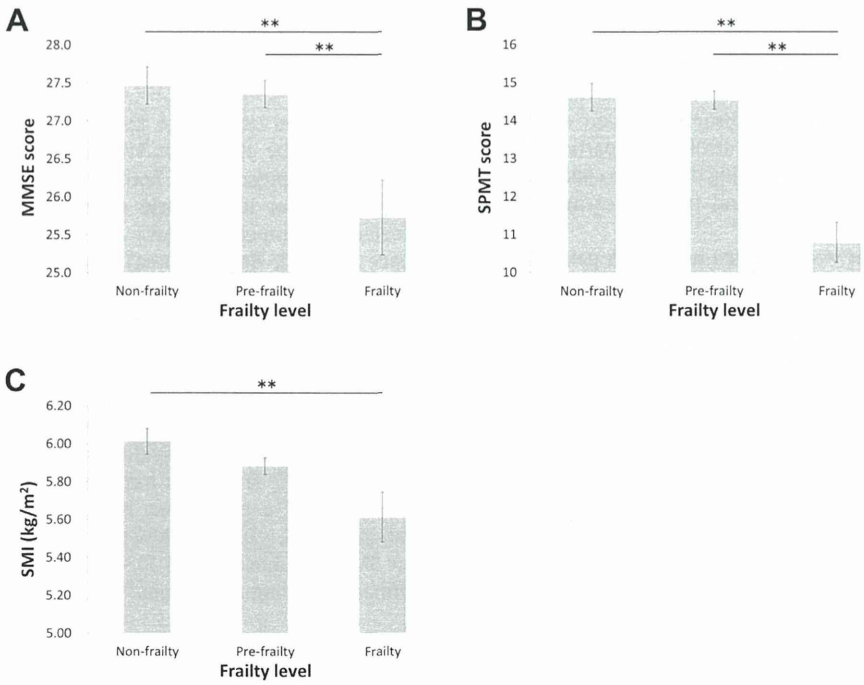

Fig. 1. Comparison of the MMSE, SPMT, and SMI between the groups according to the level of frailty. (A) There were significant differences in the MMSE scores between the 3 groups ($F = 6.78$, $P = .001$). (B) There were significant differences in the SPMT scores between the 3 groups ($F = 18.5$, $P < .001$). (C) There were significant differences in the SMI between the 3 groups ($F = 5.17$, $P = .006$). *$P < .05$, **$P < .01$.

Table 2
Relationship Between the Level of Frailty and Cognitive Decline, Memory Decline, and Sarcopenia

Frailty Level	Cognitive Decline		Memory Decline		Sarcopenia	
	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*
Nonfrailty	1 [Reference]	-	1 [Reference]	-	1 [Reference]	-
Prefrailty	1.79 (0.47–6.84)	.394	0.37 (0.10–1.36)	.134	2.77 (1.05–9.26)	.044*
Frailty	5.76 (1.20–27.6)	.029*	5.53 (1.64–18.7)	.006†	19.1 (3.73–98.0)	<.001†

The analyses for cognitive decline and memory decline were adjusted for age, BMI, and medications.
The analysis for sarcopenia was adjusted for age and medications.
*$P < .05$.
†$P < .01$.

significant differences in the prevalence of cognitive decline, memory decline, and sarcopenia (Table 1). In addition, the frailty group had significantly lower MMSE ($F = 6.78$, $P = .001$, Figure 1, a) and SPMT ($F = 18.5$, $P < .001$, Figure 1, b) than the nonfrailty and prefrailty groups, and lower SMI ($F = 5.17$, $P = .006$, Figure 1, c) than the nonfrailty group.

Eighteen participants (6.6%) had cognitive decline, 20 participants (7.3%) had memory decline, and 23 participants (8.4%) had sarcopenia. In the multivariate logistic regression analysis after adjustment for age, body mass index, and medications, by using nonfrailty group as the reference, the prefrailty group was significantly more likely to have sarcopenia (OR: 2.77, 95% CI: 1.05–9.26, $P = .044$) but not cognitive decline or memory decline (Table 2). The frailty group was significantly more likely to have cognitive decline (OR: 5.76, 95% CI: 1.20–27.6, $P = .029$), memory decline (OR: 5.53, 95% CI: 1.64–18.7, $P = .006$), and sarcopenia (OR: 19.1, 95% CI: 3.73–98.0, $P < .001$) (Table 2).

In the logistic regression analysis in which the frailty groups were the dependent variables and cognitive decline and sarcopenia were independent variables, cognitive decline was independently only associated with a frailty score of ≥3 (OR: 3.73, 95% CI: 1.23–11.4, $P = .020$), whereas sarcopenia was independently associated with both prefrailty (score ≥1; OR: 5.33, 95% CI: 1.22–23.3, $P = .026$) and frailty (score ≥3; OR: 13.1, 95% CI: 4.98–34.2, $P < .001$). These associations remained significant after adjustment for age and medications (Table 3).

Discussion

The results of this study showed that frailty (defined as frailty score ≥3) was associated with cognitive decline, memory decline, and sarcopenia, and that prefrailty (frailty score = 1 or 2) was associated with only sarcopenia. It is a new and interesting finding that there were differences in the association between physical frailty and cognitive decline, memory decline, and sarcopenia according to level of frailty.

In this study, we showed that frailty, but not prefrailty, was associated with cognitive decline and memory decline. Our results also showed that frailty and prefrailty were associated with sarcopenia, in contrast to cognitive and memory decline. In Japanese, multicenter, population-based studies, the prevalence of dementia was not high among those aged 65–74 years (less than 10%), but was higher among those aged 75 years and older.[24] The prevalence of sarcopenia exhibited the same tendency, with the prevalence rising among those aged 75 years and older.[25,26] Thus, older adults (particularly those 75 and older) are prone to both cognitive impairment and sarcopenia. However, low physical performance, low physical strength, and the decrease of muscle mass, which overlap with both sarcopenia and frailty, can be found from middle age.[27–29] Thus, as shown in the results of this study, it is possible that sarcopenia is associated with frailty at an earlier stage than is cognitive impairment, and that sarcopenia is affected more by frailty than is cognitive impairment.

A recent study investigated the association of physical frailty and pre-frailty with dementia and cognitive impairment.[30] In that study, physically frail older adults were over 4 times more likely to have AD, and 8 times more likely to have cognitive impairment than robust older adults were. Prefrail older adults showed an increased risk for dementia in the aforementioned study, but some estimates were not statistically significant in the fully adjusted models.[30] The results of that study were consistent with our study. Previous studies indicated that frailty is associated with AD pathology[13] and biological mechanisms,[14] such as diffuse neuritic plaques, oxidative stress, and inflammation. It is also possible that frailty and AD share common lifestyle risk factors, such as physical inactivity and smoking, that lead to their pathophysiology, which contributes simultaneously to physical frailty and AD.[13] On the other hand, it has been indicated that comorbidities caused by cognitive impairment were also associated with frailty in patients with AD or mild cognitive impairment.[31] Thus, it is likely that these associations interact with one another, leaving the causal association between physical frailty and cognitive decline unclear. Further studies are required to understand these associations.

Definitions of frailty and sarcopenia overlap, and sarcopenia is considered one of the core symptoms of physical frailty.[5,6] The causal mechanisms underlying sarcopenia can be oxidative stress, dysregulation of inflammatory cytokines and hormones, malnutrition,

Table 3
Independent Relationship Between Each Level of Frailty and Cognitive Decline or Sarcopenia

Domains	Univariate Analysis						Multivariate Analysis					
	Frailty Score						Frailty Score					
	≤1		≤2		≤3		≤1		≤2		≤3	
	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*
Cognitive decline	1.76 (0.56–5.51)	.331	1.43 (0.54–3.84)	.473	3.73 (1.23–11.4)	.020*	2.48 (0.68–9.07)	.168	1.63 (0.56–4.72)	.371	4.61 (1.27–16.8)	.020*
Sarcopenia	5.33 (1.22–23.3)	.026*	9.07 (3.22–25.5)	<.001†	13.1 (4.98–34.2)	<.001†	5.47 (1.21–24.6)	.027*	8.75 (3.00–25.5)	<.001†	10.0 (3.40–29.6)	<.001†

The multivariate analyses were adjusted for age and medications.
*$P < .05$.
†$P < .01$.

physical inactivity, and muscle apoptosis, all of which have been hypothesized to contribute to frailty through interactive pathways.[32,33] Recently, the definition of sarcopenia has been the coexistence of low muscle mass and low physical performance,[5,20,34] which are contained in frailty domains. Thus, the association of sarcopenia with even prefrailty seems reasonable. Overlapping intervention strategies (eg, nutritional supplementation and exercise) may be required to prevent both frailty and sarcopenia.

During recent years, the definition of frailty has been changing. Frailty has been considered to include other aspects, for instance social aspects and comorbidities.[15] In addition to these aspects, poor cognition needs to be included in the definition of frailty, as shown in previous studies[4,8] and by this study. Furthermore, this study indicated that poor cognition was associated with frailty and that sarcopenia was associated even with prefrailty. The results indicate that we need to understand the consecutive mechanism as well as the association of prefrailty and frailty with cognitive decline, sarcopenia, and other adverse health outcomes. Interventions may need to be tailored to the level of frailty to effectively prevent various functional declines. Future studies should investigate these intervention strategies.

There were several limitations to this study. First, the cross-sectional design prevented us from establishing causal associations between frailty and cognitive decline or sarcopenia. Second, the findings in this study should be considered preliminary owing to the relatively small sample size, which may introduce some error of inference, reduce the power of analysis, and limit generalization. Third, the design of this study was not a population sampling, and participants in this study were independent in activities of daily living. This may lead to an underestimation of the prevalence of frailty, cognitive decline, and sarcopenia, as the participants were relatively healthy elderly persons.

In conclusion, our results indicate that there were differences in the association between physical frailty and cognitive decline, memory decline, and sarcopenia according to the level of frailty. Cognitive decline and memory decline were associated with frailty. Sarcopenia was associated with prefrailty and frailty. Further studies are required to understand these associations including biological mechanisms.

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Original article

Comparison of frailty between users and nonusers of a day care center using the Kihon Checklist in Brazil

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ABSTRACT

Background/purpose: Day care centers are rapidly expanding in Brazil to meet the needs of the increasing older population. However, health profiles of their clients remain unclear. Therefore, this study aimed to investigate and compare the health conditions of users and nonusers of a day care center using a new frailty index, the Kihon Checklist.

Methods: This was a cross-sectional observational study. We recruited 59 users (mean age 81.1 ± 6.69 years) and 173 nonusers (mean age 69.9 ± 7.39 years). The nonusers were recruited at a recreational club and municipal health units, and the users were recruited at a day care center for the elderly in Brazil. Measurements consisted of questionnaires regarding sociodemographic and health-related characteristics and the Kihon Checklist.

Results: Compared with the nonusers, users had a higher prevalence of frailty ($p < 0.001$) and impairment of all specific domains (instrumental activities of daily living impairment, $p < 0.001$; physical inactivity, $p < 0.001$; seclusion, $p < 0.001$; cognitive deficit, $p < 0.001$; and depression, $p < 0.001$). The users were also more likely to be frail [odds ratio (OR), 14.226; 95% confidence interval (CI), 5.423–37.320; $p < 0.001$], dependence in instrumental activities of daily living (OR, 78.845; 95% CI, 19.569–317.674; $p < 0.001$), physically inactive (OR, 3.509; 95% CI, 1.467–8.394; $p = 0.005$), cognitively impaired (OR, 5.887; 95% CI, 2.360–14.686; $p < 0.001$), and depressed (OR, 5.175; 95% CI, 2.322–11.531; $p < 0.001$) than the nonusers.

Conclusion: The users of the day care center were frailer than nonusers, especially with regard to independence in instrumental activities of daily living, physical strength, cognitive function, and mood. Health care workers should use the Kihon Checklist to verify frequently the condition of elderly patients to prevent worsening of frailty.

1. Introduction

By 2050, the elderly population in Brazil is projected to represent approximately 30% of the total population, making Brazil one of the countries with the largest absolute number of elderly people worldwide.[1,2] These demographic changes will present a new challenge to the Brazilian health care system.[3]

In this context, noninstitutionalized care modalities that assist frail older persons are emerging in Brazil.[4] One example is day care centers that offer programs designed to meet the needs of elderly persons who require supervised care during the day but can return home in the afternoon or evening. Such institutions are rapidly expanding. However, the health profiles of the day care center attendees and their specific needs remain unclear due to the busy work schedule of the center staffs who do not have time required for the massive assessments for older adults.

Hence, this study sought to (1) investigate health conditions of the users of a day care center using a new frailty assessment tool known as the Kihon Checklist (KCL), a comprehensive and fast questionnaire, and (2) compare health profiles of the day care center users with those of elderly community-dwelling nonusers of such facilities.

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2. Methods

This was a cross-sectional observational study.

2.1. Participants

The inclusion criteria were as follows: community-dwelling adults aged 60 years or older, users or nonusers of day care services, who were able to respond to the questionnaire independently or by proxy. Individuals who did not match these criteria or did not want to participate were excluded. All participants received explanations regarding the research procedures and signed an informed consent form.

The nonusers of day care services were recruited at a recreational club and municipal health units, whereas the users were recruited at a day care center for the elderly with a maximum capacity of 30 participants per day. The prior criterion to attend the center included the need for support to perform daily activities. The center's professional team consists of medical doctors, nurses, physical therapists, social assistants, and volunteers. The main objectives of the institution are to provide proper care to the elderly, offering activities that preserve their dignity, and also to improve the quality of life of the participants and their families. All institutions were private and located in the same city in southern Brazil. Patient recruitment and data collection were carried out from June 2012 to April 2013.

The study protocol was approved by the Ethics Committee at Kyoto University Graduate School of Medicine, Kyoto, Japan (E-1575).

2.2. Assessments

The collected data were as follows: (1) sociodemographic information, including age, sex, living structure, educational level, and working status; (2) health-related characteristics, including body mass index (BMI), use and number of medications, frequency of medical consultation in the past 6 months, hospitalization in the past year, and life satisfaction; and (3) the translated and validated Brazilian Portuguese version of the KCL.[5]

The KCL was developed by the Japanese Ministry of Health, Labor, and Welfare, based on the needs of the Japanese long-term care insurance system. This checklist is used to screen frail older adults and identify those at higher risk of becoming dependent.[6–8] The checklist is a self-administered questionnaire that comprises 25 yes/no questions divided into instrumental activities of daily living (IADLs), physical strength, nutrition, eating, socialization, memory, and mood domains. A higher score indicates a frailer health condition. We determined the following cutoff points: for the KCL total score (sum of the scores of all questions) $\geq$7 points; IADL domain $\geq$3 points; physical domain $\geq$3 points, representing physical inactivity; nutrition domain score = 2 points, indicating malnutrition; additionally in question number 12, regarding body composition in the same domain, we adopted a cutoff of BMI <20.5; oral domain $\geq$2 points, suggesting oral dysfunction; socialization domain $\geq$1 point, representing seclusion; memory domain $\geq$1 point, suggesting cognitive impairment; and finally, mood domain $\geq$2 points, indicating depression. These cutoff points were adopted based on our previous findings that determined the KCL cutoffs associated with an elevated risk of requiring long-term care insurance service.[7,9] The time required to answer the KCL is approximately 15 minutes. Further details of the KCL have been described previously.[5]

2.3. Statistical analysis

Regarding sociodemographic and health-related characteristics, we analyzed the differences in age, BMI, and number of medications between users and nonusers of the day care service using an unpaired t test. For categorical variables (i.e., sex, living structure, educational level, working status, use of medication, medical consultation, hospitalization, and life satisfaction), we used the Chi-square test. For the variables that exhibited a significant difference ($p < 0.05$; i.e., living structure, working status, and life satisfaction), we dichotomized each item and conducted a Chi-square analysis separately for each category. Additionally, we analyzed the differences in KCL domains (mean scores) between groups using analysis of covariance (ANCOVA) adjusted for age.

We calculated the differences in the percentage of frail older adults (according to the KCL cutoff points) between the groups using the Chi-square test. We also performed a binary logistic regression analysis adjusted for age and sex, using each KCL domain as a dependent variable. For the total KCL score and for each domain, the robust condition was coded as 0 and frail condition as 1. The nonuser group was the reference group. Finally, to determine the variables with higher influence on day care use, we performed a binary logistic regression analysis (using the stepwise method), adjusted for age and sex, with "use of day care" (nonusers = 0 and users of day care service = 1) as the dependent variable. Dichotomous covariates included were the KCL variables that showed a significance in the previous regression analysis (using the enter method). Statistical significance was set at $p < 0.05$. All analyses were performed using the SPSS (version 21.0, SPSS; IBM Inc., Chicago, IL, USA).

3. Results

3.1. Sociodemographic and health-related characteristics

A total of 232 elderly persons met the criteria for the study (community, $n = 173$, mean age 69.9 $\pm$ 7.39 years; day care, $n = 59$, mean age 81.1 $\pm$ 6.69 years).

Among the 59 users of day care services, 18.6% utilized the day care center once a week, 48.8% twice a week, 25.6% three times per week, 4.7% four times per week, and 2.3% five times per week.

The users of day care services were older, and the majority lived with their children ($p < 0.001$). By contrast, most of the nonusers lived with their partners ($p = 0.017$). Additionally, most of the users were retired ($p < 0.001$), whereas some of the nonusers were still engaged in volunteer activities ($p = 0.044$). Furthermore, the nonusers of day care services had a higher BMI ($p = 0.004$) and were more satisfied with their lives than the users ($p = 0.013$) (Table 1).

3.2. Frailty condition

Differences were identified in the total mean KCL score ($p < 0.001$) and the mean KCL scores for all the domains between the two groups. Even when results for each domain were adjusted for age, the users of day care services were found to be frailer than the nonusers in terms of IADLs ($p < 0.001$), physical strength ($p < 0.001$), nutrition ($p = 0.001$), eating ($p = 0.01$), socialization ($p < 0.001$), memory ($p < 0.001$), and mood ($p < 0.001$) (Table 2).

Based on the results that identified frailty using the cutoff points, we observed that the users had a higher prevalence of frailty according to the total KCL score ($p < 0.001$) than the nonusers. Moreover, the user group contained more participants with IADL impairment ($p < 0.001$), physical inactivity ($p < 0.001$), seclusion ($p < 0.001$), cognitive deficit ($p < 0.001$), and depression ($p < 0.001$) (Table 3).

Results of the logistic regression, adjusted for age and sex, confirmed that the users of day care services were more likely to be frailer than the nonusers. Compared with nonusers, the day care