sensitivity and specificity) (Shumway-Cook, Brauer, & Woollacott, 2000; Podsiadlo & Richardson, 1991; Steffen, Hacker, & Mollinger, 2002). The functional reach test also showed appropriate inter-rater reliability (ICC = 0.098) and a high test-retest reliability (ICC = 0.92) (Duncan, Weiner, Chandler, & Studenski, 1990). In Japan, OLS is widely used not only in clinical settings but also in community settings, and studies showed acceptable test-retest reproducibility and inter-rater reliability (Michikawa, Nishiwaki, Takebayashi & Toyama 2009; Franchignoni, Tesio, Martino, & Ricupero, 1998; Giorgetti, Harris, & Jette, 1998; Wolinsky, Miller, Andresen, Malmstrom, & Miller, 2005). The CS showed excellent reliability (0.89, 95% CI = 0.79, 0.95), sensitivity (95% CI) = 0.66 (0.55, 0.76), specificity (95% CI) = 0.55 (0.49, 0.61), relative risk (95% CI) = 2.0 (1.3, 3.0); and Likelihood ratio = 1.47 (Tiedemann, Shimada, Sherrington, Murray, & Lord, 2008). Finally, the HGS is also reliable as a study examined the reliability of HGS measured over a 12-week period and the test-retest measurements did not differ significantly over time on either side; additionally the intraclass correlation coefficients were 0.954 and 0.912 for the left and right hands, respectively (Bohannon, & Shaubert, 2005).

Statistical Analysis

The demographic information was described by the results of the descriptive analysis. We used One way ANOVA to verify the differences of the physical test results among the SRH groups. When a significant difference ($p < 0.05$) was found in the One way ANOVA analysis, we carried out the Tukey's Post Hoc to identify the SRH groups that differed according to the respective variable. Additionally, we used chi-square analysis to verify the difference of subjects divided by health sense groups (good, normal, and bad health conditions) who had score below and those who had score above the mean of each QOL assessment's domain.

RESULTS

The subjects were 51 community-dwelling Japanese women (mean age = 75.3 ± 6.0), 49% of them evaluated their health condition as good, 35.3% as normal, and 15.7% as bad health condition. They were then divided into three groups by their SRH, good health ($n = 25$), normal health ($n = 18$), and bad health ($n = 8$). There were statistical differences regarding the use of tobacco, frequency of medical consultation, and number of medications among these three groups. The group of subjects that evaluated their health as bad had more smokers and showed the highest frequency of medical consultation and highest number of medications (Table 1). No statistical differences were found regarding the other variables.

As shown in Table 2, body mass index was very similar among the groups. Considering waist circumference, a slight difference between those who evaluated their health as good and bad (78.3 ± 10.1 vs. 81.2 ± 17.8) was observed, but it was not statistically significant.

There were differences regarding physical performance in the FR and CS among the three groups. Additionally, there were some tendencies to show different performance in HGS and OLS. By the post hoc analysis, we verified the difference of FR, HGS, and CS between the normal and the bad health condition groups, and a

TABLE 1. Socio Demographic Characteristics of the Self-Rated Health Groups (n = 51)

		Good Valid% (n = 25)	Normal Valid% (n = 18)	Bad Valid% (n = 8)	p value
Age	(Mean ± SD)	76.4 ± 5.2	74.0 ± 7.2	74.8 ± 5.6	0.426
Education	Junior high school	21.7	25.0	14.3	0.850
	High school	30.4	12.5	28.6	
	Junior college	21.7	37.5	28.6	
	Technical course	17.4	6.3	14.3	
	University	8.7	18.8	14.3	
Live with	Alone	34.8	41.2	50.0	0.848
	Couple	34.8	29.4	12.5	
	3 or more	30.4	29.4	37.5	
Work	Do not work	75.1	66.7	100	0.683
	Volunteer	8.3	5.6	—	
	Agricultural work	8.3	11.1	—	
	Others	8.3	16.6	—	
Financial satisfaction	Satisfied	87.1	72.2	75	0.456
	Normal	4.3	27.8	25	
	Dissatisfied	8.6	—	—	
Go out home (per week)	Rarely	4.2	5.6	—	0.275
	1–2 times	16.7	5.6	—	
	3–4 times	20.8	22.2	62.5	
	Almost everyday	58.3	66.7	37.5	
Physical activity	Sedentary	13.0	27.8	12.5	0.401
	Almost everyday	26.1	16.7	37.5	
	2–3 times per week	56.5	44.4	25.0	
	1–2 times per month	4.3	11.1	25.0	
Tobacco	Yes	—	—	14.3	0.047
Alcohol	No consumption	70.8	50.0	42.9	0.375
	Rarely	8.3	5.6	28.6	
	Sometimes	12.5	33.3	14.3	
	Almost everyday	8.3	11.1	14.3	
Medical consultation	0 times	16.7	5.6	—	0.032
	1–2 times	37.5	22.2	—	
	3–4 times	8.3	27.8	14.3	
	5–6 times	12.5	33.3	14.3	
	7 times or more	25.0	11.1	71.4	
Hospitalization	Yes	12.5	—	—	0.189
Medication	Yes	80.0	88.9	100	0.332
Medications	(mean ± SD)	2.0 ± 1.5	2.9 ± 1.5	4.0 + 0	0.001

tendency was found for OLS. Moreover, CS was also different between the good and the bad groups. No difference was found for TUG (Table 2).

Considering general evaluation, without group distinction, the mean value of the SF1- General health was 49.3 ± 6.4, SF2- Physical functioning was 46.2 ± 6.3, SF3- Role physical was 46.9 ± 6.6, SF4- Bodily pain was 46.9 ± 8.0, SF5- Vitality was 51.4 ± 6.1, SF6- Social functioning was 48.3 ± 7.6, SF7- Role emotional was 51.1 ± 6.1, and SF8- Mental health was 50.1 ± 5.0.

We found a statistically significant difference regarding the general health, bodily pain, and vitality domains. In the general health and vitality domains, the majority

TABLE 2. Anthropometric Measures and Physical Performance in Each Level of Self-Rated Health ($n = 51$)

	Good ($n = 25$) Mean + SD	Normal ($n = 18$) Mean + SD	Bad ($n = 8$) Mean + SD	p value
Body mass index (kg/m^2)	22.3 ± 2.7	21.9 ± 2.6	22.4 ± 3.0	0.854
Waist circumference (cm)	78.3 ± 10.1	79.3 ± 9.8	81.2 ± 17.8	0.819
Timed up and go (sec)	7.1 ± 1.5	7.2 ± 1.5	7.9 ± 2.7	0.465
Functional reach (cm)	24.5 ± 5.7	28.0 ± 5.4^a	21.8 ± 5.7^a	0.025
One leg stand (sec)	19.8 ± 10.3	20.5 ± 9.6^c	10.1 ± 12.4^c	0.054
Five chair stands (sec)	7.8 ± 2.3^d	7.8 ± 2.1^e	10.7 ± 4.2^{d,e}	0.022
Hand grip strength (kg)	20.9 ± 5.6	22 ± 3.6^b	17.1 ± 2.3^b	0.052

Notes: Post Hoc a: $p = 0.03$; b: $p = 0.04$; c: $p = 0.05$; d: $p = 0.02$; e: $p = 0.03$.

of the subjects who assessed their health as good and normal conditions had scores above the mean; while the majority of those who assessed their health as bad had scores below the mean. Concerning the bodily pain, the majority of the subjects who assessed their health as normal and bad conditions had scores below the mean, those in the good health condition had the same proportion of scores below and above the mean (Table 3).

DISCUSSION

Our findings showed that most of the subjects evaluated their health condition as good (49%) and that those who assessed their health condition as bad (15.7%) were a minority. According to the literature, SRH is strongly associated with mortality (Cesari et al., 2008; Ford et al., 2008; Okamoto et al., 2008). In accordance, a study

TABLE 3. Quality of Life in Each Level of Self-Rated Health

		Good Valid% (n)	Normal Valid% (n)	Bad Valid% (n)	p value
SF1 General health	High QOL	88 (22)	88.9 (16)	25 (2)	<0.01
	Low QOL	12 (2)	11.1 (2)	75 (6)	
SF2 Physical function	High QOL	54.2 (13)	61.1 (11)	25 (2)	0.23
	Low QOL	45.8 (11)	38.9 (7)	75 (6)	
SF3 Role physical	High QOL	64 (16)	66.7 (12)	25 (2)	0.11
	Low QOL	36 (9)	33.3 (6)	75 (6)	
SF4 Bodily pain	High QOL	50 (12)	23.5 (4)	—	0.02
	Low QOL	50 (12)	76.5 (13)	100 (8)	
SF5 Vitality	High QOL	76 (19)	70.6 (12)	25 (2)	0.03
	Low QOL	24 (6)	29.4 (5)	75 (6)	
SF6 Social function	High QOL	60.9 (14)	52.9 (9)	25 (2)	0.22
	Low QOL	39.1 (9)	47.1 (8)	75 (6)	
SF7 Role emotional	High QOL	44 (11)	41.2 (7)	25 (2)	0.63
	Low QOL	56 (14)	58.8 (10)	75 (6)	
SF8 Mental health	High QOL	45.8 (11)	47.1 (8)	25 (2)	0.54
	Low QOL	54.2 (13)	52.9 (9)	75 (6)	

Notes: High QOL represents the values above the mean and low QOL represents those values below the mean.

showed that the strongest predictor of death was "poor" or "fair" self-rated health (with 52.3% and 28%, respectively, of women in these categories dying) (Okamoto et al., 2008), we then assume that the minority needs special attention.

Additionally, poorer SRH and lifestyle habits, such as being a current or ex-smoker, physical inactivity, being a non-drinker of alcohol, being underweight, older age, lower educational level, and being single or widowed; are other examples of significant factors associated with increased mortality (Ford et al., 2008). In our study, the group of subjects who evaluated their health as bad had more smokers and showed a higher frequency of medical consultation and more medications than the others.

Regarding physical performance, our findings showed that those who evaluated their health as bad had poorer physical performance in FR comparing with those who evaluated it as normal, and in CS comparing with those who evaluated as good and normal conditions. Cesari et al. (2008) found an independent prediction of CS and SRH to mortality in older adults; however, authors softened the SRH results stating that participants with a good physical performance had a lower risk of dying compared to those with poor performance, independently of their self-perceived health status.

Our data also indicate that those who evaluated their health as bad presented lower performance on HGS and OLS than the other groups. However, the difference was statistically significant only in HGS between normal and bad groups; additionally, no difference was found for TUG. Different from our findings, Jylha et al. (2001) found a strong graded association of fair or poor SRH with increasing severity of walking difficulty in an age adjusted model. They also found that mobility was a central constituent of SRH for older women. Moreover, they did not find a significant independent effect of SRH on the other performance measures (chair stands, balance and grip strength) once mobility was accounted for. The reference values for TUG in healthy Japanese elderly are 6.60 s with maximum effort and 8.86 s at the usual pace (Kamide, Takahashi, & Shiba, 2011). In our study, we requested them to do with their maximum effort during test, and we found a mean of 7.1 ± 1.5, 7.2 ± 1.5, and 7.9 ± 2.7 for good, normal, and bad groups, respectively. In our understanding, mobility was not a problem in the studied participants, and then the other physical measures were different among SRH groups, but not TUG. Possible reasons are hypothesized ahead.

Self-rated health (SRH) is a subjective assessment based on the personal beliefs and also on the living context, and it is possible to credit some different results among the SRH studies to the cultural aspects that require different physical patterns. For example, Japanese people, particularly older adults, keep the tradition such as sleeping in *tatami*, sitting on the floor, using the Japanese bathroom (squatting position), and bathing in the *ofuro*; thus, all these differences in their daily routine intensely require certain physical abilities such as stretching (here evaluated by FR), muscle power (CS), strength (HGS), and balance (OLS) that seem to be relevant based on the present findings. However, we did not investigate their lifestyle in detail, so we cannot extend our results until this point. Certainly, further researches towards the SRH with a cross-cultural view are needed to clarify this inference.

Concerning QOL, those reporting a bad health condition in our study showed poorer results in general health and vitality domains comparing with the other SRH groups; and in bodily pain, comparing solely with the good condition group. Our study provides evidence of the cycle involving SRH, physical performance and QOL. These data can be supported by another study indicating that limitations in subjective health are particularly experienced by older people with impaired physical ability that lead to limitations in everyday management associated with the risk of losing independence, which is highly significant for QOL (Gunzelmann, Hinz, & Brähler, 2006).

Another study with Japanese older adults suggested the importance of maintaining the physical health to assure mental and social health of older adults. Their findings indicated that people who can keep an overall healthy state were those with a good physical condition that may deal with the daily life demands independently with a paucity of disease, or those who maintain a heightened psychological well-being and active connections with society on the basis of being in satisfactory physical condition (Yuasa et al., 2012). Furthermore, considering a 10-year follow up, the researchers found that a good QOL was a strong positive correlate of both mobility and SRH in older women (Sirola et al., 2010).

Self-rated health (SRH) appears to be a multidimensional phenomenon and the concept of health of older adults is not an isolated event, but rather it involves all the aspects of their lives and the living context. And we, as health providers, must develop skills in understanding the health aspects and the demands of the older adults to attend them adequately. We should attempt to give special attention to their physical condition/performance; however, we should not fragment the health just on this basis, extending our care to the other relevant aspects such as QOL including the mental and the social conditions. In a community setting, SRH could be used to save time when screening older adults due to its association with QOL and physical performance. Then, for those representing the self-reported bad health condition, one should attempt further assessments.

Our study has several limitations. First, it has a cross-sectional design and we cannot extend the results to affirm that the physical performance and QOL are predictors for SRH. Another limitation is that the sample size was small and we recruited only the participants from an urban city in Japan. Therefore, further studies should be conducted with a larger sample size and participants of different areas, if possible, of different countries; and to apply different measurements to continue the investigation among the dimensions of health that SRH captures.

CONCLUSIONS

Our present study contributes to understand that the self-ratings of health may be modified by physical performance and QOL among older women in Japan. Those who assessed their health as bad had worst physical performance in FR, HGS, and CS, and also presented lower QOL scores in general health, bodily pain, vitality than other SRH groups. We encouraged the use of the SRH assessment and the interpretation of its results based on the present findings such as associating the SRH of older women with their physical performance and QOL.

Declaration of interest: The authors report no conflict of interest. The authors alone are responsible for the content and writing of this paper.

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Original article

Urban-rural differences in physical performance and health status among older Japanese community-dwelling women

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Background/Purpose: Assessment of physical performance allows the identification of health and functional independence among older adults. Several factors, such as environmental conditions, influence the results; therefore our objective was to compare the physical performance and the health status between older Japanese women living in urban and rural communities.
Methods: The Japanese women were aged ≥65 years, and recruited in urban ($n = 41$, age $= 73.8 \pm 3.92$ years) and rural ($n = 54$, age $= 73.8 \pm 4.15$ years) locations through the local press. Physical performance was assessed by the Timed Up and Go (TUG), one leg stand (OLS), repeated chair stands (CS) and handgrip strength (HGS) tests. Health status was investigated using socio-demographic characteristics; anthropometric measures and body composition; physical activity, a pedometer, Life-Space Assessment (LSA); Geriatric Depression Scale; incidence of falls, fear of falling; and medical information. Variables were compared by χ^2 test, Independent-Samples t test and Mann Whitney U-test.
Results: Rural individuals presented a better performance in the HGS test ($p = 0.01$) than urban individuals, who had a better performance in the CS test ($p < 0.001$). No statistical differences were found in the TUG or OLS tests. Rural women also had a higher body mass index ($p = 0.04$), waist circumference ($p < 0.01$), and body fat percentage ($p = 0.014$) than urban women, who showed higher scores in LSA ($p < 0.001$). Concerning medical information, more rural women complained of low back pain ($p = 0.01$) and gastrointestinal problems ($p = 0.02$).
Conclusion: Our findings showed that the physical performance and health status varied according to the place. Rural individuals had worse results in the CS test, but a better performance in the HGS test than urban individuals. We emphasize that health interventions should address the specific demand of each location.

1. Introduction

Japan has the world's highest average life expectancy, reaching 86.4 years for women, according to the 2010 records.[1] However, specialists have defended that the process of aging "well", such as remaining healthy, vigorous, and free of disability, is as important as the absolute number of years achieved.[2]

One of the enemies to the process of aging well is a sedentary lifestyle; a key risk of premature morbidity and mortality. Following this concept, the assessment of physical performance is receiving special attention, because it allows an early identification of older adults at risk of health and functional decline, situations that typically precede the onset of disability.[3,4] Moreover, physical performance measures are predictors of functional, psychological, and social health,[4,5] and additionally, in this complex relationship, they are influenced by several factors, such as environmental conditions.

Studies have shown that physical activity levels differ according to the environment; in rural communities, the physical activity level could be expected to be lower than that in urban neighborhoods.[6,7] A study conducted in Japan examined the association between the neighborhood environment and physical activity among Japanese adults[8]; however, to our knowledge, no study has directly compared the physical performance and the health status

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between older urban and rural community-dwelling adults yet. Therefore, we aimed to compare the physical performance and the health status between older Japanese women living in urban and rural communities.

2. Methods

2.1. Study participants

The participants were older Japanese women, recruited in urban ($n = 41$) and rural ($n = 54$) locations through the local press, by requesting healthy, community-dwelling volunteers to collaborate in this research. The inclusion criteria were age ≥65 years and the ability to perform the physical tests, to fill the questionnaires, and to give consent to participation in the study. Data was collected from November 2011 to March 2012.

Rural and urban locations were defined and classified directly with emphasis on the morphology of their settlements and the wider geographic context of such settlements. This approach ensured that the focus remained clearly on the most physical aspects of these environments, as described elsewhere.[9] The participants in an urban location lived in Kyoto city (1.47 million people), while the population in rural environments was <9000, in an area of 15.2 km^2. For this categorization, we also considered factors beyond the population size, such as differentiation by economic field, in which rural residents used the land as a direct source of income or wealth generation.

2.2. Physical performance

In the Timed Up and Go (TUG) test, participants were asked to stand up from a standard chair, walk 3 meters, turn, and sit down again; a shorter measured time indicated better ability. In the one leg stand (OLS) test, participants were instructed to stand unassisted on one leg, eyes opened and arms by the side of the trunk; the OLS was timed not exceeding 30 seconds, with a longer time indicating better balance ability. In the repeated chair stands (CS), participants were asked to stand up and sit down five times from a chair as quickly as possible, keeping their arms folded across the chest. Finally, the handgrip strength (HGS) was tested with a standard handheld dynamometer (HHD) (mTas F-1; ANIMA, Tokyo, Japan). The participant was asked to stand up and hold the dynamometer with arms parallel to the body; the HGS was measured for both hands once on each side, and the higher value was used to characterize the maximum muscle strength of the participant, as previously described.[10] HGS was expressed in kg.

2.3. Health status

Socio-demographic characteristics, such as age, living structure, educational level and current work; anthropometric measures, such as body mass index (BMI), waist circumference (WC); and body composition features, such as body fat percentage (BF%), skeletal muscle mass index (SMMI), arm muscle mass, and leg muscle mass—collected by bioelectrical impedance analysis (Inbody 430; Biospace Co, Ltd, Seoul, Korea)—were obtained.

Regarding the bioelectrical impedance, the instrument makes use of eight tactile electrodes: two are in contact with the palm and thumb of each hand and two with the anterior and posterior aspects of the sole of each foot. The individual stands with their soles in contact with the foot electrodes and grabs the hand electrodes. Resistance of arms, trunk, and legs was measured at frequencies of 5, 50 and 250 kHz. Examination provided values for skeletal muscle mass, BF% and segmental muscle mass (right and left arms and legs, and trunk). From these measurements, skeletal muscle mass was then adjusted by height and for segmental muscle mass. This bioelectrical impedance method had previously been validated as having a strong correlation to muscle volume and fat mass, as measured by dual energy X-ray absorptiometry.[11]

Moreover, regular practice of physical activity (PA) was collected by a self-administered questionnaire and was characterized by moderate walking, gymnastics, resistance training, yoga, golf, and other activities. Then, pedometer data (Yamax Powerwalker EX-510; Yamasa Co., Ltd., Tokyo, Japan), and Life-Space Assessment (LSA)[12] were also collected. Concerning the pedometer, the participants were recommended to wear the instrument in the morning and to register the number of steps in a diary at the end of the day. After 1 week, they were requested to send the pedometers by mail to researchers, including the diary record. The diary record was then matched with the pedometer memory and an average of steps counting in 1 week was used in analysis.

For psychological characteristics, the Geriatric Depression Scale (GDS-15) was used. Finally, information about the incidence of falls in a 1 year period, fear of falling, medical information, such as medical consultation frequency and hospitalization history in the last 6 months, medications, and comorbidities were also collected. Through a self-administered questionnaire, individuals were asked about the presence or absence of low back pain, diabetes, osteoporosis, hypertension, hyperlipidemia, arthropathy and gastrointestinal problems; their report was considered positive when they were assumed to be using prescribed medication for the specific comorbidity.

The study protocol was approved by the Kyoto University Graduate School of Medicine Ethics Committee (No. E1245, 2011). All participants were informed of the purpose and procedures of the study and a written consent was obtained.

2.4. Statistical analysis

Aiming to verify the normality of the data, the Shapiro-Wilk test was used. Participants' characteristics were investigated using a descriptive analysis. Socio-demographic and categorical health-status variables were compared by living environment, using the χ^2 test, while continuous variables were analyzed by the Independent-Samples t test, if normally distributed, or the Mann Whitney U-test, if skewed. Concerning the functional performance tests, only the CS was analyzed by the Independent-Samples t test, while for the others, the Mann Whitney U-test was used. The considered level of significance was $p < 0.05$. For data analysis, the Statistical Package for the Social Science (SPSS, IBM Inc., Chicago, IL, USA), version 15.0 was used.

3. Results

In total, 95 older women (urban $n = 41$, age 73.7 ± 3.92 years; rural $n = 54$, age 73.7 ± 4.15 years) participated in this study. Socio-demographic characteristics are shown in Table 1. Despite no statistical differences in their characteristics, an environmental difference was observed. Those in rural areas lived in groups of three persons or more (52.8%), while those in urban environments had the same proportion in all categories of living alone, living with a spouse, or three persons or more (33%). Moreover, rural participants showed a slightly lower educational level, in which most of them studied until junior high school (40%), while urban women studied until high school (34.3%) or university (20%). Additionally, rural women did not work (45.1%) or were engaged in farm work (37.3%), and the majority of urban women were retired (67.5%).

As shown in Table 2, participants living in rural neighborhoods presented a better performance in HGS ($p = 0.01$) than urban participants. In contrast, urban participants had a better

Table 1
Socio-demographic characteristics of older women living in urban and rural communities.

Variable	Urban	n	Rural	n	p
Age (y)[a]	73.7 ± 3.92	41	73.7 ± 4.15	54	0.99
Living structure[b]					
Alone	33.3	39	15.1	53	0.07
With spouse	33.3		32.1		
With 3 persons or more	33.3		52.8		
Education[b]					
Elementary school	11.4	35	6	50	0.17
Junior high school	20		40		
High school	34.3		26		
Technical school	14.3		20		
University	20		8		
Work[b]					
Does not work	67.5	40	45.1	51	0.23
Integral period	2.5		3.9		
Part-time work	2.5		2		
Autonomous work	2.5		2		
Farm work	12.5		37.3		
Volunteer work	7.5		7.8		
Other	5		2		

[a] Mean ± SD.
[b] Percentage.

performance in CS ($p < 0.001$). No statistical differences were found in TUG or OLS.

According to anthropometric measures, rural women had a higher BMI ($p = 0.04$), WC ($p < 0.01$) and BF% ($p = 0.01$) than urban women. A tendency to more engagement in physical activity ($p = 0.05$) and higher scores in LSA ($p < 0.001$) was found in urban participants, even though a statistically insignificant higher average pedometer count was found in rural participants.

The median found in the GDS was low (urban = 1 vs. rural = 2); most urban women had ≥ seven medical consultations (30%) in the last 6 months, while rural women had five or six (24.5%); 7.5% of urban versus 5.6% of rural participants were hospitalized in the last 6 months; and 80% of urban and 81.5% of rural participants took medications. With regards to the above mentioned factors, no statistical differences were found between the two groups, however more rural women complained of low back pain (rural = 27.8% vs. urban = 7.3%, $p = 0.01$) and gastrointestinal problems (rural = 16.7% vs. urban = 2.4%, $p = 0.02$) (Table 3).

4. Discussion

The main findings of our study were that physical performance and health status differed according to the environment; women from rural areas had a better performance in HGS and a worse performance in CS. Additionally, rural women presented higher BMI, WC, BF%, a higher prevalence of low back pain, and gastrointestinal problems, and higher weekly average step counts than urban women. By contrast, those living in urban areas showed higher regular physical activity engagement and higher scores in LSA.

Table 2
Physical performance measurements of older women living in urban and rural communities.

Variable	Urban	n	Rural	n	p
Timed Up and Go (s)[a]	6.44 (5.9–7.35)	41	6.59 (6–7.55)	54	0.44
One Leg Stand (s)[a]	23.35 (10–30)	41	28.31 (12.3–30)	54	0.38
Handgrip Strength (kg)[a]	22 (19–26)	40	25 (21.7–26.5)	54	0.01
Five Chair Standing (s)[b]	7.43 ± 1.75	41	8.97 ± 2.18	54	<0.001

[a] Median (interquartile).
[b] Mean ± SD.

Table 3
Health status measurements of older women living in urban and rural communities.

Variable	Urban	n	Rural	n	p
BMI (kg/m^2)[a]	21.9 ± 2.50	41	23.2 ± 3.45	54	0.04
Waist Circumference (cm)[a]	72.2 ± 5.78	39	76.7 ± 8.14	54	<0.01
Body Fat Percentage[a]	29.0 ± 6.49	39	32.5 ± 6.67	54	0.01
SMMI (kg/m^2)[b]	8.28 (7.63–8.6)	39	8.01 (7.67–8.63)	54	0.91
Arm muscle mass (kg/m^2)[b]	1.36 (1.2–1.51)	39	1.42 (1.33–1.61)	54	0.06
Leg muscle mass (kg/m^2)[b]	4.59 (4.29–4.98)	39	4.41 (4.1–4.71)	54	0.08
Pedometer[b]	5791 (3992–7634)	35	6734 (5447–7794)	53	0.07
Physical activity[c]					
No	17.9	39	35.4	48	0.05
Almost everyday	20.5		6.3		
2 or 3 per week	46.2		52.1		
1 or 2 per month	15.4		6.3		
Life-space assessment[a]	97.0 ± 17.7	32	73.2 ± 19.9	53	<0.001
Geriatric Depression Scale[b]	1 (0–3)	33	2 (0.75–4)	54	0.19
Fear of falling[c]	45.7	35	40.7	54	0.64
Fell in past year[c]	35.1	37	24.1	54	0.25
Medical consultation[c]					
No	17.5	40	18.9	53	0.36
1~2 times	27.5		20.8		
3~4 times	15		17		
5~6 times	10		24.5		
7 or more	30		18.9		
Hospitalization[c]	7.5	40	5.6	54	0.70
Medications[c]	80	40	81.5	54	0.99
Low back pain[c]	7.3	41	27.8	54	0.01
Diabetes[c]	4.9	41	13	54	0.18
Osteoporosis[c]	24.4	41	25.9	54	0.86
Hypertension[c]	43.9	41	38.9	54	0.62
Hyperlipidemia[c]	26.8	41	35.2	54	0.38
Arthropathy[c]	24.4	41	22.6	54	0.84
Gastrointestinal problems[c]	2.4	41	16.7	54	0.02

SMMI = skeletal muscle mass index.
[a] Mean ± SD.
[b] Median (interquartile).
[c] Percentage.

Even though no statistical difference was found, rural participants had a slightly greater arm muscle mass and urban participants a higher leg muscle mass. One possible explanation for this difference is regarding their lifestyle routine (e.g., rural women were more involved in farm work, which usually requires hand and general strength, while urban women seem to be more engaged in physical activity and had higher scores in LSA). However, this is only a hypothesis, as lifestyle factors were not investigated in detail.

Concerning the CS, rising from a chair is a complex task involving movement of all body segments from head to foot; the activity requires coordinated joint mobility, strength and balance to enable the center of mass to be transferred forward and upward from the seated position to erect standing.[13] One could say that the lower performance in CS in rural participants may be linked with the higher incidence of low back pain, as this comorbidity was identified by Janssen et al (2002) as a subject-related determinant for CS in a review study. Additionally, in our research, the CS was done with arms folded across the chest; studies have verified that standing without using armrests requires different kinematics and kinetics, and older adults usually do trunk flexion to keep the balance. Beginning the movement from a position different from erect is also related with increased time movement[14] and could be influenced by low back pain as well. In our studied rural sample, the farm work might be a possible cause for this comorbidity[15] as a kyphotic or squatting position is frequently required in agriculture.

Moreover, the class of medications usually prescribed for low back pain includes nonsteroidal antiinflammatory drugs, skeletal muscle relaxants and opioid analgesics; unfortunately, we did not investigate the classes of the medication that the participants used, however, there is evidence supporting the fact that some of this class of medications may be related with their gastrointestinal problems as well.[16]

The values for HGS and CS in urban individuals were similar to previous studies developed in urban communities in Japan[10,17]; however, our studied rural group had higher HGS and lower CS in comparison.

A study aimed at identifying HGS cutoffs for women and its results showed the threshold of 21 kg at any level of BMI, with values below the cutoff indicating mobility limitations.[18] Another study verified that poor HGS is a predictor of accelerated dependency in activities of daily living (ADL) and cognitive decline in the oldest old[5] and predicts cause-specific mortality in middle-aged and elderly individuals.[19]

Additionally, individuals from rural environments had higher BMI, WC and BF% than those from the urban cohort, however, both groups are inside the cutoff values for BMI, according to the World Health Organization (normal range = 18.5–24.99 kg/m^2)[20] and specific WC (80 cm) for the diagnosis of metabolic syndrome in Japanese women.[21] Such differences on anthropometric features are also linked with lifestyle factors, however, as we did not investigate dietary habits, we cannot extend our conclusions to this point.

TUG has been used as a screening of fall risk.[22] The values we found were better in comparison with other studies; Herman et al (2011) verified a mean score of 9.5 ± 1.7 seconds, ranging from 5.4 to 15.6 seconds, however, their study involved both genders. Another study developed in Japan, with only women (mean age = 78.6 years), found a mean score of 10.3 seconds for TUG,[23] and a review study referenced an Australian research that found a mean score of 8.5 ± 1.6 seconds for women aged 70–79 years.[24]

Another review study conducted by Michikawa et al (2009) identified reference values for OLS time in elderly participants, and stated that this measure of balance can be used as a practical marker to screen the elderly for frailty. Because various procedures are used, the measured values varied widely from study to study, with a mean of 6.9 to 32.9 seconds reported for women aged 70–79 years (considering the maximum time of 60 seconds). Clearly, this variation may be due to individual, as well as procedural, differences. Also, many studies provided combined data for men and women. In their original research, the authors found a median value of 27.8 seconds for women aged 75–79 years, also considering the maximum time of 60 seconds execution.[25] Despite the different methodology, our results are similar to theirs.

In our study, rural women showed lower scores in LSA and a tendency to be less engaged in physical activity. Our results were consistent with another urban–rural comparison study conducted in the United States, which showed that rural older women had a higher BMI and less engagement in physical activity than their urban counterparts.[7] Consistently, another study showed that rural participants had less engagement in physical activity and less active transportation.[6] In Japan, a study was conducted to examine the association between the neighborhood environment and physical activity among Japanese adults; it was reported that people living in neighborhoods with a high residential density, good access to shops, the presence of sidewalks, and the presence of bike lanes, had higher physical activity levels.[8] Furthermore, Peel et al (2005), in a study about the measure of mobility for older community-dwelling adults, found that rural participants also had lower physical performance and function, but higher scores in LSA than urban participants. The authors justified their findings, stating that rural individuals usually travel farther to accomplish tasks, and some community services enabling residents to stay at home, may be unavailable in rural communities.[26]

A study conducted by Van Dyck et al (2010) showed additional evidence regarding pedometer data, in which they concluded that rural individuals took fewer average steps per day than urban ones, contrasting with our results, which showed a higher weekly average step count in individuals from a rural environment; however, their sample was younger (mean age = 42.4 years) than ours.[6] A national survey conducted in Japan showed 5823 steps per day, on average, in people aged 65–74 years, similar to our findings from an urban community, but lower than those observed in the rural community.[27] We may explain our results by the socio-demographic data, that participants from the rural community were more engaged in work and farm activities, even though no statistical differences were found. When performing these daily activities, it is expected that they will take more steps per day. Additionally, we may reinforce the results of LSA supposing that, if participants from rural communities had lower scores, they do not travel farther and use less transportation than urban ones. Aiming to move through the community or going to work, they may do it on foot. Consequently, they accumulated more steps per day/week. Moreover, they may walk to nearby fields for agriculture work.

LSA is an important measure of frailty, as it allows early verification of mobility restriction, which may permit the identification of persons in the course of disability development and at a time when such disability can be prevented. This approach in community dwelling older adults showed strong correlations with age,[28] physical performance measures,[12] daily activities,[12,28] comorbid conditions,[12,28] depressive symptoms,[12] social activities,[28] self-reported health,[12,28] and poor psychological well-being.[28]

Our findings should be useful in targeting and evaluating interventions that enable people to maintain independent mobility and physical performance in their living environment. We emphasize that health interventions should address the specific demand of each location.

To our knowledge, no study has been done to show a direct comparison regarding physical performance and general health status in older urban and rural Japanese women, and our study is the first that shows some evidence about these variables. However, it has several limitations, such as the small sample size, a different number of respondents in each assessment, and it includes only one gender. Therefore, further studies with a variability of geographic settings and a larger sample are needed to continue the investigation concerning differences in the environment to confirm our findings.

Disclosure statement

None of the authors have conflicts of interest or financial disclosures.

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ORIGINAL ARTICLE: EPIDEMIOLOGY, CLINICAL PRACTICE AND HEALTH

Both conventional indices of cognitive function and frailty predict levels of care required in a long-term care insurance program for memory clinic patients in Japan

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Aim: To delineate relationships among cognitive function, frailty and level of care required in the Japanese long-term care insurance program (LTCIP) in outpatient memory clinic patients.

Methods: This was a cross-sectional study carried out at an outpatient memory clinic. Participants were 201 cognitively impaired patients. Cognitive function was measured by the Mini-Mental State Examination (MMSE). Frailty was measured by Timed Up & Go (TUG) and grip strength. Waist circumference, body mass index, living arrangement and level of care required in the LTCIP (rank 1 minor disability to rank 7 severe disability) were also assessed.

Results: Mean age, MMSE score, TUG score and grip strength were 78.8 ± 6.9 years, 19.6 ± 6.1, 14.6 ± 6.7 s and 16.9 ± 7.5 kg, respectively. A total of 70 patients (34.8%) had not applied for the certification, at least in part because of their younger age and existence of family caregivers. LTCIP rank was correlated both with MMSE score (β: −0.49, $P = 0.001$), grip strength (β: −0.27, $P = 0.005$) and living alone (β: −0.18, $P = 0.03$), but not with TUG score (β: 0.14, $P = 0.105$).

Conclusion: In outpatients of a memory clinic, care ranks, which define the upper limit of monthly benefit in the Japanese LTCIP, were influenced by age, cognitive function, frailty and living arrangements. Understanding the relationship among these parameters would be useful in predicting the needs of cognitively impaired patients and important when comparing the possible services provided by long-term care systems for them worldwide. **Geriatr Gerontol Int 2012; 12: 630–636.**

Keywords: cognition, dementia, frailty, living arrangements, long-term care insurance program.

Introduction

With the accelerated aging of the population, the number of patients suffering from dementia is increasing. There were estimated to be more than 1.8 million dementia patients in Japan in 2005, and 24.3 million

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worldwide in 2001.[1] To improve quality of life for cognitively impaired patients, it is important to use social services in addition to the care provided by family caregivers.[2] In developed countries facing the social burden of aging, care systems have been constructed taking into account national characteristics, such as history, nationality, percentage of elderly people and economic conditions.[3,4] The main framework of these systems consists of comprehensive evaluation of the elderly and provision of care in-kind or payments to help families secure care, according to the anticipated care requirement. In Japan, a long-term care insurance program (LTCIP) has been implemented since 2000.[5–7]

Despite the importance of social services for dementia patients, few studies have investigated correlations between anticipated care requirement, which determines the care services allocated, with common indices of dementia severity, such as the Mini-Mental State Examination (MMSE).[8,9] When predicting the amount of care needed, care providers carry out comprehensive assessments of activities of daily living (ADL), instrumental activities of daily living (IADL), cognition, behavioral and psychological symptoms of dementia (BPSD), functions of sensory organs important for communication (particularly hearing and visual acuity), nutritional status, and existence of pain.[6,10] It is important that such assessments are comprehensive in order to evaluate a broad range of functions in elderly people; however, the complex nature of these assessments and the complex condition of the elderly might hamper a simple description of care needs of dementia patients. Care needs of most of dementia patients might instead be assessed in terms of cognitive impairment and ambulatory problems if BPSD are appropriately treated. In the present report, we compare the level of care required, which determines the care allocated, with indices of cognition and frailty. We also intended to carry out this analysis to provide information for the international comparison of care assurance systems that could contribute to their improvement.

Methods

Participants

Participants were 201 patients with cognitive impairment regularly followed up at the outpatient memory clinic in Kyoto University Hospital, Kyoto, Japan. Types of dementia were Alzheimer's disease (AD, $n = 144$), vascular dementia (VD, $n = 9$), mixed type dementia ($n = 10$), dementia with Lewy bodies (DLB, $n = 13$) and other types of dementia ($n = 3$; a semantic dementia, a Fahr disease and an alcohol dementia). A total of 22 patients with mild cognitive impairment (MCI) were also included. The diagnosis of AD, VD, DLB and MCI was made according to the following criteria: AD, Diagnostic and Statistical Manual of Mental Disorders, 4th edition, and National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association;[11,12] VD, National Institute of Neurological Disorders and Stroke, and Association Internationale pour la Recherché et l'Enseignement en Neurosciences;[13] DLB, McKeith's;[14] and MCI, Petersen's.[15] The diagnosis of mixed-type dementia was made when patients were found to have dementia not explained solely by AD or VD. The present study was approved by the ethics committee of Kyoto University, and written informed consent was obtained from participants.

Measures

Participants were evaluated at a regular outpatient consultation from April to July, 2008. The evaluation consisted of measurements of frailty and an interview of caregivers to obtain information relevant to the patients care. Cognitive status was evaluated by the MMSE[16] carried out within 6 months of this evaluation, usually on another visit. Timed Up & Go test (TUG) and grip strength were used for the assessment of frailty.[17,18] Body mass index (BMI) and waist circumference were also measured. The caregiver interview consisted of questions on living arrangements, frequency of care provided by family members not living with the patient and level of care required in the LTCIP. We also asked about the number of family members who provided care, but did not live with the patient, and how far these family members lived from the patients' home, although some of this information was not included in the present report.

LTCIP in Japan

The care requirement was determined by a national system (Fig. 1). The LTCIP was implemented in Japan in 2000 and underwent major reform in 2005.[6,10] The original version listed seven ranks of care required (not eligible, needing support and needing care levels 1–5). After the reform, these ranks were expanded to eight (not eligible, needing support levels 1 and 2, and needing care levels 1–5). As level of required care is evaluated every 6–24 months, depending on the stability of the physical and mental conditions of the elderly, all participants in the present study had their level of care required assessed after the reform. In the Japanese LTCIP, the first step to assessing level of care required involves a computer algorithm to determine the estimated time assumed necessary for the care of an individual elderly person. In this assessment, the time is estimated by trained municipal officers using a 79-item checklist consisting of basic and instrumental ADL, cognitive function, BPSD, and auditory acuity. In the

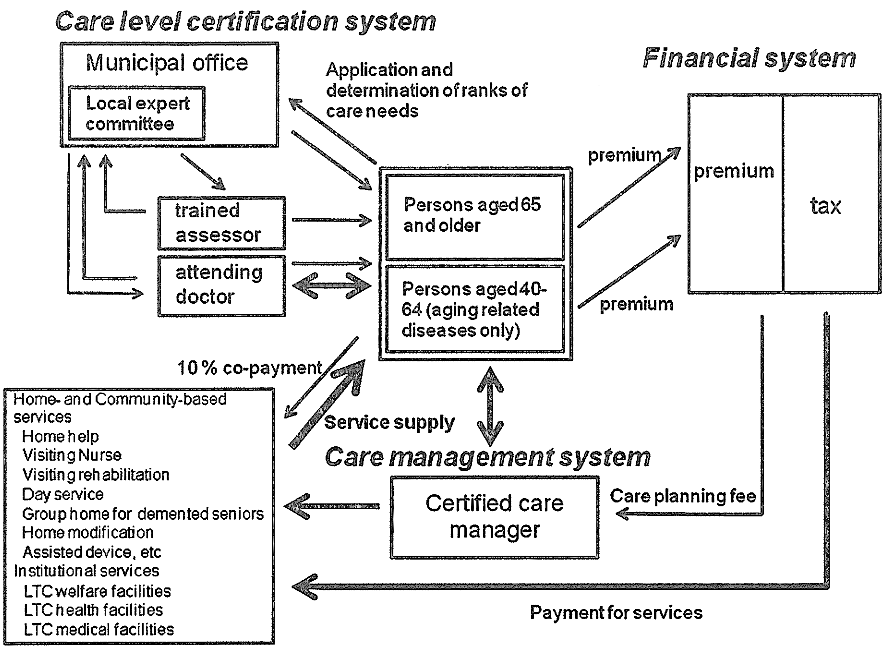

Figure 1 Schema of the long-term care insurance program in Japan.

second step, a local expert committee checks the results of the first step and a medical certificate from the elderly person's attending physician, and finally decides on the level of care required (Fig. 1). If the elderly person applies for certification, and their physical and cognitive status is not frail enough for level 1 of care support, they are not eligible for LTCIP services. There were no such patients in the present series of participants. However, there were patients who opted not to apply for care certification, because they or their family did not think that they needed social services, and we designated these patients as rank 0. Care support levels 1 and 2 are designated here as ranks 1 and 2, and care needs levels 1 to 5 are designated as ranks 3 to 7, respectively.

In the Japanese LTCIP, care benefits are provided in kind, and the upper limit of the benefit available in a month expressed as the amount of money equivalent to the cost of services is determined according to the level of care required. The upper limits per month are 49 700 yen (552 US dollars ($) at an exchange rate of 90 yen to 1 US dollar) for rank 1; 104 000 yen ($1156) for rank 2; 165 800 yen ($1842) for rank 3; 194 800 yen ($2164) for rank 4; 267 500 yen ($2972) for rank 5; 306 000 yen ($3400) for rank 6 and 358 300 yen ($3981) for rank 7, respectively. The benefits in kind are provided as home- and community-based services, such as home help, visiting nurse, day services and group home service, or as institutional services, such as long-term care welfare facilities, health facilities and medical facilities. The charges for each service are uniform throughout Japan. People using care services usually ask their certified care manager to draw up a care plan (Fig. 1).

Statistical analysis

All data are presented as mean ± standard deviation (SD). Student's *t*-tests were used to assess differences between group means for continuous variables. Pearson's χ^2-tests were used to assess differences between groups for categorical variables. Because of the small sample size, patients in care ranks 1 and 2, and those in care ranks 6 and 7 were combined for analysis. One-way analysis of variance (ANOVA) was used to analyze differences between groups. Post-hoc comparisons were made using the Tukey–Kramer test. Finally, a multiple regression analyses was carried out with care rank as the dependent variable, and age, education, sex, MMSE score, grip strength and TUG score as independent variables.

Results

Demographic information and basic characteristics of participants are shown in Table 1. No significant differences were found in age, education or sex among the diagnostic entities. There were, however, significant differences in MMSE score between AD and MCI. There were no statistical differences in TUG or grip strength among the groups. In DLB patients, the mean of MMSE score was higher than that in AD, but the frailty indices were worse than in AD. When MMSE scores were divided by the reciprocal of TUG and compared between diagnoses, significant differences were apparent among the groups ($F = 6.577$, $P < 0.001$). This modified score was significantly higher in DLB than in AD (AD 250.2 ± 110.5, DLB 404.3 ± 245.7,

Table 1 Demographic information and basic characteristics of participants

n	Total 201	AD 144	MCI 22	MIX 10	VD 9	DLB 13	Other 3
Age (years)							
Mean (SD)	78.7 (7.0)	78.9 (7.3)	77.7 (5.7)	78.9 (7.5)	80.6 (6.6)	79.3 (5.2)	69.0 (1.7)
Sex							
Female	132	96	15	5	5	11	0
Male	69	48	7	5	4	2	3
MMSE*							
Female (%)	65.7	66.7	68.2	50.0	55.6	84.6	0.0
Mean (SD)	19.7 (6.1)	18.0 (5.8)	26.7 (1.5)	21.0 (2.6)	23.6 (2.4)	22.2 (6.2)	18.0 (8.7)
TUG (s)							
Mean (SD)	14.4 (6.4)	14.6 (6.6)	12.0 (4.1)	13.9 (2.9)	15.4 (5.3)	17.1 (9.0)	9.3 (2.2)
Grip strength (kg)							
Mean (SD)	16.9 (7.5)	16.7 (7.7)	19.1 (9.0)	16.8 (5.9)	16.9 (6.6)	13.9 (4.6)	20.7 (3.1)
BMI* (kg/m^2)							
Mean (SD)	22.4 (3.5)	22.1 (3.5)	22.5 (2.8)	24.9 (4.0)	25.0 (1.9)	22.0 (3.2)	20.4 (4.0)
Waist circumference* (cm)							
Mean (SD)	84.1 (9.0)	83.1 (9.3)	85.1 (7.0)	89.5 (10.8)	89.5 (5.0)	83.4 (6.6)	92.7 (6.6)
Living arrangement							
Living alone	33	20	7	1	1	4	0
Other	168	124	15	9	8	9	3
Living alone (%)	16.4	13.9	31.8	10.0	11.1	30.8	0.0
Care rank*							
Mean (SD)	2.4 (2.1)	2.6 (2.1)	0.4 (0.8)	2.8 (1.5)	2.7 (2.3)	3.5 (1.5)	1.7 (2.1)

*$P < 0.05$ P values were calculated by one-way ANOVA and χ^2-test. AD, Alzheimer's disease; BMI, body mass index; DLB, dementia with Lewy bodies; MCI, mild cognitive impairment; MIX, mixed type dementia; MMSE, Mini-Mental State Examination; TUG, Timed Up & Go; VD, vascular dementia.

MCI 321.1 ± 107.7, MIX 289.4 ± 79.2 and VD 359.2 ± 107.5). Although there were significant differences in BMI and waist circumferences among disease groups, with both indices being higher in VD and MIX, post-hoc analysis failed to find a significant difference between specific groups. The percentage of elderly people living alone did not vary among the groups. Care rank in MCI was lower than in the other groups.

A total of 70 patients had not applied for LTCIP certification (rank 0). When patients were divided according to care rank (Table 2), there was no overall tendency for increased age to be associated with higher care rank, although patients in ranks 3, 4 and 5 were significantly older than patients in care rank 0. There was a clear tendency that the higher the care rank, the worse the MMSE score and frailty indices, with the exception of MMSE scores from care ranks 0 to 3. Neither waist circumference nor BMI differed among care ranks. The percentage of patients living alone differed significantly according to care rank; beyond rank 4, very few patients lived alone. In contrast, there were also fewer patients in rank 0 who lived alone. When ranks 0, 1–2 and 3 were analyzed separately, patients in rank 0 were younger and less likely to live alone than those in rank 3 (data not shown), although they had similar levels of cognitive impairment (Table 2).

Finally, we analyzed factors that correlated with care rank by multiple regression analysis. In this analysis, patients in rank 0 were excluded, as this rank was related to non-cognitive and non-physical factors (age and living arrangement), as described earlier. The analysis showed that MMSE, grip strength and living arrangement were independent predictors of care rank (Table 3).

Discussion

In the present report, we presented the distribution of care ranks determined according to the Japanese LTCIP certification in outpatients of a memory clinic, and the relationship between these ranks and conventional indices of cognition and frailty. Although LTCIP certification is carried out through a complex comprehensive assessment system consisting of two independent pathways, one by a certified assessor and one by an attending physician,[5,6] the present results showed a strong correlation between the results of this

Table 2 Relationship between care ranks and clinical and demographic variables

Care rank	0	1–2	3	4	5	6–7	*P*-value
n	70	18	48	31	22	12	
Age (years)							
Mean (SD)	75.3 (6.8)	79.8 (4.7)	80.1* (6.1)	79.6* (7.1)	83.5* (5.8)	80.5 (6.7)	<0.001
Sex							
Female	41	11	35	21	14	10	0.466$
Male	29	7	13	10	8	2	
Female (%)	58.6	61.1	72.9	67.7	63.6	70.6	
MMSE							
Mean (SD)	21.9 (4.9)	23.1 (3.3)	21.1 (4.1)	17.4*†‡ (5.6)	14.1*†‡ (6.6)	8.6*†‡§ (4.2)	<0.001
TUG (s)							
Mean (SD)	12.2 (5.0)	13.2 (4.7)	14.3 (5.7)	16.4* (8.0)	17.6* (6.8)	21.9*†‡ (7.6)	<0.001
Grip strength (kg)							
Mean (SD)	20.3 (8.2)	18.8 (6.9)	15.7* (6.8)	14.1* (4.5)	12.7* (5.5)	9.6*† (5.8)	<0.001
BMI (kg/m2)							
Mean (SD)	22.8 (3.3)	22.0 (3.9)	22.2 (3.8)	22.5 (3.3)	21.7 (3.2)	21.9 (3.7)	0.806
Waist circumference (cm)							
Mean (SD)	84.2 (7.7)	87.3 (11.4)	83.5 (10.3)	83.9 (8.4)	82.8 (7.0)	82.8 (12.6)	0.681
Living arrangement							
Living alone	7	7	15	3	0	1	<0.001$
Other	63	11	33	28	22	11	
Living alone (%)	10	38.9	31.3	9.7	0	8.3	

*$P < 0.05$ versus 0, †$P < 0.05$ versus 1–2, ‡$P < 0.05$ versus 3, §$P < 0.05$ versus 4. *P*-value was calculated by one-way ANOVA and χ^2-test ($). BMI, body mass index; MMSE, Mini-Mental State Examination; TUG, Timed Up & Go.

Table 3 Factors correlated with care rank on multiple regression analysis

Independent variable	Care rank ($R^2 = 0.41$) β	*P*
Age (years)	−0.09	0.324
Sex (male)	0.05	0.624
Education (years)	0.06	0.465
MMSE score	−0.49	0.001
Grip strength (kg)	−0.27	0.005
TUG (s)	0.14	0.105
Living alone	−0.18	0.03

β, Standard partial regression coefficient; MMSE, Mini-Mental State Examination; TUG, Timed Up & Go.

assessment expressed as care rank and simple conventional indices. As those with dementia and related disorders are the largest population requiring care, this simple assumption could be beneficial for daily clinical practice and also useful in comparing care assurance systems among countries. We found specific tendencies among disease groups. DLB patients were frailer and had higher care ranks despite a smaller decline in cognitive function as measured by MMSE score than AD patients. DLB patients might be frailer than AD patients, because DLB often accompanies Parkinsonism. Another explanation is that disability of DLB patients might not be highly associated with MMSE. A recent report shows relative preservation of MMSE scores in DLB patients despite overall severity of the disease.[19] MCI patients showed, as expected, better cognitive and physical function concomitant with a lower care rank when compared with dementia patients.

Most developed countries have introduced care assurance systems, although these systems differ significantly among countries because of factors including their history, nationality, culture and economic status. Countries differ in many aspects, including assessment systems, check-points for assessment, people responsible for assessment, number of levels of care required, source of funding (tax or insurance), severity of condition for those certified to receive care, how patients with dementia are taken into account, methods of care supply (in-kind, cash or personal budget), existence of a care management system and types of care services provided.[3,4] Although it is difficult to determine which care system is more appropriate in each country, it is essential to know the relationship between fundamental abilities of patients and possible care supply in order to carry out international comparisons of the care supply to dementia patients.

In the present study, we used MMSE as the index of cognitive function, because it is a widely used cognitive assessment tool worldwide and is easy to administer.[16] We used TUG and grip strength as the indices of frailty, because these assessment tools are simple and often used for assessment.[17,18] The present results showed that the higher the level of care required, the lower the MMSE, the longer the TUG and the weaker the grip strength. Intriguingly, these results are in line with recent reports that both cognitive function and frailty are intimately related during the clinical course of dementia.[20–24] There might be several reasons why TUG was not significantly associated with care ranks in the present multiple regression analysis. First, as there are few patients in the present study cohort who suffer from gait disturbance as a result of hemiparesis or musculoskeletal disease, which are popular causes of dependency, TUG might not have been related to care ranks in our analysis. Second, because TUG is a complex marker affected by not only muscle weakness, but also balance and executive functions, sarcopenia as represented by grip strength might be more important to determine care ranks in cognitively impaired elderly patients. Third, we might not have had a sufficient power to detect the significance of TUG in the present cohort.

When we look more closely at the results, the correlation between care levels as certified by the LTCIP and simple indices of cognition and frailty was not clear from ranks 0 to 3, although it was apparent at the care needs level (ranks 3–7). Instead, the present data suggest that age and living arrangement have a significant effect on patients in care ranks 0–3. As far as we know, there are no reports showing that younger dementia patients are more reluctant to use care services than older patients. However, in the future, it should be considered whether younger dementia patients might be reluctant to use care services or whether the actual contents of these care services do not match their needs. It is also important to think about living arrangements. In the current series, only one patient who lived alone had a care rank beyond 4, suggesting that dementia patients with higher care needs find it difficult to live alone. In contrast, people in the lowest level, rank 0, were also less likely to live alone than those in other ranks. These patients were those who had not applied for certification, irrespective of their cognitive and physical abilities, and a significant proportion of such patients would have been provided care by informal caregivers. In the Japanese LTCIP, all care services are in kind and cash payments do not occur. Future studies must therefore consider how to estimate the contribution of informal caregivers.[25,26]

The following limitations were recognized. We did not assess ADL and IADL of patients, and because these factors might be related to cognitive and physical abilities, direct assessment would provide more information for analysis. We also did not assess BPSD despite the fact that this is included in the first stage assessment of care level certification and should accordingly have a certain effect on care need.[5,6] Although the patients in the present study were treated appropriately in terms of BPSD, including an assessment of BPSD would give more information to construct simple explanatory models of care ranks. Finally, this was a cross-sectional study of outpatients of one memory clinic. A further multicenter study is required to confirm the results obtained.

As the number of dementia patients is anticipated to increase dramatically, it is important to establish social support systems in all countries. What kinds of services and what extent of such services are required for dementia patients in various stages of the disease? How much are we prepared to pay for providing these services? To consider these issues, international comparisons are necessary. Despite the influence of age and living arrangements, the present correlations between certified care levels, which reflect appropriate available benefits, with simple cognitive and physical parameters could contribute to international comparisons and to improvement of care systems.

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Disclosure statement

None of the authors have a personal or financial conflict of interest with regard to this manuscript.

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