24. Ministry of Health Labour and Welfare. Specific Health Checkups and Specific Health Guidance [cited 2015 April, 19]. Available: http://www.mhlw.go.jp/english/wp/wp-hw3/dl/2-007.pdf.

25. Nguyen ND, Pongchaiyakul C, Center JR, Eisman JA, Nguyen TV. Identification of high-risk individuals for hip fracture: a 14-year prospective study. J Bone Miner Res. 2005; 20:1921–8. PubMed PMID: 16234964.

26. Waterloo S, Nguyen T, Ahmed LA, Center JR, Morseth B, Nguyen ND, et al. Important risk factors and attributable risk of vertebral fractures in the population-based Tromso study. BMC Musculoskelet Disord. 2012; 13:163. PMID: 22935050. doi: 10.1186/1471-2474-13-163

27. Schoeni RF, Liang J, Bennett J, Sugisawa H, Fukaya T, Kobayashi E. Trends in old-age functioning and disability in Japan, 1993–2002. Popul Stud (Camb). 2006; 60:39–53. PMID: 16464774.

28. Barnett K, Mercer SW, Norbury M, Watt G, Wyke S, Guthrie B. Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. Lancet. 2012. PMID: 22579043. doi: 10.1016/S2213-2600(12)70053-X

a preliminary report. *Psychogeriatrics* 2012; **12**: 120–123.
5 Furukawa K, Ootsuki M, Kodama M, Arai H. Exacerbation of dementia after the earthquake and tsunami in Japan. *J Neurol* 2012; **259**: 1243.
6 Furukawa K, Ootsuki M, Nitta A, Okinaga S, Kodama M, Arai H. Aggravation of Alzheimer's disease symptoms after the earthquake in Japan: a comparative analysis of subcategories. *Geriatr Gerontol Int* 2013; **13**: 1081–1082.

Development of conversion formulae between 4-m, 5-m and 6-m gait speed

Dear Editor,

Physical performance is considered an essential component of the definition of sarcopenia and its diagnostic strategy.[1] Recently, the Asian Working Group on Sarcopenia has recommended that 6-m usual gait speed be used for measurement of physical performance.[2,3] Unfortunately, the measurement method of usual gait speed varies considerably by study, minimizing the ability to generalize the study findings. In Japan, 5-m gait speed has been used in several major cohort studies in the elderly.[4–6] In the present study, we aimed to develop conversion formulae between 6-m and 5-m gait speed.

Data were taken from the second year examinations of the Kashiwa study. Briefly, the Kashiwa study is a prospective cohort study on community-dwelling, functionally independent adults aged 65 years or older living in Kashiwa, Chiba, Japan, and the second year examination was conducted between September and November 2013.[5] All 1529 participants who underwent gait speed measurements were included in the analysis (782 men, 747 women). Gait speed measurements were conducted by instructing participants to walk over an 11-m straight course on a flat floor at their usual speed, during which the time was measured for both a 5-m walk (from 3-m to 8-m line) and 4-m walk (from the starting line to 4-m line) during one walk. Gait speed for both measurements was calculated in m/s. The correlation between these two measurements was 0.82.

The non-parametric locally weighted scatter plot smoothing (LOESS) method showed that the relationship between 4-m gait speed and 5-m gait speed was piecewise linear with an inflection point (change of slope) at a 5-m usual gait speed of 1.6 m/s. The piecewise linear model had better fit than a simple linear model, and the change of slope was statistically significant ($P < 0.001$). We also tested if the relationship between 4-m gait speed and 5-m gait speed was modified by sex, but the modification effect was not statistically significant ($P = 0.22$). All analyses were conducted using SAS version 9.3 (SAS Institute, Cary, NC, USA).

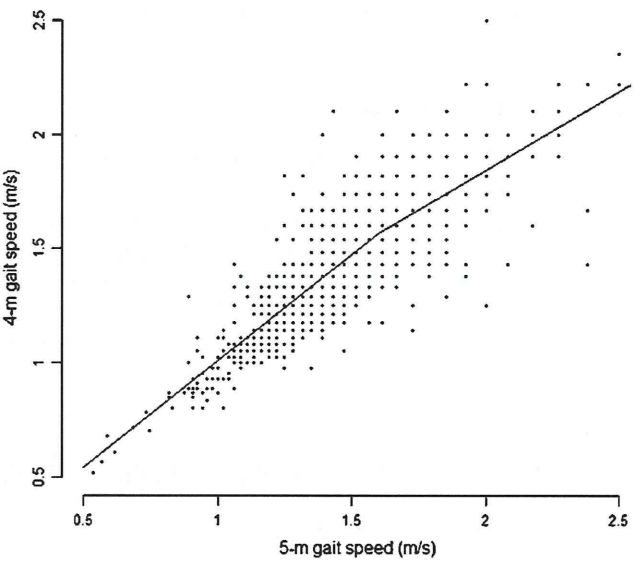

Figure 1 Scatter plot for 4-m gait speed and 5-m gait speed, and fitted piecewise linear relationship.

Participant characteristics (mean ± standard deviation) were: age 73.9 ± 5.5 years, 5-m gait speed 1.52 ± 0.25 m/s and 4-m gait speed 1.48 ± 0.26 m/s. Piecewise linear regression showed that the following equations could be used to convert from 5-m to 4-m gait speed:

For 5-m gait speed ≤1.6 m/s:

$$\text{4-m gait speed} = 0.934 \times (\text{5-m gait speed}) + 0.074$$

For 5-m gait speed >1.6 m/s:

$$\text{4-m gait speed} = 0.69 \times (\text{5-m gait speed}) + 0.463$$

The scatter plot of 4-m and 5-m gait speed, and their piecewise linear relationship are shown in Figure 1. The $R^2 = 0.68$.

To convert to 6-m gait speed, we substituted the aforementioned equations for 4-m gait speed in the formula with the R^2 of 0.93 from a previous study on a

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cohort of 61 individuals,[7,8] and obtained the following conversion formulae.

For 5-m gait speed ≤ 1.6 m/s:

$$6\text{-m gait speed} = 0.951 \times (5\text{-m gait speed}) + 0.11$$

For 5-m gait speed > 1.6 m/s:

$$6\text{-m gait speed} = 0.703 \times (5\text{-m gait speed}) + 0.507$$

These formulae should be used with caution. The formulae were derived from data on functionally independent elderly, and might not be applicable to those with severe functional impairment. However, the conversion formulae for gait speed measurements developed in the present study would help interpret findings on gait speed and sarcopenia from studies on a similar population.

Disclosure statement

No potential conflicts of interest were disclosed.

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References

1 Cruz-Jentoft AJ, Baeyens JP, Bauer JM *et al.* Sarcopenia: European consensus on definition and diagnosis: Report of the European Working Group on Sarcopenia in Older People. *Age Ageing* 2010; **39**: 412–423.
2 Chen LK, Liu LK, Woo J *et al.* Sarcopenia in Asia: consensus report of the Asian Working Group for Sarcopenia. *J Am Med Dir Assoc* 2014; **15**: 95–101.
3 Arai H, Akishita M, Chen LK. Growing research on sarcopenia in Asia. *Geriatr Gerontol Int* 2014; **14** (Suppl 1): 1–7.
4 Tanimoto Y, Watanabe M, Sun W *et al.* Association of sarcopenia with functional decline in community-dwelling elderly subjects in Japan. *Geriatr Gerontol Int* 2013; **13**: 958–963.
5 Ishii S, Tanaka T, Shibasaki K *et al.* Development of a simple screening test for sarcopenia in older adults. *Geriatr Gerontol Int* 2014; **14** (Suppl 1): 93–101.
6 Shinkai S, Watanabe S, Kumagai S *et al.* Walking speed as a good predictor for the onset of functional dependence in a Japanese rural community population. *Age Ageing* 2000; **29**: 441–446.
7 Guralnik JM, Ferrucci L, Pieper CF *et al.* Lower extremity function and subsequent disability: consistency across studies, predictive models, and value of gait speed alone compared with the short physical performance battery. *J Gerontol A Biol Sci Med Sci* 2000; **55**: M221–M231.
8 Studenski S, Perera S, Patel K *et al.* Gait speed and survival in older adults. *JAMA* 2011; **305**: 50–58.

Predictors of death among nursing home patients: A 5-year prospective study

Dear Editor,

Several studies have assessed which factors could predict mortality in nursing home patients.[1–3] These predictors could help the identification of modifiable factors, discussion of prognosis and goals of long-term care.[4]

Within this context, Thomas *et al.* carried out a recent systematic review, and found that the domains most frequently associated with nursing care mortality were nutrition, physical function, shortness of breath and disease diagnosis.[1]

However, most studies in this area are centered in the USA and Europe. Therefore, assessing mortality risk factors among long-term care in other social, economic and cultural contexts are important to provide further evidence to this field of research. The present study aimed to evaluate the survival rate of Brazilian nursing home patients up to 5 years and to identify factors associated with their mortality.

This was a 5-year prospective study of residents living in a Brazilian nursing home. Participants were evaluated by a geriatrician who assessed the following aspects: sociodemographic data, functional capacity (Katz index),[5] comorbidities, drugs in use, time of institutionalization, number of drugs, number of diagnosis and 5-year-mortality.

We used the Mann–Whitney test (continuous) and χ^2-test (categorical) to compare patients who died or survived in the 5 years (Table 1). Then, a backward logistic regression on 5-year mortality was carried out using SPSS 17.0 (SPSS, Chicago, IL, USA), including mortality as the dependent variable and all other variables as independent variables (sex, age, hypertension, diabetes, hyperlipidemia, dementia, stroke sequelae, depression, cardiovascular diseases, anemia, cancer, other neurological disorders, dependency, number of medications, number of diagnoses). Goodness of fit was evaluated by the Hosmer–Lemeshow test. A *P*-value of 0.05 was used to define statistical significance.

applicable to all disaster areas, the interindividual differences in amount of physical activity might have been related to whether or not they were involved in community activities or evacuation activities in the acute period of the earthquake.

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Disclosure statement

The authors declare no conflict of interest.

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COMMENTS

Re: Growing research on sarcopenia in Asia

Dear Editor,

The Editorial by Arai *et al.*[1] signifies a major advance in sarcopenia research in Asia, and the members of the Asian Working Group for Sarcopenia (AWGS) should be praised for their attempt to develop an Asian consensus on sarcopenia diagnosis. The Asian consensus put forth by AWGS is similar to the European consensus by the European Working Group on Sarcopenia in Older People (EWGSOP),[2] and requires the measurement of muscle strength (handgrip strength) and physical performance (usual gait speed) in addition to muscle mass for the diagnosis of sarcopenia, but differs in some important ways.[3] One of the important differences is that AWGS suggests cut-off values for each of these three components, whereas EWGSOP proposes a cut-off value for usual gait speed only. However, AWGS also allows the use of a young reference group or the lowest quintile of sample distribution in each study to determine country- or study-specific cut-off values for grip strength and muscle mass.[3] This approach is prudent and appropriate in my view, considering the large heterogeneity of Asian countries and scarcity of outcome-oriented studies in Asia.

In contrast, AWGS proposes a single cut-off value for usual gait speed, 0.8 m/s. Gait speed is affected by muscle strength and body composition,[4,5] but there appears to be cross-national differences in gait speed beyond the

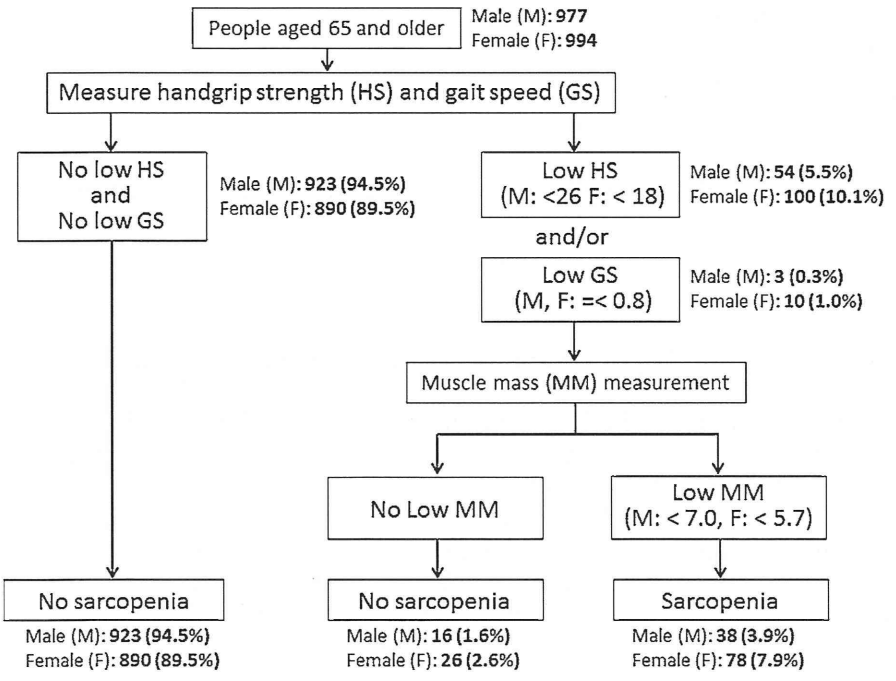

Figure 1 Prevalence of sarcopenia, low muscle mass, low gait speed and low grip strength according to the recommended diagnostic algorithm of the Asian Working Group for Sarcopenia. GS, gait speed; HS, handgrip strength; MM, muscle mass.

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influences of muscle strength and body composition.[6] Therefore, the proposed cut-off value, 0.8 m/s, might portend different outcomes in different countries.

We are carrying out a longitudinal observational study of community-dwelling, functionally independent adults aged 65 years or older in Kashiwa, Chiba, Japan.[7] Among 1971 study participants (977 men, 994 women, mean age 72.9 years), just 0.3% of men and 1.0% of women had usual gait speed <0.8 m/s, indicating a relatively low prevalence of sarcopenia (Fig. 1). The prevalence of sarcopenia would be 4.8% in men and 8.9% in women using 1.0 m/s as the cut-off value for usual gait speed. This finding suggests that a cut-off value higher than 0.8 m/s might be more appropriate for Japanese older adults. Our study sample was randomly selected using the resident register, and other studies in Japan reported similar gait speed in older adults, supporting the validity of our data.[8–10]

It is an arduous task to develop an Asian consensus for sarcopenia, and we understand there is a compelling need to establish uniform cut-off values to increase the ability to generalize study findings. However, failure to acknowledge cross-national heterogeneity and proposing a single cut-off value could lead to inaccurate estimation of sarcopenia prevalence and misleading results. Therefore, we consider that the cut-off value for usual gait speed should be study- or country-specific, until future studies prove that a uniform cut-off value is applicable regardless of country.

Disclosure statement

No potential conflicts of interest were disclosed.

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References

1 Arai H, Akishita M, Chen LK. Growing research on sarcopenia in Asia. *Geriatr Gerontol Int* 2014; **14** (Suppl 1): 1–7.
2 Cruz-Jentoft AJ, Baeyens JP, Bauer JM *et al.* Sarcopenia: European consensus on definition and diagnosis: report of the European Working Group on Sarcopenia in Older People. *Age Ageing* 2010; **39**: 412–423.
3 Chen LK, Liu LK, Woo J *et al.* Sarcopenia in Asia: consensus report of the Asian Working Group for Sarcopenia. *J Am Med Dir Assoc* 2014; **15**: 95–101.
4 Buchner DM, Larson EB, Wagner EH, Koepsell TD, de Lateur BJ. Evidence for a non-linear relationship between leg strength and gait speed. *Age Ageing* 1996; **25**: 386–391.
5 Bohannon RW. Comfortable and maximum walking speed of adults aged 20–79 years: reference values and determinants. *Age Ageing* 1997; **26**: 15–19.
6 Capistrant BD, Glymour MM, Berkman LF. Assessing mobility difficulties for cross-national comparisons: results from the world health organization study on global ageing and adult health. *J Am Geriatr Soc* 2014; **62**: 329–35.
7 Ishii S, Tanaka T, Shibasaki K *et al.* Development of a simple screening test for sarcopenia in older adults. *Geriatr Gerontol Int* 2014; **14** (Suppl 1): 93–101.
8 Yamada Y, Matsuda K, Bjorkman MP, Kimura M. Application of segmental bioelectrical impedance spectroscopy to the assessment of skeletal muscle cell mass in elderly men. *Geriatr Gerontol Int* 2014; **14** (Suppl 1): 129–134.
9 Tanimoto Y, Watanabe M, Sun W *et al.* Association of sarcopenia with functional decline in community-dwelling elderly subjects in Japan. *Geriatr Gerontol Int* 2013; **13**: 958–963.
10 Yamada M, Nishiguchi S, Fukutani N *et al.* Prevalence of sarcopenia in community-dwelling Japanese older adults. *J Am Med Dir Assoc* 2013; **14**: 911–915.

Small Group Teaching in a psychiatric hospital for dementia patients

Dear Editor,

In Japan, the cost of dementia, including the cost of care, is estimated to become approximately two- to threefold that of cancer or other major diseases within the next 30 years.[1] Therefore, dementia is the most important illness to teach medical students about in geriatric medicine. From April 2011 to March 2014, fifth grade medical students of Tohoku University Medical School, approximately 100 students per year, visited Sendai Tomizawa Hospital, a psychiatric hospital for dementia patients, for Small Group Teaching (SGT). SGT, groups of five or six students, took place on Thursday afternoon every 2 weeks as part of the geriatric medical training.

From noon to 12.30 PM, lecturers asked the students of their impressions of geriatric medicine during lunchtime. From 12.30 PM to 1.10 PM, an introductory lecture titled "Hybrid therapy for dementia", which means combinational therapy of medicine and care, took place.

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Original Study

Eating Alone as Social Disengagement is Strongly Associated With Depressive Symptoms in Japanese Community-Dwelling Older Adults

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Keywords:
Eating alone
depressive symptoms
social engagement

A B S T R A C T

Objectives: Depression in later life poses a grave challenge for the aging countries. The reported key risk factors include social disengagement, but the lack of social companionship during mealtimes, namely eating alone, has not been examined extensively, especially in relation to living arrangement. Past studies on changes along geriatric trajectories in the association between social engagement and depression also remain inadequate. This study aims to examine the association between social engagement and depressive symptoms with a particular focus on eating alone and how the association changes along the aging and mental frailty trajectories.
Design: A cross-sectional study.
Setting: Kashiwa-city, Chiba-prefecture in Japan.
Participants: A total of 1856 community-dwelling older adults.
Measurements: The 15-item Geriatric Depression Scale was used to measure depressive symptoms. The indicators used to assess social engagement included eating alone, living arrangement, reciprocity of social support, social participation, social stressors and social ties.
Results: Social engagement was significantly associated with depressive symptoms. Those who live with their families yet eat alone were found to be at particular risk (odds ratio = 5.02, 95% confidence interval 2.5–9.9 for young-old; odds ratio = 2.41, 95% confidence interval 1.2–4.8 for old-old). Younger and less mentally frail populations showed stronger associations.
Conclusions: Eating alone was a key risk factor for depressive symptoms in community-dwelling older adults. The living arrangement in which they eat alone is important in identifying those with the greatest risk. Mental health management for older adults requires comprehensive assessment of their social relations that takes into account their companionship during mealtimes. Social preventive measures need to involve early interventions in order to augment their effectiveness against mental frailty.

The problem of depression in later life has become a pressing global concern, as the population aging continues worldwide.[1] It undermines well-being and quality of life while adding to healthcare costs, with potential consequences on a wide range of health outcomes.[2] The problem poses a grave socioeconomic burden on aging countries, not least in Japan where the unprecedented level of aging threatens to undermine its social security system.[3] The prevalence of

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depression among community-dwelling older adults varies enormously and has been reported to be as high as 35%.[4]

The key reported predictors of depressive symptoms include female gender, cognitive and functional impairments, medical disorders, low level of education, and social disengagement.[1,5–10] Social engagement is an "umbrella concept for the various components of an individual's social behavior and social structure"[11] and its different aspects have consistently been found to predict mortality, disease outcomes, disability, cognitive decline as well as depressive symptoms.[12–16] While the conceptualization of social engagement lacks a strong consensus,[17] this should not be viewed as a weakness but as an invitation to explore its unexamined aspects in a search for the most relevant screening questions to identify older adults at risk.[11] This study, thus, aims to examine new concepts and ideas that remain under-explored, especially in relation to depression.

One such aspect is the social behavior during mealtimes. Commensality (ie, the act of eating with others) provides opportunities for social interactions and exchange of information and support by facilitating participation in shared social activities of mealtimes.[18] Eating alone deprives older adults such valuable social opportunities. Eating alone has been studied in relation to dietary intake, but research in relation to depression and wider health outcomes remains limited.[19] To our knowledge, none has examined its association with depression in combination with other components of social engagement nor investigated it in relation to the living arrangement. Living alone is often cited as a key risk factor for older adults, as does the Ministry of Health, Labor and Welfare, Japan, but eating alone is rarely discussed. A shared living arrangement may result in increased opportunities for commensality, but does not guarantee it,[18,19] requiring independent considerations.

Furthermore, past studies have not adequately examined how the association between social engagement and depression changes along geriatric trajectories such as aging and frailty. Frailty is not only a physical but a multidimensional concept,[20] and mental frailty, one important dimension, may manifest as depressive states. The role of social engagement vis-à-vis depression is expected to change as older adults age or become more mentally frail, influencing the effectiveness of social intervention measures.

The purpose of the present study is 2-fold. The first objective is to examine whether social engagement is associated with depressive symptoms with a particular focus on eating alone and its relation to the living arrangement. Second, effects of geriatric trajectories, namely aging and mental frailty trajectory on the above association, are examined in order to better identify the most effective social intervention sites for depressive symptoms.

Methods

Study Design

The study was cross-sectional.

Setting and Participants

This study was based on data from 1856 randomly selected community-dwelling older adults (independent or those requiring support), aged 65–94, who participated in the first year health assessment of a 3-year cohort study between 2012 and 2014 in Kashiwa city, Japan. A total of 2044 persons participated in the assessment and 188 persons were excluded due to missing items of data.

Measurements

Depressive symptoms

The 15-item Geriatric Depression Scale (GDS) was used. Scores of ≥6 were defined as "depressive symptoms,"[21] 6–9 as "mild depression," and ≥10 as "severe depression."[4]

Social engagement

Seven components were assessed: (1) living arrangement; (2) eating arrangement; (3) reciprocal social support; (4) social participation; (5) social stressors; (6) social ties with family; and (7) social ties with friends. The following questions were asked regarding each item: (1) Do you live with your family: yes or no? (No = living alone); (2) Do you eat your meals with anyone else, at least once a day: yes or no? (No = eating alone); (3) Do you give advice and a helping hand to your family or friends: yes or no? (No = low reciprocal social support); (4) Are you going out less frequently compared to last year: yes or no? (The Kihon Check List, Ministry of Health, Labor and Welfare) (No = fewer frequency of going out); and (5) Did you experience any major changes in life in the past year, such as moving home, retirement, loss of relatives, financial troubles, troubles in the relationships with people: yes or no? (Yes = major change in life). For (6) and (7), the abbreviated Lubben Social Network Scale-6 and its Family and Friends subscales[22,23] were used. Living arrangement and eating arrangement were crossed to construct 4 dummy variables: "living and eating alone," "living alone yet eating with others," "living with others yet eating alone," and "living and eating with others" (reference).

Sociodemographic variables

Age and the years of education were included in the analysis as continuous variables. Health literacy was measured by 5 items developed for Japanese persons.[24] Information on economic status was obtained as income ranking based on long-term care insurance premiums. Logistic regression was performed with the income ranking and depressive symptoms as the independent and dependent variables, respectively. The odds ratios were plotted to observe changes in the trend and those with less than 1.4 million Japanese Yen per person were categorized as the "low income" group.

Medical histories

Medical histories of hypertension, osteoporosis, cerebrovascular diseases, diabetes, heart diseases, and malignant neoplasm were obtained through medical interviews by nurses.

Number of medications

The total number of oral medications was recorded as a continuous variable, as polypharmacy is known to be associated with increased depressive symptoms.[25]

Physical health and functions

Instrumental activities of daily living (IADL) was measured using the Tokyo Metropolitan Institute of Gerontology index of competence.[26] Mobility was assessed by Life-Space Assessment,[27,28] measured with the Elderly-Status Assessment Set.[29,30] The highest level of life-spaces (level 5) was used. To assess usual and maximum gait speeds, participants were instructed to walk over an 11-m course and the time spent in the middle 5 m was recorded.[31]

Cognitive function

The Mini-Mental State Examination was used, and its score was included in the analysis as a continuous variable.

Oral health and functions

The Japanese version of the General Oral Health Assessment Index (GOHAI)[32,33] was used to measure the oral health-related quality of

Table 1
Geriatric Characteristics of Normal (Nondepressed) and Depressed Study Participants* (n = 1856)

Variables	Young-Old (65–74 Years Old)			Old-Old (≥75 Years Old)		
	Normal (n = 1033)	Depressive Symptoms (n = 168)		Normal (n = 551)	Depressive Symptoms (n = 104)	
	Mean ± SD or n (%)		*P* Value	Mean ± SD or n (%)		*P* Value
Sociodemographic variables						
Sex (male)	519 (50.2)	71 (42.3)	.055	282 (51.2)	56 (53.8)	.618
Age	69.6 ± 2.7	69.6 ± 2.6	.969	79.0 ± 3.7	79.4 ± 4.0	.294
Education (years)	13.0 ± 2.5	12.6 ± 2.6	.089	12.4 ± 3.1	11.7 ± 3.3	.056
Health literacy	4.03 ± 0.61	3.71 ± 0.67	<.001	4.07 ± 0.60	3.64 ± 0.70	<.001
Low income	598 (57.9)	126 (75.0)	<.001	293 (53.2)	62 (59.6)	.227
Social engagement						
Living alone	77 (7.5)	20 (11.9)	.050	84 (15.2)	15 (14.4)	.830
Eating alone	91 (8.8)	42 (25.0)	<.001	104 (18.9)	34 (32.7)	.002
Living and eating with others	929 (89.9)	124 (73.8)	<.001	428 (77.7)	68 (65.4)	.007
Living and eating alone	64 (6.2)	18 (10.7)	.031	65 (11.8)	13 (12.5)	.839
Living alone yet eating with others	13 (1.3)	2 (1.2)	1.000	19 (3.4)	2 (1.9)	.555
Living with others yet eating alone	27 (2.6)	24 (14.3)	<.001	39 (7.1)	21 (20.2)	<.001
Low reciprocal social support	45 (4.4)	29 (17.3)	<.001	34 (6.2)	18 (17.3)	<.001
Fewer frequency of going out	127 (12.3)	65 (38.7)	<.001	107 (19.4)	47 (45.2)	<.001
Major change in life	225 (21.8)	62 (36.9)	<.001	85 (15.4)	28 (26.9)	.004
Social ties with family	8.33 ± 3.1	6.58 ± 3.1	<.001	8.21 ± 3.2	6.91 ± 3.0	<.001
Social ties with friends	8.43 ± 3.5	6.23 ± 3.4	<.001	8.43 ± 3.6	6.30 ± 3.4	<.001
Medical histories						
Hypertension	388 (37.6)	78 (46.4)	.029	270 (49.0)	69 (66.3)	.001
Cerebrovascular diseases	36 (3.5)	16 (9.5)	<.001	47 (8.5)	13 (12.5)	.198
Diabetes	116 (11.2)	17 (10.1)	.671	68 (12.3)	14 (13.5)	.752
Osteoporosis	77 (7.5)	21 (12.5)	.027	79 (14.3)	23 (22.1)	.045
Heart diseases	151 (14.6)	28 (16.7)	.489	111 (20.1)	32 (30.8)	.016
Malignant neoplasm	152 (14.7)	16 (9.5)	.072	92 (16.7)	23 (22.1)	.183
Number of medications	2.21 ± 2.5	2.85 ± 2.9	.008	3.80 ± 3.3	5.72 ± 3.9	<.001
Physical health and functions						
IADL	4.90 ± 0.36	4.77 ± 0.63	.013	4.85 ± 0.50	4.61 ± 0.89	.007
Mobility	25.8 ± 9.8	21.1 ± 10	<.001	24.1 ± 9.9	20.9 ± 11	.003
Cognitive function: MMSE	28.5 ± 1.7	28.0 ± 1.9	.002	28.0 ± 1.9	27.3 ± 2.3	.006
Oral health and functions: GOHAI	55.8 ± 5.4	51.3 ± 7.1	<.001	54.5 ± 6.3	49.5 ± 8.9	<.001
Nutritional and dietary status						
BMI (kg/m^2)	23.0 ± 2.9	22.6 ± 3.0	.071	22.7 ± 3.1	22.6 ± 3.0	.625
Food variety	3.63 ± 2.0	3.04 ± 1.9	<.001	4.23 ± 2.1	3.72 ± 2.1	.021
MNA-SF	12.7 ± 1.3	12.1 ± 1.8	<.001	12.4 ± 1.5	11.8 ± 1.8	.004

BMI, body mass index; MMSE, Mini-Mental State Examination; SD, standard deviation.
*χ^2 test or Fisher exact test was used for categorical variables and nonpaired *t*-test was used for continuous variables.

life. Numbers of remaining teeth were counted by dental hygienists. Occlusal force was assessed by Dental Prescale (Fujifilm, Shizuoka-prefecture, Japan).

Nutritional and dietary status

BMI was calculated by dividing the weight by the square of height. Food variety score was calculated from a 10-item questionnaire.[34] Nutritional status was assessed by Mini-Nutrition Assessment-Short Form (MNA-SF), with scores ≤ 11 indicating possible malnutrition.[35]

Statistical Analysis

Binomial multiple logistic regression analysis was performed with depressive symptoms as the dependent variable, stratified by the age groups (65–74 years old indicating "young-old" and ≥75 years old indicating "old-old"). Multinomial multiple logistic regression analysis was performed with different degrees of depressive states ("mild depression" and "severe depression") as the outcome. The characteristics of the 4 groups by eating and living arrangement were also compared, to explore the reasons behind their differing associations with depressive symptoms. For continuous variables only, multiple comparison test (Dunnett T3) was used to test whether there were significant differences between "living with others yet eating alone" and "living and eating with others." IBM SPSS statistics v 22 for Windows (IBM Japan, Tokyo, Japan) was used to perform statistical analysis. *P* value of <.05 was considered to indicate statistical significance.

Ethical Considerations

The study was approved by the Ethics Committee of the University of Tokyo. Data received for analysis had the participants' names substituted with ID numbers, and confidential information was excluded to ensure protection of personal information.

Results

Sample Characteristics

Of the total 1856 participants (928 male and 928 female, mean age was 72.9 ± 5.5 years), 1201 (64.7%) were young-old whereas 655 (35.3%) were old-old. Furthermore, 14.7% showed depressive symptoms (14.0% of young-old and 15.9% of old-old, 15.6% of women and 13.7% of men); 10.6% were living alone (8.1% of young-old and 15.1% of old-old, 15.4% of women and 5.7% of men); 14.6% were eating alone (11.1% of young-old and 21.1% of old-old, 17.9% of women and 11.3% of men); and 6.0% were eating alone despite living with family members (4.2% of young-old and 9.2% of old-old, 5.2% of women and 6.8% of men).

Table 2
Association Between Depressive Symptoms and Risk Factors by Binomial Multiple Logistic Regression

Variables	Young-Old (65–74 Years Old) (n = 1201)			
	Model 1		Model 2	
	OR (95% CI)	*P* Value	OR (95% CI)	*P* Value
Social engagement				
Living and eating with others (ref)	–		–	
Living and eating alone	1.94 (1.1–3.6)	.034	1.53 (0.79–2.9)	.204
Living alone yet eating with others	1.59 (0.32–7.9)	.569	1.14 (0.19–6.8)	.885
Living with others yet eating alone	6.33 (3.3–12)	<.001	5.02 (2.5–9.9)	<.001
Low reciprocal social support	2.57 (1.5–4.6)	.001	2.41 (1.3–4.5)	.006
Fewer frequency of going out	3.79 (2.6–5.6)	<.001	2.57 (1.7–3.9)	<.001
Major change in life	1.78 (1.2–2.6)	.004	1.72 (1.1–2.6)	.009
Social ties with family	0.901 (0.84–0.96)	.002	0.905 (0.84–0.97)	.005
Social ties with friends	0.911 (0.86–0.96)	.001	0.940 (0.88–1.0)	.049
Sociodemographic variables				
Sex (male)			1.29 (0.77–2.2)	.334
Health literacy			0.691 (0.52–0.93)	.013
Low income			1.77 (1.0–3.0)	.038
Medical histories				
Hypertension			1.17 (0.75–1.8)	.486
Cerebrovascular diseases			1.99 (0.89–4.4)	.094
Osteoporosis			1.38 (0.74–2.6)	.308
Number of medications			1.03 (0.96–1.1)	.402
Physical health and functions				
IADL			0.824 (0.54–1.3)	.369
Mobility			0.973 (0.96–0.99)	.007
Cognitive function: MMSE			1.04 (0.92–1.2)	.521
Oral health and functions: GOHAI			0.944 (0.92–0.97)	<.001
Nutritional and dietary status				
Food variety			0.929 (0.84–1.0)	.163
MNA-SF			0.870 (0.76–0.99)	.038
Variables	Old-Old (≥75 Years Old) (n = 655)			
	Model 1		Model 2	
	OR (95% CI)	*P* Value	OR (95% CI)	*P* Value
Social engagement				
Living and eating with others (ref)	–		–	
Living and eating alone	1.01 (0.51–2.0)	.968	1.06 (0.48–2.4)	.889
Living alone yet eating with others	0.753 (0.17–3.4)	.712	0.979 (0.19–5.0)	.980
Living with others yet eating alone	2.45 (1.3–4.7)	.006	2.41 (1.2–4.8)	.014
Low reciprocal social support	1.91 (0.95–3.9)	.071	1.04 (0.48–2.3)	.917
Fewer frequency of going out	2.97 (1.9–4.7)	<.001	2.09 (1.2–3.6)	.008
Major change in life	1.98 (1.2–3.4)	.012	2.18 (1.2–3.9)	.009
Social ties with family	0.981 (0.90–1.1)	.651	0.972 (0.89–1.1)	.548
Social ties with friends	0.880 (0.82–0.94)	<.001	0.895 (0.83–0.97)	.006
Sociodemographic variables				
Sex (male)			1.56 (0.88–2.8)	.126
Health literacy			0.499 (0.34–0.74)	<.001
Medical histories				
Hypertension			1.46 (0.83–2.6)	.185
Osteoporosis			1.27 (0.63–2.5)	.505
Heart diseases			1.21 (0.68–2.1)	.525
Number of medications			1.10 (1.0–1.2)	.010
Physical health and functions				
IADL			0.842 (0.59–1.2)	.340
Mobility			1.00 (0.98–1.0)	.990
Cognitive function: MMSE			0.919 (0.82–1.0)	.160
Oral health and functions: GOHAI			0.935 (0.90–0.97)	<.001
Nutritional and dietary status				
Food variety			0.982 (0.87–1.1)	.770
MNA-SF			0.929 (0.79–1.1)	.365

CI, confidence interval; MMSE, Mini-Mental State Examination; OR, odds ratio.
Model 1: social engagement.
Model 2: social engagement, sociodemographic variables, medical histories, number of medications, physical health and functions, cognitive function, oral health and functions, and nutritional and dietary status.

Social Engagement and Depressive Symptoms by Age Groups

Table 1 shows the comparison of the geriatric characteristics between normal and depressed participants for young-old and old-old, respectively. Based on this result, logistic regression was performed to identify the key risk factors for depressive symptoms (Table 2). The variables independently associated with depressive symptoms for both age-groups were "living with others yet eating alone," social participation (fewer frequency of going out), social stressors (major change in life), and social ties of friends, health literacy, and GOHAI. Those unique to young-old were low reciprocal social support, social ties with family, low income, mobility, and MNA-SF scores. Risk factor unique to old-old was the number of medications.

Table 3
Geriatric Characteristics of Normal, Mildly Depressed and Severely Depressed Participants* (n = 1856)

Variables	Normal (n = 1584)	Mild Depression (n = 193)	Severe Depression (n = 79)	*P* Value
	Mean ± SD or n (%)			
Sociodemographic variables				
Sex (male)	801 (50.6)	84 (43.5)	43 (54.4)	.601
Age	72.8 ± 5.4	72.7 ± 5.6	74.8 ± 6.0	.201
Education (years)	12.8 ± 2.7	12.3 ± 2.9	12.2 ± 3.1	.007
Health literacy	4.04 ± 0.61	3.75 ± 0.67	3.52 ± 0.70	<.001
Low income	891 (56.3)	137 (71.0)	51 (64.6)	.001
Social engagement				
Living alone	161 (10.2)	19 (9.8)	16 (20.3)	.031
Eating alone	195 (12.3)	47 (24.4)	29 (36.7)	<.001
Living and eating with others (ref)	1357 (85.7)	146 (75.6)	46 (58.2)	<.001
Living and eating alone	129 (8.1)	19 (9.8)	12 (15.2)	.031
Living alone yet eating with others	32 (2.0)	0 (0.0)	4 (5.1)	.681
Living with others yet eating alone	66 (4.2)	28 (14.5)	17 (21.5)	<.001
Low reciprocal social support	79 (5.0)	30 (15.5)	17 (21.5)	<.001
Fewer frequency of going out	234 (14.8)	75 (38.9)	37 (46.8)	<.001
Major change in life	310 (19.6)	66 (34.2)	24 (30.4)	<.001
Social ties with family	8.29 ± 3.1	6.82 ± 3.1	6.42 ± 3.0	<.001
Social ties with friends	8.43 ± 3.5	6.42 ± 3.4	5.86 ± 3.4	<.001
Medical histories				
Hypertension	658 (41.5)	107 (55.4)	40 (50.6)	.001
Cerebrovascular diseases	83 (5.2)	17 (8.8)	12 (15.2)	<.001
Diabetes	184 (11.6)	23 (11.9)	8 (10.1)	.805
Osteoporosis	156 (9.8)	31 (16.1)	13 (16.5)	.003
Heart diseases	262 (16.5)	43 (22.3)	17 (21.5)	.043
Malignant neoplasm	244 (15.4)	27 (14.0)	12 (15.2)	.739
Number of medications	2.77 ± 2.9	3.84 ± 3.4	4.20 ± 3.9	<.001
Physical health and functions				
IADL	4.88 ± 0.42	4.73 ± 0.70	4.66 ± 0.83	<.001
Mobility	25.2 ± 9.8	21.0 ± 10	20.9 ± 11	<.001
Cognitive function: MMSE	28.3 ± 1.8	27.7 ± 2.0	27.7 ± 2.2	<.001
Oral health and functions: GOHAI	55.4 ± 5.8	51.1 ± 7.4	49.2 ± 8.7	<.001
Nutritional and dietary status				
BMI (kg/m^2)	22.9 ± 3.0	22.7 ± 3.1	22.3 ± 2.9	.163
Food variety	3.84 ± 2.0	3.34 ± 2.0	3.20 ± 2.1	<.001
MNA-SF	12.6 ± 1.4	12.1 ± 1.7	11.7 ± 1.9	<.001

BMI, body mass index; MMSE, Mini-Mental State Examination; SD, standard deviation.
*Cochran-Armitage trend test was used for categorical variables and Jonckheere-Terpstra trend test was used for continuous variables.

Social Engagement and Different Degrees of Depression

Table 3 shows the comparison of the geriatric characteristics between "normal," "mildly depressed" and "severely depressed" participants. Based on this result, multinomial logistic regression was performed, as shown in Table 4. The variables independently associated with both degrees of depression were eating alone, social participation (fewer frequency of going out), social ties with friends, health literacy, the number of medications, and GOHAI. Those unique for "mild depression" were living alone; they had low reciprocal social support, social stressors (major change in life), social ties with family, age, low income, and mobility. Risk factors unique for "severe depression" were male gender, history of cerebrovascular diseases, and MNA-SF scores.

Living Arrangement and Eating Arrangement

To examine further the role of eating alone and its potential risk factors, living arrangement and eating arrangement were crossed and the physical, mental, oral, cognitive, nutritional and dietary as well as social characteristics of the 4 resultant groups [living and eating alone (n = 160), living alone yet eating with others (n = 36), living with others yet eating alone (n = 111), living and eating with others (n = 1549)] were compared. The results are shown in Table 5.

The participants "living with others yet eating alone" had the poorest scores of social ties with family and friends, years of education, health literacy, physical health and functions (normal and maximum gait speeds, IADL and mobility), cognitive function, oral health and functions (GOHAI, number of remaining teeth, and occlusal force), and nutritional and dietary status (MNA-SF and food variety).

Furthermore, greater proportion of those who "live with others yet eat alone" live with their children, children-in-law, and grandchildren, compared with those who "live and eat with others," most of whom live with their spouse.

Discussion

The main aim of the present study was to examine the association between social engagement and depressive symptoms in community-dwelling Japanese older adults, with a particular focus on eating alone and on the changes in the association along geriatric trajectories of aging and mental frailty.

The study was carried out on a population sample of Japanese older adults, of whom 14.7% showed depressive symptoms (GDS ≥6). This is on the lower end compared with previous studies that used the same GDS cut-off point, in which the prevalence ranged between 14% and 40%.[4]

The results highlighted a significant association between depressive symptoms and social engagement variables such as social ties, eating alone, social participation, social stressors and reciprocity of social support. Of particular interest was eating alone, which to our knowledge has not been assessed before in combination with different components of social engagement and in relation to the