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Research report

Combined effects of eating alone and living alone on unhealthy dietary behaviors, obesity and underweight in older Japanese adults: Results of the JAGES

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ABSTRACT

We examined whether eating alone is associated with dietary behaviors and body weight status, and assessed the modifying effects of cohabitation status in older Japanese people. Data from the 2010 Japan Gerontological Evaluation Study, with a self-reported questionnaire for 38,690 men and 43,674 women aged ≥65 years, were used. Eating status was classified as eating with others, sometimes eating alone, or exclusively eating alone. We calculated adjusted prevalence ratios (APRs) of unhealthy dietary behaviors, obesity, and underweight, adjusting for age, education, income, disease, and dental status using Poisson regression. Overall, 16% of men and 28% of women sometimes or exclusively ate alone. Among those who exclusively ate alone, 56% of men and 68% of women lived alone. Men who exclusively ate alone were 3.74 times more likely to skip meals than men who ate with others. Among men who exclusively ate alone, those who lived alone had a higher APR than men who lived with others. Compared with subjects who ate and lived with others, the APRs of being obese (BMI ≥ 30.0 kg/m^2) among men who exclusively ate alone were 1.34 (1.01–1.78) in those who lived alone and 1.17 (0.84–1.64) in those who lived with others. These combined effects of eating and living alone were weaker in women, with a potential increase in the APRs among those who ate alone despite living with others. Men who exclusively ate alone were more likely to be underweight (BMI < 18.5 kg/m^2) than men who ate with others in both cohabitation statuses. Eating alone and living alone may be jointly associated with higher prevalence of obesity, underweight and unhealthy eating behaviors in men.

1. Introduction

Population aging is a global trend. In Japan, 32% of the population is aged ≥60 years, the highest rate worldwide (WHO, 2014). Several studies have suggested that social participation and interpersonal interactions are key factors in maintaining the physical and mental abilities of older adults, and reducing mortality (Aida et al., 2011; Glass, de Leon, Marottoli, & Berkman, 1999; Holt-Lunstad, Smith, & Layton, 2010; Takagi, Kondo, & Kawachi, 2013). However, changes in family structures have reduced the interactions among family members in recent decades. In Japan, 4.3% of men and 11.2% of women lived alone in 1980, increasing to 11.1% of men and 20.3% of women in 2010 (Cabinet Office, 2013). There is a concern that older adults who live alone may be vulnerable to developing unhealthy dietary behaviors, such as low vegetable and fruit intake (Conklin et al., 2014).

Eating is a daily activity, and eating with other people, may be an important determinant of physical and mental health (Fulkerson, Larson, Horning, & Neumark-Sztainer, 2014; Goldfarb, Tarver, & Sen, 2014). Eating behaviors might also be affected by cohabitation

Abbreviations: APR, adjusted prevalence ratio; BMI, body mass index; CI, confidence interval; JAGES, Japan Gerontological Evaluation Study.

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status. People living alone are less likely to have an opportunity to eat with others. Many studies involving shared meals have focused on children and adolescents, and suggest that shared meals may protect against nutritional-related health problems, including obesity, unhealthy eating, and disordered eating (Fulkerson et al., 2014; Hammons & Fiese, 2011). Although several studies among older adults have reported that eating alone is a nutritional risk (Shahar, Shai, Vardi, & Fraser, 2003; Sharkey, 2002), few studies have investigated gender differences and the modifying effects of cohabitation status in older adults.

Using data from a large-scale, population-based, epidemiologic study, we examined the prevalence of eating alone in older Japanese people. Next, we investigated the associations of eating alone with meal skipping and low frequency of vegetable and fruit intake as dietary behaviors. We did so because meal skipping has been found to be associated with an array of unhealthful outcomes, including lower nutrient intake (Redondo et al., 1997), and cardiovascular disease risk (Fabry, Fodor, Hejl, Geizerova, & Balcarova, 1968) among older adults; further, Japanese cohort studies have found low vegetable and fruit intake to be associated with increased risk of cardiovascular disease mortality (Nagura et al., 2009; Okuda et al., 2015; Takachi et al., 2008). Subsequently, we investigated the association of eating alone with not only obesity and dietary behaviors but also underweight. Underweight is a known risk factor for dementia and fracture among older adults (Chen et al., 2010; De Laet et al., 2005; Deschamps et al., 2002). We also examined how cohabitation status, which would influence the likelihood of older adults eating alone, modified the associations of eating alone with body weight status and dietary behaviors.

2. Material and methods

2.1. Study design and subjects

We used data from the Japan Gerontological Evaluation Study (JAGES) performed in 2010. The survey covered 28 municipalities in 11/47 prefectures across Japan. Between August 2010 and January 2012, self-reported questionnaires were mailed to 160,382 community-dwelling individuals aged ≥65 years who were physically and cognitively independent (i.e., they were not receiving any benefits from public long-term care insurance). The survey was conducted using a random sampling method in 15 large municipalities and administered to all eligible residents in the 13 small municipalities. A total of 106,460 subjects returned the questionnaire. The present analyses were carried out using data for 83,364 subjects (38,690 men and 43,674 women), after excluding the following subjects: subjects whose information on sex and age were missing; and subjects who did not complete the questions related to eating status, cohabitation status, height, weight, and dietary behaviors; or medical treatment for cancer, heart disease, stroke, hypertension, diabetes mellitus, hyperlipidemia, osteoporosis, gastrointestinal disease, and dysphagia. Furthermore, subjects who reported limitations in activities of daily living, defined as being unable to walk, take a bath, or use the toilet without assistance (Katz, Downs, Cash, & Grotz, 1970) were also excluded to control for people who were eating alone because of these limitations. The JAGES protocol was approved by the Ethics Committee in Research of Human Subjects at Nihon Fukushi University (No. 10-05). The use of the data was approved by the Ethics Committee of The University of Tokyo, Faculty of Medicine (No. 10555).

2.2. Body weight and diet status

Subjects reported their height and weight in centimeters and kilograms, respectively. Standard categories of BMI (WHO, 2000) were used to characterize subjects as obese (BMI ≥ 30.0 kg/m^2), overweight (BMI = 25.0–29.9 kg/m^2), normal (BMI = 18.5–24.9 kg/m^2), and underweight (BMI < 18.5 kg/m^2). Although this categorization was not specifically developed for older adults, a recent Japanese cohort study reported that both BMI < 18.5 kg/m^2 and BMI ≥30 kg/m^2 were associated with increased risk for mortality among older adults (Matsuo et al., 2008). Dietary factors were assessed by the self-reported questionnaire. Daily meal frequency was assessed using the question "How many meals do you have a day?", for which the responses were "one", "two", "three" or "four or more often", which were used to determine whether the subject regularly ate three meals or skipped meals. Skipping meal was defined as under two times a day because about 95% of the subjects ate three or more times a day (Table 1). The frequency of vegetable and fruit intake was assessed using the question "How often did you eat vegetables and fruit over the past month?", for which the responses were "not at all", "less than once a week", "once a week", "two to three times a week", "four to six times a week", "once a day", or "at least twice a day." Respondents who ate vegetables and fruit less than once a day were categorized as having a low frequency of vegetable and fruit intake. This cutoff point was defined by prevalence to be under 25% of subjects included (Table 1) because the lowest quartile of low vegetable and fruit intake was associated with poor health outcomes (Nagura et al., 2009; Okuda et al., 2015; Takachi et al., 2008).

2.3. Eating and living status

Eating status was assessed using the question "Who do you usually have meals with?" for which the responses were "No

Table 1
Characteristics of subjects and the prevalences of meal skipping, low frequency of vegetable and fruit intake, obesity, overweight and underweight in older Japanese men and women.

		Males (n = 38,690)		Females (n = 43,674)	
		n	%	n	%
Age (years)					
65–69		12,139	31.4	12,975	29.7
70–74		11,380	29.4	12,943	29.6
75–79		8510	22.0	9656	22.1
≥80		6661	17.2	8100	18.6
Eating status					
Eat with others		32,389	83.7	31,509	72.2
Sometimes eat alone		2120	5.5	3312	7.6
Exclusively eat alone		4181	10.8	8853	20.3
Living status					
Living with others		36,023	93.1	36,350	83.2
Living alone		2667	6.9	7324	16.8
Eating and living status					
Eat with others	Live with others	32,277	83.4	31,183	71.4
	Live alone	112	0.3	326	0.8
Sometimes eat alone	Live with others	1909	4.9	2299	5.3
	Live alone	211	0.6	1013	2.3
Exclusively eat alone	Live with others	1837	4.8	2868	6.6
	Live alone	2344	6.1	5985	13.7
Body weight status (BMI, kg/m^2)					
Obesity (≥30.0)		688	1.8	1217	2.8
Overweight (25.0–29.9)		7961	20.6	8113	18.6
Normal (18.5–24.9)		27,929	72.2	30,516	69.9
Underweight (<18.5)		2112	5.5	3828	8.8
Daily meal frequency (n/day)					
≥ 3		36,717	94.9	42,248	96.7
≤2 (meal skipping)		1973	5.1	1426	3.3
Frequency of vegetable/fruit intake (n/day)					
≥1/day		29,180	75.4	37,020	84.8
< 1/day (low vegetable/fruit intake)		9510	24.6	6654	15.2

BMI = body mass index.

one", "Spouse", "Children", "Grandchildren", "Friends", or "Other". Multiple responses were allowed. Eating status was classified as "eat with others" (for the responses "Spouse", "Children", "Grandchildren", "Friends", or "Other"), "sometimes eat alone" (for the response "No one" together with "Spouse", "Children", "Grandchildren", "Friends", or "Other"), or exclusively eat alone (if the response was only "No one"). We also asked the subjects to report their cohabitation status to determine whether they lived alone or with others. The eating and cohabitation statuses were combined to generate six categories: eat with others and live with others; eat with others and live alone; sometimes eat alone and live with others; sometimes eat alone and live alone; exclusively eat alone and live with others; and exclusively eat alone and live alone (Fig. 1). Cohabitation status was further divided into four categories: living only with the spouse; living with both the spouse and children and/or grandchildren; living only with children and/or grandchildren; and living alone.

2.4. Covariates

Sociodemographic characteristics were assessed using the self-reported questionnaire. Age was divided into four categories (65–69, 70–74, 75–79, and ≥80 years). The duration of education was divided into four categories (≤9, 10–12, or ≥ 13 years, and other/missing). Annual normalized household income was determined from the household income and the number of household members. The annual income question had 15 categories, and midpoints of household income were set in each category. Annual household income was adjusted for household size, dividing the income by the square root of the number of people in that household. The annual normalized household income was divided into four categories (<2.00, 2.00–3.99, or ≥ 4.00 million yen, and missing). The respondents were asked whether they were currently under medical treatment for any of the following (multiple responses were allowed): cancer, heart disease, stroke, hypertension, diabetes mellitus, hyperlipidemia, osteoporosis,

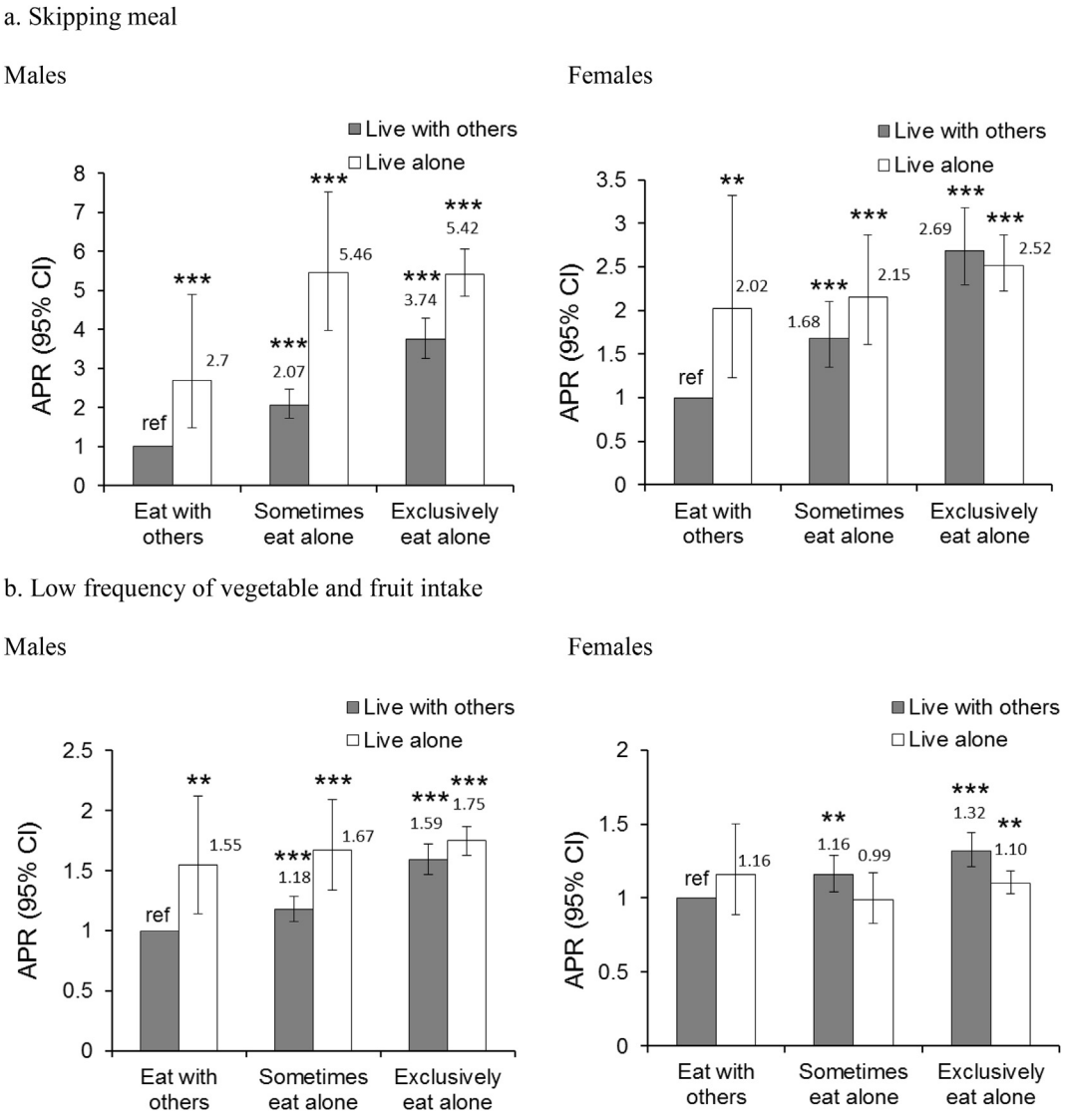
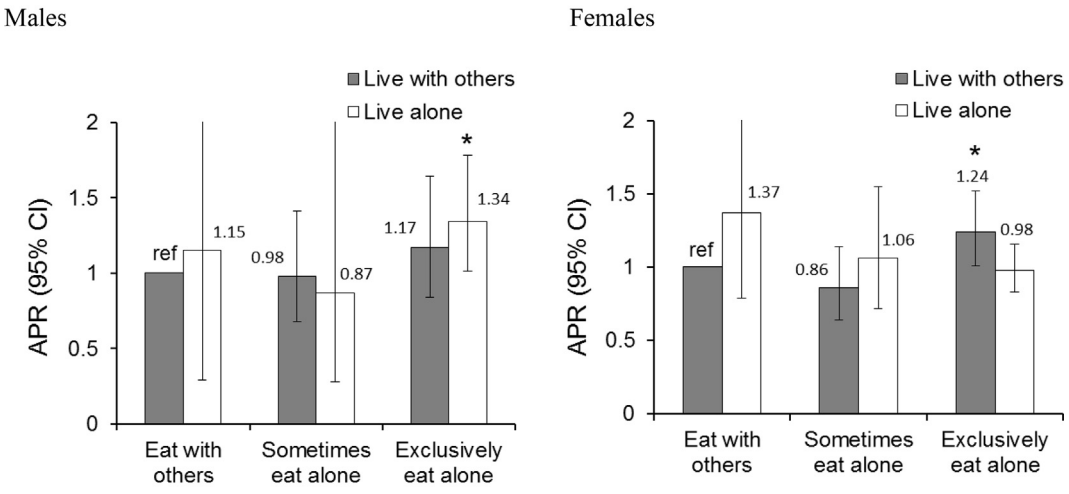
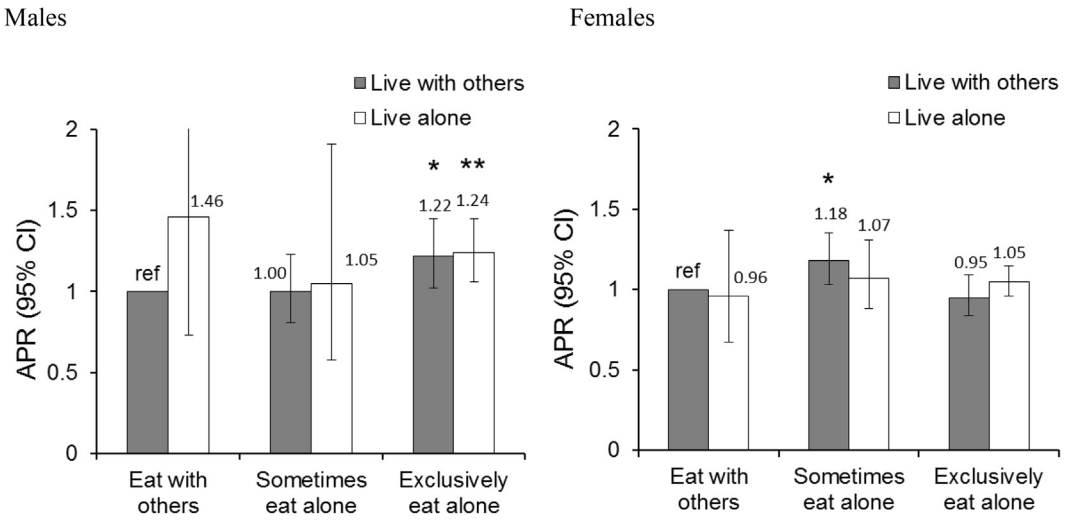


Fig. 1. Adjusted prevalence ratios of meal skipping, low frequency of vegetable and fruit intake, obesity, and underweight according to the eating and living statuses of older Japanese men (n = 38,690) and women (n = 43,674). The models were adjusted for age (65–69, 70–74, 75–79, and ≥80 years), education (≤9, 10–12, or ≥ 13 years, and other/missing), annual normalized household income (<2.00, 2.00–3.99, or ≥ 4.00 million yen, and missing), cancer (yes/no), heart disease (yes/no), stroke (yes/no), hypertension (yes/no), diabetes mellitus (yes/no), hyperlipidemia (yes/no), osteoporosis (yes/no), gastrointestinal disease (yes/no), dysphagia (yes/no) and dental status (≥20 teeth, ≤19 teeth, and missing).

c. Obesity



d. Underweight



APR = adjusted prevalence ratio; CI = confidence interval.

*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$ versus subjects who ate with others and lived with others.

Fig. 1. (*continued*).

gastrointestinal disease, or dysphagia. The respondents were also asked to classify their dental status (≥20 teeth, ≤19 teeth, or missing).

2.5. Statistical analysis

Analyses were stratified by gender because our preliminary analysis showed a very different association between eating and cohabitation statuses and our health outcomes, and a distinct pattern of confounders between men and women. Subjects with a low frequency of vegetable and fruit intake and those with overweight were not uncommon—not under 15%—so the odds ratio derived from the logistic regression was unable to approximate the prevalence ratio (Barros & Hirakata, 2003; Zhang & Yu, 1998). Therefore, Poisson regression analysis was used to examine the associations between eating status and dietary and body weight statuses to calculate the adjusted prevalence ratios (APRs) with 95% confidence intervals (CIs). The models were adjusted for the following potential confounding factors: age (65–69, 70–74, 75–79, and ≥80 years); education (≤9, 10–12, or ≥13 years, and other/missing); annual normalized household income (<2.00, 2.00–3.99, or ≥4.00 million yen, and missing); presence/absence of cancer, heart disease, stroke, hypertension, diabetes mellitus, hyperlipidemia, osteoporosis, gastrointestinal disease, or dysphagia; and dental status (≥20 teeth, ≤19 teeth, and missing). In the analyses of body weight status, the normal body weight category (BMI = 18.5–24.9 kg/m^2) was used as the reference category. All analyses were conducted using Statistical Analysis Systems software version 9.4 (SAS Institute Inc., Cary, NC, USA).

3. Results

Overall, 16% of men and 28% of women reported that they sometimes or exclusively ate alone. Among men and women who exclusively ate alone, 2344 men (56%) and 5985 women (68%) lived alone. Among men and women who sometimes ate alone, 211 men (10%) and 1013 women (31%) lived alone (Table 1). Among subjects who ate with others and lived with others, 90% of men and 74% of women lived with their spouses, and 38% of men and 46% of women lived with children (Table 2). Among subjects who exclusively ate alone and lived with others, only 52% of men and 21% of women lived with their spouses, and 55% of men and 66% of women lived with children. Among subjects who ate with others and lived alone, 23% of men and 40% of women ate with children, and 22% of men and 27% of women ate with friends. Among subjects who sometimes ate alone and lived alone, 28% of men and 45% of women ate with children, and 63% of men and 66% of women ate with friends.

Men who exclusively ate alone were 3.74 times (95% CI: 3.25–4.30, $P < 0.001$) more likely to skip meals than men who ate with others (Table 3). Among men who exclusively ate alone, those who lived alone had a higher APR of skipping meals (5.42; 95% CI: 4.86–6.06, $P < 0.001$) than men who lived with others (3.74; 95% CI: 3.25–4.30, $P < 0.001$) (Fig. 1a). Women who exclusively ate alone were 2.69 times (95% CI: 2.29–3.18, $P < 0.001$) more likely to skip meals than women who ate with others (Table 3). Further analysis using detailed information on cohabitation status showed that compared with women who lived alone, women living with both a spouse and children and/or grandchildren appeared to be at a high risk of skipping meals (Supplementary Fig. 1a).

Men and women who exclusively ate alone were 1.59 (95% CI: 1.47–1.72, $P < 0.001$) and 1.32 (95% CI: 1.21–1.44, $P < 0.001$) times more likely to have lower frequency of vegetable and fruit intake compared with individuals who ate with others (Table 3). Among women who exclusively ate alone, the APR of a low frequency of vegetable and fruit intake was greater in women who lived with others (1.32; 95% CI: 1.21–1.44, $P < 0.001$) than in women who lived alone (1.10; 95% CI: 1.03–1.18, $P < 0.01$) (Fig. 1b). The APR of a low frequency of vegetable and fruit intake tended to be high among women who lived with both a spouse and children and/or grandchildren compared with women who lived alone (Supplementary Fig. 1a).

Men who exclusively ate alone and lived alone were 1.34 times (95% CI: 1.01–1.78, $P < 0.05$) more likely to be obese (BMI $\geq$ 30.0 kg/m^2) than men who ate and lived with others, whereas the APR in men who exclusively ate alone and lived with others was 1.17 (95% CI: 0.84–1.64, $P = 0.35$) (Fig. 1c). The APR of overweight (BMI = 25.0–29.9 kg/m^2) was also significant for men who exclusively ate alone and lived alone (1.10; 95% CI: 1.01–1.21, $P < 0.05$). Among women who exclusively ate alone, the APR of obesity was greater in women who lived with others (1.24; 95% CI: 1.01–1.52, $P < 0.05$) than in women who lived alone (0.98; 95% CI: 0.83–1.16, $P = 0.80$) (Fig. 1c). The APR of obesity tended to be high among women who lived only with children and/or grandchildren compared with women who lived alone (Supplementary Fig. 1a). Men who exclusively ate alone were 1.22 times (95% CI: 1.02–1.45, $P < 0.05$) more likely to be underweight (i.e. BMI < 18.5 kg/m^2) than men who ate with others (Table 4). The APR of being underweight was greater in women who sometimes ate alone (1.18; 95% CI: 1.03–1.35, $P < 0.05$) than in women who exclusively ate alone (0.95; 95% CI: 0.84–1.09, $P < 0.47$) (Table 4). Among women who sometimes ate alone, the APR of underweight was higher in women who lived with others (1.18; 95% CI: 1.03–1.35, $P < 0.05$) than in women who lived alone (1.07; 95% CI: 0.88–1.31, $P < 0.50$) (Fig. 1d).

4. Discussion

To our knowledge, this is the first study to examine the prevalence of eating alone according to cohabitation status among older adults, and to investigate the combined effects of eating and cohabitation statuses with dietary behaviors and body weight status. We found strong evidence that the combined effects of eating alone and living alone on meal skipping and obesity were more prominent in men than women. Conversely, women who ate alone were more likely to skip meals and be obese when they lived with others.

Of the study population, 16% of men and 28% of women reported that they sometimes or exclusively ate alone. These prevalence were lower than those reported in other countries. For example, Marshall et al. (1999) reported that among US subjects aged ≥65 years, 21% of Hispanic white men, 28% of non-Hispanic white men, 32% of Hispanic white women, and 41% of non-Hispanic white women reported eating alone most of the time (Marshall et al., 1999). Another US-based study reported that >45% of older adults

Table 2
Eating and living statuses of older Japanese men (n = 38,690) and women (n = 43,674).

	Eat with others				Sometimes eat alone				Exclusively eat alone			
	Live with others		Live alone		Live with others		Live alone		Live with others		Live alone	
	Male %	Female %	Male %	Female %	Male %	Female %	Male %	Female %	Male %	Female %	Male %	Female %
Eating status												
Eat with spouse	94.7	77.9	23.2	5.5	77.8	36.5	1.9	1.4	0	0	0	0
Eat with children	19.2	34.8	23.2	40.2	41.7	65.8	27.5	45.2	0	0	0	0
Eat with grandchildren	10.9	18.0	9.8	19.9	23.8	34.2	14.7	26.9	0	0	0	0
Eat with friends	1.9	3.8	22.3	27.0	15.4	27.2	62.6	65.7	0	0	0	0
Eat with others	3.0	4.5	35.7	23.0	7.6	8.2	22.3	12.2	0	0	0	0
Living status												
Live with spouse	90.0	74.0	0	0	77.4	35.4	0	0	52.4	21.1	0	0
Live with children	38.3	46.3	0	0	54.0	70.9	0	0	55.3	65.5	0	0
Live with children's spouse	16.5	22.0	0	0	19.0	32.1	0	0	21.3	32.5	0	0
Live with grandchildren, great-grandchildren	17.6	23.7	0	0	22.8	34.7	0	0	18.8	29.0	0	0
Live with own parent	3.3	1.1	0	0	3.2	1.0	0	0	2.9	1.7	0	0
Live with spouse's parent	2.1	2.3	0	0	2.3	1.5	0	0	2.2	1.9	0	0

Eating and living statuses were assessed using the self-reported questionnaire (multiple responses were allowed). Eating status was classified as “eat with others” (for the responses “Spouse”, “Children”, “Grandchildren”, “Friends”, or “Other”), “sometimes eat alone” (for the response “No one” together with “Spouse”, “Children”, “Grandchildren”, “Friends”, or “Other”), or “exclusively eat alone” (if the response was only “No one”). Living status was classified as “live with others” (for the responses “Spouse”, “Children”, “Children's spouse”, “Grandchildren, great-grandchildren”, “Own parent”, “Spouse's parent”, or “Other”) or “live alone” (if the response was only “Live alone”).

Table 3
Adjusted prevalence ratios of meal skipping and low frequency of vegetable and/or fruit intake according to the eating and living statuses of older Japanese men ($n = 38,690$) and women ($n = 43,674$).

	Meal skipping[a]		Low frequency of vegetable and fruit intake[b]	
	Males	Females	Males	Females
	APR (95%CI)	APR (95%CI)	APR (95%CI)	APR (95%CI)
Eating status				
Eat with others	Ref	Ref	Ref	Ref
Sometimes eat alone	2.07 (1.73–2.48)***	1.68 (1.35–2.10)***	1.18 (1.08–1.29)***	1.16 (1.04–1.29)**
Exclusively eat alone	3.74 (3.25–4.30)***	2.69 (2.29–3.18)***	1.59 (1.47–1.72)***	1.32 (1.21–1.44)***
Living status				
Live with others	Ref	Ref	Ref	Ref
Live alone	2.70 (1.49–4.89)**	2.02 (1.23–3.32)**	1.55 (1.14–2.12)**	1.16 (0.89–1.50)
Eating/living interactions				
Sometimes eat alone × Live alone	0.98 (0.49–1.96)	0.63 (0.34–1.16)	0.91 (0.62–1.35)	0.74 (0.53–1.02)
Exclusively eat alone × Live alone	0.54 (0.29–0.99)*	0.46 (0.27–0.78)*	0.71 (0.51–0.99)*	0.72 (0.55–0.96)*

APR = adjusted prevalence ratio; CI = confidence interval.
The models were adjusted for age (65–69, 70–74, 75–79, and ≥80 years), education (≤9, 10–12, or ≥13 years, and other/missing), annual normalized household income (<2.00, 2.00–3.99, or ≥4.00 million yen, and missing), cancer (yes/no), heart disease (yes/no), stroke (yes/no), hypertension (yes/no), diabetes mellitus (yes/no), hyperlipidemia (yes/no), osteoporosis (yes/no), gastrointestinal disease (yes/no), dysphagia (yes/no) and dental status (≥20 teeth, ≤19 teeth, and missing).
*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$.
[a] Meal skipping: daily meal frequency ≤2/day.
[b] Low frequency of vegetable and fruit intake: frequency of vegetable and fruit intake <1/day.

Table 4
Adjusted prevalence ratios of obesity, overweight and underweight according to the eating and living statuses of older Japanese men ($n = 38,690$) and women ($n = 43,674$).

	Obesity (BMI ≥ 30.0 kg/m^2)		Overweight (BMI = 25.0–29.9 kg/m^2)		Underweight (BMI < 18.5 kg/m^2)	
	Males	Females	Males	Females	Males	Females
	APR (95%CI)	APR (95%CI)	APR (95%CI)	APR (95%CI)	APR (95%CI)	APR (95%CI)
Eating status						
Eat with others	Ref	Ref	Ref	Ref	Ref	Ref
Sometimes eat alone	0.98 (0.68–1.41)	0.86 (0.64–1.14)	0.95 (0.85–1.05)	1.07 (0.98–1.18)	1.00 (0.81–1.23)	1.18 (1.03–1.35)*
Exclusively eat alone	1.17 (0.84–1.64)	1.24 (1.01–1.52)*	1.03 (0.93–1.15)	1.01 (0.93–1.11)	1.22 (1.02–1.45)*	0.95 (0.84–1.09)
Living status						
Live with others	Ref	Ref	Ref	Ref	Ref	Ref
Live alone	1.15 (0.29–4.60)	1.37 (0.79–2.37)	1.53 (1.10–2.13)*	0.87 (0.66–1.14)	1.46 (0.73–2.93)	0.96 (0.67–1.37)
Eating/living interactions						
Sometimes eat alone × Live alone	0.77 (0.12–4.81)	0.90 (0.44–1.85)	0.76 (0.49–1.20)	1.05 (0.76–1.46)	0.72 (0.28–1.84)	0.95 (0.62–1.46)
Exclusively eat alone × Live alone	1.00 (0.23–4.26)	0.58 (0.32–1.05)	0.70 (0.49–0.99)*	1.05 (0.78–1.41)	0.70 (0.33–1.45)	1.16 (0.78–1.71)

APR = adjusted prevalence ratio; CI = confidence interval; BMI = body mass index (kg/m^2).
The models were adjusted for age (65–69, 70–74, 75–79, and ≥80 years), education (≤9, 10–12, or ≥13 years, and other/missing), annual normalized household income (<2.00, 2.00–3.99, or ≥4.00 million yen, and missing), cancer (yes/no), heart disease (yes/no), stroke (yes/no), hypertension (yes/no), diabetes mellitus (yes/no), hyperlipidemia (yes/no), osteoporosis (yes/no), gastrointestinal disease (yes/no), dysphagia (yes/no) and dental status (≥20 teeth, ≤19 teeth, and missing).
*$P < 0.05$.

ate alone (Quigley, Hermann, & Warde, 2008). One possible reason for the difference in the prevalence of eating alone may be the differences in living arrangements. In Japan, 7% of men and 17% of women aged ≥65 years lived alone (Table 1), whereas 37.5% of older adults aged ≥ 60 years lived alone in the United States (Cabinet Office, 2010).

As expected, the associations between eating alone and the risks for obesity and poor dietary behavior in men were more prominent among those living alone. By contrast, among women who ate alone, the risks were higher in those who lived with others. This gender difference may be explained by differences in cooking skills (Hughes, Bennett, & Hetherington, 2004) and nutritional knowledge (Baker & Wardle, 2003). In other words, men who live with others may receive meals prepared by a family member, whereas men who live alone need to prepare food themselves. This might prompt men who live alone to follow poor dietary behaviors, such as skipping meals and low vegetable and fruit intake (Conklin et al., 2014). The lack of cooking skills may also prompt men to consume convenient, unhealthy foods, such as fast food. The key motivations for selecting foods in older adults include sensory perceptions of taste rather than convenience, monetary considerations and physical well-being (Betts, 1985; Falk, Bisogni, & Sobal, 1996; Krondl, Lau, Yurkiw, & Coleman, 1982). This may result in making food choices that are likely to lead to obesity. Additionally, men might be likely to choose foods because of their sensory appeal rather than for health reasons (Steptoe, Pollard, & Wardle, 1995). Other factors might include differences in the setting of the meal (e.g., eating at home or restaurants) and the source of food (e.g., whether the food was cooked at home, prepared in a restaurant, or had other origins) (Fulkerson et al., 2011). Men who exclusively ate alone and lived alone may eat out (i.e. setting) and/or consume less home-cooked food (i.e. source). Therefore, men may benefit from cohabitation in terms of a better diet and regular meals. An intervention study showed that family-style meals increased energy intake and prevented body weight loss among nursing home residents (Nijs, de Graaf, Kok, & van Staveren, 2006). If the mealtime companion is a meal preparer, the companion may help to provide a balanced diet regardless of personal taste preferences. For men, especially older Japanese men who are unlikely to prepare their meals by themselves, their mealtime companions are likely to be the ones preparing the meals.

Considering the results of this study, social isolation may have even greater implications on the health of women, because older Japanese women are usually skilled with cooking, and most of them may be able to easily prepare well-balanced meals, despite living alone. Additionally, women who ate alone even though they lived with others may have additional problems that lead to potentially unhealthy eating habits and diets. Women may be highly influenced by the psychological aspects of the meal. For example, eating alone may deprive women of the emotional satisfaction of caring for others, because women have been socialized to be responsible for preparing meals for their families (Fürst, 1997) and value having meals with their family (Quandt, Vitolins, DeWalt, & Roos, 1997). Consequently, women who live with others may be more likely to feel socially isolated when eating alone, and this psychosocial strain may promote skipping meals and/or reduce the frequency of vegetable and fruit intake. If living with others, family discord may lead to stress that causes or contributes to obesity (Sominsky & Spencer, 2014). Another reason may be that women are likely to eat leftover meals prepared by others. Reverse causality is also possible, whereby eating habits and body weight may influence eating alone. For example, obese women who are trying to lose weight may reduce frequency of family meal to minimize food shopping and preparation, events that are associated with additional food intake and greater body weight (McIntosh et al., 2010). Further studies are needed to examine this gender difference in terms of the consistency of the results and the potential mechanisms.

Exclusively eating alone was significantly associated with underweight among men. It is not simply the presence of others in the household that has an impact on body weight. Instead, the presence of others during meals may have significant effects on body weight. Energy intake in a meal was reported to be greater in people who ate with others than in people who ate alone because the mealtimes are extended when others are present, and people have greater exposure to food and are more likely to eat more than they require (de Castro, 1994). However, caution is needed when interpreting these results because of the potential for reverse causation in that being underweight may promote eating alone, rather than the opposite. For example, the lack of an appetite among underweight individuals may lead them to skip the chance of eating a meal with other people. As such, further longitudinal studies are needed to examine the causal relationship between underweight and eating alone.

Several limitations of this study should be mentioned. First, there is no established definition for differentiating between exclusively eating alone and sometimes eating alone. We acknowledged that subjects who stated that they only ate alone were not eating with others, but we lack information on the frequency of eating alone. Therefore, subjects who sometime eat with others may also be included in the exclusively eating alone category. Future studies should include a question to allow researchers to differentiate this point. Second, the use of self-reported questionnaires may lead to the under-reporting of weight and over-reporting of height (Connor Gorber, Tremblay, Moher, & Gorber, 2007). In previous studies, older women underestimated their weight by 0.6–1.2 kg compared with the directly measured values, whereas older men underestimated their weight by 0.5–1.9 kg (Gunnell et al., 2000; Kuczmarski, Kuczmarski, & Najjar, 2001; Lawlor, Bedford, Taylor, & Ebrahim, 2002). Height was overestimated in 70-year-old men by 3.1–4.3 cm and in women by 2.9–4.5 cm (Kuczmarski et al., 2001). When calculated from self-reported height, BMI was underestimated in both men (by 0.8–1.3 kg/m^2) and women (by 0.8–1.1 kg/m^2) (Gunnell et al., 2000; Kuczmarski et al., 2001). Third, the frequency of vegetable and fruit intake was assessed using a very simple, single-item scale, which has not been validated. Many population-based studies have used simple measures to assess the frequency of vegetable and fruit intake, representing a limitation of this field of research. Fourth, we did not account for family members who lived together. The constructions of families differ by sex and eating status, and may contribute to the gender differences. Fifth, because this was a cross-sectional study, we cannot assess causality. However, eating alone was significantly associated with poor dietary behaviors and BMI, and these findings may be particularly important in terms of identifying potential targets for interventions aimed at promoting healthy eating or improving body weight management.

This large-scale study has provided novel findings regarding the associations of eating alone with dietary behaviors and body weight status in a broad cross-section of older Japanese adults. It is difficult to intervene with respect to living status with the increasingly aged population. However, it is possible to intervene in eating behaviors by encouraging individuals to eat with others rather than eat alone through the support of family, friends and neighbors, and by promoting shared meal settings and community restaurants in municipalities. Further longitudinal studies are needed to clarify the effects of eating alone and identify possible targets for interventions. Although the present study focused on body weight as a potential outcome of eating with others, future studies should examine other physical, psychological, and social outcomes that may be associated with eating with others.

Authorship

Y.T. conceived and designed the study, collected data, performed the statistical analyses, and wrote the manuscript. N.K. helped conceive and design the study, helped write the study protocol, and helped to write and edit the manuscript. D.T., M.S., H.H, Y.I., T.O., and K.K. collected data and helped to edit the manuscript. Y.T. N.K., M.S., H.H., T.O., K.K. and The JAGES Group were involved in the study design, data collection, and data management. All authors approved the final version of the manuscript.

Conflicts of interest

The authors declare no personal or financial conflicts of interest.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.appet.2015.06.005.

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