Original Article

Living status and frequency of eating out-of-home foods in relation to nutritional adequacy in 4,017 Japanese female dietetic students aged 18–20 years: A multicenter cross-sectional study

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ABSTRACT

Background: Living status (e.g., living with family or alone) may affect dietary habits. We compared nutritional adequacy according to living status and the frequency of eating out-of-home foods in young Japanese women.
Methods: Female dietetic students (aged 18–20 years; n = 4,017) participated in a cross-sectional multicenter study, which was conducted in 85 dietetic schools in 35 of 47 prefectures in Japan. Habitual dietary intake was assessed with a validated diet history questionnaire. Nutritional adequacy was determined based on the Dietary Reference Intakes for Japanese, 2015, for two goals: preventing non-communicable chronic disease (a tentative dietary goal for preventing lifestyle-related diseases [DG] that tracks five nutrients) and avoiding insufficient intake of mainly vitamins and minerals (estimated average requirement [EAR] that tracks 14 nutrients).
Results: Women living with their family were less likely to meet DG nutrient levels, but more likely to meet EAR nutrient levels compared with those living alone. In contrast, women living alone had more inadequate nutrients with EAR and fewer nutrients with not-meeting DG than those living with families. A higher frequency of eating out-of-home was significantly associated with a higher prevalence of not-meeting DG nutrient levels only in the women living with their family.
Conclusions: The prevalence of nutritional adequacy varied based on living status. In addition, women living with their family and those with a high frequency of eating out-of-home foods had the highest prevalence of not-meeting DG. Effective ways of improving dietary quality among young Japanese women differ by living status.

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Introduction

Dietary habits are influenced by the household environment, such as living arrangements[1,2] and cohabitation.[1,3] In particular, living alone is one of the risk factors of malnutrition[4,5] and unfavorable dietary intakes[6–9] among middle-aged and elderly populations. Meanwhile, information on the relationship of living alone with diet is lacking among young adults. Previous studies showed that, while 26–72% of Japanese students aged ≥18 years lived with their family,[10–12] other students who lived alone had unhealthy dietary habits[11] and were at risk of becoming overweight.[12] However, these studies did not assess the dietary intakes of the subjects.

Women continue to spend much more time on household activities, including cooking (2.5 h/day), than men (0.3 h/day).[13] Additionally, the correlation of dietary intake between a mother and child is stronger than that between a father and child in many countries,[14–16] and a mother's dietary habits might affect those of her children throughout their lives.[17] Investigating the dietary intake among young women and clarifying the factors that affect their diet, including living status, is important to propose dietary

strategies for the health of not only young women themselves but also for the next generation.

Because younger age and living alone were related to less time for cooking among women,[18] young women living alone may rely on ready-made meals or may frequently eat out at restaurants. Previous studies indicated that the intake of the foods prepared or consumed out of the home was associated with increased energy intake, shortages of some micronutrients, and an increase in body weight.[19–21] Therefore, eating out-of-home foods was assumed to be one of the factors associated with unfavorable dietary intakes among young women living alone. Meanwhile, a previous study showed that frequent out-of-home eaters reported similar dietary intakes out of home and at home,[22] which suggests that the diet consumed by frequent out-of-home eaters may not be differentially influenced by the consumption of out-of-home foods. Therefore, the effect of out-of-home eating on the dietary intakes among young women living alone may be weaker than in those living with their families.

Here, we investigated the nutritional adequacy among young women living alone compared to those living with their families using a diet history questionnaire, which can assess the dietary intakes of an adult population. Further, the effect of out-of-home foods on the adequacy of nutrient intakes was also examined.

Methods

Procedure

The study was based on data from the Three-generation Study of Women on Diets and Health. This was a cross-sectional, self-administered questionnaire survey given to dietetic students (freshmen) and their mothers, grandmothers, or acquaintances from 85 institutions (universities, colleges, and technical schools) in 35 of 47 prefectures in Japan. A detailed description of the study design and survey procedure has been published elsewhere.[23,24] Briefly, a dietary assessment questionnaire and lifestyle questionnaire were distributed to a total of 7,016 dietetic students during the orientation session or a first lecture designed for freshmen in April 2011 or 2012. A total of 4,933 students, including 4,656 women and 277 men answered both questionnaires (response rate: 70.3%). The protocol of this study was approved by the Ethics Committee of the University of Tokyo Faculty of Medicine (approval number: 3249; approved on November 29, 2010). Written informed consent was obtained from all participants.

Study population

The participants analyzed in the present study were limited to the female students aged 18–20 years (n = 4,533). We excluded those participants who lived in eastern Japan and answered questionnaires in 2011 (n = 41), in consideration of the effects of the Great East Japan Earthquake in March 2011; those who answered the questionnaires on or after May 20th (n = 77), to eliminate the influence of dietetic education; those whose age, height, weight, and the frequency of eating out-of-home foods were missing (n = 10); and those with a reported energy intake less than half the energy requirement for the lowest physical activity category according to the Dietary Reference Intakes for Japanese (DRI), 2015 (<825 kcal/d; n = 59) or equal to or more than 1.5 times the energy requirement for the highest physical activity category (≥3,300 kcal/d; n = 78).[25] The participants were categorized into groups of living alone, living with their family, and living with others according to the cohabiters reported in the lifestyle questionnaire. Family members were defined as fathers, mothers, brothers, sisters, or grandparents of the participants. The participants categorized as living with others were excluded (n = 161). The final sample consisted of 4,107

adult women aged 18–20 years categorized into the following two groups: living with their family (n = 3,096) and living alone (n = 1,011).

Dietary assessment

Dietary habits during the preceding month were assessed using a self-administered diet history questionnaire (DHQ).[26–30] Details of the structure, method of calculating dietary intake, and validity for commonly studied food and nutrient intakes of the DHQ have been published elsewhere.[26–28] Briefly, the DHQ is a semi-quantitative questionnaire that can estimate intakes for a total of 151 foods and beverages. Although dietary supplement use was queried in the lifestyle questionnaire, intake from supplements was not included in the analysis due to the lack of a reliable composition table of dietary supplements in Japan.

All self-administered dietary assessments could not avoid reporting errors, especially under- or over-reporting.[31,32] In order to make the comparison of the reported nutrient intakes and the corresponding DRI values practically possible, we adjusted the reported dietary intakes based on the assumption that each subject takes her estimated energy requirement (EER) rather than her reported energy. We used the EER based on the reported physical activity level of each subject. The calculation method was as follows: Dietary intake (unit/d) = reported dietary intake (unit/d)/reported energy intake (kcal/d) × EER (kcal/d). For total fat, saturated fatty acid (SFA), and carbohydrate, a percentage from daily energy intake was calculated using crude values.

Determination of nutritional adequacy

Adequacy of each nutrient was assessed using the method reported in the previous study,[33] which was determined by comparing nutrient levels with each dietary reference value in the Japanese DRIs.[25] In the Japanese DRIs, the different types of reference values are set according to their purposes. The tentative dietary goal for preventing life-style related disease (DG) is set for preventing non-communicable diseases and the estimated average requirement (EAR) is set for avoiding insufficiency of nutrients. For five nutrients in the DG, the intake levels outside the range of corresponding DG values were considered not-meeting. For 13 nutrients in the EAR (except for iron), the intake levels below the EAR were considered inadequate using a cut-point method.[25] For iron, the cut-point method cannot be used due to the seriously skewed distribution of the requirement in menstruating women.[34–36] Therefore, probability of inadequacy >50% for menstruating women whose bioavailability of iron is 15% (<9.3 mg/d[37]) was considered as inadequate.

Other variables

In the lifestyle questionnaire, the participants reported their residential area, which was grouped into six regions (Hokkaido and Tohoku, Kanto, Hokuriku and Tokai, Kinki, Chugoku and Shikoku, or Kyushu) and also into three categories according to population size (city with a population ≥1 million, city with a population <1 million, or town and village). In the DHQ, the participants reported their date of birth and body height and weight. Body mass index was calculated as current body weight (kg) divided by the square of body height (m). The participants also reported current smoking status (yes or no) and dietary supplement use (yes or no) in the lifestyle questionnaire, along with physical activity level (low, moderate, or high), alcohol drinking (yes or no), and frequency of eating out-of-home foods (≤1 times/month, 2–3 times/month, 1–3 times/week, or ≥4 times/week) in the DHQ. Out-of-home foods

include all foods prepared at a restaurant or other food service establishments, regardless of where those were eaten. Takeaway foods and ready-made meals were considered out-of-home foods.

Statistical analysis

All statistical analyses were performed with the SAS statistical software, version 9.4 (SAS Institute Inc., Cary, NC, USA). All reported *P* values were two-tailed, with a *P* value < 0.05 considered statistically significant. Characteristics of the groups living with their family and living alone were compared using the independent samples *t*-test for continuous variables and the chi-square test for categorical variables.

The mean and standard deviation of dietary variables was calculated for each group. Significant differences of nutrient and food intakes between the groups were assessed using the independent samples *t*-test. To examine the nutritional adequacy of nutrient intakes of each group, we estimated the percentage of subjects whose intake was below the EAR or outside the range of the DG. The chi-square test was used to examine the difference of the prevalence of not-meeting DRIs.

To assess the overall nutritional adequacy of each participant, we counted the number of nutrients that did not meet the DRIs among five nutrients in the DG and 14 nutrients in the EAR. The ranges of the number of nutrients with not-meeting DRIs were 0—5

for the nutrients in the DG and 0—14 for the nutrients in the EAR. Significant differences in the numbers of nutrients with not-meeting DRIs between women living with their family and living alone were assessed using independent samples *t*-tests. Further, we examined the mean number of nutrients with not-meeting DRIs in each of four classifications of the frequency of eating out-of-home, separating the group into living with their family and living alone. We tested for linear trends with increasing levels of the frequency of eating out-of-home (times/week) by assigning the median value for the category and the number of nutrients with not-meeting DRIs as a continuous variable for each participant. Further, Dunnett's test was performed to examine the significance level, with the value of each group comparing the value of ≤1 times/month group. We also examined the food group intakes according to the frequency of eating out-of-home in the same way of the number of nutrients with not-meeting DRIs.

Results

Basic characteristics of the participants are shown in Table 1. A total of 3,096 (75%) participants were living with their family. Compared to the participants living with their family, those living alone had a lower proportion living in Kanto, Hokuriku and Tokai, and Kinki and a lower proportion living in a city with a population ≥1 million. The participants living alone had a significantly higher

Table 1
Basic characteristics of 4,107 adult women living with their family or living alone.

	Total (n = 4,107)		Living with their family (n = 3,096)		Living alone (n = 1,011)		P^a
	Mean	SD	Mean	SD	Mean	SD	
Age, years	18.1	0.3	18.1	0.3	18.2	0.4	<0.0001
Body height, cm	157.8	5.3	157.8	5.3	157.6	5.3	0.19
Body weight, kg	52.0	7.8	52.1	8.0	51.6	7.3	0.06
Body mass index, kg/m^2	20.9	2.8	20.9	2.9	20.8	2.6	0.14
Survey year, n (%)							0.41
2011	2,551 (62.1)		1,934 (62.5)		617 (61.0)		
2012	1,556 (37.9)		1,162 (37.5)		394 (39.0)		
Residential block, n (%)							<0.0001
Hokkaido and Tohoku	404 (9.8)		245 (7.9)		159 (15.7)		
Kanto	1,195 (29.1)		974 (31.5)		221 (21.9)		
Hokuriku and Tokai	847 (20.6)		666 (21.5)		181 (17.9)		
Kinki	505 (12.3)		423 (13.7)		82 (8.1)		
Chugoku and Shikoku	572 (13.9)		351 (11.3)		221 (21.9)		
Kyushu	584 (14.2)		437 (14.1)		147 (14.5)		
Size of residential area, n (%)							<0.0001
City with a population ≥1 million	777 (18.9)		641 (20.7)		136 (13.5)		
City with a population <1 million	3,004 (73.1)		2,223 (71.8)		781 (77.3)		
Town and village	326 (7.9)		232 (7.5)		94 (9.3)		
Current smoking, n (%)							0.54
No	4,098 (99.8)		3,090 (99.8)		1,008 (99.7)		
Yes	9 (0.2)		6 (0.2)		3 (0.3)		
Alcohol drinking, n (%)							0.06
No	3,839 (93.5)		2,907 (93.9)		932 (92.2)		
Yes	268 (6.5)		189 (6.1)		79 (7.8)		
Dietary supplement use, n (%)							0.21
No	3,832 (93.3)		2,880 (93.0)		952 (94.2)		
Yes	275 (6.7)		216 (7.0)		59 (5.8)		
Physical activity level, n (%)							0.08
Level I (low)	2,770 (67.5)		2,101 (67.9)		669 (66.2)		
Level II (moderate)	1,271 (31.0)		939 (30.3)		332 (32.8)		
Level III (high)	66 (1.6)		56 (1.8)		10 (1.0)		
Eating out-of-home foods, n (%)							0.005
≤1 times/month	412 (10.0)		316 (10.2)		96 (9.5)		
2—3 times/month	1,349 (32.9)		1,020 (33.0)		329 (32.5)		
1—3 times/week	1,682 (41.0)		1,295 (41.8)		387 (38.3)		
≥4 times/week	664 (16.2)		465 (15.0)		199 (19.7)		
Energy intake, kcal/d	1,703	456	1,746	458	1,572	424	<0.0001

SD, standard deviation.
[a] Means for continuous values were compared using an independent samples *t*-test, and proportions for categorical values were compared using the chi-square test between living with their family and living alone.

frequency of eating out-of-home foods than did those living with their families.

For nutrient intake, only carbohydrate intake was significantly higher in the participants living alone than in those living with their families (Table 2). The intakes of all the other nutrients examined, except for copper, were significantly lower in the participants who were living alone than in those living with their families. The participants living with their families had a significantly higher prevalence of not-meeting DG for total fat, SFA, and sodium than did those living alone. Only total dietary fiber had a higher prevalence of not-meeting DG in the participants living alone than in those living with their families. Meanwhile, the living alone group showed a significantly higher percentage of participants who did not meet the EAR than did those who were living with their families for almost all the nutrients in the EAR.

The mean number of nutrients with not-meeting DG was 3.3 for those living with their family and 2.9 for those living alone (Fig. 1). The participants living with their families had a significantly higher number of nutrients with not-meeting DG ($P < 0.0001$). Meanwhile, the mean number of inadequate nutrients in the EAR was 6.0 for those living with their families and 7.1 for those living alone. For the nutrients in the EAR, the participants living alone had a significantly higher number of inadequate nutrients than did those living with their families ($P < 0.0001$).

Fig. 2 shows the relationship between the frequency of eating out-of-home foods and the number of nutrients with not-meeting DRIs. In the living with their family group, the number of nutrients with not-meeting DG was positively associated with the frequency of eating out-of-home foods (P for trend < 0.0001). For the nutrients in the EAR, no association of the frequency of eating out-of-home with the number of inadequate nutrients was observed (P for trend = 0.47). In the living alone group, there were no

associations between the number of nutrients with not-meeting DRIs and the frequency of eating out-of-home foods for the nutrients in the DG (P for trend = 0.55) or EAR (P for trend = 0.17).

The associations between the frequency of eating out-of-home foods and food group intakes among the women living with family and living alone are shown in eFig. 1. In the group living with family, higher frequency of eating out-of-home was significantly associated with higher intakes of noodles, confectionaries, and soft drinks, and lower intakes of vegetables. These associations were weakly or not significantly observed in the women living alone. Meanwhile, bread intake was significantly positively and rice intake was significantly negatively associated with the frequency of eating out-of-home foods in both groups. The intakes of nuts and pulses, potatoes, fruits, fish and shellfish, meats, eggs, and dairy products were not associated with the frequency of eating out-of-home foods in either group.

Discussion

In this study, young Japanese women living with their families had a higher prevalence of not-meeting DG for total fat, SFA, and sodium than did those living alone. The number of nutrients with not-meeting DG for the women living with their families was higher than for those living alone. Meanwhile, the women living alone had a higher prevalence of inadequate intakes for almost all the nutrients in the EAR. The number of inadequate nutrients in the EAR for the women living alone was higher than for those living with their families. The frequency of eating out-of-home foods was associated with the number of nutrients with not-meeting DG only among the women living with their families. In young women living alone, no association was observed between the frequency of eating out-of-home foods and nutritional adequacy. This is the first

Table 2
Daily nutrient intakes and prevalence of not-meeting DG and EAR among 4,107 adult women living with their family or living alone.[a]

	Reference value[b]	Living with their family (n = 3,096)			Living alone (n = 1,011)			P[d]
		Mean	SD	Not-meeting DRIs[c] (%)	Mean	SD	Not-meeting DRIs[c] (%)	
Nutrients with DG								
Total fat, % energy	20–30	30.0	6.0	54.6	27.4	6.3	45.2	<0.0001
SFA, % energy	≤7	8.48	2.22	73.8	7.77	2.21	61.5	<0.0001
Carbohydrate, % energy	50–65	55.6	7.0	30.1	58.7	7.2	27.5	0.11
Total dietary fiber, g	≥18	11.0	3.8	95.2	10.7	3.5	96.7	0.04
Sodium (salt-equivalent), g	<7	9.56	3.84	73.8	8.35	3.50	60.3	<0.0001
Nutrients with EAR								
Protein, g	≥40	58.0	10.8	2.9	54.5	10.4	5.3	0.0003
Vitamin A, μgRE[e]	≥450	496	360	58.0	418	329	70.2	<0.0001
Vitamin B$_1$, mg	≥0.9	0.73	0.19	84.3	0.67	0.18	89.8	<0.0001
Vitamin B$_2$, mg	≥1.0	1.19	0.35	30.7	1.08	0.34	45.7	<0.0001
Niacin, mgNE[f]	≥9	22.1	5.3	0	19.7	5.0	0	–
Vitamin B$_6$, mg	≥1.0	0.92	0.28	69.0	0.81	0.28	81.4	<0.0001
Vitamin B$_{12}$, μg	≥2.0	5.05	2.64	5.6	3.75	2.36	21.5	<0.0001
Folate, μg	≥200	266	97	24.6	234	83	40.4	<0.0001
Vitamin C, mg	≥85	85.2	42.7	58.5	71.0	36.4	72.8	<0.0001
Calcium, mg	≥550	437	173	79.7	423	174	81.4	0.23
Magnesium, mg	≥230	201	53	77.2	191	53	83.4	<0.0001
Iron, mg[g]	≥8.5	6.49	1.72	93.7	6.00	1.67	95.9	0.01
Zinc, mg	≥6	7.10	1.17	16.7	6.82	1.18	25.2	<0.0001
Copper, mg	≥0.6	0.99	0.20	0.6	0.99	0.20	0.7	0.69

DG, tentative dietary goal for preventing lifestyle-related disease; DRI, Dietary Reference Intakes; EAR, estimated average requirement; NE, niacin equivalents; PUFA, polyunsaturated fatty acid; RE, retinol equivalents; SD, standard deviation; SFA, saturated fatty acid.
  [a] Adjustment of reporting error was performed according to the following equation: Nutrient intake (unit/d) = reported nutrient intake (unit/d)/reported energy intake (kcal/d) × estimated energy requirement (EER, kcal/d). All nutrient intakes, except for copper, were significantly different between women living with their family and living alone ($P < 0.05$; independent samples t-test).
  [b] DRIs for non-pregnant Japanese females aged 18–29 years old.
  [c] Percentage of subjects whose nutrient intake was not meeting DG or EAR. Each nutrient intake was compared with each DRI value using the cut-point method.
  [d] The prevalence of not-meeting DRIs was compared using chi-square test between those living with their family and living alone.
  [e] Sum of retinol, β-carotene/12, α-carotene/24, and cryptoxanthin/24.
  [f] Sum of niacin and protein/6,000.
  [g] The probability of inadequacy >50% for menstruating women whose bioavailability of iron is 15% (<9.3 mg/d[37]) was considered inadequate.
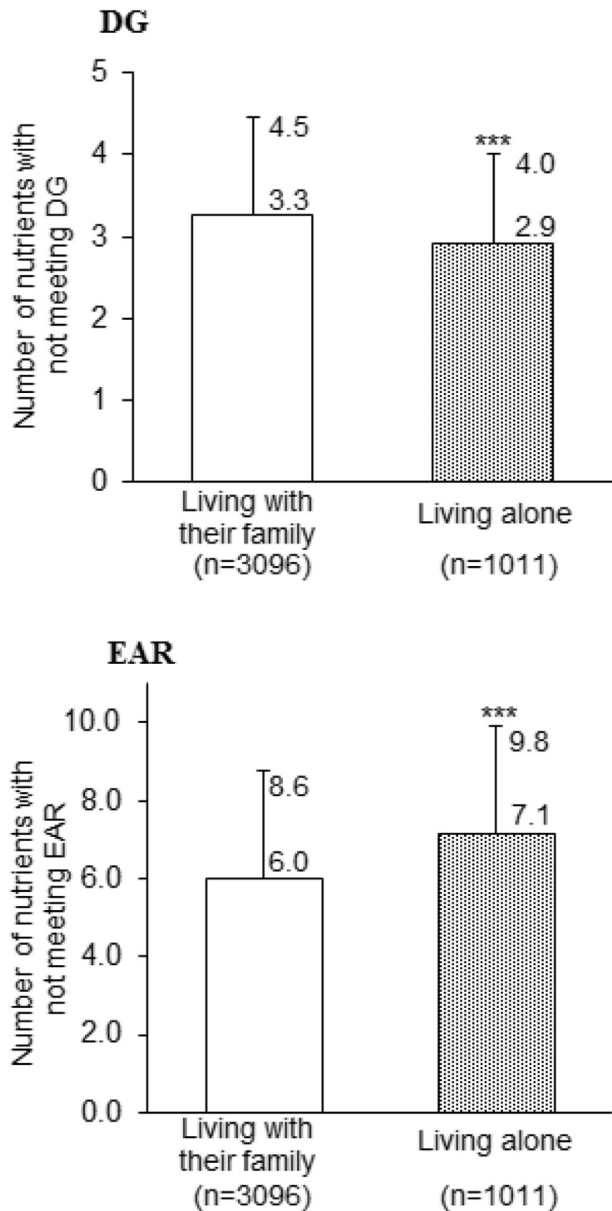
DG

EAR

Fig. 1. The number of nutrients with not-meeting DG and EAR among 4,107 adult women living with their family or living alone. Significance of each value was compared using independent *t*-test (***$P < 0.001$). DG, tentative dietary goal for preventing lifestyle-related disease; EAR, estimated average requirement.

study to examine nutrient intakes among young adults living alone compared to those living with their families and showed that the effect of out-of-home foods on nutrient intake was different between young women living with their families and those living alone.

Although the previous studies, which suggested that college students living alone had unhealthy dietary habits,[11,12] did not assess dietary intakes among the students living alone, we assessed the dietary intakes among female students living alone and compared the nutritional adequacy of participants living alone to those living with their families. Our results suggest that interventions to improve nutritional adequacy for the younger generation should be different for those living with and without their families. The nutrients in the DG have reference values of the upper limit for preventing non-communicable diseases.[25] Therefore, the young women living with their families should be careful to avoid

excess intake of these nutrients. Meanwhile, the nutrients in the EAR are set at a lower limit as reference values for avoiding insufficiency of these nutrients.[25] The young women living alone should increase their intake of micronutrients for which Japanese people are susceptible to experiencing an insufficiency.

Previous studies showed that eating out of the home or eating prepared meals was associated with a higher intake of total energy and energy from fat and a lower intake of micronutrients,[21,38] as well as anthropometric changes, including weight gain.[19,20] In our present study, eating out-of-home foods was associated with nutrient adequacy for only the nutrients in the DG among the participants living with their families. This result may be caused by higher intakes of confectionaries and soft drinks in the women frequently eating out-of-home foods. Since a young adult living with his or her family and frequently eating out-of-home foods may have as much fat and sodium as found in previous studies,[21,38] decreasing the frequency of eating out-of-home foods may be one of the strategies for preventing the intake of excess fat and sodium. However, the participants living alone had a higher number of inadequacies for the nutrients in the EAR than did those living with their families, and the frequency of eating out-of-home foods was not associated with the number of nutrients with not-meeting DRIs. The participants living alone would naturally cook their own meals when they eat homemade meals. Young women may be inexperienced cooks, and their cooking skills may still be developing. They might therefore cook meals similar to out-of-home foods that do not contain adequate micronutrients. Although cooking frequently at home was associated with healthier dietary intakes in a previous study,[39] another study showed that cooking skills were also associated with healthier dietary habits.[40] Therefore, reducing the frequency of eating out-of-home foods and increasing cooking may not necessarily improve the dietary quality among young women living alone. After the young women understand the importance of a healthy diet and achieve the ability to select a favorable diet, recommending that the food industry sell reasonable healthy meals, which contain plenty of micronutrients and less fats, and improving food labeling may be more effective dietary strategies for improving the overall dietary quality among young women living alone, rather than merely decreasing the frequency of eating out-of-home foods. Further, developing cooking skills to make meals from an abundant variety of foods may promote the improvement of overall dietary quality for young women.

The major strength of the present study was its evaluation of dietary intake in a large number of participants using multicenter epidemiological data. In particular, the participants lived over a wide geographical range of Japan and had a variety of dietary and lifestyle habits.

Several limitations of this study also warrant mention. First, the validity of estimating intakes of many nutrients with the DHQ used in the present study was previously examined among subjects aged 31–69 years, not young women aged 18–20 years.[26–28] However, one validation study suggested that the DHQ had reasonable ability to estimate sodium and potassium intakes among young women.[29] Further, the validity of the intakes of comprehensive foods and nutrients estimated using the DHQ was similar between the age groups among the adult women who were the same subjects of the previous validation study.[26,27] The median Spearman's correlation coefficients of foods were 0.37 for women aged 30–39 years, 0.43 for those aged 40–49 years, 0.38 for those aged 50–59 years, and 0.34 for those aged 60–69 years, and median Pearson's correlation coefficients of nutrients were 0.50 for women aged 30–39 years, 0.52 for those aged 40–49 years, 0.49 for those aged 50–59 years, and 0.36 for those aged 60–69 years (S. Kobayashi, unpublished observations, 2016). Also, similar intakes were observed in the
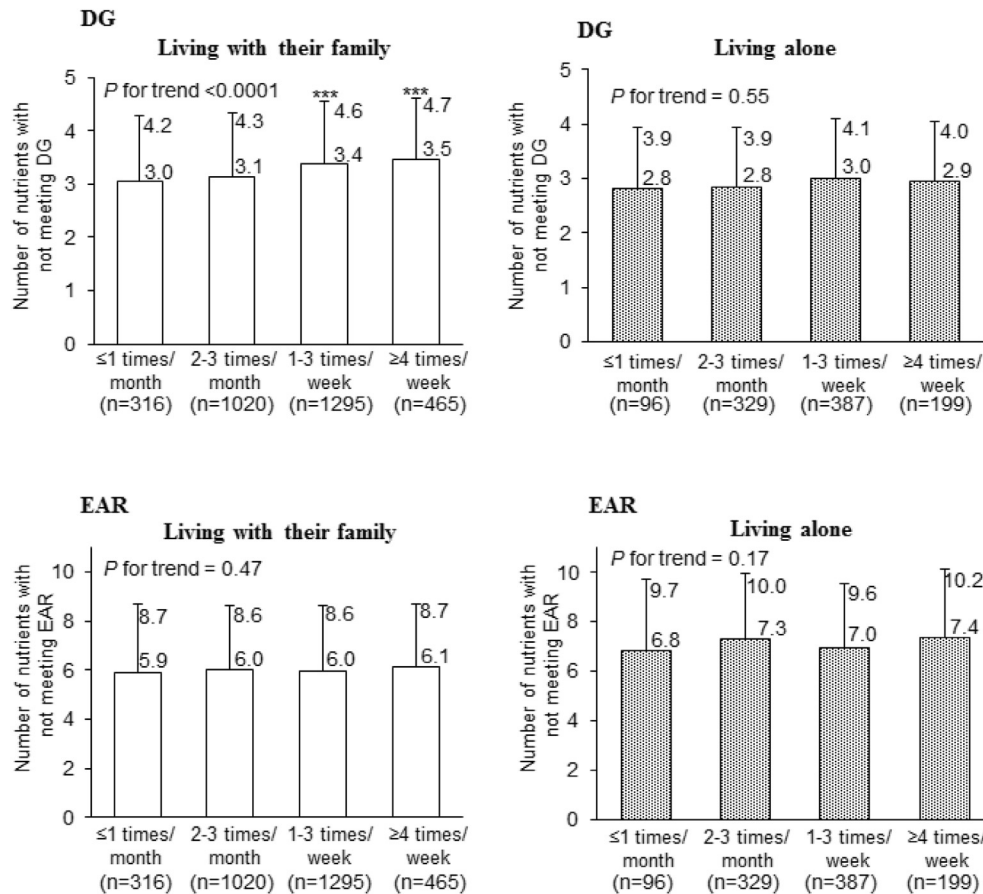
Fig. 2. The number of nutrients with not-meeting DG and EAR according to the frequency of eating out-of-home foods among 4,107 adult women living with their family or living alone. A linear trend test was used with the median value in each category of the frequency of eating out-of-home foods (0.2, 0.6, 2.5, and 5.0 times/week for those living with their family and 0.2, 0.6, 1.0, and 5.0 times/week for those living alone, respectively) as a continuous variable in linear regression. Significance level with a value of ≤1 times/month was compared using Dunnett's test (***P < 0.001). DG, tentative dietary goal for preventing lifestyle-related disease; EAR, estimated average requirement.

women aged 20–29 years and 30–39 years from the National Health and Nutrition Survey in Japan, 2014.[41] These results may indicate that the DHQ can assess dietary intakes among young women aged about 20 years.

Second, the participants answered the questionnaires during April and May. Although most of the participants provided information on their dietary intakes from late April to May 20th, 23% of the participants living alone supplied dietary intake information during the previous month before mid-April. Therefore, their dietary intakes might contain information during which they were still living with their family, because April is when students in Japan enter school and experience new living arrangements. However, similar results were obtained when we excluded the participants who answered the questionnaires before mid-April (data not shown).

Third, the group of students living alone possibly contained those living in a dormitory where all meals are served. Although we should have excluded these participants, our questionnaire did not collect information on whether they lived in a dormitory or not. However, we did observe significant differences in dietary intake among the women living with their families and those living alone. Excluding the participants living in a dormitory might have more clearly revealed the differences of the intakes between those living with their families and those living alone.

Fourth, all our present participants were female dietetic students and were thus not a random sample of Japanese adult women. Not all Japanese adolescents enter college or university

(enrollment ratio, 57%[42]), and all the participants might therefore have relatively high social and economic status. Thus, our results might not be capable of being extrapolated to represent the general population of Japanese young adults.

Finally, we used adjusted nutrient intakes to compare DRI values when considering possible under- or over-reporting of the nutrient intakes. However, the scientific justification of the adjustment in the present study is scarce.

In conclusion, reducing the use of out-of-home foods may be an effective way to improve the dietary quality in women living with their families. For women living alone, achieving the ability to select a favorable diet and the accessibility of healthy meals may be better dietary strategies to improve dietary habits, rather than decreasing the use of out-of-home foods. Further studies that carefully examine the dietary intake among young women are needed before recommendations for improving their dietary habits can be made.

Conflicts of interest

None declared.

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women: a multicenter cross-sectional study. Nutr J 2013; 12: 164. This study was supported by JSPS KAKENHI Grant Number 22240077 from the Japan Society for the Promotion of Science.

Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.je.2016.07.002.

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