

Which Consumers are Least Likely to Have a Balanced Diet in Japan?

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ABSTRACT

There have been only a few large-scale nationwide studies regarding the frequency of eating a balanced diet consisting of staple food, the main dish, and side dishes in Japan. Therefore, this study aimed to clarify factors affecting the frequency of eating a balanced meal that consists of staple food, the main dish, and side dishes twice a day. We analyzed the secondary data of 13,772 responses from the 7-year pooled cross-sectional data of the nationwide Surveys of Attitudes toward *Shokuiku* (Food and Nutrition Education) by the Cabinet Office and the Ministry of Agriculture, Forestry and Fisheries of Japan. Ordered logit regression was used to find factors affecting the frequency of having a balanced diet. Our estimation results suggested that gender, age, cohabitation, eating meals with family, subjective economic status, and residential area could be factors affecting the probability of having balanced meals every day. In conclusion, single men in their 20s-50s, single men in their 80s, older male adults living but not eating together with family, single women in their 20s-30s, and individuals with low economic status were identified as high-risk groups who did not have a balanced diet in Japan.

Moreover, we found that the government health promotion program called *Kenko Nippon 2013* (Health Japan 21, the second term) did not improve the dietary behavior of the consumer in Japan.

ARTICLE INFO

Article history:

Received: 4 August 2020

Accepted: 3 November 2020

Published: 26 March 2021

DOI: <https://doi.org/10.47836/pjssh.29.1.23>

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Keywords: Balanced diet, cohabitation, Japan, Ordered logit, *Shokuiku* (food and nutrition education)

INTRODUCTION

It has been well documented that, along with tobacco use, insufficient physical activity, and harmful alcohol consumption, a diet that is not nutritionally diverse or balanced causes noncommunicable diseases (World Health Organization [WHO], 2011), such as cardiovascular or metabolic diseases (Micha et al., 2017), some forms of cancer (Vieira et al., 2016), and chronic obstructive pulmonary disease (Schols et al., 2014), and aggravates frailty in later life (Wang et al., 2020). Meanwhile, food and nutritional interventions may promote healthy eating behaviors and improve the quality of life (Cecchini et al., 2010; Krishnan & Zhou, 2019; Zhou et al., 2018). Therefore, the report by WHO (2011) has recommended the implementation of government interventions aimed at improving nutritional health. Detailed targets have been set and nutritional intervention programs carried out in many countries, including Japan.

Since 2013, the Japanese government has implemented the health promotion program called *Kenko Nippon 21*, or Health Japan 21 (the second term). The program encourages eating a balanced diet consisting of staple food, main dish, and side dish more than twice a day to increase fruit and vegetable intake, prevent both obesity/overweight and underweight irrespective of age and gender, and thereby prevent and control non-communicable diseases. The program targets to increase the proportion of individuals who eat a balanced diet to 80% by 2022, but the rate had been fluctuating from a highest of 68.1% (2013) to a lowest

of 57.7% (2017) between 2013 and 2018, which is far below the target (Health Science Council, 2018). Such a situation indicates the need for researchers as well as policymakers to identify high-risk groups who do not eat a balanced diet and clarify the factors affecting dietary behavior among Japanese consumers.

To our knowledge, however, there have been only a few studies regarding the frequency of eating a balanced diet comprising a staple food, main dish, and side dish, based on nationwide surveys with a large sample size. Therefore, this study aimed to clarify the factors affecting the frequency of eating balanced meals by analyzing the 7-year pooled cross-sectional data of the nationwide Surveys of Attitudes toward *Shokuiku* (Food and Nutrition Education) by the Cabinet Office and the Ministry of Agriculture, Forestry and Fisheries of Japan.

MATERIALS AND METHODS

In 2005, the *Shokuiku* Basic Act was promulgated in Japan to promote food and nutrition education to encourage the public to eat a healthy diet. In the same year, a preliminary Special Public Opinion Survey on *Shokuiku* was conducted by the Cabinet Office to collect basic information on public awareness about food and nutrition practices. The survey was followed by the nationwide Survey of Attitudes toward *Shokuiku*, which has been conducted by the Japanese government annually since 2007. Individual secondary data of adults aged ≥ 20 years from the

surveys conducted after 2007 are available upon personal request from the Center for Social Research and Data Archives, Institute of Social Science, the University of Tokyo, but we only used the pooled cross-sectional data of 2009, 2011, 2012, and 2014-2017 surveys from which all necessary information for analysis were available. The government used a two-stage stratified random sampling method to select 5,000 participants from 2009 and 3,000 participants aged ≥ 20 years from each other year, considering that the number of people interviewed was proportional to the population ratio of each prefecture. Although the provided individual datasets were not longitudinal, the credibility of the respondents' answers seemed acceptable for quantitative analysis because trained staff conducted face-to-face interviews with those who agreed to participate. Of the total number of 23,000 participants, the number of respondents was 13,851, of whom 13,772 provided adequate data and were included for further analyses. Ethical approval was not required for this secondary analysis of publicly available data.

It has been reported that the frequency of eating the main dish, main side dishes, and sub-side dishes during a meal is positively associated with subjective quality of life in Japan (Ainuki et al., 2013). Moreover, it has been found that eating a main dish, main side dishes, and sub-side dishes during a meal more than twice a day can increase vegetable consumption among the middle-aged Japanese population (Ozawa et al., 2018) and pregnant Japanese women

(Hayashi et al., 2020). Therefore, we used the responses from the following question for analysis: "How many days on average per week do you eat the main dish (an energy source of carbohydrates such as rice, bread, or noodles), main side dishes (the main source of protein and fat such as fish, meat, eggs, or soybean products), and sub-side dishes (source of vitamins, minerals, and fiber, which are limited in main dishes and main side dishes) during a meal more than twice a day?" Given that the responses regarding the eating frequency were ordinal in nature (4 = almost every day, 3 = 4-5 days/week, 2 = 2-3 days/week, 1 = ≤ 1 day/week), ordered logit regression was used to obtain the predicted probability to analyze the factors that determine the extent of eating a balanced diet in Japan. All data were analyzed with STATA version 16.0, using 95% confidence intervals (CIs) and a significance level of 0.05.

After confirming a lack of multicollinearity between independent variables, the following categories were formulated: a dummy-coded gender variable (man and woman), a dummy-coded age variable (20-29, 30-39, 40-49, 50-59, 60-69, 70-79, and ≥ 80 years old), a dummy-coded variable for cohabitation and eating with family (single, living but not eating with family, and living and eating with family), a dummy-coded variable for self-reported economic condition measured on a 5-point Likert scale (very bad, bad, so-so, good, and very good), a dummy-coded variable for the region (Eastern Japan excluding the Kanto region, Kanto region, Kinki

region, and Western Japan excluding the Kinki region), a dummy-coded variable for residence (ordinance-designated city, city with >100,000 people, city with <100,000 people, and village/town), and a dummy-coded variable for the government health promotion program (before and after the introduction of *Kenko Nippon 2013*). The frequency of each independent variable is shown in Table 1.

According to the 2015 National Health and Nutrition Survey in Japan (Ministry of Health, Labour and Welfare, 2017), the rate of having ≥ 350 g of vegetable intake per day – which is the government’s target for promoting a healthy dietary life – is

considerably high, at approximately 20%, for respondents who eat the main dish, main side dishes, and sub-side dishes every day. Conversely, for the rest of the sample, the rate of eating ≥ 350 g of vegetables per day was $\leq 5.5\%$, clearly indicating that whether a respondent eats a nutritionally balanced diet every day or not is related to the amount of vegetable intake in Japan. Therefore, we divided the samples into two categories based on whether the individual eats a nutritionally balanced diet every day or not. The predicted probability of eating a balanced diet “almost every day” was used for further discussion below.

Table 1
Summary of independent variables

Variable	Frequency	%
<i>Gender</i>		
Female	7,593	55.1
Male	6,179	44.9
<i>Age</i>		
20s	1,099	8.0
30s	1,857	13.5
40s	2,402	17.4
50s	2,393	17.4
60s	3,093	22.5
70s	2,213	16.1
80s	715	5.2
<i>Cohabitation and eating with family</i>		
Single	1,222	8.9
Living and eating with family	8,138	59.1
Living but not eating with family	4,412	32.0

Table 1 (Continued)

Variable	Frequency	%
<i>Subjective economic status</i>		
Very bad	563	4.1
Bad	2,669	19.4
So-so	4,639	33.7
Good	4,364	31.7
Very good	1,537	11.2
<i>Region</i>		
Eastern Japan excluding the Kanto region	4,450	32.3
Kanto region	4,290	31.2
Kinki region	2,085	15.1
Western Japan excluding the Kinki region	2,947	21.4
<i>Population size</i>		
Ordinance-designated city	3,348	24.3
City with >100,000 people	5,749	41.7
City with <100,000 people	3,235	23.5
Village/town	1,440	10.5
<i>Health promotion program</i>		
Before the introduction of <i>Kenko Nippon 2013</i>	6,554	47.6
After implementing the program in 2013	7,218	52.4
Total	13,772	100.0

Note: Authors' calculation

RESULTS

The predicted probability of eating a nutritionally balanced diet daily was 0.600 (CI: 0.588-0.612) for men and 0.660 (CI: 0.650-0.670) for women, suggesting that women were more likely to eat a nutritionally balanced diet than men (see Table 2; the estimation results of the ordered logit regression are also shown in Appendix 1). As for age regardless of gender, the predicted probability consistently increased

with age, from 0.424 (CI: 0.397-0.452) for individuals in their 20s to 0.744 (CI: 0.723-0.764) for individuals in their 70s, and slightly decreased to 0.722 (CI: 0.686-0.759) for individuals in their 80s and above. However, we noted a wide gender difference in the tendency to eat a balanced diet daily, especially for older adults. Although the probability for men increased with age, peaking at 0.731 (CI: 0.702-0.761) in the 70s and decreasing to 0.648 (CI: 0.593-0.703) in

Table 2
Predicted probability of eating a balanced diet twice a day

	Predicted probability	95% confidence interval	
		Lower limit	Upper limit
<i>Gender</i>			
Female	0.660	0.650	0.670
Male	0.600	0.588	0.612
<i>Age</i>			
20s	0.424	0.397	0.452
30s	0.503	0.482	0.524
40s	0.582	0.563	0.601
50s	0.640	0.622	0.659
60s	0.705	0.689	0.721
70s	0.744	0.723	0.764
80s	0.722	0.686	0.759
<i>Gender × age</i>			
Female			
20s	0.435	0.399	0.470
30s	0.513	0.486	0.540
40s	0.618	0.593	0.644
50s	0.672	0.647	0.697
60s	0.744	0.722	0.766
70s	0.753	0.725	0.781
80s	0.797	0.751	0.843
Male			
20s	0.410	0.366	0.455
30s	0.492	0.458	0.526
40s	0.539	0.509	0.569
50s	0.606	0.578	0.633
60s	0.659	0.635	0.682
70s	0.731	0.702	0.761
80s	0.648	0.593	0.703

Table 2 (Continued)

	Predicted probability	95% confidence interval	
		Lower limit	Upper limit
<i>Cohabitation and eating together</i>			
Single	0.426	0.399	0.453
Living and eating with family	0.691	0.681	0.701
Living but not eating with family	0.576	0.561	0.591
<i>Gender × cohabitation and eating with family</i>			
Female			
Single	0.508	0.469	0.547
Living and eating with family	0.706	0.693	0.718
Living but not eating with family	0.611	0.590	0.632
Male			
Single	0.325	0.291	0.359
Living and eating with family	0.673	0.657	0.689
Living but not eating with family	0.532	0.511	0.553
<i>Cohabitation and eating together × age</i>			
Single			
20s	0.169	0.121	0.216
30s	0.202	0.142	0.261
40s	0.330	0.251	0.410
50s	0.452	0.377	0.528
60s	0.553	0.499	0.606
70s	0.573	0.514	0.631
80s	0.637	0.560	0.713
Living and eating with family			
20s	0.483	0.440	0.526
30s	0.570	0.540	0.600
40s	0.644	0.617	0.670
50s	0.704	0.680	0.728
60s	0.758	0.740	0.776
70s	0.802	0.782	0.821
80s	0.814	0.778	0.850

Table 2 (Continued)

	Predicted probability	95% confidence interval	
		Lower limit	Upper limit
Living but not eating with family			
20s	0.383	0.347	0.419
30s	0.463	0.430	0.495
40s	0.540	0.511	0.568
50s	0.581	0.551	0.611
60s	0.653	0.619	0.687
70s	0.685	0.635	0.735
80s	0.602	0.516	0.687
<i>Gender × cohabitation and eating together × age</i>			
Female × single			
20s	0.153	0.084	0.223
30s	0.196	0.104	0.287
40s	0.412	0.283	0.542
50s	0.607	0.485	0.728
60s	0.644	0.574	0.714
70s	0.655	0.594	0.716
80s	0.822	0.752	0.892
Female × living and eating with family			
20s	0.502	0.449	0.555
30s	0.575	0.540	0.610
40s	0.671	0.640	0.702
50s	0.706	0.676	0.736
60s	0.788	0.765	0.812
70s	0.804	0.777	0.831
80s	0.812	0.760	0.863
Female × living but not eating with family			
20s	0.386	0.336	0.436
30s	0.484	0.436	0.532
40s	0.579	0.538	0.620
50s	0.627	0.586	0.669
60s	0.691	0.643	0.739
70s	0.688	0.618	0.758
80s	0.763	0.657	0.869

Table 2 (Continued)

	Predicted probability	95% confidence interval	
		Lower limit	Upper limit
<i>Male × single</i>			
20s	0.187	0.127	0.248
30s	0.210	0.142	0.278
40s	0.229	0.153	0.305
50s	0.263	0.186	0.339
60s	0.441	0.359	0.523
70s	0.471	0.365	0.578
80s	0.410	0.262	0.557
<i>Male × living and eating with family</i>			
20s	0.460	0.390	0.529
30s	0.563	0.512	0.615
40s	0.610	0.566	0.654
50s	0.701	0.662	0.740
60s	0.720	0.693	0.748
70s	0.799	0.770	0.827
80s	0.817	0.767	0.868
<i>Male × living but not eating with family</i>			
20s	0.379	0.328	0.430
30s	0.436	0.394	0.478
40s	0.492	0.453	0.530
50s	0.524	0.480	0.567
60s	0.606	0.559	0.653
70s	0.681	0.612	0.750
80s	0.403	0.263	0.544
<i>Subjective economic status</i>			
Very bad	0.512	0.476	0.549
Bad	0.570	0.553	0.587
So-so	0.627	0.614	0.640
Good	0.674	0.661	0.687
Very good	0.699	0.677	0.721

Table 2 (Continued)

	Predicted probability	95% confidence interval	
		Lower limit	Upper limit
<i>Region</i>			
Eastern Japan excluding the Kanto region	0.645	0.631	0.658
Kanto region	0.629	0.615	0.643
Kinki region	0.628	0.609	0.646
Western Japan excluding the Kinki region	0.620	0.604	0.636
<i>Population size</i>			
Ordinance-designated city	0.637	0.621	0.652
City with >100,000 people	0.624	0.612	0.635
City with <100,000 people	0.646	0.630	0.661
Village/town	0.621	0.596	0.646
<i>Region × population size</i>			
Eastern Japan excluding the Kanto region			
Ordinance-designated city	0.625	0.595	0.655
City with >100,000 people	0.629	0.608	0.650
City with <100,000 people	0.679	0.655	0.702
Village/town	0.675	0.641	0.709
Kanto region			
Ordinance-designated city	0.636	0.614	0.658
City with >100,000 people	0.638	0.619	0.658
City with <100,000 people	0.607	0.574	0.640
Village/town	0.622	0.567	0.677
Kinki region			
Ordinance-designated city	0.654	0.619	0.689
City with >100,000 people	0.588	0.560	0.617
City with <100,000 people	0.703	0.663	0.743
Village/town	0.553	0.483	0.623
Western Japan excluding the Kinki region			
Ordinance-designated city	0.643	0.604	0.681
City with >100,000 people	0.620	0.596	0.645
City with <100,000 people	0.612	0.582	0.642
Village/town	0.586	0.544	0.628

Table 2 (Continued)

	Predicted probability	95% confidence interval	
		Lower limit	Upper limit
<i>Health promotion program</i>			
Before the introduction of <i>Kenko Nippon 2013</i>	0.673	0.663	0.683
After implementing the program in 2013	0.597	0.586	0.607

Note: All values of predicted probability are significant at 1%.

the 80s, it consistently increased with age, from 0.435 (CI: 0.399-0.470) for the 20s to 0.797 (CI: 0.751-0.843) for the 80s, for women. Thus, the difference in probability between men and women of the same age was greatest in their 80s.

As for cohabitation and eating meals with family, the probability of eating a balanced diet daily was 0.426 (CI: 0.399-0.453) for single individuals, 0.691 (CI: 0.681-0.701) for individuals living and eating with family, and 0.576 (CI: 0.561-0.591) for individuals living but not eating with family. These estimation results indicate that not only single individuals but also those living but not eating with family were more likely to eat a nutritionally unbalanced diet than those living and eating with family. The differences between these three individual categories were on average greater for men than for women, and single men had the lowest predicted probability of 0.325 (CI: 0.291-0.359) and women living and eating with the family the highest probability of 0.706 (CI: 0.693-0.718).

Considering gender, cohabitation, and eating meals with family, and age altogether,

we could observe a clear gender difference in the tendency to eat a balanced diet twice a day for older adults. The probability for single men was lowest at 0.187 (CI: 0.127-0.248) in the 20s, increased with age, peaked at 0.471 (CI: 0.365-0.578) in the 70s, and decreased to 0.410 (CI: 0.262-0.557) in the 80s. As for men living but not eating meals with family, the probability increased with age, from 0.379 (CI: 0.328-0.430) in the 20s to 0.681 (CI: 0.612-0.750) in the 70s, but drastically decreased to 0.403 (CI: 0.263-0.544) in the 80s. In contrast, the probability consistently increased with age, from 0.153 (CI: 0.084-0.223) and 0.386 (CI: 0.336-0.436) for the 20s to 0.822 (CI: 0.752-0.892) and 0.763 (CI: 0.657-0.869) for the 80s, for single women and women living but not eating meals with family, respectively.

Irrespective of gender, individuals who were living and eating meals with family were more likely to eat balanced meals as they get older. In addition, the predicted probability of eating a healthy balanced diet was higher at almost all ages among these individuals than among single individuals or those living but not eating with family.

We also noted the following two points. First, given that all probabilities for single women in their 20s-30s and single men in their 20s-50s were below 0.3, the majority of young single individuals and middle-aged single men were the least likely to eat a balanced meal every day. Second, more than half of single men over their 60s and men over their 80s who were living but not eating with their family were also less likely to eat a balanced meal every day.

In terms of subjective economic status, the probabilities of eating a healthy balanced diet among individuals at the bottom two categories of economic status were 0.512 (CI: 0.476-0.549) and 0.570 (CI: 0.553-0.587), while those for the top two categories were 0.674 (CI: 0.661-0.687) and 0.699 (CI: 0.677-0.721). These findings suggest that the higher the individual's economic status, the greater the predicted probability of eating a balanced diet.

The predicted probabilities by region were 0.645 (CI: 0.631-0.658) for Eastern Japan excluding the Kanto region, 0.629 (CI: 0.615-0.643) for the Kanto region, 0.628 (CI: 0.609-0.646) for the Kinki region, and 0.620 (CI: 0.604-0.636) for Western Japan excluding the Kinki region. These results suggest that respondents residing in Eastern Japan excluding the Kanto region were slightly more likely to eat a balanced meal than those in other regions. Considering both the region and population size of the residential area, we found that the predicted probability for Eastern Japan excluding the Kanto region increased as the population size decreased, with high

values being 0.679 (CI: 0.655-0.702) for a city with a population of <100,000 and 0.675 (CI: 0.641-0.709) for a village/town with the smallest population. However, the probability generally decreased as the population size decreased in Western Japan, and was the lowest in a village/town with the smallest population (0.553 [CI: 0.483-0.623] in the Kinki region and 0.586 [CI: 0.544-0.628] in Western Japan excluding the Kinki region). Among the four regions, the Kanto region had the narrowest range of probability (0.607-0.638) of eating a healthy balanced diet according to the population size.

The predicted probability before *Kenko Nippon 2013* was introduced was 0.673 (CI: 0.663-0.683), and that after 2013 was 0.597 (CI: 0.586-0.607). These findings suggest that the government health promotion program was not effective in improving the dietary behavior of Japanese consumers.

DISCUSSION

This study showed that men were less likely to eat a nutritionally balanced diet than women. This result is consistent with findings by previous studies pointing out that men tend to engage in more unfavorable dietary practices than women, such as breakfast skipping (Arimune et al., 2012; Mishra et al., 2017), nutritionally unbalanced diet (Mishra et al., 2017), and over-intake of fat, sugar, and salt (Mishra et al., 2017). Women were also reported to be less likely to practice poor dietary habits (Fukuda et al., 2005) and showed more positive attitudes toward healthy eating

(Ainuki et al., 2013; Akamatsu et al., 2005). These gender differences in the frequency of eating a nutritionally balanced diet may be explained by the fact that women have more nutritional knowledge (Matsumoto et al., 2019), are more conscious about food safety (Kageyama et al., 2007), are more aware of the relationships between diet and health (Girois et al., 2001), and understand more that a combination of main dish, main side dishes, and sub-side dishes comprises a well-balanced meal (Ministry of Health, Labour and Welfare, 2020).

We also found that older people were more likely to eat a nutritionally balanced diet every day, which is consistent with the findings of Mishra et al. (2017) and the Ministry of Health, Labour and Welfare (2020). Several studies have shown that the younger generation is more likely to skip breakfast (Arimune et al., 2012; Mishra et al., 2017), practice poor dietary habits (Fukuda et al., 2005), and rarely check food labels for food choice (Kageyama et al., 2007). Although to our knowledge, very few Japanese studies have analyzed whether the poor dietary habits of the younger generation will improve with age, a national survey by the Ministry of Health, Labour and Welfare (2019) had shown that the proportions of people who skipped breakfast tended to increase especially among middle-aged people between 2003 and 2017. This finding may suggest that a fraction of the younger generation did not likely have any improvement in poor dietary habits along with age in the last 15 years.

Among all gender, age, and cohabitation groups, single women in their 20s-30s and single men in their 20s-50s showed the lowest probability of eating a nutritionally balanced diet every day. The average percentages of unmarried men (and women) at the age of 45-49 and 50-54 years have increased from 3.9% (4.3%) in 1985 to 23.4% (14.1%) in 2015 and are predicted to increase to 29.5% (18.7%) in 2040 (Cabinet Office, 2018). If the percentage of unmarried individuals continues to increase in the younger and middle-aged generations in the next decades, the proportions of single men and women may increase but not decrease in the future. Thus, there is a need to improve dietary practices among young and middle-aged adults, especially single men and women.

In this study, the predicted probabilities of eating balanced meals every day for single men over their 60s and men in their 80s who live but do not eat meals with their families were significantly lower than those for elderly women and men who eat meals with their families. In addition, among male and female older adults, those who live but do not eat meals with family were apparently less likely to eat balanced meals than older peers of the same age. Ohara et al. (2020) found that, regardless of cohabitation status, eating alone was significantly associated with oral frailty among older adults, even after controlling for possible confounders. Social isolation may lead to malnutrition (Arai & Sakakibara, 2015) and loss of appetite (Fukunaga et al., 2012), and eating alone may result in dissatisfaction

with one's daily dietary habits (Ishida & Ishida, 2019; Yoshida et al., 2012). Therefore, not only cohabitation status but also eating meals with family are crucial when evaluating unbalanced nutrition intake in older adults irrespective of gender. Tsuji et al. (2019) reported that low dietary diversity was significantly associated with malnutrition among older Japanese home-care recipients. Meanwhile, a high dietary variety prevented a decline in functional capacity (Kumagai et al., 2003), physical performance (Yokoyama et al., 2017), and cognitive function (Otsuka et al., 2017) among older adults. Several studies have shown that local government-led measures such as community health worker-based interventions (Murayama et al., 2020) and community-based social health programs (Kimura et al., 2013) improve dietary diversity among community-dwelling older people in Japan. Therefore, effective nutritional health measures should be taken to prevent poor dietary habits in response to rapid aging among older adults.

We also found that the higher the individual's economic status, the greater the predicted probability of eating a balanced diet every day. This finding is consistent with those of previous studies in North America, Australia, and European countries (Darmon & Drewnowski, 2008; Zujko et al., 2020) and those of previous Japanese studies pointing out that a high income or socioeconomic status was associated with a reduced likelihood of poor dietary habits (Fukuda et al., 2005; Fukuda & Hiyoshi, 2012; Hayashi et al., 2015; Ministry of

Health, Labour and Welfare, 2020). Nagahata et al. (2018) and The Ministry of Health, Labour and Welfare (2020) also pointed out that a low socioeconomic status was associated with low vegetable, fish, meat, and milk intakes in a representative Japanese population. The most plausible explanation for these findings is that household members with a low income or subjective economic status tend to not eat a balanced diet because they are less likely to afford to purchase a wide variety of nutrient-rich foods, which are relatively more expensive than low-nutrient and energy-dense foods. Other possible explanations are that high economic status is associated with more knowledge on food choice and cooking, more interest in cooking and tasting food, and more emphasis on nutritional values when purchasing food (Hayashi et al., 2015). Hence, a low household income or economic status is a risk factor for unbalanced dietary intakes. As the proportion of irregular workers with generally low and unstable income is steadily increasing and the rise in their wages is limited due to the long-term stagnant economic growth in Japan, attention should be paid to strengthening the social security support for low-income households, increasing the minimum wages set by the district government, and improving the working conditions of irregular workers to improve their subjective economic status.

In this study, respondents residing in Eastern Japan excluding the Kanto region were slightly more likely to eat a balanced meal than those in other regions. There have been few studies based on nationwide

surveys regarding regional differences in the frequency of eating balanced meals. According to the 2015 National Health and Nutrition Survey, the prefectures where the average daily vegetable intakes for men and women exceed the government's target of 350 g are Nagano, Fukushima, Tokushima, Miyagi, Aomori, and Yamanashi. All these prefectures except Tokushima are located in the Tosan and Tohoku regions of Eastern Japan, where the production and supply of vegetables and fruits are not only for urban consumers mainly around the most populous area of Tokyo and other Kanto areas but also for local consumers, through supermarkets, greengrocers, and farmers' markets. In addition, Machida et al. (2017) found a positive relationship between vegetable intake frequency and per capita amount of not-for-sale vegetables ([amount of vegetable production – the amount of vegetables shipped]/number of population) produced in each prefecture. They also estimated that all six prefectures of Tohoku and Nagano of Tosan were included in the top 10 prefectures in terms of the per capita amount of not-for-sale vegetables usually consumed by producers or given to neighbors/relatives living nearby. Therefore, the easy access and availability of vegetables in the Tohoku and Tosan regions seem to be one of the reasons why respondents residing in Eastern Japan excluding the Kanto region were slightly more likely to eat a balanced meal than respondents from other regions.

As for differences in predicted probability by population size, Machida and Yoshida (2018) highlighted that vegetable

intake frequency was higher in rural areas than in suburban or urban areas and that vegetable cultivation for own consumption and receiving vegetables from neighbors were linked to these regional differences in the Gunma prefecture of Eastern Japan. As mentioned above, the per capita amount of not-for-sale vegetables tended to be higher in Eastern Japan than in Western Japan (Machida et al., 2017). These findings could explain our estimation results indicating that the predicted probability of eating a healthy diet in Eastern Japan excluding the Kanto region increased as the population size decreased, while that in Western Japan decreased as the population size decreased.

As pointed out by the Health Science Council (2018), the estimation results suggest that the proportion of consumers who eat a healthy diet has not improved after the government health promotion program *Kenko Nippon 2013* was launched in 2013 and that the program has not been effective in rectifying unhealthy dietary behavior among adult consumers in general and young consumers in particular. One possible explanation is that prepared convenience foods, some of which could be nutritionally unbalanced, are more pervasively available and long-term low economic growth has prevented consumers from having more vegetables and fruits that are relatively expensive than other food items.

In conclusion, this study revealed that gender, age, cohabitation, eating meals with family, subjective economic status, and residential area could be factors affecting the probability of eating a balanced diet every

day. Single men in their 20s-50s, single men in their 80s, older male adults living but not eating together with family, single women in their 20s-30s, and individuals with low economic status were at high risk for eating a nutritionally unbalanced diet in Japan. Moreover, we found that the government health promotion program called *Kenko Nippon 2013* (Health Japan 21, the second term) did not improve the dietary behavior of Japanese consumers.

This study has limitations. The main limitation is that because our conclusion was based on estimation results using pooled cross-sectional data, it is not clear whether the factors that we pointed out were associated with dietary behavior. Therefore, detailed statistical analysis using longitudinal data, which contains more information than cross-sectional data, is warranted. In addition, further research based on the latest dataset with more detailed information on respondents is required to confirm the relationship between population size and the probability of eating a balanced meal and to explain regional differences in probability between Eastern and Western Japan. Further research is also needed to develop measures that encourage consumers to eat more balanced food and examine their effectiveness through social experiments.

ACKNOWLEDGEMENTS

The authors are grateful to the Social Science Japan Data Archive, Center for Social Research and Data Archives, Institute of Social Science, The University

of Tokyo, and the Consumer Affairs and *Shokuiku* (Food and Nutrition Education) Division, Food Safety and Consumer Affairs Bureau, the Ministry of Agriculture, Forestry and Fisheries of Japan for providing individuals' data for the Survey of Attitudes toward *Shokuiku* 2009, 2011-2012, and 2014-2017.

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