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Food group intakes and all-cause mortality among a young older Japanese population of the same age: the New Integrated Suburban Seniority Investigation Project

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ABSTRACT

Evaluating the effects of dietary intake on mortality in older populations has become increasingly important in modern aging societies. The objective of the present study was to investigate the associations between food group intakes and all-cause mortality among a young older population. We conducted a prospective study on 1,324 men and 1,338 women aged 64–65 years at baseline who were living in a suburban city from 1996 to 2005. The participants were followed for all-cause mortality from 1996 through 2015 to assess the effects of 17 food group intakes (g) per 1,000 kcal after multivariable adjustments in proportional hazard models. During follow-up (mean: 13.2 years), 339 deaths were registered. In women, total mortality was significantly and inversely associated with the consumption of milk and dairy products and vegetables. The hazard ratios across intake quartiles after multivariable adjustment were 1, 0.70 (95% confidence interval: 0.42–1.17), 0.66 (0.40–1.10), and 0.40 (0.22–0.75) (*P* for trend = 0.003) for milk and dairy products, and 1, 0.77 (0.46–1.28), 0.83 (0.50–1.38), and 0.42 (0.23–0.78) (*P* for trend = 0.008) for vegetables. In men, a positive association was found between total mortality and sugar and sweetener consumption (*P* for trend = 0.038). Higher consumption of milk and dairy products and vegetables was suggested to reduce all-cause mortality in young older women.

Keywords: food group intakes, young older people, mortality, milk and dairy products, vegetables

Abbreviations:
FFQ: food frequency questionnaire
HR: hazard ratio
CI: confidence interval.

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INTRODUCTION

Japan has been a leading country in terms of higher life expectancy for the past few decades.[1] Among several factors that contribute to longevity, diet plays an important role for the prevention of diseases associated with mortality. Considering the rapid advancement and future needs of the aging society, evaluating the effects of dietary intake on mortality in older populations with a higher life expectancy has become increasingly important.

In general populations, although consuming higher amounts of fruits and vegetables has been found to be effective for reducing mortality, the influence of protein-rich foods such as meat or fish has been inconsistent among populations.[2-7] In older populations in Western countries, adhering to a Mediterranean-like dietary pattern (i.e., higher intakes of fruits, vegetables, legumes, cereals, potatoes, and fish, accompanied by lower intakes of meat and dairy products) or the World Health Organization guidelines (e.g., including higher dietary fiber, vegetables, and fruit intakes) has been found to partially reduce mortality, which suggests consuming a variety of foods with not only sufficient vitamin and mineral, but also protein and energy intake, might contribute to longevity.[8-10] In older populations in Asian countries, inverse associations between mortality and fish, fruit, and vegetable intakes have only been reported in a few studies[11,12]; therefore, existing evidence remains limited.

Meanwhile, it may be helpful to assess young older populations who change their lifestyle, including their dietary habits, after retirement.[13,14] Additionally, from the statistical point of view, confounding by age has been a common limitation of previous research. Because age is one of the strongest determinants for the incidence of disease, even after adjustment, residual confounding may remain. Therefore, it could be valuable to assess the influence of diet in young older populations with longer life expectancies without confounding by age.[15]

The aim of the present study was to evaluate the association between food group intakes and all-cause mortality among a young older Japanese population of almost the same age.

METHODS

Study population

The participants of the present study were subjects in the New Integrated Suburban Seniority Investigation Project, an age-specific research project involving residents in Nisshin city, located in central Japan.[16] Community-dwelling older people aged 64–65 years were invited by letter to undergo a free comprehensive medical health checkup and complete a questionnaire survey each year from 1996 to 2005. Among 3,073 potential participants, we excluded those with no dietary (n = 112) or health examination data (n = 4) at baseline, as well as those with no sufficient follow-up data (n = 2). We additionally excluded those with a history of cancer (n = 110), stroke (n = 124), or ischemic heart disease (n = 40) at baseline, as well as those whose estimated total energy intake was outside the sex-specific mean ± 3 standard deviations (n = 19). Finally, 2,662 subjects (1,324 men and 1,338 women) remained for the final analyses.

This study was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving the study participants were approved by the Ethics Committees of Nagoya University Graduate School of Medicine, the National Center for Geriatrics and Gerontology of Japan, Aichi Medical University School of Medicine, and Hokkaido University Graduate School of Medicine. Informed consent for participating in the study, including the follow-up, was obtained from all participants. An opt-out approach was applied from 1996 to 2001. The health checkup examinees who declined to participate in the study were recorded and excluded from the survey. From 2002 to 2005, written consent was obtained using an opt-in approach.

Lifestyle measurements

Lifestyle information was obtained using a self-administered questionnaire. Height and weight measurements were included in the health checkups. Body mass index was calculated using the following formula: body weight (kg) / (height [m])^2. Blood chemistry was performed after overnight fasting.

A food frequency questionnaire (FFQ) including 97 modern Japanese foods and dishes was used to evaluate the intakes of 17 food groups (rice, bread, noodles, sugars and sweeteners, confectionaries, fats and oils, nuts and seeds, pulses, fish and shellfish, meats, eggs, milk and dairy products, vegetables, green-yellow vegetables, other vegetables, fruits, and mushrooms), energy, saturated fatty acid, polyunsaturated fatty acid, and dietary fiber at baseline. The consumption of each food group was estimated based on the frequency of food items using an incremental scale (< once/month, once/month, 2–3 times/month, once/week, 2–4 times/week, 5–6 times/week, once/day, 2–3 times/day, ≥ 4 times/day). Portion sizes were fixed for all foods except rice. The FFQ has been validated for food group and nutrient intakes.[17,18] The de-attenuated Pearson correlation coefficients adjusted for energy intake and age between the daily consumption of food groups based on the FFQs and that from dietary records for rice, bread, noodles, sugars and sweeteners, confectionaries, fats and oils, nuts and seeds, pulses, fish and shellfish, meats, eggs, milk and dairy products, vegetables, green-yellow vegetables, other vegetables, fruits, and mushrooms were 0.54, 0.71, 0.59, 0.13, 0.34, 0.49, 0.47, 0.54, 0.16, 0.36, 0.49, 0.75, 0.31, 0.39, 0.12, 0.67 and 0.28, respectively, for men, and 0.65, 0.35, 0.11, 0.27, 0.37, 0.57, 0.22, 0.66, 0.33, 0.61, 0.42, 0.69, 0.52, 0.57, 0.42, 0.66 and 0.48, respectively, for women.

Follow-up and primary end point

The primary end point was death from any cause during the follow-up period (1996–2015). We used the city's resident register to identify participant deaths.

Statistical analysis

All analyses were performed separately in men and women. The participants' baseline characteristics were compared between survivors and those who had died. Categorical and continuous data were statistically analyzed using the chi-squared test and Student's *t*-test, respectively.

Food group intakes were included in the analysis as consumption per 1,000 kcal. Cox regression models were used to assess the associations between food group intake quartiles at baseline and mortality during follow-up. Those who moved out of Nisshin city during the follow-up period were treated as censored cases.

Hazard ratios (HRs) and 95% confidence intervals (CIs) were estimated using the lowest consumption group as a reference. In the Cox regression analysis, adjustments were made for total energy intake (continuous variable). Survey year (1996–1999, 2000–2002, 2003–2005), body mass index (< 18.5, 18.5–24.9, ≥ 25.0 kg/m^2), smoking status (current/former and never), drinking status (current/almost none), walking time (< 30, 30–59, 60–119, ≥ 120 min/day), sleeping time (< 7.0, 7.0–7.9, ≥ 8.0 h/day), education level (high school graduate or above, yes/no), employment status (employment, yes/no), use of vitamin supplements (yes/no), hypertension (systolic blood pressure ≥ 140 mmHg, diastolic blood pressure ≥ 90 mmHg, and/or antihypertensive drug use, yes/no), and diabetes mellitus (fasting blood glucose ≥ 126 mg/dL, glycated hemoglobin levels ≥ 6.5%, and/or antidiabetic drug use, yes/no) were additionally adjusted as covariates. We considered the survey year because it took 10 years to recruit all the participants. *P* for trend was estimated using the median of each quartile for food group intake in the Cox regression model. Further adjustments were made for saturated fatty acid and polyunsaturated fatty acid intakes because they may partially affect mortality (data not shown).[19] For sensitivity analyses, we repeated the analysis after excluding the participants who had died within 3 years from baseline.

All statistical tests were two-sided, and $P < 0.05$ was considered statistically significant. All statistical analyses were conducted using STATA software (ver. 15; Stata Corp., College Station, TX, USA).

RESULTS

During follow-up (mean: 13.2 years), 339 participants (233 men and 106 women) died and 225 (109 men and 116 women) moved out of Nisshin city.

The participants' background characteristics according to survival status are shown in Table 1. Body mass index was significantly different between the surviving and deceased men. Educational attainment was significantly higher, and the proportion of current smokers, prevalence of diabetes, and energy intake were significantly lower in surviving than in deceased men ($P < 0.05$ for all). Sleeping time was significantly shorter in surviving than in deceased women.

The associations observed between food group intakes and all-cause mortality in men and women are summarized in Tables 2 and 3, respectively. In men, a significant positive association was found between all-cause mortality and the intake of sugars and sweeteners after multivariable adjustment (*P* for trend = 0.038); however, the HR for each intake quartile was not significant. Meanwhile, in women, inverse associations were found between all-cause mortality and the intakes of milk and dairy products and vegetables. The HRs across intake quartiles after multivariable adjustment were 1, 0.70 (95% CI: 0.42–1.17), 0.66 (0.40–1.10), and 0.40 (0.22–0.75) (*P* for trend = 0.003) for milk and dairy products, and 1, 0.77 (0.46–1.28), 0.83 (0.50–1.38), and 0.42 (0.23–0.78) (*P* for trend = 0.008) for vegetables. These associations remained after additional adjustments for saturated fatty acid and polyunsaturated fatty acid intakes. Although an inverse association with green-yellow vegetable intake was observed in women (*P* for trend = 0.029), none of the HRs across intake quartiles were significant. Although the highest quartile of other vegetable intake was significantly associated with reduced mortality, the *P* for trend was not significant (*P* for trend = 0.052). However, the intakes of both green-yellow and other vegetables were significantly associated with reduced all-cause mortality after additional adjustments for saturated fatty acid and polyunsaturated fatty acid intakes. The HRs across intake quartiles were 1, 1.04 (95% CI: 0.63–1.71), 0.82 (0.48–1.43), and 0.50 (0.27–0.92) (*P* for trend = 0.014) for green-yellow vegetables, and 1, 1.02 (0.60–1.73), 1.19 (0.70–2.04), and 0.44 (0.23–0.83) (*P* for trend = 0.015) for other vegetables. Furthermore, after excluding the participants who had died within 3 years from baseline, the strong associations with milk and dairy products and vegetable intakes in women remained. Inverse associations were also found between all-cause mortality and mushroom intake. The HRs across intake quartiles after multivariable adjustment were 1, 0.94 (95% CI: 0.57–1.55), 0.75 (0.44–1.27), and 0.48 (0.26–0.90) (*P* for trend = 0.015). However, after excluding the participants who had died within 3 years from baseline, the association with mushroom intake in women was partially attenuated.

Table 1 Background characteristics of the participants at baseline by survival status

	Men (n = 1,324)					Women (n = 1,338)				
	Survived (n = 1,091)		Died (n = 233)			Survived (n = 1,232)		Died (n = 106)		
	Mean or %	SD	Mean or %	SD	*P**	Mean or %	SD	Mean or %	SD	*P**
Year of participation										
1996–1999	30.8		47.6		<0.001	36.9		53.8		<0.001
2000–2002	34.2		40.3			30.8		30.2		
2003–2005	35.0		12.0			32.3		16.0		
Body mass index (kg/m^2)										
<18.5	3.6		8.2		0.008	5.0		5.7		0.787
18.5–24.9	72.1		68.2			75.5		77.4		
≥25.0	24.3		23.6			19.6		17.0		
Current drinker	69.3		72.1		0.397	18.9		23.6		0.242
Current smoker	29.2		48.9		<0.001	3.4		5.7		0.232
Diabetes mellitus‡	11.5		19.7		0.001	6.4		10.4		0.118
Hypertension§	49.6		54.1		0.213	38.6		44.3		0.248
Sleeping time (h/day)										
<7.0	33.9		28.3		0.191	44.5		36.8		0.037
7.0–7.9	38.1		39.1			38.0		35.9		
≥8.0	28.0		32.6			17.5		27.4		
Walking time (min/day)										
<30	16.5		22.8		0.079	8.3		5.7		0.685
30–59	34.0		35.2			24.4		27.4		
60–119	25.9		23.2			28.8		26.4		
≥120	23.7		18.9			38.6		40.6		
Education (high school graduate or above)	73.3		61.8		<0.001	65.7		56.6		0.061
Employment status (employee)	47.9		43.8		0.248	18.0		14.2		0.317
Vitamin supplement use	12.8		11.6		0.604	20.7		21.7		0.808
Daily dietary intake										
Energy (kcal)	1,891	574	1,988	698	0.024†	1,921	612	1,935	636	0.824†
Saturated fatty acid (g)	13.6	6.0	14.4	7.1	0.067†	16.2	6.9	16.4	7.7	0.752†
Polyunsaturated fatty acid (g)	12.9	5.4	13.6	6.5	0.099†	14.7	6.1	15.5	7.0	0.177†

* Chi-squared test.
† Student's *t*-test.
‡ Diabetes mellitus was defined as the use of antidiabetic medicine, fasting blood glucose ≥ 126 mg/dL, or glycated hemoglobin levels (National Glycohemoglobin Standardization Program) ≥ 6.5%.
§ Hypertension was defined as the use of antihypertensive drugs, systolic blood pressure ≥ 140 mmHg, or diastolic blood pressure ≥ 90 mmHg.

Table 2 Hazard ratios for all-cause mortality according to food group intake quartiles (/1,000 kcal) among men (n = 1,324)

	Intake quartiles								
	Q1	Q2		Q3		Q4		*P* for trend
Rice (g/1,000 kcal)*	128	190		252		346		
Deaths/total number	54/277	60/271		49/282		70/261		
Energy-adjusted HR (95% CI)	1 (reference)	1.02	(0.71–1.48)	0.81	(0.55–1.19)	1.17	(0.82–1.67)	0.484
Multivariable-adjusted HR (95% CI)†	1 (reference)	1.01	(0.70–1.47)	0.71	(0.48–1.06)	1.01	(0.70–1.46)	0.827
Multivariable-adjusted HR (95% CI)‡	1 (reference)	1.11	(0.75–1.64)	0.75	(0.50–1.15)	1.02	(0.69–1.51)	0.765
Bread (g/1,000 kcal)*	0.0	3.0		14.4		26.4		
Deaths/total number	74/257	51/280		57/274		51/280		
Energy-adjusted HR (95% CI)	1 (reference)	0.73	(0.51–1.05)	0.77	(0.55–1.10)	0.79	(0.55–1.14)	0.365
Multivariable-adjusted HR (95% CI)†	1 (reference)	0.93	(0.65–1.35)	0.93	(0.65–1.34)	0.96	(0.65–1.40)	0.859
Multivariable-adjusted HR (95% CI)‡	1 (reference)	0.98	(0.67–1.44)	1.03	(0.70–1.50)	0.92	(0.62–1.37)	0.747
Noodles (g/1,000 kcal)*	14.3	31.1		58.5		101.0		
Deaths/total number	52/279	61/270		66/265		54/277		
Energy-adjusted HR (95% CI)	1 (reference)	1.20	(0.83–1.73)	1.20	(0.83–1.74)	0.97	(0.66–1.42)	0.651
Multivariable-adjusted HR (95% CI)†	1 (reference)	1.24	(0.85–1.81)	1.20	(0.83–1.75)	0.95	(0.64–1.39)	0.489
Multivariable-adjusted HR (95% CI)‡	1 (reference)	1.23	(0.83–1.81)	1.22	(0.83–1.81)	0.92	(0.61–1.38)	0.445
Sugars and sweeteners (g/1,000 kcal)*	1.0	1.5		2.1		3.3		
Deaths/total number	52/279	50/281		66/265		65/266		
Energy-adjusted HR (95% CI)	1 (reference)	0.92	(0.62–1.36)	1.25	(0.87–1.80)	1.28	(0.89–1.84)	0.079
Multivariable-adjusted HR (95% CI)†	1 (reference)	0.97	(0.66–1.45)	1.35	(0.93–1.95)	1.38	(0.95–2.00)	0.038
Multivariable-adjusted HR (95% CI)‡	1 (reference)	1.01	(0.66–1.53)	1.46	(0.99–2.14)	1.36	(0.91–2.03)	0.063
Confectioneries (g/1,000 kcal)*	0.8	3.1		5.7		13.6		
Deaths/total number	73/258	52/279		53/278		55/276		
Energy-adjusted HR (95% CI)	1 (reference)	0.69	(0.48–0.98)	0.69	(0.49–0.99)	0.71	(0.50–1.01)	0.178
Multivariable-adjusted HR (95% CI)†	1 (reference)	0.73	(0.51–1.04)	0.86	(0.59–1.24)	0.88	(0.61–1.27)	0.857
Multivariable-adjusted HR (95% CI)‡	1 (reference)	0.67	(0.46–0.98)	0.84	(0.58–1.24)	0.83	(0.56–1.22)	0.682
Fats and oils (g/1,000 kcal)*	2.5	4.3		6.2		8.8		
Deaths/total number	53/278	58/273		61/270		61/270		
Energy-adjusted HR (95% CI)	1 (reference)	1.11	(0.76–1.61)	1.13	(0.78–1.64)	1.18	(0.81–1.70)	0.406
Multivariable-adjusted HR (95% CI)†	1 (reference)	1.10	(0.76–1.61)	1.15	(0.79–1.69)	1.21	(0.83–1.77)	0.321
Multivariable-adjusted HR (95% CI)‡	1 (reference)	1.21	(0.81–1.80)	1.30	(0.87–1.94)	1.28	(0.86–1.92)	0.237
Nuts and seeds (g/1,000 kcal)*	0.1	0.5		0.9		2.9		
Deaths/total number	70/261	53/278		60/271		50/281		
Energy-adjusted HR (95% CI)	1 (reference)	0.68	(0.48–0.98)	0.83	(0.59–1.18)	0.63	(0.44–0.91)	0.054
Multivariable-adjusted HR (95% CI)†	1 (reference)	0.63	(0.44–0.91)	0.94	(0.67–1.34)	0.70	(0.48–1.01)	0.230
Multivariable-adjusted HR (95% CI)‡	1 (reference)	0.62	(0.42–0.91)	0.95	(0.66–1.37)	0.70	(0.47–1.03)	0.272
Pulses (g/1,000 kcal)*	17.8	28.8		40.2		60.3		
Deaths/total number	67/264	56/275		48/283		62/269		
Energy-adjusted HR (95% CI)	1 (reference)	0.80	(0.56–1.15)	0.73	(0.50–1.06)	0.94	(0.66–1.32)	0.812
Multivariable-adjusted HR (95% CI)†	1 (reference)	0.73	(0.51–1.05)	0.73	(0.50–1.05)	0.93	(0.65–1.32)	0.898
Multivariable-adjusted HR (95% CI)‡	1 (reference)	0.73	(0.50–1.06)	0.78	(0.53–1.15)	0.95	(0.66–1.38)	0.915
Fish and shellfish (g/1,000 kcal)*	16.7	26.4		37.8		61.4		
Deaths/total number	56/275	46/285		61/270		70/261		
Energy-adjusted HR (95% CI)	1 (reference)	0.83	(0.56–1.22)	1.06	(0.74–1.53)	1.21	(0.85–1.73)	0.113
Multivariable-adjusted HR (95% CI)†	1 (reference)	0.78	(0.53–1.16)	1.01	(0.70–1.46)	1.13	(0.79–1.62)	0.191
Multivariable-adjusted HR (95% CI)‡	1 (reference)	0.79	(0.52–1.20)	1.12	(0.76–1.64)	1.14	(0.78–1.67)	0.216

Meats (g/1,000 kcal)*	10.4		18.9		26.2		38.1		
Deaths/total number	52/279		53/278		61/270		67/264		
Energy-adjusted HR (95% CI)	1 (reference)	0.97	(0.66–1.42)	1.16	(0.80–1.68)	1.22	(0.84–1.76)	0.196
Multivariable-adjusted HR (95% CI)†	1 (reference)	0.98	(0.67–1.44)	1.13	(0.77–1.64)	1.09	(0.75–1.59)	0.539
Multivariable-adjusted HR (95% CI)‡	1 (reference)	0.95	(0.63–1.43)	1.10	(0.74–1.63)	1.12	(0.76–1.66)	0.438
Eggs (g/1,000 kcal)*	3.6		10.2		19.2		32.7	
Deaths/total number	55/276		59/272		66/265		53/278	
Energy-adjusted HR (95% CI)	1 (reference)	0.96	(0.66–1.39)	1.07	(0.74–1.55)	0.89	(0.61–1.30)	0.634
Multivariable-adjusted HR (95% CI)†	1 (reference)	0.94	(0.65–1.37)	1.10	(0.76–1.61)	0.92	(0.63–1.34)	0.820
Multivariable-adjusted HR (95% CI)‡	1 (reference)	1.02	(0.69–1.51)	1.21	(0.81–1.79)	0.90	(0.60–1.35)	0.689
Milk and dairy products (g/1,000 kcal)*	5.6		48.2		98.7		160.9	
Deaths/total number	71/260		49/282		59/272		54/277	
Energy-adjusted HR (95% CI)	1 (reference)	0.65	(0.45–0.94)	0.78	(0.55–1.10)	0.77	(0.54–1.10)	0.296
Multivariable-adjusted HR (95% CI)†	1 (reference)	0.73	(0.50–1.06)	0.85	(0.60–1.22)	0.98	(0.67–1.42)	0.906
Multivariable-adjusted HR (95% CI)‡	1 (reference)	0.78	(0.53–1.15)	0.89	(0.61–1.29)	1.04	(0.70–1.53)	0.713
Vegetables (g/1,000 kcal)*	52.5		85.7		119.6		177.9	
Deaths/total number	53/278		61/270		59/272		60/271	
Energy-adjusted HR (95% CI)	1 (reference)	1.12	(0.77–1.62)	1.05	(0.72–1.52)	1.19	(0.82–1.72)	0.426
Multivariable-adjusted HR (95% CI)†	1 (reference)	1.27	(0.88–1.85)	1.08	(0.74–1.58)	1.34	(0.92–1.95)	0.221
Multivariable-adjusted HR (95% CI)‡	1 (reference)	1.24	(0.84–1.83)	1.10	(0.74–1.63)	1.29	(0.87–1.91)	0.307
Green-yellow vegetables (g/1,000 kcal)*	15.1		31.2		50.9		103.1	
Deaths/total number	61/270		55/276		59/272		58/273	
Energy-adjusted HR (95% CI)	1 (reference)	0.86	(0.60–1.25)	0.98	(0.68–1.40)	0.99	(0.69–1.42)	0.811
Multivariable-adjusted HR (95% CI)†	1 (reference)	1.03	(0.71–1.49)	1.12	(0.78–1.61)	1.15	(0.80–1.65)	0.433
Multivariable-adjusted HR (95% CI)‡	1 (reference)	0.99	(0.67–1.47)	1.20	(0.82–1.75)	1.08	(0.74–1.60)	0.617
Other vegetables (g/1,000 kcal)*	31.1		46.6		62.4		90.1	
Deaths/total number	54/277		58/273		55/276		66/265	
Energy-adjusted HR (95% CI)	1 (reference)	1.04	(0.72–1.51)	0.98	(0.67–1.43)	1.20	(0.84–1.72)	0.318
Multivariable-adjusted HR (95% CI)†	1 (reference)	1.06	(0.73–1.55)	1.02	(0.70–1.50)	1.18	(0.82–1.70)	0.394
Multivariable-adjusted HR (95% CI)‡	1 (reference)	1.06	(0.71–1.57)	0.99	(0.66–1.48)	1.21	(0.83–1.77)	0.334
Fruits (g/1,000 kcal)*	21.0		56.8		90.6		146.6	
Deaths/total number	66/265		61/270		54/277		52/279	
Energy-adjusted HR (95% CI)	1 (reference)	0.89	(0.63–1.27)	0.81	(0.56–1.16)	0.83	(0.57–1.19)	0.271
Multivariable-adjusted HR (95% CI)†	1 (reference)	1.01	(0.71–1.45)	1.03	(0.70–1.50)	1.12	(0.76–1.65)	0.554
Multivariable-adjusted HR (95% CI)‡	1 (reference)	0.97	(0.66–1.41)	1.05	(0.71–1.56)	1.11	(0.74–1.66)	0.553
Mushrooms (g/1,000 kcal)*	1.1		2.3		5.3		9.4	
Deaths/total number	60/271		61/270		58/273		54/277	
Energy-adjusted HR (95% CI)	1 (reference)	1.00	(0.70–1.44)	0.97	(0.68–1.40)	0.98	(0.68–1.42)	0.869
Multivariable-adjusted HR (95% CI)†	1 (reference)	1.09	(0.76–1.56)	1.03	(0.71–1.49)	1.06	(0.73–1.53)	0.907
Multivariable-adjusted HR (95% CI)‡	1 (reference)	1.02	(0.69–1.49)	1.10	(0.75–1.61)	1.01	(0.68–1.50)	0.899

HR, hazard ratio; CI, confidence interval.
* Median intakes by quartile of consumption for each food group (g/1,000 kcal).
† Adjusted for energy intake, survey year, body mass index, smoking status, drinking status, walking time, sleeping time, education levels, employment status, vitamin supplement use, hypertension, and diabetes mellitus.
‡ Excluding participants who died within 3 years from baseline (n = 23).

Table 3 Hazard ratios for all-cause mortality according to food group intake quartiles (/1,000 kcal) among women (n = 1,338)

	Intake quartiles								
	Q1	Q2		Q3		Q4		*P* for trend
Rice (g/1,000 kcal)*	110	165		219		301		
Deaths/total number	27/308	22/312		25/310		32/302		
Energy-adjusted HR (95% CI)	1 (reference)	0.75	(0.42–1.31)	0.81	(0.47–1.39)	0.99	(0.59–1.66)	0.838
Multivariable-adjusted HR (95% CI)†	1 (reference)	0.74	(0.42–1.31)	0.77	(0.44–1.33)	0.95	(0.56–1.62)	0.977
Multivariable-adjusted HR (95% CI)‡	1 (reference)	0.76	(0.40–1.43)	0.91	(0.51–1.64)	1.12	(0.63–2.00)	0.490
Bread (g/1,000 kcal)*	0.8	4.5		17.4		26.6		
Deaths/total number	25/310	26/308		31/304		24/310		
Energy-adjusted HR (95% CI)	1 (reference)	1.11	(0.64–1.92)	1.35	(0.79–2.29)	1.04	(0.59–1.84)	0.692
Multivariable-adjusted HR (95% CI)†	1 (reference)	1.17	(0.67–2.05)	1.42	(0.83–2.44)	1.06	(0.60–1.89)	0.650
Multivariable-adjusted HR (95% CI)‡	1 (reference)	1.18	(0.65–2.14)	1.30	(0.73–2.33)	1.16	(0.63–2.13)	0.591
Noodles (g/1,000 kcal)*	11.3	25.7		47.7		94.1		
Deaths/total number	30/305	24/310		24/311		28/306		
Energy-adjusted HR (95% CI)	1 (reference)	0.77	(0.45–1.32)	0.80	(0.47–1.37)	0.93	(0.55–1.56)	0.969
Multivariable-adjusted HR (95% CI)†	1 (reference)	0.69	(0.40–1.19)	0.75	(0.44–1.30)	0.92	(0.55–1.55)	0.893
Multivariable-adjusted HR (95% CI)‡	1 (reference)	0.72	(0.40–1.29)	0.89	(0.50–1.57)	0.82	(0.46–1.45)	0.743
Sugars and sweeteners (g/1,000 kcal)*	1.3	1.9		2.5		3.5		
Deaths/total number	24/311	25/309		22/313		35/299		
Energy-adjusted HR (95% CI)	1 (reference)	1.02	(0.58–1.80)	0.90	(0.50–1.60)	1.52	(0.90–2.55)	0.100
Multivariable-adjusted HR (95% CI)†	1 (reference)	1.05	(0.59–1.85)	0.98	(0.54–1.76)	1.60	(0.95–2.72)	0.064
Multivariable-adjusted HR (95% CI)‡	1 (reference)	0.98	(0.53–1.80)	0.94	(0.50–1.77)	1.64	(0.94–2.87)	0.053
Confectioneries (g/1,000 kcal)*	2.3	5.6		11.4		20.9		
Deaths/total number	31/304	29/305		20/315		26/308		
Energy-adjusted HR (95% CI)	1 (reference)	1.01	(0.61–1.68)	0.63	(0.36–1.11)	0.87	(0.52–1.47)	0.429
Multivariable-adjusted HR (95% CI)†	1 (reference)	1.06	(0.63–1.77)	0.68	(0.38–1.21)	0.98	(0.57–1.67)	0.720
Multivariable-adjusted HR (95% CI)‡	1 (reference)	1.06	(0.62–1.83)	0.68	(0.37–1.26)	0.91	(0.51–1.62)	0.544
Fats and oils (g/1,000 kcal)*	2.7	4.6		6.4		8.9		
Deaths/total number	19/316	22/312		34/301		31/303		
Energy-adjusted HR (95% CI)	1 (reference)	1.10	(0.59–2.04)	1.75	(0.99–3.09)	1.58	(0.89–2.80)	0.059
Multivariable-adjusted HR (95% CI)†	1 (reference)	1.11	(0.60–2.06)	1.80	(1.01–3.20)	1.52	(0.85–2.71)	0.082
Multivariable-adjusted HR (95% CI)‡	1 (reference)	1.28	(0.65–2.52)	2.14	(1.14–4.02)	1.65	(0.87–3.13)	0.076
Nuts and seeds (g/1,000 kcal)*	0.2	0.6		1.1		3.2		
Deaths/total number	27/308	23/311		27/308		29/305		
Energy-adjusted HR (95% CI)	1 (reference)	0.82	(0.47–1.44)	0.96	(0.56–1.64)	1.11	(0.65–1.89)	0.444
Multivariable-adjusted HR (95% CI)†	1 (reference)	0.81	(0.46–1.42)	1.00	(0.58–1.72)	1.21	(0.71–2.08)	0.259
Multivariable-adjusted HR (95% CI)‡	1 (reference)	0.76	(0.42–1.38)	0.89	(0.50–1.58)	1.06	(0.59–1.89)	0.540
Pulses (g/1,000 kcal)*	22.4	34.9		47.7		72.4		
Deaths/total number	21/314	37/297		21/314		27/307		
Energy-adjusted HR (95% CI)	1 (reference)	1.79	(1.05–3.06)	1.05	(0.57–1.92)	1.39	(0.79–2.46)	0.690
Multivariable-adjusted HR (95% CI)†	1 (reference)	1.83	(1.07–3.14)	1.07	(0.58–1.98)	1.37	(0.77–2.43)	0.750
Multivariable-adjusted HR (95% CI)‡	1 (reference)	1.64	(0.93–2.88)	0.82	(0.42–1.59)	1.43	(0.80–2.59)	0.569
Fish and shellfish (g/1,000 kcal)*	21.0	32.7		45.6		69.4		
Deaths/total number	30/305	22/312		33/302		21/313		
Energy-adjusted HR (95% CI)	1 (reference)	0.70	(0.40–1.21)	1.07	(0.65–1.78)	0.69	(0.39–1.22)	0.394
Multivariable-adjusted HR (95% CI)†	1 (reference)	0.69	(0.39–1.21)	1.06	(0.63–1.76)	0.66	(0.37–1.17)	0.313
Multivariable-adjusted HR (95% CI)‡	1 (reference)	0.67	(0.36–1.23)	1.17	(0.68–2.02)	0.70	(0.38–1.30)	0.525

Meats (g/1,000 kcal)*	12.5		22.2		31.4		46.4	
Deaths/total number	23/312		23/311		26/309		34/300	
Energy-adjusted HR (95% CI)	1 (reference)	0.97	(0.54–1.74)	1.06	(0.60–1.87)	1.40	(0.81–2.42)	0.168
Multivariable-adjusted HR (95% CI)†	1 (reference)	0.97	(0.54–1.74)	1.08	(0.61–1.92)	1.42	(0.82–2.49)	0.151
Multivariable-adjusted HR (95% CI)‡	1 (reference)	0.96	(0.50–1.82)	1.19	(0.65–2.21)	1.54	(0.84–2.80)	0.095
Eggs (g/1,000 kcal)*	3.9		12.2		19.8		31.8	
Deaths/total number	32/303		27/307		18/317		29/305	
Energy-adjusted HR (95% CI)	1 (reference)	0.82	(0.49–1.39)	0.53	(0.29–0.95)	0.84	(0.51–1.39)	0.403
Multivariable-adjusted HR (95% CI)†	1 (reference)	0.87	(0.51–1.48)	0.55	(0.30–1.00)	0.91	(0.55–1.53)	0.585
Multivariable-adjusted HR (95% CI)‡	1 (reference)	0.76	(0.43–1.34)	0.59	(0.32–1.10)	0.82	(0.47–1.42)	0.455
Milk and dairy products (g/1,000 kcal)*	20.4		83.5		129.4		195.1	
Deaths/total number	39/296		26/308		26/309		15/319	
Energy-adjusted HR (95% CI)	1 (reference)	0.68	(0.41–1.13)	0.67	(0.41–1.11)	0.39	(0.21–0.70)	0.002
Multivariable-adjusted HR (95% CI)†	1 (reference)	0.70	(0.42–1.17)	0.66	(0.40–1.10)	0.40	(0.22–0.75)	0.003
Multivariable-adjusted HR (95% CI)‡	1 (reference)	0.70	(0.41–1.19)	0.62	(0.36–1.07)	0.31	(0.15–0.62)	0.001
Vegetables (g/1,000 kcal)*	79.4		116.3		150.1		215.3	
Deaths/total number	35/300		27/307		29/306		15/319	
Energy-adjusted HR (95% CI)	1 (reference)	0.75	(0.45–1.24)	0.80	(0.49–1.32)	0.42	(0.23–0.77)	0.007
Multivariable-adjusted HR (95% CI)†	1 (reference)	0.77	(0.46–1.28)	0.83	(0.50–1.38)	0.42	(0.23–0.78)	0.008
Multivariable-adjusted HR (95% CI)‡	1 (reference)	0.73	(0.42–1.26)	0.73	(0.42–1.26)	0.43	(0.23–0.81)	0.011
Green-yellow vegetables (g/1,000 kcal)*	27.7		47.8		71.9		123.8	
Deaths/total number	32/303		33/301		25/310		16/318	
Energy-adjusted HR (95% CI)	1 (reference)	1.07	(0.66–1.74)	0.84	(0.49–1.41)	0.54	(0.30–0.99)	0.024
Multivariable-adjusted HR (95% CI)†	1 (reference)	1.10	(0.67–1.80)	0.89	(0.51–1.52)	0.55	(0.30–1.01)	0.029
Multivariable-adjusted HR (95% CI)‡	1 (reference)	1.15	(0.68–1.95)	0.79	(0.44–1.44)	0.63	(0.34–1.19)	0.076
Other vegetables (g/1,000 kcal)*	40.3		59.1		76.8		104.5	
Deaths/total number	26/309		31/303		34/301		15/319	
Energy-adjusted HR (95% CI)	1 (reference)	1.12	(0.67–1.89)	1.29	(0.77–2.16)	0.52	(0.27–0.97)	0.057
Multivariable-adjusted HR (95% CI)†	1 (reference)	1.07	(0.63–1.82)	1.33	(0.79–2.25)	0.50	(0.26–0.94)	0.052
Multivariable-adjusted HR (95% CI)‡	1 (reference)	1.01	(0.58–1.76)	1.21	(0.70–2.10)	0.38	(0.19–0.78)	0.015
Fruits (g/1,000 kcal)*	54.3		100.7		144.8		213.6	
Deaths/total number	26/309		35/299		24/311		21/313	
Energy-adjusted HR (95% CI)	1 (reference)	1.33	(0.80–2.20)	0.97	(0.56–1.69)	0.88	(0.49–1.57)	0.425
Multivariable-adjusted HR (95% CI)†	1 (reference)	1.44	(0.86–2.42)	1.03	(0.58–1.82)	0.92	(0.51–1.67)	0.510
Multivariable-adjusted HR (95% CI)‡	1 (reference)	1.46	(0.85–2.50)	0.82	(0.44–1.53)	0.83	(0.44–1.56)	0.258
Mushrooms (g/1,000 kcal)*	2.0		5.5		8.4		13.2	
Deaths/total number	35/300		31/303		25/310		15/319	
Energy-adjusted HR (95% CI)	1 (reference)	0.91	(0.56–1.49)	0.74	(0.44–1.24)	0.47	(0.26–0.86)	0.010
Multivariable-adjusted HR (95% CI)†	1 (reference)	0.94	(0.57–1.55)	0.75	(0.44–1.27)	0.48	(0.26–0.90)	0.015
Multivariable-adjusted HR (95% CI)‡	1 (reference)	1.07	(0.62–1.83)	0.78	(0.44–1.38)	0.56	(0.29–1.07)	0.049

HR, hazard ratio; CI, confidence interval.
* Median intakes by quartile of consumption for each food group (g/1,000 kcal).
† Adjusted for energy intake, survey year, body mass index, smoking status, drinking status, walking time, sleeping time, education levels, employment status, vitamin supplement use, hypertension, and diabetes mellitus.
‡ Excluding participants who died within 3 years from baseline (n = 13).

DISCUSSION

In this age-specific and prospective cohort study in a Japanese young older population, inverse associations were observed between all-cause mortality and the intakes of milk and dairy products and vegetables in women, while a positive association was found between all-cause mortality and sugar and sweetener consumption in men.

Although the association between mortality and the consumption of milk and dairy products remains controversial, meta-analyses have reported inverse associations between these foods and mortality, especially cardiovascular disease mortality.[20,21] In Asian populations, the consumption of milk and dairy products has been shown to decrease cardiovascular disease mortality.[22,23] Dietary calcium from dairy products has also been associated with a reduction in stroke mortality in Japan.[24] However, in older populations, the association between mortality and the consumption of milk and dairy products has been inconsistent, showing different effects depending on the type of dairy product.[25,26] Few studies have evaluated the association between mortality and the consumption of milk and dairy products in older Asian populations. The nutrient composition of milk and dairy products, which includes not only calcium, but also protein and vitamin D, can have favorable effects on human health.[27] High-quality protein, such as milk protein, has also been found to improve health in older individuals.[28] Our findings are therefore consistent with those from previous studies in the Asian general population. The consumption of different types of milk and dairy products across populations might be the reason for the inconsistencies observed in previous research in Western countries.[29]

Increasing fruit and vegetable consumption has been recommended for the prevention of chronic diseases, including cancer and cardiovascular diseases, which are the leading causes of death worldwide.[30,31] This rationale is supported by the biologically favorable effects of a large number of antioxidant nutrients in these food groups, such as vitamins, carotene, and fiber. A recent meta-analysis found that higher fruit and vegetable consumption was associated with a reduction in all-cause mortality, particularly cardiovascular mortality.[2] Likewise, in older populations, significant associations between lower all-cause or cardiovascular disease mortality and higher vegetable consumption and dietary patterns with a relatively high intake of fruit and vegetables have been reported.[8,9,32] Additionally, in older women, an inverse association between mortality and the total serum concentrations of carotenoids has been noted.[33] Vegetables are among the principal dietary sources of carotenoids. Other groups of vegetables, such as cruciferous vegetables, have also been investigated in regard to cancer prevention.[34] In the present study, higher consumption of total vegetables was associated with lower all-cause mortality in young older women, which is consistent with previous studies. Total vegetable consumption in those aged $\geq$ 60 years tends to be higher than that in younger generations in Japan.[35] Our findings suggest that increased vegetable consumption remains one of the most important dietary factors for longevity, and that recommending sufficient vegetable intake remains valid in young older populations.

Meanwhile, in the present study, fruit intake was not associated with mortality reduction in either men or women. Although some previous studies have found inverse correlations between mortality and higher fruit intake, the results of this study do not support these findings.[36,37] Although fruit contains micronutrients that might promote longevity, such as β-cryptoxanthin, the characteristics of the compositions of each type of fruit are diverse.[38] In addition, the association between mortality and fruit intake might be influenced by the main subtypes of fruit intake in different populations.[39]

We also observed a significant inverse association between all-cause mortality and mushroom intake in women; however, this association was partially attenuated after excluding the participants who had died within 3 years from baseline. Higher mushroom intake has been suggested to provide protective effects against cardiovascular diseases and certain types of cancer.[40,41] One review mentioned that the relevant nutritional aspects of mushrooms, such as dietary fiber and potassium, as well as bioactive compounds, may exert positive effects on metabolic markers such as blood lipid concentration and blood pressure. As an example of a plausible mechanism, soluble fiber may help inhibit cholesterol and triglyceride absorption. Eritadenine in *Lentinula edodes* (shiitake) also seems to contribute hypocholesterolemic action by modifying hepatic phospholipid metabolism. Additionally, antitumor effects of polysaccharides in mushrooms have also been reported.[42] Although their biological effectiveness against specific cancers is not clear, polysaccharides may have the ability to induce apoptosis and other forms of cancer cell death through immunological mechanisms. Because evaluations in large cohort studies remain limited, further studies are needed to clarify the effectiveness of higher mushroom intake for reducing mortality.

In the present study, no inverse associations were found between mortality and any food group in men. One possible reason for this might be that the intakes of food groups related to mortality reduction were lower in men than in women. In addition, factors other than diet, such as smoking or diabetes, might have affected mortality more strongly than dietary intake in men. Meanwhile, a significant positive association was observed between mortality and the consumption of sugars and sweeteners only in men; however, this trend was attenuated in the analysis after excluding the participants who had died within 3 years from baseline. A previous study reported a positive association between mortality, especially cardiovascular mortality, and the consumption of added sugars.[43] However, in the present study, the validity of daily sugar and sweetener consumption as estimated by the FFQ was extremely low (Pearson correlation coefficient adjusted for energy and age in men = 0.13).[17,18] Furthermore, the current estimation of sugar and sweetener intake did not include sweetened beverages. Therefore, the validity of the association between mortality and sugar and sweetener intake is lower in the present compared with previous studies.

In the multivariable adjustment analysis, we included employment status as a confounder. In 2018, the employment rate among Japanese aged 65–69 years was 57.2% for men and 36.6% for women.[44] Although the number of working people aged 65–69 years has been gradually increasing, many employment patterns have changed, e.g., from a full- to a part-time job. Therefore, an evaluation at 65 years of age may be worthwhile as the starting point of a new lifestyle. However, because the employment patterns of young older adults may become more diverse over time, these could be important confounders when assessing mortality risk or health status.

The strength of this study is that all participants were almost the same age at baseline, which excluded confounding by age. However, some limitations should be noted. First, we obtained information on dietary intake only at baseline; thus, changes in dietary habits during follow-up could not be considered. Second, due to the limitations of the FFQ, detailed groups of dairy products, fruits, and vegetables (e.g., nonfat dairy products, cruciferous or *Allium* vegetables, citrus fruits) could not be specified. Finally, cause-specific mortality could not be assessed in the present study because of the small number of deaths. Additional studies in larger populations with longer follow-up periods are needed to clarify further the associations between the intake of different food groups and specific causes of death in young older people.

CONCLUSION

In conclusion, the present study revealed inverse associations between all-cause mortality and the consumption of milk and dairy products and vegetables in a cohort of young older Japanese women.

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CONFLICT OF INTEREST

The authors declare no competing financial interests.

REFERENCES

1 Ikeda N, Saito E, Kondo N, et al. What has made the population of Japan healthy? *Lancet*. 2011;378(9796):1094–1105. doi:10.1016/S0140-6736(11)61055-6.

2 Wang X, Ouyang Y, Liu J, et al. Fruit and vegetable consumption and mortality from all causes, cardiovascular disease, and cancer: systematic review and dose-response meta-analysis of prospective cohort studies. *BMJ*. 2014;349:g4490. doi:10.1136/bmj.g4490.

3 Zhao LG, Sun JW, Yang Y, Ma X, Wang YY, Xiang YB. Fish consumption and all-cause mortality: a meta-analysis of cohort studies. *Eur J Clin Nutr*. 2016;70(2):155–161. doi:10.1038/ejcn.2015.72.

4 Wang X, Lin X, Ouyang YY, et al. Red and processed meat consumption and mortality: dose-response meta-analysis of prospective cohort studies. *Public Health Nutr*. 2016;19(5):893–905. doi:10.1017/S1368980015002062.

5 Nagao M, Iso H, Yamagishi K, Date C, Tamakoshi A. Meat consumption in relation to mortality from cardiovascular disease among Japanese men and women. *Eur J Clin Nutr*. 2012;66(6):687–693. doi:10.1038/ejcn.2012.6.

6 Nakamura Y, Ueshima H, Okamura T, et al. Association between fish consumption and all-cause and cause-specific mortality in Japan: NIPPON DATA80, 1980–99. *Am J Med*. 2005;118(3):239–245. doi:10.1016/j.amjmed.2004.12.016.

7 Nagata C, Takatsuka N, Shimizu H. Soy and fish oil intake and mortality in a Japanese community. *Am J Epidemiol*. 2002;156(9):824–831. doi:10.1093/aje/kwf118.

8 Sjögren P, Becker W, Warensjö E, et al. Mediterranean and carbohydrate-restricted diets and mortality among elderly men: a cohort study in Sweden. *Am J Clin Nutr*. 2010;92(4):967–974. doi:10.3945/ajcn.2010.29345.

9 Jankovic N, Geelen A, Streppel MT, et al. Adherence to a healthy diet according to the World Health Organization guidelines and all-cause mortality in elderly adults from Europe and the United States. *Am J Epidemiol*. 2014;180(10):978–988. doi:10.1093/aje/kwu229.

10 Jankovic N, Geelen A, Streppel MT, et al. WHO guidelines for a healthy diet and mortality from cardiovascular disease in European and American elderly: the CHANCES project. *Am J Clin Nutr*. 2015;102(4):745–756. doi:10.3945/ajcn.114.095117.

11 Zhang XH, Woo J, Heller RF. Increasing dietary fish intake has contributed to decreasing mortality from CHD among the older population in Hong Kong. *Public Health Nutr*. 2009;12(8):1248–1253. doi:10.1017/S1368980008003790.

12 Shi Z, Zhang T, Byles J, Martin S, Avery JC, Taylor AW. Food habits, lifestyle factors and mortality among oldest old chinese: the Chinese Longitudinal Healthy Longevity Survey (CLHLS). *Nutrients*. 2015;7(9):7562–7579. doi:10.3390/nu7095353.

13 Plessz M, Guéguen A, Goldberg M, Czernichow S, Zins M. Ageing, retirement and changes in vegetable consumption in France: findings from the prospective GAZEL cohort. *Br J Nutr*. 2015;114(6):979–987. doi:10.1017/S0007114515002615.

14 Ding D, Grunseit AC, Chau JY, Vo K, Byles J, Bauman AE. Retirement-A Transition to a Healthier Lifestyle?: Evidence From a Large Australian Study. *Am J Prev Med*. 2016;51(2):170–178. doi:10.1016/j.amepre.2016.01.019.

15 Fontana L, Partridge L. Promoting health and longevity through diet: from model organisms to humans.

Cell. 2015;161(1):106–118. doi:10.1016/j.cell.2015.02.020.
16 Kitamura T, Kawamura T, Tamakoshi A, Wakai K, Ando M, Ohno Y. Rationale, design, and profiles of the New Integrated Suburban Seniority Investigation (NISSIN) Project: a study of an age-specific, community-based cohort of Japanese elderly. *J Epidemiol*. 2009;19(5):237–243. doi:10.2188/jea.je20081026.
17 Egami I, Wakai K, Kato K, et al. A simple food frequency questionnaire for Japanese diet--Part II. Reproducibility and validity for nutrient intakes. *J Epidemiol*. 1999;9(4):227–234. doi:10.2188/jea.9.227.
18 Wakai K, Egami I, Kato K, et al. A simple food frequency questionnaire for Japanese diet--Part I. Development of the questionnaire, and reproducibility and validity for food groups. *J Epidemiol*. 1999;9(4):216–226. doi:10.2188/jea.9.216.
19 Nagata C, Nakamura K, Wada K, et al. Total fat intake is associated with decreased mortality in Japanese men but not in women. *J Nutr*. 2012;142(9):1713–1719. doi:10.3945/jn.112.161661.
20 Soedamah-Muthu SS, Ding EL, Al-Delaimy WK, et al. Milk and dairy consumption and incidence of cardiovascular diseases and all-cause mortality: dose-response meta-analysis of prospective cohort studies. *Am J Clin Nutr*. 2011;93(1):158–171. doi:10.3945/ajcn.2010.29866.
21 Alexander DD, Bylsma LC, Vargas AJ, et al. Dairy consumption and CVD: a systematic review and meta-analysis. *Br J Nutr*. 2016;115(4):737–750. doi:10.1017/S0007114515005000.
22 Kondo I, Ojima T, Nakamura M, et al. Consumption of dairy products and death from cardiovascular disease in the Japanese general population: the NIPPON DATA80. *J Epidemiol*. 2013;23(1):47–54. doi:10.2188/jea.je20120054.
23 Maruyama K, Iso H, Date C, et al. Dietary patterns and risk of cardiovascular deaths among middle-aged Japanese: JACC Study. *Nutr Metab Cardiovasc Dis*. 2013;23(6):519–527. doi:10.1016/j.numecd.2011.10.007.
24 Umesawa M, Iso H, Date C, et al. Dietary intake of calcium in relation to mortality from cardiovascular disease: the JACC Study. *Stroke*. 2006;37(1):20–26. doi:10.1161/01.STR.0000195155.21143.38.
25 Tognon G, Rothenberg E, Petrolo M, Sundh V, Lissner L. Dairy product intake and mortality in a cohort of 70-year-old Swedes: a contribution to the Nordic diet discussion. *Eur J Nutr*. 2018;57(8):2869–2876. doi:10.1007/s00394-017-1556-2.
26 Um CY, Prizment A, Hong CP, Lazovich D, Bostick RM. Associations of calcium and dairy product intakes with all-cause, all-cancer, colorectal cancer and CHD mortality among older women in the Iowa Women's Health Study. *Br J Nutr*. 2019;121(10):1188–1200. doi:10.1017/S000711451900045X.
27 Visioli F, Strata A. Milk, dairy products, and their functional effects in humans: a narrative review of recent evidence. *Adv Nutr*. 2014;5(2):131–143. doi:10.3945/an.113.005025.
28 Wolfe RR. Update on protein intake: importance of milk proteins for health status of the elderly. *Nutr Rev*. 2015;73 Suppl 1:41–47. doi:10.1093/nutrit/nuv021.
29 Lee MS, Wahlqvist ML, Peng CJ. Dairy foods and health in Asians: Taiwanese considerations. *Asia Pac J Clin Nutr*. 2015;24 Suppl 1:S14–S20. doi:10.6133/apjcn.2015.24.s1.03.
30 U.S. Department of Health and Human Services and U.S. Department of Agriculture. 2015–2020 Dietary Guidelines for Americans. 2015; http://health.gov/dietaryguidelines/2015/guidelines/. Accessed March, 2020.
31 Minister of Health, Labour and Welfare. Health Japan 21 (the second term). 2012; https://www.mhlw.go.jp/file/06-Seisakujouhou-10900000-Kenkoukyoku/0000047330.pdf. Accessed March, 2020.
32 Masala G, Ceroti M, Pala V, et al. A dietary pattern rich in olive oil and raw vegetables is associated with lower mortality in Italian elderly subjects. *Br J Nutr*. 2007;98(2):406–415. doi:10.1017/S0007114507704981.
33 Nicklett EJ, Semba RD, Xue QL, et al. Fruit and vegetable intake, physical activity, and mortality in older community-dwelling women. *J Am Geriatr Soc*. 2012;60(5):862–868. doi:10.1111/j.1532-5415.2012.03924.x.
34 Higdon JV, Delage B, Williams DE, Dashwood RH. Cruciferous vegetables and human cancer risk: epidemiologic evidence and mechanistic basis. *Pharmacol Res*. 2007;55(3):224–236. doi:10.1016/j.phrs.2007.01.009.
35 Minister of Health, Labour and Welfare. National health and Nutrition Survey, 2017. 2018; https://www.mhlw.go.jp/content/000451755.pdf. Accessed March, 2020.
36 Okuda N, Miura K, Okayama A, et al. Fruit and vegetable intake and mortality from cardiovascular disease in Japan: a 24-year follow-up of the NIPPON DATA80 Study. *Eur J Clin Nutr*. 2015;69(4):482–488. doi:10.1038/ejcn.2014.276.
37 Du H, Li L, Bennett D, et al. Fresh fruit consumption and all-cause and cause-specific mortality: findings from the China Kadoorie Biobank. *Int J Epidemiol*. 2017;46(5):1444–1455. doi:10.1093/ije/dyx042.
38 Jacob JK, Tiwari K, Correa-Betanzo J, Misran A, Chandrasekaran R, Paliyath G. Biochemical basis for functional ingredient design from fruits. *Annu Rev Food Sci Technol*. 2012;3:79–104. doi:10.1146/annurev-food-022811-101127.
39 Lai HT, Threapleton DE, Day AJ, Williamson G, Cade JE, Burley VJ. Fruit intake and cardiovascular

disease mortality in the UK Women's Cohort Study. *Eur J Epidemiol*. 2015;30(9):1035–1048. doi:10.1007/s10654-015-0050-5.
40 Li J, Zou L, Chen W, et al. Dietary mushroom intake may reduce the risk of breast cancer: evidence from a meta-analysis of observational studies. *PLoS One*. 2014;9(4):e93437. doi:10.1371/journal.pone.0093437.
41 Guillamón E, García-Lafuente A, Lozano M, et al. Edible mushrooms: role in the prevention of cardiovascular diseases. *Fitoterapia*. 2010;81(7):715–723. doi:10.1016/j.fitote.2010.06.005.
42 Friedman M. Mushroom polysaccharides: chemistry and antiobesity, antidiabetes, anticancer, and antibiotic properties in cells, rodents, and humans. *Foods*. 2016;5(4):80. doi:10.3390/foods5040080.
43 Yang Q, Zhang Z, Gregg EW, Flanders WD, Merritt R, Hu FB. Added sugar intake and cardiovascular diseases mortality among US adults. *JAMA Intern Med*. 2014;174(4):516–524. doi:10.1001/jamainternmed.2013.13563.
44 Ministry of Internal Affairs and Communications. Japan's elderly in statistics. 2019; https://www.stat.go.jp/data/topics/pdf/topics121.pdf, Accessed June, 2020.