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High quality nutrient intake is associated with higher household expenditures by Japanese adults

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Summary **There is little evidence of socioeconomic differences in dietary intake in the Japanese population. This study examined the association between household expenditures and dietary intake using nationally representative surveys of Japan. We analyzed data from the Comprehensive Survey of Living Conditions and National Health and Nutrition Survey, 2003-2007. For subjects ages 18 to 74 years (11,240 men and 11,472 women), the sex-specific association between household expenditure quartiles and selected nutrient intake was examined using comparison of means and prevalence of a healthy intake. Higher household expenditures were associated with an increase in the mean levels of total energy, fat, protein, carbohydrates, calcium, vitamins A and C, niacin, and fiber for both men and women and salt for men. Prevalence comparison indicated that most of the recommendations for dietary intake were met for people with higher household expenditures than for those with lower household expenditures. There was no clear association between fat intake and expenditures. Higher household expenditures were associated with a healthy and balanced nutrient intake in Japanese adults. The findings suggest that socioeconomic differences in dietary patterns contribute to socioeconomic inequalities in mortality and morbidity in Japan.**

Keywords: Health inequalities, socioeconomic factors, household expenditures, nutrient intake, diet quality

1. Introduction

Socioeconomic differences in health are currently a great concern in the field of public health and health policies. Health is determined by a wide range of individual socioeconomic circumstances and social environments that are termed social determinants of health (*1*). Social epidemiology is the branch of epidemiology that seeks to ascertain health inequalities and social determinants of health (*2*). Like in Western countries, prior studies in Japan found that disparities in mortality, morbidity, self-rated health, psychological distress, health behaviors, and other aspects were explained by socioeconomic status such as educational attainment, income, and occupational status (*3*).

The pathways from socioeconomic status to poor health are complicated. One of the important pathways is related to health behaviors including dietary patterns and nutrient intake (*1*). People of a lower socioeconomic status in terms of education, income, occupational status, *etc.* have been found to have a poor quality diet (*4-7*). An unhealthy dietary intake pattern results in increased risk factors particularly for cardiovascular disease, including obesity, diabetes, and dyslipidemia (*8,9*).

Several studies in Japanese populations have examined socioeconomic differences in health, and differences in mortality, morbidity, and health risks were noted (*3*). However, the socioeconomic differences were moderate compared with those in other countries, and the association between socioeconomic status and major diseases and risks was not entirely consistent (*10-14*). In particular, there are

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limited findings relating to socioeconomic differences in dietary intake by the Japanese population. In a prior study of pregnant Japanese women, a healthy dietary intake was associated with education but not household income (*15*). Another study found that increasing monetary costs of dietary energy were associated with both healthy and unhealthy dietary intake patterns (*16*). Since these studies examined specified populations, nationwide differences in dietary intake need to be examined.

The present study used nationally representative surveys to examine the association between household expenditures as a socioeconomic indicator and the intake of major nutrients by the Japanese population.

2. Methods

2.1. *Data*

Two nationally representative surveys conducted by the Ministry of Health, Labor, and Welfare in Japan were used: the Comprehensive Survey of Living Conditions (CSLC) and the National Health and Nutritional Survey (NHNS), 2003-2007 (*17,18*).

The CSLC began in 1986 and has been conducted every three years since, with smaller surveys in-between. In both types of surveys, the entire land area of Japan was divided into approximately one million enumeration districts (EDs). The large surveys randomly selected around 5,000 EDs while the small surveys selected 1,000 EDs. Interviewers visited all households within the selected areas using lists of households and approached all members of the household. The questionnaires included basic household and individual information regarding demographics, health, illness profiles, lifestyle, monthly household expenditures, and other items. The survey sample was about 280,000 households for the large surveys in 2004 and 2007 and about 57,000 households in 2003, 2005, and 2006. The response rates were about 80%.

The NHNS is an annual nationwide nutrition survey that began in 1948. Using the EDs of the CSLC, around 300 EDs were randomly selected every year, and all members of the household 1 year of age and older were approached. The survey consisted of an anthropometric examination including height, weight, and blood pressure; blood tests; a dietary survey; and health-related behaviors. The subject sample every year from 2003 to 2007 was around 5,000 households and 15,000 members of those households. The response rates were almost 60%.

The dietary survey was carried out using a food weight record method for one day of November, excluding Sunday and national holidays, in each household (*17*). Trained dietitians visited participants, and they were asked to weigh and record all foods and beverages that any of the members of the household consumed. Dietary records were coded using the Standard Tables for Food in Japan, 5th edition, and the intake of nutrients and food groups were tallied for every household. Nutrient intake per person was calculated as intake per household simply divided by the number of members of the household 1 year of age and over.

Since the NHNS and CSLC utilize the same sampling units, survey data were linked using the survey year, regional area, number of households, number of members of the household, age, and sex. These data were narrowed to those from subjects from ages 18 to 74 years with no missing data for relevant variables.

The data from the two surveys were used with permission of the Ministry of Health, Labor, and Welfare.

2.2. *Outcomes*

The following eleven nutrients served to indicate outcomes; total energy, total fat, carbohydrates, protein, calcium, vitamins A, B_1, and C, niacin, fiber, and salt. This nutrient intake was estimated by the Ministry of Health, Labour and Welfare. Total fat and carbohydrates were represented as % energy, and protein, calcium, vitamins A, B_1, and C, niacin, fiber and salt were calculated per 1,000 kcal.

The prevalence of a healthy nutrient intake was determined using the recommended dietary allowance (RDA) or the tentative dietary goals for preventing lifestyle-related disease (DG) according to the Dietary Reference Intakes for Japanese, 2010 (*19*). The values were total fat: 20-30%; carbohydrates: 50-70%; protein: 60 g for men and 50 g for women; calcium: 700 mg for men and 650 mg for women; vitamin A: 850 μg for men and 650 μg for women, vitamin B_1: 1.4 mg for men and 1.1 mg for women; vitamin C: 100 mg; niacin: 15 mg for men and 12 mg for women; fiber: 19 mg for men and 12 mg for women; and salt: 9 g for men and 7.5 g for women. To adjust for total energy intake, the values of calcium to salt were divided by the mean of total energy intake by subjects: 2,197 kcal for men and 1,752 kcal for women. The final cut-offs are shown in Table 1.

2.3. *Analysis*

Equivalent household expenditures were used as a socioeconomic measure in this study. Expenditures were calculated by dividing total household expenditures per month by the square root of household size according to a recent method devised by the OECD (*20*). The study subjects were then grouped into quartiles according to expenditures. Quartile lines were 100, 140, and 180 thousand yen per month.

Statistical analysis was conducted separately by sex. Age-adjusted means of nutrient intake were estimated and compared by household expenditure quartiles using

Table 1. Summary of basic characteristics and nutrient intake by study subjects

Variable	Men (*n* = 11,240)	Women (*n* = 11,472)
Age (years, mean ± standard deviation)	49.5 ± 15.5	49.2 ± 15.5
Marital status (%)		
Married	75.6%	69.0%
Single	20.3%	18.4%
Separated	1.6%	7.5%
Divorced	2.5%	5.1%
Nutrient intake (mean ± standard deviation)		
Total energy (kcal/day)	2,197.4 ± 613.4	1,751.7 ± 462.5
Total fat (% energy)	24.0 ± 7.3	25.9 ± 7.5
Carbohydrates (% energy)	61.4 ± 8.2	58.7 ± 8.3
Protein (g/1,000 kcal)	36.6 ± 7.8	38.4 ± 7.9
Calcium (mg/1,000 kcal)	244.3 ± 113.1	302.4 ± 140.0
Vitamin A (μg/1,000 kcal)	348.6 ± 420.1	433.8 ± 437.9
Vitamin B_1 (mg/1,000 kcal)	0.72 ± 2.69	0.87 ± 3.68
Vitamin C (mg/1,000 kcal)	53.1 ± 71.5	77.5 ± 115.1
Niacin (mg/1,000 kcal)	8.25 ± 3.52	8.32 ± 3.44
Fiber (g/1,000 kcal)	7.07 ± 2.82	8.57 ± 3.32
Salt (g/1,000 kcal)	5.77 ± 2.07	6.15 ± 2.20
Healthy nutrient intake (%)*		
Total fat 20-30% energy	26.5%	24.0%
Carbohydrates 50-70% energy	77.5%	77.6%
Protein ≥ 27.3 (m), 28.5 (w) g/1,000 kcal	90.7%	91.5%
Calcium ≥ 319 (m), 371 (w) mg/1,000 kcal	21.9%	25.8%
Vitamin A ≥ 387 (m), 371 (w) μg/1,000 kcal	27.4%	43.2%
Vitamin B_1 ≥ 0.64 (m), 0.63 (w) mg/1,000 kcal	13.4%	16.5%
Vitamin C ≥ 45.5 (m), 57.1 (w) mg/1,000 kcal	40.4%	46.8%
Niacin ≥ 6.8 mg/1,000 kcal	62.2%	63.6%
Fiber ≥ 8.6 (m), 9.7 (w) g/1,000 kcal	24.8%	43.8%
Salt < 4.1 g/1,000 kcal	20.2%	15.3%

* (m) for men, (w) for women.

Table 2. Nutrient intake by men according to quartiles of household expenditures: age-adjusted mean ± standard error

Nutrient intake	1st (lowest) quartile (*n* = 2,724)	2nd quartile (*n* = 2,523)	3rd quartile (*n* = 2,936)	4th (highest) quartile (*n* = 3,057)
Total energy (kcal/day)	2,173.2 ± 11.8[4]	2,183.3 ± 12.2[4]	2,194.2 ± 11.3[4]	2,233.8 ± 11.1[1,2,3]
Total fat (% energy)	23.2 ± 0.1[2,3,4]	23.8 ± 0.1[1,4]	24.0 ± 0.1[1,4]	24.7 ± 0.1[1,2,3]
Carbohydrates (% energy)	62.6 ± 0.2[2,3,4]	61.6 ± 0.2[1,3,4]	61.1 ± 0.1[1,2,4]	60.4 ± 0.1[1,2,3]
Protein (g/1,000 kcal)	35.6 ± 0.1[2,3,4]	36.4 ± 0.2[1,3,4]	37.2 ± 0.1[1,2]	37.2 ± 0.1[1,2]
Calcium (mg/1,000 kcal)	236.3 ± 2.1[2,3]	240.2 ± 2.2[3,4]	247.0 ± 2.0[1,2]	252.3 ± 2.0[1,2]
Vitamin A (μg/1,000 kcal)	319.6 ± 8.0[2,3,4]	354.5 ± 8.3[1]	351.8 ± 7.7[1]	366.6 ± 7.6[1]
Vitamin B_1 (mg/1,000 kcal)	0.65 ± 0.05	0.73 ± 0.05	0.73 ± 0.05	0.74 ± 0.05
Vitamin C (mg/1,000 kcal)	49.4 ± 1.4[3,4]	51.3 ± 1.4[4]	54.7 ± 1.3[1]	56.4 ± 1.3[1,2]
Niacin (mg/1,000 kcal)	7.84 ± 0.07[2,3,4]	8.11 ± 0.07[1,2,4]	8.48 ± 0.06[1,2]	8.51 ± 0.06[1,2]
Fiber (g/1,000 kcal)	6.92 ± 0.05[3,4]	6.98 ± 0.05[3,4]	7.13 ± 0.05[1,2]	7.22 ± 0.05[1,2]
Salt (g/1,000 kcal)	5.66 ± 0.04[3,4]	5.77 ± 0.04	5.84 ± 0.04[1]	5.79 ± 0.04[1]

[1, 2, 3, 4] significant ($p < 0.05$) compared to the 1st, 2nd, 3rd, and 4th quartiles, respectively.

the General Linear Model and the least significant difference method. The prevalence of a healthy nutrient intake by household expenditure quartiles was also compared *via* the chi-squared test for trends. Then, the odds ratio (OR) of the prevalence for age, household expenditure quartiles, and marital status (being married *vs*. not being married, including being separated or divorced) was estimated using multiple logistic regression analysis. The statistics package SPSS 19 was used for all statistical analyses.

3. Results

The data for 11,240 men and 11,472 women were analyzed. Table 1 shows the basic characteristics of age and marital status. Age and marital status were almost the same for men and women.

A summary of nutrient intake is also shown in Table 1. The prevalence of a healthy nutrient intake ranged from 13.4% for vitamin B_1 to 90.7% for protein in men and from 15.3% for salt to 91.5% for protein in women.

Table 2 shows the age-adjusted mean and the standard error (S.E.) of nutrient intake according to quartiles of household expenditures for men. Intake of all nutrients except carbohydrates and vitamin B_1 trended to increase as household expenditures increased. A significant decrease in carbohydrates in accordance with expenditures was noted. There were no

differences in the intake of vitamin B_1.

As shown in Table 3, men and women had similar results. This was not true for salt intake: the highest (4th) quartile had a significantly lower salt intake than other quartiles.

Table 4 shows the prevalence of a healthy nutrient intake and the odds ratio (OR) for men. Significant gradients of increased prevalence with an increase in household expenditures were noted for carbohydrates, protein, calcium, vitamins A, B_1, and C, niacin, and fiber: the OR for the 4th quartile compared to that for the 1st quartile ranged from 1.20 for vitamin B_1 to 1.82 for protein. For total fat, there was no significant OR among quartiles. For salt, the 2nd and 3rd quartiles had

Table 3. Nutrient intake by women according to quartiles of household expenditures: age-adjusted mean ± standard error

Nutrient intake	1st (lowest) quartile (n = 2,696)	2nd quartile (n = 2,488)	3rd quartile (n = 2,782)	4th (highest) quartile (n = 2,909)
Total energy (kcal/day)	1,702.3 ± 8.9[3,4]	1,727.4 ± 9.2[3,4]	1,765.9 ± 8.7[1,2,4]	1,804.5 ± 8.5[1,2,3]
Total fat (% energy)	25.3 ± 0.1[2,3,4]	25.7 ± 0.1[1,4]	26.0 ± 0.1[1,4]	26.6 ± 0.1[1,2,3]
Carbohydrates (% energy)	59.8 ± 0.2[2,3,4]	58.9 ± 0.2[1,4]	58.5 ± 0.2[1,4]	57.9 ± 0.1[1,2,3]
Protein (g/1,000 kcal)	37.5 ± 0.2[2,3,4]	38.5 ± 0.2[1]	38.7 ± 0.1[1]	38.9 ± 0.1[1]
Calcium (mg/1,000 kcal)	292.0 ± 2.6[3,4]	298.4 ± 2.7[4]	304.4 ± 2.6[1,4]	313.8 ± 2.5[1,2,3]
Vitamin A (μg/1,000 kcal)	398.8 ± 8.4[2,3,4]	437.6 ± 8.7[1]	436.3 ± 8.3[2,4]	460.6 ± 8.1[1,3]
Vitamin B_1 (mg/1,000 kcal)	0.78 ± 0.07	0.88 ± 0.07	0.91 ± 0.07	0.92 ± 0.07
Vitamin C (mg/1,000 kcal)	69.4 ± 2.2[3,4]	73.5 ± 2.3[4]	77.5 ± 2.2[1,4]	88.5 ± 2.1[1,2,3]
Niacin (mg/1,000 kcal)	7.96 ± 0.07[2,3,4]	8.34 ± 0.07[1]	8.46 ± 0.07[1]	8.50 ± 0.06[1]
Fiber (g/1,000 kcal)	8.32 ± 0.06[3,4]	8.59 ± 0.06[1]	8.61 ± 0.06[1]	8.75 ± 0.06[1]
Salt (g/1,000 kcal)	6.14 ± 0.04[4]	6.25 ± 0.04[4]	6.21 ± 0.04[4]	6.02 ± 0.04[1,2,3]

[1, 2, 3, 4] significant ($p < 0.05$) compared to the 1st, 2nd, 3rd, and 4th quartiles, respectively.

Table 4. Prevalence of a healthy nutrient intake by men and the odds ratio (OR) and 95% confidence interval (CI) for quartiles of household expenditures and marital status

Nutrient intake	Total fat 20-30% energy % OR (95% CI)	Carbohydrates 50-70% energy % OR (95% CI)	Protein ≥ 27.3 g/1,000 kcal % OR (95% CI)
Age (per ten-year increase)	1.08 (1.04-1.11)	0.91 (0.87-0.94)	1.14 (1.08-1.19)
Household expenditures			
1st (lowest) quartile	25.7% 1.00 reference	74.4% 1.00 reference	87.2% 1.00 reference
2nd quartile	26.7% 1.04 (0.92-1.17)	76.5% 1.10 (0.97-1.25)	90.4% 1.38 (1.16-1.64)
3rd quartile	27.5% 1.07 (0.95-1.20)	78.4% 1.25 (1.11-1.41)	92.0% 1.63 (1.37-1.95)
4th (highest) quartile	26.0% 0.99 (0.88-1.11)	80.2% 1.42 (1.25-1.60)	92.8% 1.82 (1.53-2.18)
Trend		***	***
Not married (reference = married)	0.94 (0.82-1.07)	0.72 (0.63-0.82)	1.13 (0.94-1.36)

Nutrient intake	Calcium ≥ 319 mg/1,000 kcal % OR (95% CI)	Vitamin A ≥ 387 μg/1,000 kcal % OR (95% CI)	Vitamin B_1 ≥ 0.64 mg/1,000 kcal % OR (95% CI)
Age (per ten-year increase)	1.36 (1.31-1.41)	1.18 (1.14-1.22)	1.03 (0.99-1.08)
Household expenditures			
1st (lowest) quartile	19.2% 1.00 reference	22.8% 1.00 reference	12.2% 1.00 reference
2nd quartile	20.0% 1.05 (0.92-1.21)	26.3% 1.20 (1.05-1.36)	12.9% 1.08 (0.92-1.27)
3rd quartile	20.5% 1.18 (1.04-1.35)	29.8% 1.39 (1.24-1.57)	14.1% 1.19 (1.02-1.39)
4th (highest) quartile	25.3% 1.35 (1.19-1.53)	30.2% 1.40 (1.25-1.58)	14.3% 1.20 (1.03-1.40)
Trend	***	***	*
Not married (reference = married)	1.56 (1.35-1.80)	1.10 (0.97-1.26)	1.21 (1.03-1.43)

Nutrient intake	Vitamin C ≥ 45.5 mg/1,000 kcal % OR (95% CI)	Niacin ≥ 6.8 mg/1,000 kcal % OR (95% CI)	Fiber ≥ 8.6 g/1,000 kcal % OR (95% CI)	Salt < 4.1 g/1,000 kcal % OR (95% CI)
Age (per ten-year increase)	1.64 (1.59-1.70)	1.10 (1.07-1.14)	1.59 (1.53-1.65)	0.86 (0.83-0.89)
Household expenditures				
1st (lowest) quartile	34.9% 1.00 reference	56.4% 1.00 reference	21.4% 1.00 reference	23.4% 1.00 reference
2nd quartile	37.7% 1.12 (1.00-1.26)	60.5% 1.16 (1.04-1.29)	23.3% 1.10 (0.96-1.26)	20.9% 0.88 (0.77-1.00)
3rd quartile	42.8% 1.33 (1.19-1.49)	64.0% 1.33 (1.19-1.48)	25.4% 1.17 (1.03-1.33)	19.1% 0.80 (0.70-0.91)
4th (highest) quartile	45.1% 1.41 (1.26-1.57)	67.1% 1.51 (1.36-1.69)	28.3% 1.32 (1.17-1.50)	17.8% 0.74 (0.65-0.85)
Trend	***	***	***	***
Not married (reference = married)	1.67 (1.47-1.89)	0.76 (0.67-0.85)	1.33 (1.15-1.55)	0.99 (0.87-1.14)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ with a chi-squared test for trends. % was prevalence of a healthy nutrient intake: *e.g.* total fat 20-25% energy. OR was estimated with multiple logistic regression using age, household expenditure quartile, and marital status. Individuals who were single, separated, or divorced were designated as "not married".

Table 5. Prevalence of a healthy nutrient intake by women and the odds ratio (OR) and 95% confidence interval (CI) for quartiles of household expenditures and marital status

Nutrient intake	Total fat 20-30% energy		Carbohydrates 50-70% energy		Protein ≥ 28.5 g/1,000 kcal	
	%	OR (95% CI)	%	OR (95% CI)	%	OR (95% CI)
Age (per ten-year increase)		1.16 (1.12-1.21)		1.05 (1.02-1.09)		1.24 (1.18-1.32)
Household expenditures						
1st (lowest) quartile	24.4%	1.00 reference	77.2%	1.00 reference	88.3%	1.00 reference
2nd quartile	22.9%	0.93 (0.82-1.06)	77.2%	1.00 (0.88-1.14)	91.5%	1.44 (1.20-1.73)
3rd quartile	24.5%	0.99 (0.88-1.12)	78.0%	1.04 (0.91-0.18)	92.6%	1.60 (1.33-1.93)
4th (highest) quartile	24.3%	0.98 (0.87-1.11)	77.9%	1.03 (0.91-1.17)	93.5%	1.82 (1.51-2.21)
Trend					***	
Not married (reference = married)		0.97 (0.84-1.11)		0.90 (0.79-1.04)		1.46 (1.19-1.80)

Nutrient intake	Calcium ≥ 371 mg/1,000 kcal		Vitamin A ≥ 371 μg/1,000 kcal		Vitamin B_1 ≥ 0.63 mg/1,000 kcal	
	%	OR (95% CI)	%	OR (95% CI)	%	OR (95% CI)
Age (per ten-year increase)		1.35 (1.30-1.40)		1.21 (1.18-1.25)		1.06 (1.02-1.10)
Household expenditures						
1st (lowest) quartile	23.6%	1.00 reference	37.4%	1.00 reference	14.6%	1.00 reference
2nd quartile	24.7%	1.11 (0.97-1.26)	42.0%	1.25 (1.12-1.40)	16.3%	1.15 (0.99-1.34)
3rd quartile	25.9%	1.14 (1.00-1.29)	45.7%	1.41 (1.26-1.57)	17.2%	1.22 (1.06-1.42)
4th (highest) quartile	28.8%	1.32 (1.16-1.49)	47.4%	1.50 (1.35-1.68)	17.8%	1.26 (1.09-1.46)
Trend	***		***		***	
Not married (reference = married)		1.55 (1.34-1.78)		1.22 (1.08-1.38)		1.30 (1.12-1.52)

Nutrient intake	Vitamin C ≥ 57.1 mg/1,000 kcal		Niacin ≥ 6.8 mg/1,000 kcal		Fiber ≥ 9.7 g/1,000 kcal		Salt < 4.1 g/1,000 kcal	
	%	OR (95% CI)	%	OR (95% CI)	%	OR (95% CI)	%	OR (95% CI)
Age (per ten-year increase)		1.66 (1.61-1.72)		1.16 (1.12-1.19)		1.61 (1.56-1.67)		0.83 (0.80-0.87)
Household expenditures								
1st (lowest) quartile	42.2%	1.00 reference	58.0%	1.00 reference	40.1%	1.00 reference	17.1%	1.00 reference
2nd quartile	44.6%	1.18 (1.05-1.32)	63.7%	1.29 (1.15-1.44)	43.6%	1.22 (1.08-1.37)	13.9%	0.78 (0.67-0.90)
3rd quartile	48.1%	1.27 (1.13-1.42)	65.5%	1.36 (1.22-1.52)	44.4%	1.17 (1.04-1.31)	14.2%	0.82 (0.71-0.95)
4th (highest) quartile	51.6%	1.47 (1.31-1.64)	66.8%	1.44 (1.29-1.61)	46.8%	1.29 (1.15-1.44)	15.7%	0.93 (0.80-1.07)
Trend	***		***		***			
Not married (reference = married)		1.91 (1.68-2.17)		1.13 (1.00-1.28)		1.63 (1.43-1.85)		0.85 (0.72-0.99)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ with a chi-squared test for trends. % was prevalence of a healthy nutrient intake: *e.g.* total fat 20-25% energy. OR was estimated with multiple logistic regression using age, household expenditure quartile, and marital status. Individuals who were single, separated, or divorced were designated as "not married".

a significantly lower OR compared to the 1st quartile. In terms of marital status, not being married was significantly associated with a healthy intake compared to being married; intake of calcium, vitamins B_1 and C, and fiber increased while that of carbohydrates and niacin decreased.

As shown in Table 5, women and men had similar results. There were differences, however. There was no significant OR for carbohydrates, and increased salt intake was associated with lower household expenditures. In terms of marital status, not being married had a significantly increased OR compared to being married for all nutrients except total fat, carbohydrates, and salt.

4. Discussion

This study found an association between socioeconomic status and nutrient intake in a nationally representative sample in Japan. Results indicated that people with higher household expenditures were likely to have a healthier nutrient intake. Different patterns were noted mainly for fat and salt intake.

More favorable nutrient intake was associated with higher household expenditures. This finding was in line with prior studies in Western countries, in which higher socioeconomic position was associated with better dietary quality (*4-7*). These findings suggest that people with higher expenditures and income can select and purchase nutrient-rich food, including vegetables and fruit. In a study of pregnant Japanese women, healthy intake patterns were related to education but not income (*15*). Presumably, food choices are determined based on the ability to understand dietary recommendations rather than on other socioeconomic factors (*e.g.* income). However, the present study found that monetary advantages also promote a healthy diet.

In terms of fat intake, people with higher household expenditures had a higher mean of % energy. This seems to suggest that higher household expenditures are associated with an unhealthy fat intake, since an increase in fat results in cardiovascular risk factors such as obesity and dyslipidemia. However, the prevalence of fat intake in the recommended range (20 to 30%

energy) did not differ among quartiles of household expenditures. Therefore, higher household expenditures were not associated with a detrimental increase in fat intake.

Salt intake was associated with household expenditures for men, while women with the highest quartile of expenditures had the lowest salt intake. A prior study of Japanese women found no association between sodium intake and any socioeconomic indicator of education, occupation, or income (*15*). High salt intake is one of the most critical issues affecting nutrient intake in Japan, and a significant decrease in this intake has not been noted in recent years (*17*). This suggests that individuals have difficulty decreasing their salt intake, even if they are of a higher socioeconomic status.

Socioeconomic status is generally associated with cardiovascular disease and risk, which dietary and nutrient intake contribute to (*8,9*). The association between household expenditures and nutrient quality appears to partly explain the increase in cardiovascular disease and risk in people of a lower socioeconomic status. Fat and salt intake are important contributors to cardiovascular disease, but individuals with lower household expenditures were not found to have an unhealthy fat or salt intake. This finding might relate to the moderate association between socioeconomic status and cardiovascular disease and risk in Japan compared to that in Western countries (*11-14*).

The association between marital status and nutrient intake noted by this study is interesting. Not being married was associated with the healthy intake of most nutrients including vitamins and fiber, particularly for women. Prior studies in Japan found that being married decreased mortality and morbidity (*21,22*), so married people are assumed to have a healthier diet than unmarried people. Several studies in other countries found that married individuals tend to eat healthier diets than unmarried individuals do (*23-26*), while a few studies had inconsistent findings (*27,28*). Although the present study did not explore the background of the relationship, unmarried people might be likely to consume nutrient-rich food outside the home, for example. Another possibility is that the method of nutrient estimation is related to a healthy intake by unmarried people. The nutrient intake per capita is obtained by dividing the whole amount consumed in a household by the number of members of the household, regardless of their age and sex. Therefore, the nutrient intake of married subjects and subjects with children might be underestimated.

The mechanisms by which socioeconomic disadvantage leads to an unhealthy nutrient intake have frequently been discussed (*4,8*). Food choice and nutrition security are influenced by individual knowledge and training, food price and diet cost, food access, and the food environment, including neighborhood context, cultural issues, and other aspects (*4,8*). A few studies in Japan examined neighborhood environment and dietary intake but found no meaningful association (*29-31*). Therefore, individual factors might be better suited to explaining socioeconomic differences in nutrient intake in the Japanese population.

A few limitations should be noted. First, household expenditures were found to be less sensitive as an indicator of socioeconomic status compared to household income (*32*). Since income information was not collected in all of the years covered by the present study, household expenditures were divided by equivalent household size. Equivalent expenditures have been found to be useful for social patterning of risk factors (*32*). The second limitation relates to nutrition survey. Several problems with the NHNS have been noted, including limited accessibility of the original raw data, survey and data quality control, the low response rate, and nutrient estimation as a result of simply dividing by family size (*33*).

The findings of this study emphasize socioeconomic factors in disease prevention and health promotion. As in other industrialized countries, in Japan socioeconomic status is associated with nutrient intake, possibly through food choice and purchase. Disease prevention and health promotion should be targeted at socioeconomically disadvantaged populations. In addition to encouraging people to choose a healthy dietary pattern, accessibility to lower cost and nutrient-rich food should be promoted.

In conclusion, this study using nationally representative surveys found that people with higher household expenditures had a healthier intake of nutrients such as vitamins and fiber. The same association was not evident for fat and salt intake. An unhealthy nutrient intake associated with lower household expenditures might partly result in increased morbidity and mortality in socioeconomically disadvantaged populations.

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