Short Communication

Characteristics of food group intake by household income in the National Health and Nutrition Survey, Japan

Nobuo Nishi MD, PhD, MSc, MBA[1], Chika Horikawa RD, PhD, MSc[2], Nobuko Murayama PhD, MSc[2]

[1]*Center for International Collaboration and Partnership, National Institute of Health and Nutrition, National Institutes of Biomedical Innovation, Health and Nutrition, Tokyo, Japan*
[2]*Department of Health and Nutrition, Faculty of Human Life Studies, University of Niigata Prefecture, Niigata, Japan*

This study examines the relationship between of food group intake and household income in a representative Japanese population. A total of 11,015 subjects (5,127 men and 5,888 women) aged 20 to 79 years, in 5,475 households who were part of the National Health and Nutrition Survey, Japan, in 2010 and 2011 were analyzed. Dietary intake was recorded for one day in November for those aged one year and older, from 300 randomly selected survey districts. Household income per year was recorded in the questionnaire in three categories: low (<2 million yen), middle (2-6 million yen) and high (≥6 million yen). Multilevel regression modelling was applied to take into account the hierarchical data structure of subjects nested within households, and households nested within survey districts. Dichotomous variables divided at the median intake of each food group were used. In a model where sex, age, household size and population size of municipalities to which survey districts belonged were adjusted, the total energy intake was found to be highest in individuals from middle income households, and lowest for those from low income households. In models where a total energy intake was additionally adjusted, household members with low and middle incomes had a significantly higher intake of cereals, and a lower intake of potatoes and starches, pulses, vegetables, fruits, mushrooms, fish and shellfish, milk and seasonings and spices compared with those with high incomes. In conclusion, household members with lower incomes in Japan consumed more staple foods, but less vegetable, fruit and fish.

Key Words: household income, food group intake, multilevel modelling, National Health and Nutrition Survey, health inequality

INTRODUCTION

Causes of non-communicable diseases are complex in structure, and range from social, economic and political environmental factors to lifestyle, psychosocial and biological factors.[1] Among lifestyle factors, diet is essential to all humans (unlike smoking cigarettes and drinking alcohol), and socioeconomically disadvantaged people are forced to change both the quality and quantity of their food intake. In a review by Darmon and Drewnowski, groups of higher socioeconomic status were reported to consume more whole grains, lean meats, fish, low-fat dairy products, and fresh vegetables and fruit.[2] However, in Japan where non-communicable diseases are a major cause of death, the overall characteristics of food intake according to socioeconomic status have not been reported.

The National Health and Nutrition Survey (NHNS) is conducted every November by the Ministry of Health, Labour and Welfare. It serves as a basis for monitoring health and nutritional conditions in Japan, and is instrumental in developing health policies, such as the Health Japan 21, 2nd edition[3] policy. Fukuda and Hiyoshi examined differences of nutrient intakes according to household expenditure using the data of the NHNS and the Comprehensive Survey of Living Conditions, and found that higher household expenditure was associated with a healthier and more balanced nutrient intake in Japanese adults.[4] Due to a growing interest in socioeconomic differences in health, a question on household income was added in the questionnaire of the NHNS in 2010 and in 2011. This has provided a valuable opportunity to explore socioeconomic difference in Japanese dietary intake. Thus, this study aimed to use the results of the NHNS to examine characteristics of food group intake according to household income.

Corresponding Author: Dr Nobuo Nishi, Center for International Collaboration and Partnership, National Institute of Health and Nutrition, National Institutes of Biomedical Innovation, Health and Nutrition. 1-23-1 Toyama, Shinjuku-ku, Tokyo 162-8636, Japan.
Tel: +81-3-3203-5389; Fax: +81-3-3202-3278
Email: nnishi@nibiohn.go.jp; nobuo24@gmail.com
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METHODS

Subjects

Subjects were participants of the NHNS conducted in November 2010 and 2011. The NHNS consisted of a dietary intake survey, lifestyle questionnaire survey, and a physical examination. In 2010, there were 8,815 participants from 3,684 households, and in 2011 there were 8,247 participants from 3,412 households (aged 1 year and older).

Food group intake

Since 1995 the dietary intake survey has employed a 'one-day household-based food weighing with approximated proportion' method of assessing food group intakes. Details of this method are reported elsewhere.[5] In brief, it is a combination of household-based food weighing and approximating the proportions of food which family members shared of each dish or food in the household. The present study was based on the food composition table, 5th edition, revised. All foods consumed were categorized into small (98 groups), medium (33 groups) and large (17 groups) food groups. In this study, only data on large food groups was used.

Household income

Household income per year was collected via a lifestyle questionnaire, with four options provided from which respondents could select (<2 million yen, 2-6 million yen, ≥6 million yen and "Don't know"). Households with the answer "Don't know" and "No answer" were excluded. Households with multiple answers were also excluded. Because household income was asked by category and a share of each household member was not known, household size was used for adjustment in statistical analyses instead of calculating household income per capita.

Statistical analysis

Analyses were conducted on 5,127 men and 5,888 women from 5,475 households, after excluding subjects younger than 20 years old and older than 79 years old, as well as those who had filled out the survey incompletely. Age range was divided into 3 groups: 20-39, 40-59, and 60-79 years. Household size was divided into 3 groups: one person, two persons, and three or more persons. Survey districts were categorized by population size of the municipality that the survey districts belonged to: large (cities with population of 150,000 and over), middle (cities with population of 50,000 and over and less than 150,000), small (cities with population of less than 50,000, and towns and villages).

To take into account the hierarchical data structure of subjects (level 1), nested within households (level 2) and households within survey districts (level 3), a multilevel model was applied. Means of total calorie intake of household members with middle and low household income were compared with that of those with high household income in multilevel regression analysis, adjusting for sex, age, household size and population size of the municipality. Because of skewed distributions of intake (with some subjects having no intake of certain food groups) we used dichotomous variables to divide at the median intake of all subjects for each food group (0: lower than the median, 1: equal to or higher than the median). Analyses was conducted using IBM SPSS Statistics version 22.0 (Tokyo, Japan) and MLwiN 2.02[6] for multilevel regression analysis. p values less than 0.05 were regarded as statistically significant.

Ethical considerations

For use of the NHNS data, unlinked anonymized data was obtained with permission of the Ministry of Health, Labour and Welfare, Japan.

RESULTS

The larger a household was, the higher the household income (Table 1). Also, the larger the population size of municipalities, the higher the household income. Subjects aged 60 to 79 years, both men and women, more often belonged to low income households.

Total energy intake was about 400 kcal higher in men than in women (Table 2). The median intake of cereals, vegetables and beverages was higher than 100 g in both men and women. More than half of the subjects had no intake of nuts and seeds (73.0% for men and 70.7% for women) and no intake of confectionaries (69.2% for men and 54.8% for women), and therefore the median value for this was zero in both men and women.

In a multilevel regression model, where sex, age, household size and population size of municipalities that the survey districts belonged to were adjusted, total energy intake was found to be higher for individuals from middle income households (coefficient=22.2, SE=12.1, p=0.033) but was lower for those from low income households (coefficient=-67.4, SE=17.1, p<0.001) compared with those from high income households who had adjusted mean of 1,885 kcal.

In multilevel logistic regression models where the total energy intake was additionally adjusted, individuals who belonged to households with low or middle incomes had significantly elevated incidence of the median or higher intake of cereals, and had significantly fewer incidence of the median or higher intake of potatoes and starches, pulses, vegetables, fruit, mushrooms, fish and shellfish, milk products, and seasonings and spices (compared with those from high income households) (Table 3).

DISCUSSION

We examined total calorie intake and food group intakes by household income using the NHNS data, and found that total calorie intake was highest in middle income households. We also found that the intake of cereals was higher and that of vegetables, fruit, fish and milk products were lower among individuals belonging to lower income households. Thus, we found that households with lower incomes depended more on staple foods, rather than food groups such as vegetables, fruit, and fish. Total calorie intake was the highest in the middle income group. The households were representative of a broad cross section of regions in Japan, and to our knowledge, this is the first report on the socioeconomic characteristics of dietary intake by food group in Japan.

Fukuda and Hiyoshi examined nutrient intake by household expenditure using data from the NHNS, and the Comprehensive Survey of Living Conditions.[4] They

Table 1. Characteristics of households and subjects by household income: 11,015 subjects aged 20-79 years in 5,475 households in the National Health and Nutrition Survey, Japan, 2010 and 2011

	Household income[†]								*p* value[‡]
	All		High		Middle		Low		
	No.	%	No.	%	No.	%	No.	%	
Household (n=5,475)									
Household size									
One person	1,093	100	71	6.5	467	42.7	555	50.8	<0.001
Two persons	1,876	100	309	16.5	1,158	61.7	409	21.8	
Three persons or more	2,506	100	823	32.8	1,448	57.8	235	9.4	
Population size of municipalities									
<50,000	1,104	100	204	18.5	635	57.5	265	24.0	<0.001
≥50,000 - <150,000	1,406	100	284	20.2	791	56.3	331	23.5	
≥150,000	2,965	100	715	24.1	1,647	55.5	603	20.3	
Subject (n=11,015)									
Men (age, years)									
20-39	1,323	100	345	26.1	851	64.3	127	9.6	<0.001
40-59	1,766	100	729	41.3	884	50.1	153	8.7	
60-79	2,038	100	293	14.4	1,272	62.4	473	23.2	
Women (age, years)									
20-39	1,545	100	448	29.0	939	60.8	158	10.2	<0.001
40-59	1,962	100	760	38.7	1,000	51.0	202	10.3	
60-79	2,381	100	284	11.9	1,365	57.3	732	30.7	

[†] Household income (yen): high (≥6 million), middle (≥2 million and <6 million) and low (<2 million).
[‡] Chi-square test.

Table 2. Quartiles of intakes of total energy and food groups by sex: National Health and Nutrition Survey, Japan, 2010-2011

	Total (N=11,015)			Men (N=5,127)			Women (N=5,888)		
	Q_1	Q_2	Q_3	Q_1	Q_2	Q_3	Q_1	Q_2	Q_3
Total energy (kcal)	1,508	1,832	2,191	1,721	2,067	2,436	1,387	1,660	1,946
Cereals (g)	326	425	540	400	504	625	290	370	453
Potatoes and starches (g)	0	32.1	81.4	0	33.0	84.0	0	31.8	80.0
Sugars and sweeteners (g)	0.7	4.5	9.8	0.6	4.5	9.8	0.7	4.2	9.6
Pulses (g)	0	35.0	84.0	0	35.2	87.5	0	35.0	80.2
Nuts and seeds (g)	0	0	1.0	0	0	0.7	0	0	1.0
Vegetables (g)	160	255	376	166	264	385	156	249	367
Fruits (g)	0	66.6	172	0	33.3	150	0	85.0	182
Mushrooms (g)	0	3.0	25.0	0	2.0	25.0	0	3.5	25.0
Algae (g)	0	1.5	13.5	0	1.5	14.0	0	1.0	12.7
Fishes and shellfishes (g)	16.0	67.5	118	20.0	76.0	131	13.0	60.0	105
Meats (g)	30.0	70.0	120	38.3	82.0	138	25.0	60.0	101
Eggs (g)	1.7	32.0	55.0	3.2	36.0	57.0	0	29.2	53.6
Milks (g)	0	30.0	180	0	10.0	154	0	60.0	187
Fats and oils (g)	3.3	8.4	15.0	4.0	9.7	16.3	3.0	7.6	13.6
Confectionaries (g)	0	0	30.0	0	0	20.0	0	0	40.0
Beverages (g)	352	611	964	380	701	1089	318	584	869
Seasonings and spices (g)	41.9	64.6	104	47.1	71.7	120	38.6	59.0	92.4

Quartiles: Q_1 (25 percentile), Q_2 (50 percentile (median)) and Q_3 (75 percentile).

found that higher household expenditures were associated with an increase in total energy, fat, protein, carbohydrates, calcium, vitamins A and C, niacin, and fiber for both men and women, and salt for men. They used household expenditure rather than household income as a socioeconomic indicator, and this may be a reason for the differences between their results and the findings of this study regarding total energy intake. This report is a brief overview of the associations between household income and food group intake, but further investigations on the associations of household income with nutrient intake and other lifestyle factors are necessary.

There are some limitations in this study. First, the possibility of selection bias cannot be excluded, because data from individuals who were missing answers in the household income item were not included in the analyses. As a part of the Comprehensive Survey of Living Conditions, the income survey was conducted additionally in a subsample, which was intentionally separated from the sample of the NHNS. Thus, it is unknown whether households from one or more of the income groups selectively refused to answer the question on household income in the NHNS. Secondly, the dietary intake survey of the NHNS was conducted on one day in November. This single day may not be an appropriate representation of the habitual intake of the research subjects. However, the results using quartiles and dichotomous variables seem to show clear associations between household income and

Table 3. Odds ratios (95% confidence intervals) of intakes of the median or higher in 15 food groups by household income using multilevel logistic regression analyses[†]: 11,015 subjects aged 20-79 years in 5,475 households in the National Health and Nutrition Survey, Japan, 2010-2011

Food group	Household income		
	High	Middle	Low
Cereals	1.00 (ref)	1.33 (1.19-1.49)	1.54 (1.32-1.80)
Potatoes and starches	1.00 (ref)	0.89 (0.81-0.99)	0.83 (0.72-0.95)
Sugars and sweeteners	1.00 (ref)	1.02 (0.93-1.12)	1.10 (0.96-1.27)
Pulses	1.00 (ref)	0.91 (0.83-1.00)	0.82 (0.72-0.94)
Vegetables	1.00 (ref)	0.78 (0.70-0.86)	0.81 (0.70-0.93)
Fruit	1.00 (ref)	0.88 (0.79-0.97)	0.72 (0.62-0.83)
Mushrooms	1.00 (ref)	0.81 (0.73-0.89)	0.75 (0.66-0.86)
Algae	1.00 (ref)	0.90 (0.82-0.99)	0.95 (0.83-1.09)
Fish and shellfish	1.00 (ref)	0.85 (0.77-0.94)	0.84 (0.73-0.97)
Meat	1.00 (ref)	1.00 (0.90-1.10)	0.75 (0.65-0.87)
Eggs	1.00 (ref)	1.05 (0.96-1.16)	1.11 (0.96-1.27)
Milk products	1.00 (ref)	0.85 (0.77-0.93)	0.71 (0.62-0.81)
Fats and oils	1.00 (ref)	0.99 (0.89-1.09)	0.86 (0.75-0.99)
Beverages	1.00 (ref)	1.00 (0.91-1.11)	0.85 (0.74-0.98)
Seasonings and spices	1.00 (ref)	0.83 (0.75-0.91)	0.76 (0.66-0.87)

[†] For each food group, proportions of subjects with intakes of the median or higher in households with low (<2 million yen) and middle (≥2 million yen- <6 million yen) income were compared with those with high (≥6 million yen) income by adjusting for sex, age, household size, population size of the municipality to which a survey district belonged, and total calorie input. The food groups of 'nuts and seeds' and 'confectionaries' were excluded.

food group intake as far as large food groups were used. We did not analyze food intakes in detail because only about 20% of small food groups would give meaningful median intakes. Third, regional differences were not incorporated in the results. However, when seven regional blocks of Japan were entered into multilevel regression models as dummy variables, the results did not change materially.

In conclusion, household members with lower income consumed more staple foods but less vegetables, fruit, and fish in Japan.

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AUTHOR DISCLOSURES

No competing interests are reported.

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