

Food Intake Factors Related to Weight Loss and Weight Gain
in the Working Population

職域集団の体重の増減に関連する食物摂取要因の検討

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Food intake factors related to weight loss and weight gain in the working population

Introduction

1.1 *International trends in obesity and food intake*

According to a report by the World Health Organization (WHO), the number of obese individuals has tripled worldwide since 1975, reaching around 1.9 billion in 2018.¹⁾

Obesity is typically accompanied by hypertension, and stroke and heart disease account for half of all deaths globally. One-third of these deaths are reportedly caused by hypertension. Obesity and other lifestyle-related diseases are reported to be associated with diet.²⁾ A 2003 report by the WHO²⁾ identified the excessive consumption of high-calorie foods, saturated fatty acids, beverages with added sugar, and other foods as factors responsible for the worldwide increase in obesity. Conversely, the report also identified the consumption of foods high in dietary fiber, fruit, and vegetable as factors that reduce obesity. A recent WHO report recommended increasing the consumption of whole grains, beans, and nuts, in addition to consuming more fruits and vegetable and restricting the intake of energy from fats and sugars.³⁾

Recommendations for increasing the intake of vegetable and whole grains are presented in every country's dietary guidelines. In recent years, in addition to recommending the consumption of vegetable and fruits, the United States government's guidelines also recommend that whole grains make up at least half of all of the cereal grains consumed.⁴⁾

1.2 Domestic trends in obesity and food intake

The number of obese individuals in Japan (those with a body mass index [BMI] of 25 or higher) has recently increased and now makes up approximately 30% of the population. Trends over the past 10 years have plateaued, but the percentage of obese people was found to have increased more in 2016 than it did in 2015⁵⁾. Obesity is particularly common among men aged 40–60 years, and it is important to prevent obesity and metabolic syndrome among the working generation. Furthermore, in terms of nutrient intake, 40% of men and 50% of women in this age group have a fat-to-energy ratio in excess of 25%. In Japan, people of working age also have other problems, including the lowest vegetable intake found in the population. The diet of the Japanese working population is therefore a major problem. According to a 2007 investigation of the food intake and eating behavior of employees of a food manufacturing company with a factory in the Kanto region, the mean vegetable intake among these workers was 154 g/day for men and 178 g/day for women.⁶⁾ This falls far short of the target intake of 350 g/day recommended in Health Japan 21. Knowledge about the appropriate consumption of vegetable (350 g/day) was also found to be lacking.⁶⁾

A study examining the relationship between vegetable consumption and lifestyle-related diseases suggested that those with a high consumption of vegetable had a lower incidence of hypertension than did those with a low consumption of vegetable.⁷⁾ Furthermore, increasing one's daily vegetable consumption (cruciferous vegetable or green leafy vegetable) by about one serving has been reported to be associated with a reduced risk of ischemic stroke.⁸⁾ Furthermore, according to a 2010 meta-analysis, the

consumption of green leafy vegetable can prevent type 2 diabetes.⁹⁾ Despite multiple studies reporting similar evidence, the mean vegetable intake of the entire Japanese population remains inadequate.⁵⁾ Therefore, dietary support and preventive measures for lifestyle-related diseases are urgently needed, especially in the working population.

The 2016 Japanese guidelines for healthy dietary habits¹⁰⁾ recommend consuming fruits and vegetable in combination with other foods. However, the advice with regard to cereals is limited to the phrase “Eat enough grains such as rice and other cereals,” and cereals with different degrees of refinement are not currently specifically distinguished. However, according to recent studies,¹¹⁾ people in Japan need to increase their intake of vegetable and whole grains to approach the recommended consumption levels.

1.3 Dietary intake factors related to weight gain

In response to these circumstances, specific medical checkups and health guidance began in April 2008 for adults aged 40 years or older to whom the concept of metabolic syndrome had been introduced.^{12,13)} This year will mark 10 years since the launch of these measures, and awareness and interest have grown in this time. An established standard questionnaire form¹³⁾ is used during the specific checkups to aid in the prevention and improvement of metabolic syndrome. During the checkups, the 22 questions on this form¹³⁾ can assist in assessing an individual’s risk of developing bad lifestyle habits. The questions are sufficiently targeted for use in offering advice on the prevention of obesity and metabolic syndrome, future diet choices, and other lifestyle habits. One of these question asks about “any weight changes of at least ± 3 kg in the past year.”¹³⁾ Understanding weight gain of 3 kg or more over one year and the food

intake factors contributing to this situation could provide meaningful evidence to use when offering health guidance and dietary support and when setting assessment and behavioral goals following an individual's checkup. However, to the best of my knowledge, there is little evidence of a verified relationship between a one-year weight gain of ≥ 3 kg and food intake.

1.4 Purpose of this study

The present study aimed to investigate food intake factors related to a weight gain of 3 kg or more in one year in the working population to build evidence for the effective promotion of future health guidance, dietary support, and nutritional education.

The first chapter of this thesis, "Cohort study examining the association between vegetable consumption and weight gain in a single year among Japanese employees at a manufacturing company," describes an investigation of the risk of a one-year weight gain of at least 3 kg among individuals from the working population by vegetable consumption quartile. This chapter examines the risk that weight will increase by 3 kg or more in one year, with an emphasis on vegetable consumption as a food intake factor.

The second chapter, "Relationship between rice consumption and weight gain in Japanese workers: white versus brown rice/multigrain rice," details an investigation into the risk of a weight gain of 3 kg or more occurring in one year, based on differences in the consumption of milled rice, including brown rice and multigrain rice, as a food intake factor. "Cooked rice," which is a staple for most Japanese people, is a major source of carbohydrates and is highly likely to be consumed several times a day, almost

every day, in Japan. The amount of energy associated with the intake volume of cooked rice also accounts for a major proportion of a person's daily energy ratio. The generally recommended carbohydrate energy ratio is between 50% and 60%,¹⁴⁾ which means that the amount of energy obtained from rice accounts for the largest proportion of a person's daily energy ratio. This led to the hypothesis that the amount of rice consumed is a major factor contributing to body weight fluctuations. Rice consumption was therefore divided into three categories based on differences in the quantity of the rice to investigate the degree of risk that weight will increase.

1.5 Study design and population

This study was a one-year cohort study of male and female Japanese employees aged 19–60 years at the time of a 2007 health check (the start of the study period). The target company was a food manufacturing company in Musashino City, Tokyo, with 1,250 employees. Of these workers, 815 participants were recruited in June 2007, and 843 participants were followed up in June 2008. I limited my analysis to participants who received annual health checkups and completed the questionnaires in both years. Information for the study was sent by interoffice mail before the annual health check in both years, and consent forms were collected from the participants using self-administered questionnaires. These questionnaire forms were collected at the annual health checkups. Responses were received from 88% of the participants in 2007 and from 84% of the participants in 2008. Three investigators independently checked each survey for missing data and then solicited the information necessary to complete the questionnaires. Again, the present analyses included those participants who responded in both 2007 and 2008 (n = 478).

Chapter 1.

Cohort study examining the association between vegetable consumption and weight gain in a single year among Japanese employees at a manufacturing company

1.1 Background

The Japanese National Health and Nutrition Examination Survey reported that 31.7% of Japanese adult men (aged 20–69 years) were overweight or obese.⁵⁾ Overweight and obesity increase the risk of hypertension, type 2 diabetes, and other metabolic disorders. Many health insurance associations and clinics have recently implemented health guidance issued by Japan's Ministry of Health, Labour and Welfare for people over the age of 40 with metabolic syndrome, including specific weight loss goals set at yearly checkups.¹²⁾ One prominent risk factor for metabolic syndrome is a weight gain of more than 3 kg in a single year. Japanese physicians include this item in medical interviews conducted at all health centers, as recommended by “Health Guidance and Checkups,”¹²⁾ a national campaign promoted by health care insurers.

With regard to possible causation, several prospective studies have suggested that high vegetable intake is inversely associated with weight gain.¹⁵⁻¹⁸⁾ Examples include an association between vegetable intake and weight gain over 12 years among middle-aged women¹⁵⁾ and over 4 years among women and men in the United States,¹⁶⁾ and an association between high vegetable intake and the suppression of a weight gain of more

than 3.14 kg over 10 years in Spanish adults.¹⁷⁾ To date, however, no evidence has been published on the association between vegetable consumption and weight gain in Japanese workers.

Moreover, most existing evidence has been obtained using a follow-up of more than one year.¹⁵⁻²⁰⁾ Assessment of weight gain over short periods is important in Japan, however, because questionnaires used in health checkups nationwide to collect information on the prevention of metabolic syndrome assess “the presence or absence of a weight gain of 3 kg or more in one year.” To my knowledge, the question of whether low vegetable intake is a risk factor for a weight gain of 3 kg or more in one year has not been investigated. Furthermore, most existing studies have been conducted in Western countries, and few studies have addressed the association between vegetable intake and weight gain in Asian populations. Vegetable intake in Japan has declined in recent years across all generations, from teens to the elderly, and, unlike the situation in other countries, the decline in Japan has been particularly pronounced in men.⁵⁾ Increasing obesity rates have also been greatest for men. That is, vegetable consumption has decreased as obesity rates have increased in Japan.⁵⁾ To support the efforts of obesity prevention workers, evidence on the association between diet or dietary behaviors and obesity is urgently required.

Here, to determine whether vegetable consumption among Japanese workers is associated with a weight gain of more than 3 kg in a single year, I examined the association between vegetable intake and weight gain in a population of Japanese workers using brief diet and lifestyle questionnaires and data from a yearly health examination.

1.2 Methodology of the study

1.2.1 Study population

The study was a one-year cohort study based on data obtained from the control group for a previous study.²¹⁾ This sample has been described in detail above in Section 1.5 (“Study design and population”).

1.2.2 Questionnaires

We distributed a self-administered lifestyle questionnaire and a brief-type self-administered diet history questionnaire (BDHQ). The lifestyle questionnaire collected information on demographic factors, including sex, age, marital status, job type, attitudes and behaviors regarding food and quality of life, and knowledge of food preparation and nutritional requirements. Job type was characterized as management, supervisor, or regular employee. The BDHQ was derived from a previously validated self-administered diet history questionnaire (DHQ).²²⁾²³⁾ Energy-adjusted food consumption, which is presented in the present study as grams of foods consumed per 4,184 kJ (1000 kilocalories), was validated against a 16-day weighed dietary record as a gold standard in a previous report.²³⁾ This previous report found that differences in mean intakes were minimal, and the correlation coefficients between the two measurement methods were acceptable. Vegetable intake was assessed by asking respondents to note the frequency with which they consumed green and yellow vegetable, other vegetable, pickled vegetable, mushrooms, and seaweed. Responses were validated against the gold standard and found to have a Spearman correlation coefficient of 0.62 for men and women, signifying a moderate correlation.

1.2.3 *Health checkup data*

Body weight was measured in kilograms using electronic weight scales with direct digital reading. Height was measured in centimeters with the person standing without shoes. Body mass index (BMI; weight [kg]/height [m]²) was calculated from the weight and height measurements. All participants were measured at the same clinic using the same measurement equipment.

1.2.4 *Ethical considerations*

For the present analyses, we included those participants who responded in both 2007 and 2008 (n = 478). Written informed consent was obtained from all subjects/patients. This study was conducted in accordance with the guidelines of the Declaration of Helsinki, and all procedures involving human subjects/patients were approved by the Human Research Ethical Committee of the University of Kagawa (approval no. 257).

1.2.5 *Statistical analysis*

Questionnaires with incomplete or implausible information (total daily energy intake < 1/3 of the energy requirement for each age and sex class, assuming a low level of physical activity or > 2/3 of the energy requirement for each age and sex class, assuming a high level of physical activity; n = 41) were excluded based on the exclusion criteria described in the preceding study.²⁴⁾ After exclusion, a total of 437 respondents who provided information in both 2007 and 2008 remained in the analysis. We conducted a cross-sectional analysis of the associations between baseline covariates and the intake of vegetable. Vegetable intake was categorized into quartiles, and mean food

consumption was calculated (g/4,184 kJ). Other categories were expressed as percentages. Participants were divided into quartiles based on their vegetable consumption adjusted for energy using the density method, where energy-adjusted values were calculated using the amount of each food group consumed daily per 4,184 kJ of daily energy intake. We performed binomial logistic multiple regression analysis to examine the association between vegetable consumption and the risk of a weight gain of 3 kg or more in one year, adjusting for sex, age, weight, marital status, and intake of food with the potential to cause weight gain. Statistical tests were conducted using calorie-adjusted values. All statistical analyses were performed using SPSS version 20.0 (SPSS Inc., Chicago, IL, USA). *P*-values were two-tailed, and $p < 0.05$ was considered significant.

1.3 Results

1.3.1 Characteristics

The characteristics of participants, stratified by quartile of vegetable consumption, are shown in Table 1. The mean energy-adjusted consumption of vegetable ranged from 57.2 g/4,184 kJ in the lowest quartile to more than 143.7 g/4,184 kJ in the highest quartile at baseline. Participants in the highest quartile of vegetable consumption were significantly older, more likely to be women, and more often married. Baseline and one-year body weight decreased in parallel with vegetable consumption. Weight change over a single year was 0.6 kg less among participants in the highest quartile of vegetable intake than among participants in the lowest quartile (p for trend = 0.029). BMI measured at both baseline and after one year did not differ by quartile (p for trend = 0.816).

1.3.2 *Participants' intake of nutrients and foods*

Participants with a higher consumption of vegetable also consumed the greatest amounts of fish, milk and milk products, salad dressing, and Japanese sweets, but these participants consumed smaller amounts of cereals, sweet beverages, sugar, and alcohol, compared with participants in the lowest quartile of vegetable consumption (Table 2). The one-year increase in vegetable consumption was $1.2 (\pm 56.5)$ g/4,184 kJ (108.7 ± 73.7 g/4,184 kJ in 2007, 109.9 ± 69.7 g/4,184 kJ in 2008) (not shown in the table).

1.3.3 *Main outcomes*

Higher vegetable consumption was associated with a reduced risk of rapid weight gain (Table 3). Compared with participants in the lowest quartile, the crude odds of weight gain ≥ 3 kg in a single year for participants in the second, third, and fourth quartiles were 0.73, 0.46, and 0.35, respectively (Model 1; p for trend = 0.016) after adjustment for sex, age, marital status, baseline weight, and consumption of fish, cereals, fruits, milk, Japanese sweets, sweetened beverages, sugar, salad dressing, and alcohol (Model 4; p for trend = 0.028). Compared with participants in the lowest quartile of vegetable consumption (< 57.2 g/4,184 kJ), participants in the highest quartile (≥ 143.7 g/4,184 kJ) had a 73% lower risk of gaining ≥ 3 kg of weight in a single year (adjusted OR = 0.27, 95% CI: 0.08–0.99). However, participants in the second (57.2–93.6 g/4,184 kJ) and third (93.6–143.7 g/4,184 kJ) quartiles did not have a significantly lower risk of rapid weight gain, with risk reductions of 31% (OR = 0.69, 95% CI: 0.29–1.68) and 63% (OR = 0.37, 95% CI: 0.13–1.07), respectively.

1.4 Discussion

1.4.1 *The association between vegetable consumption and weight gain*

In this study, we confirmed that vegetable intake was inversely associated with the risk of a body weight increase of 3 kg or more over one year among Japanese employees. This association was not modified by adjustment for baseline body weight or intake of foods other than vegetable.

Our findings of an association between the risk of body weight increase and vegetable intake support the belief that high vegetable intake reduces the risk of obesity. Vioque et al.¹⁷⁾ reported an association between vegetable intake and weight gain over a period of 10 years. They found that, as vegetable intake increased, the risk of gaining more than 3.41 kg over 10 years was reduced, with an odds ratio of a weight gain of > 3.41 kg over 10 years for the group consuming the most vegetable (vs. the group consuming the least vegetable) of 0.18 (95% CI: 0.05–0.73). In a long-term cohort study that followed middle-aged women for 12 years, He et al.¹⁵⁾ reported that the risk of a weight gain of 25 kg or more in the group consuming the most vegetable was 0.76 times that in the group consuming the least vegetable. Although these studies examined the long-term and gradual association between a reduced risk of weight gain and high vegetable intake, the present study focused on weight gain in the much shorter period of one year. Although the mechanism by which vegetable consumption might prevent weight gain has not been clarified, because fruits and vegetable are rich in vitamins, minerals, and dietary fiber, they have attracted considerable attention in recent years, and many studies have assessed the association of combinations of fruits and vegetable with weight gain.^{19),25),26)} However, fruits are mostly consumed raw and without the use of oil, and this type of consumption seems very different from that of vegetable, which

are often fried or otherwise cooked and dressed with sauces.²⁷⁾ In addition, whereas vegetable are generally a side dish of a meal, fruits are often eaten as snacks (but not as substitutes for meals); although fruits and vegetable might belong to the same group at the nutrient level, they should be classified as separate groups from the perspective of meals and eating habits.²⁷⁾ In previous studies, in cases where only vegetable or only fruits were investigated, or where fruits and vegetable were distinguished as separate groups, the results were not always the same as when fruits and vegetable were considered as a single food group.^{15),16)} Therefore, we focused only on vegetable intake in the present study. In previous studies that showed an association between vegetable intake and weight gain over a long-term follow-up,^{15,17-18)} significant decreases in the risk of body weight gain were observed in the group consuming the most vegetable (approximately 140 g/4,184 kJ) in comparison with the group consuming the least vegetable, but no significantly reduced risk was observed in comparison with the other groups. In the present study, after multivariate data adjustment, the results showed no significant difference in the risk of weight gain in the second- or third-quartile intake groups in comparison with the first-quartile intake group. That is, the risk of body weight increase in the groups consuming 93.6 to 143.7 g of vegetable per 4,184 kJ was not reduced, compared with the group consuming the least amount of vegetable. Vergnaud et al.²⁷⁾ found no correlation between a vegetable intake of 100 g and body weight gain in persons other than those who had quit smoking. In our study, no significant effect was observed in the second- or third-quartile intake groups. This finding suggests that the protective effect of high vegetable intake on short-term body weight gain may require an intake of more than 143.7 g/4,184 kJ. However, it is also possible that the sample size was too small to detect significant differences between the

intake groups. Many recent intervention studies have assessed the benefit of high vegetable intake; however, most of these studies have investigated vegetable intake of less than one serving.²⁸⁻³⁰⁾ To be effective, obesity prevention programs must be based on components that reliable evidence has shown to be beneficial. Our study suggests that persons with relatively low vegetable intake (< 57.2 g/4,184 kJ) should be targeted and that daily vegetable intake should be increased to 143.7 g/4,184 kJ or more.

The rate of decrease in BMI from baseline was not as large as the decline in body weight. As the amount of vegetable intake increases, body weight decreases, and, accordingly, BMI is expected to be reduced as well. However, this was not shown in the results of this research. Although it is not clearly understood, one unit of BMI (1 kg/m²) is less variable than the unit of body weight (1 kg), so it is more difficult for change in BMI to appear.

1.4.2 Limitations and strengths

Our study has a limitation that warrants mention. Previous studies of the association between vegetable intake and long-term weight gain adjusted for exercise and smoking in their analyses.^{25) 27)} For participants who stopped smoking, vegetable intake was greater, and the risk of weight gain was lower.^{25) 27)} However, we did not collect exercise or smoking data and were therefore unable to adjust for these factors.

Despite this limitation, the present study provides important data regarding the association between vegetable intake and a weight gain of 3 kg or more in a single year. Because the tested association corresponds to the question used by physicians to assess the risk of metabolic syndrome in health checks throughout Japan, our research is more

directly applicable to the development of programs to prevent metabolic syndrome in Japan, compared with previous research on the association between vegetable intake and long-term weight gain. However, future longitudinal studies examining the potential association between increasing vegetable consumption and weight gain are needed to confirm these findings.

1.5 Financial support:

This study was partially funded by the Japan Society for the Promotion of Science (JSPS) Kakenhi (Grants-in-Aid for Scientific Research) (No. 15K00882) for fiscal years 2015–2017. This study was conducted as a part of the scientific research program of the Japanese Ministry of Health, Labour and Welfare by the research leader (Dr. Ishida) in the fiscal years 2006–2008.

1.6 Author disclosures

None of the authors have any conflicts of interest to declare.

Chapter 2

Relationship between rice consumption and weight gain in Japanese workers: white versus brown rice/multigrain rice

2.1 Background

The percentage of people who are overweight or obese is increasing worldwide (OECD 2014).³¹⁾ In Japan, approximately 30% of male workers are overweight or obese, with a body mass index (BMI) ≥ 25 kg/m².⁵⁾

Obesity is the major risk factor for metabolic syndrome and is considered to be related to many lifestyle-related and other types of diseases.³²⁻³³⁾ The WHO states that a balanced diet is effective for preventing heart disease and lifestyle disease and recommends the increased consumption of whole grains, fruits, vegetable, and beans.²⁾ Many reports have described the relationship between whole grain consumption and disease. Based on the results of systematic reviews, meta-analyses, and dose–response meta-analyses, Aune et al. reported that whole grain consumption is effective for reducing the risk of type 2 diabetes³⁴⁾ and the incidence and mortality from cardiovascular disease, coronary heart disease, and stroke.³⁵⁾

A 12-year cohort study on obesity conducted among 74,091 women aged 38 to 63 years reported a greater increase in BMI over time in the low whole grain consumption group than in the high whole grain consumption group, and in the high refined grain consumption group than in the low refined grain consumption group.³⁶⁾ Another cohort study conducted over eight years among American men aged 40 to 75 years suggested that whole grain flour consumption is negatively correlated with long-term body weight

gain and that an increase in whole grain flour consumption of 40 g/day would decrease body weight by 0.49 kg.³⁷⁾

The associations of whole grain consumption with both disease and body weight change have been investigated. Japanese people eat considerably more rice than bread or other cereals. To our knowledge, however, the relationship between body weight control for obesity prevention and the consumption of white rice or brown rice/multigrain rice (which differ in the degree of rice refinement and milling) has not been well investigated among Japanese people. Body weight control is important for the prevention of lifestyle diseases. In Japan, as part of specific medical checkups and health guidance for the prevention of metabolic syndrome,¹²⁾ people receiving these checkups are asked whether their body weight has changed in either direction by 3 kg or more in the past year.¹³⁾

The accumulation of data on the relationship between body weight change and differences in the degree of rice refinement is important for promoting the prevention of metabolic syndrome. The present study aimed to investigate the relationship between the consumption of white rice or brown rice/multigrain rice and a one-year body weight gain of 3 kg or more among Japanese workers.

2.2 Methodology of the study

2.2.1 Study population

The study population was the same as described in Chapter 1.

2.2.2 Questionnaires

A lifestyle questionnaire and brief-type self-administered diet history questionnaire (BDHQ) were used. The lifestyle questionnaire consisted of questions about sex, age, marital status, occupation, dietary habits/behaviors, quality of life, and other items.⁶⁾ In the present analysis, we used data on sex, age, and other participant characteristics. The BDHQ was a brief version of the self-administered diet history questionnaire consisting of 58 questions about daily nutrient intake during the past month and other dietary habit-related items.^{22),23)} The BDHQ has been validated for assessing nutrient and food intake in a comparison with 16-day weighed diet records. The statistical validity for rice consumption was 0.63 in men and 0.55 in women.²³⁾

2.2.3 Assessment of body indices

Body weight was measured using an electronic scale, and height was measured in the standing position without shoes. BMI (kg/m^2) was calculated from body weight and height. To ensure accuracy, all weight and height measurements were taken in the same room of the same medical institution using the same measurement devices.

2.2.4 Ethical considerations

All participants completed an informed consent document that was submitted with the questionnaire during the routine medical checkups. This study was reviewed and approved by the ethics committee of Kagawa Nutrition University (Joshi Eiyo Daigaku, review number: 199).

2.2.5 Statistical analysis

In accordance with the exclusion criteria used in previous studies,²⁴⁾ 41 workers who had insufficient or dubious information (total daily energy intake less than one-third of the energy requirement for the relevant age and sex class, assuming a low level of physical activity, or > 1.5 times the energy requirement for the relevant age and sex class, assuming a high level of physical activity) were excluded. A total of 437 workers were subject to analysis. They were classified into rice consumption tertiles. The means and standard deviations of body weight, blood pressure at baseline, and food consumption were calculated using the density method. Other categorical variables were expressed as percentages. To compare the baseline characteristics of the groups, linear fraction tests were performed for continuous variables and chi-square tests were performed for categorical variables. Binomial logistic regression analyses were conducted to calculate the odds ratios of a one-year body weight gain of 3 kg or more. Model I was adjusted for sex, age, and weight, and Model II was additionally adjusted for consumption of fish, meat, vegetable, fruits, milk and milk products, Western sweets, Japanese sweets, salad dressing, and alcohol. Odds ratios and 95% confidence intervals (95% CI) for the second and third tertiles were calculated using dummy variables. Two-sided tests were performed to calculate *p*-values, and significance was set at *p* < 0.05. SPSS Statistics (Version 20, IBM Japan, Ltd.) was used for all analyses.

2.3 Results

The percentages of those who ate brown rice/multigrain rice in the three intake frequency tertiles are shown in Table 4, and the baseline characteristics of those who ate white rice or brown rice/multigrain rice are shown by intake frequency tertile in Table 5. In both consumption groups, the percentage of men was greater in the third tertile (high

rice consumption) than in the first tertile (low rice consumption). In the white rice consumption group, the number of young participants increased with increasing rice consumption. The mean energy-adjusted rice consumption in the brown rice/multigrain rice consumption group was 82.3 g/4,184 kJ in the first tertile and 232.8 g/4,184 kJ in the third tertile. The mean energy-adjusted rice consumption in the white rice consumption group was 88.3 g/4,184 kJ in the first tertile and 251.3 g/4,184 kJ in the third tertile (Table 6). In both groups, the consumption of meat, fish, vegetable, Western sweets, and Japanese sweets was significantly lower in the third tertile. In the white rice consumption group, the consumption of salad dressing and alcohol was significantly lower in the third tertile. In the brown rice/multigrain rice consumption group, the consumption of milk and dairy products was significantly lower in the third tertile. Logistic regression analyses were conducted to investigate relationships between the risk of a one-year body weight gain of 3 kg or more and rice consumption (Table 7). In the white rice consumption group, without adjustment, the number of subjects with a one-year body weight gain of 3 kg or more was significantly greater in the third tertile ($p = 0.045$). The odds of a one-year body weight gain of 3 kg or more for those in the third tertile were 3.45 times (95% CI: 1.11–10.76) higher than for those in the first tertile and 1.92 times (95% CI: 0.56–6.66) higher than for those in the second tertile. After adjusting for sex, age, and body weight at baseline, the odds of a one-year body weight gain of 3 kg or more for those in the third tertile were 3.36 times (95% CI: 1.05–10.82) higher than for those in the first tertile ($p = 0.048$). After multivariate adjustment (intake of meat, fish, vegetable, fruits, milk, dairy products, Western sweets, Japanese sweets, salad dressing, and alcohol), the odds of a one-year body weight gain of 3 kg or more for those in the third tertile were 4.86 times (95% CI: 1.02–23.06) higher than for

those in the first tertile ($p = 0.034$). In the brown rice/multigrain rice consumption group, the odds of a one-year body weight gain of 3 kg or more were no greater in the second or third tertiles, compared with the first tertile (odds ratio = 2.19, 95% CI: 0.47–10.30) ($p = 0.322$). This was maintained even after multivariate adjustment ($p = 0.42$ in Model I and 0.387 in Model II).

2.4 Discussion

2.4.1 The association between rice consumption and weight gain

This study aimed to investigate the relationship between rice consumption and the risk of a one-year body weight gain of 3 kg or more. This was accomplished by examining people's consumption of white or brown rice/multigrain rice. In the white rice consumption group, high rice consumption was positively associated with the risk of weight gain. In the brown rice/multigrain rice consumption group, in contrast, the level of rice consumption was not significantly associated with the risk of weight gain, even after adjusting for risk factors for body weight gain. These findings suggest that high white rice consumption is related to body weight gain and that brown rice/multigrain rice consumption contributes to body weight control and the prevention of metabolic syndrome.

Pol et al. reported the results of systematic reviews and meta-analyses of a set of data obtained in a randomized clinical trial on the effects of brown rice/multigrain rice consumption on body weight. Their findings suggested that brown rice/multigrain rice consumption does not suppress body weight gain.³⁸⁾ However, they also reported that the results of sub-analyses suggested that, although the consumption of whole grain

wheat, barley, or rye did not significantly suppress body weight gain, whole grain rice consumption did significantly suppress body weight gain in some populations. Because the data for the sub-analyses were obtained from 483 Chinese³⁹⁾ and Korean people⁴⁰⁾ participating in two studies, it is possible that brown rice/multigrain rice consumption might suppress body weight gain in Asian people.

In a randomized comparative clinical study among Vietnamese women,⁴¹⁾ brown rice/multigrain rice consumption, in contrast to white rice consumption, was significantly associated with body weight loss. This finding supports the above hypothesis. Because brown rice and multigrain rice are rich sources of vitamins, minerals, and plant fiber and have high glycemic index values, many clinical studies have investigated the effects of brown rice/multigrain rice consumption on type 2 diabetes. Clinical studies with Japanese or Chinese participants have also suggested that brown rice/multigrain rice consumption suppresses type 2 diabetes.⁴²⁾

Because patients with metabolic syndrome or obesity generally have difficulty reducing their food consumption, they should instead consider consuming alternative foods. Especially for people who consume high levels of white rice, consuming more than 188.8 g/1814k J of brown rice/multigrain rice instead of white rice will be effective in preventing weight gain. These results indicate that medical providers should recommend the consumption of brown rice or multigrain rice in place of white rice for body weight control. This health promotion approach can be applied at the worksite cafeteria, which can offer brown or multigrain rice at every lunch.

2.4.2 Limitations and strengths

There are many types of rice, including brown rice, rice with germ, and semi-polished rice. However, because there are no items related to many specific types of rice in BDHQ, it is unclear exactly which grains the participants consumed. Additionally, the present research into rice consumption was carried out using a questionnaire rather than the “gold standard” of the 24-hour recording method. However, for this study, the BDHQ was more suitable than the 24-hour recording method because the objective of the study was to understand participants’ habitual diets.

Japanese and other Asian people eat rice almost every day, and occasionally several times a day. Considering this frequency and amount of consumption, rice is likely to have a major influence on health—either beneficial or harmful. Here, we found that white rice consumption was positively associated with the risk of a one-year weight gain of 3 kg or more, whereas brown rice/multigrain rice consumption was not. This finding suggests that brown rice/multigrain rice consumption is useful for body weight control in Japanese workers.

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Summary

Chapter 1 introduces the association between vegetable consumption and weight gain over a single year among Japanese employees at a manufacturing company. Overweight and obesity increase the risk of hypertension, type 2 diabetes, and other metabolic disorders and are increasing in Japan, particularly among men. Several prospective studies have suggested that high vegetable intake is inversely associated with weight gain. Here, the association between vegetable consumption and weight gain over the course of one year in a group of food manufacturing workers was investigated.

The study was a one-year cohort study using data from a nutrition and lifestyle survey. The study population consisted of Japanese employees aged 19–60 years working at a manufacturing company located in Musashino City, Tokyo, Japan. The same validated brief self-administered diet history and dietary lifestyle questionnaire was administered to 815 workers in 2007 and 843 workers in 2008. Clinical assessments of body weight were also performed to measure changes in weight. We analyzed participants who responded in both 2007 and 2008 ($n = 478$). The risk of a weight gain of more than 3 kg was significantly lower in the group consuming the most vegetable than in the group consuming the least vegetable, and this difference remained significant after adjustment for baseline age, sex, and consumption of other foods (p for trend = 0.028). Thus, weight gain was inversely associated with high vegetable consumption. Encouraging Japanese employees to consume more vegetable may be an important strategy for controlling weight gain and preventing metabolic syndrome.

Chapter 2 introduces the relationship between white versus brown rice/multigrain rice consumption and body weight gain in Japanese workers. The desire for dietary support for successful body weight control has led to increased research interest in metabolic syndrome. However, the questionnaire used in metabolic syndrome-specific medical checkups at medical institutions in Japan only asks whether body weight has increased or decreased by at least 3 kg in the past year. We investigated the relationship between white or brown/multigrain rice consumption and a one-year body weight gain of 3 kg or more. A secondary analysis was conducted using data from a one-year cohort study using a nutrition and lifestyle survey as part of routine medical checkups for Japanese workers at a food factory in Tokyo (n = 478). These research participants were divided into white rice and brown/multigrain rice consumption groups. They were then further classified by tertile of rice consumption. Multiple logistic regression analyses were conducted by tertile to predict a one-year weight gain of ≥ 3 kg. For the white rice consumption group, the risk of a one-year body weight gain of 3 kg or more was significantly greater in the third tertile (high white rice consumption) than in the first tertile (low white rice consumption). This was maintained after adjustment for age, sex, and consumption of other foods related to body weight change ($p = 0.034$). In the brown/multigrain rice consumption group, however, there was no significant difference in the risk of weight gain between the first and third tertiles, even after multivariate adjustment ($p = 0.387$). White rice consumption is significantly and positively associated with a one-year body weight gain of at least 3 kg.

Other limitations and strengths of the full study

Limitations

Although this research was only carried out in a one-year cohort, it is usually desirable to conduct a survey over a longer time period. Future work should verify the results with tracking over time. Furthermore, because the present study was conducted at a single factory in Tokyo, the data obtained may not be applicable to all adults. Additionally, regarding the assessment of weight gain and food intake, weight gain and food factors should have first been analyzed and confirmed as a whole, and food intake should have been verified, including intake of vegetable, brown rice, and other types of foods. There is a possibility that factors may exist other than those examined. In this study, as mentioned above, it was not sufficient to approach Japanese food intake using the methods used in previous studies. Rather, this study focused on the consumption of vegetable and whole grains, which has gained attention and been recommended in recent years. However, it cannot be denied that there may be other food-related factors that are relevant for our outcome of interest.

Furthermore, because we did not have data on individual characteristics such as educational history or income, we were unable to adjust for or examine the relevance of these factors. When this survey was conducted, it was not yet common to ask these types of questions in Japan. However, in recent years, educational history and income have been reported to be associated with food intake. Therefore, although it is possible that adding these questions may affect the response rate, we would like to consider doing this in future research. In addition, because the number of participants was

insufficient to stratify the analysis by sex, we performed multiple regression analyses using sex as a confounding factor. Finally, the use of a self-report questionnaire instead of direct assessment of consumed food carries the risk of introducing response biases, including social desirability bias and recall bias.

Strengths

The main strength of this study was that all of the participants were Asian people (Japanese), excluding the possibility of race as a confounding factor. The initial sample did include a very small number of non-Japanese workers, but these participants were excluded from the present research.

Additionally, weight measurements, which were thought to be the most susceptible to self-report bias, were taken at the health checkups by medical staff using the same scale for both checkups. These measures were also taken at a similar date (in June in both years). However, the time of day was not consistent. Therefore, instructions on fasting for 5 hours or more were distributed, but these instructions were not always strictly followed. Furthermore, the nutrition data collected were considered to be of high quality because the data were checked in triplicate by trained dietitians, and there were no missing data. The response rates were also good, with more than 80% of the participants responding to the questionnaires. In the present study, the error found after energy adjustment was 4.6% in 2007 and 4.9% in 2008. This is lower than the exclusion rate of 10% (excluding 2 people from 21 subjects) in other studies of elderly people.⁴³⁾ However, because the rate of underestimation significantly affects BMI and age,⁴⁴⁾ it cannot be determined whether the error for men and women aged 19 to 60 years is generally high or low. It would be desirable to see many additional reports on error by

gender and age.

Conclusions

This study investigated the association of consumption of vegetable and cooked rice (including white, brown, and multigrain rice) with a weight gain of 3 kg or more over one year. The aim of this investigation was to examine dietary intake factors related to weight loss and weight gain in the working population.

Chapter 1 focused on vegetable consumption and examined the presence or absence of a one-year weight gain of 3 kg or more among individuals from the working population sorted into quartiles by quantity of vegetable consumption. Being in the groups with higher consumption of vegetable instead of the group with the lowest vegetable consumption was associated with a one-year weight gain of 3 kg or more.

Chapter 2 examined the risk of a weight increase of 3 kg or more in one year by white vs. brown/multigrain rice consumption and rice consumption levels. Among those who ate white rice, an association was seen between higher levels of rice consumption (compared with the lowest level of consumption) and a one-year weight gain of 3 kg or more. However, among those who consumed brown or multigrain rice, no association was seen between rice consumption and a one-year weight gain of 3 kg or more.

These results provide effective evidence for professionals in terms of specific health guidance and nutritional education, as they advise their clients to increase their vegetable consumption and replace white rice with less-refined staples such as brown rice or multigrain rice, with the ultimate goal of controlling weight gain in the working population.

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Table 1. Characteristics of the study population (n = 437) by quartile of vegetable intake/day at baseline

Characteristic	Q ₁ (n=110)	Q ₂ (n=108)	Q ₃ (n=109)	Q ₄ (n=109)	<i>p</i> value ^a	<i>p</i> for trend ^b
Mean (SD)						
Age (y)	31.0 (9.7)	33.6 (10.3)	39.0 (11.3)	44.3 (12.7)	<0.001	<0.001
Weight (kg)	63.0 (10.8)	62.5 (11.1)	60.4 (10.3)	57.6 (10.9)	0.001	<0.001
1-year weight gain (kg)	0.6 (2.3)	0.4 (2.5)	0.1 (2.2)	0.0 (2.2)	0.171	0.029
BMI (kg/m ²)	22.1 (3.4)	22.0 (3.6)	22.2 (3.2)	22.0 (3.5)	0.943	0.893
BMI after 1 year (kg/m ²)	22.4 (3.4)	22.2 (3.6)	22.4 (3.3)	22.2 (3.5)	0.968	0.816
SBP (mmHg)	123.6 (13.3)	120.5 (12.4)	123.7 (13.5)	121.2 (13.0)	0.148	0.465
DBP (mmHg)	70.2 (11.3)	69.5 (11.6)	71.4 (11.5)	70.8 (10.5)	0.617	0.420
Proportion (%)						
Weight gain ≥3 kg	14.5	11.1	7.3	5.6	0.107	0.015
Male	85.5	78.7	66.4	39.4	<0.001	<0.001
Unmarried	72.7	63.0	50.0	47.2	<0.001	<0.001
Regular employee ^c	94.5	95.4	96.4	97.2	0.961	0.080

Q₁: < 57.2 g/4184 kJ; Q₂: 57.2–93.6 g/4184 kJ; Q₃: 93.6–143.7 g/4184 kJ; Q₄: ≥ 143.7 g/4184 kJ

DBP: diastolic blood pressure; SBP: systolic blood pressure

^aContinuous data: one-way analysis of variance; Categorical data: χ^2 test

^bContinuous data: test of general linear trend; Categorical data: Kruskal–Wallis test

^cRegular employee: indicates an employee in a non-managerial position

Table 2. Nutrients and foods consumed by participants (n = 437) by quartile of vegetable intake/day at baseline

Nutrient/food type	Q ₁ (n=110)	Q ₂ (n=108)	Q ₃ (n=110)	Q ₄ (n=109)	<i>p</i> value ^b	<i>P</i> for trend ^c
Mean (SD)						
Energy (kcal)	1884 (557)	1969 (613)	1971 (574)	1878 (536)	0.444	0.952
Food type (g/4184 kJ)						
Vegetables	33.4 (15.9)	74.7 (9.8)	111.7 (14.0)	215.1 (55.1)	<0.001	<0.001
Cereals	246.9 (83.4)	248.3 (64.3)	217.5 (63.4)	182.9 (67.1)	<0.001	<0.001
Meat	39.1 (25.4)	35.9 (17.0)	39.5 (17.4)	35.9 (20.4)	0.366	0.489
Fish	25.8 (27.0)	29.9 (17.6)	36.9 (18.7)	45.2 (24.2)	<0.001	<0.001
Milk/dairy products	48.4 (55.3)	46.0 (46.1)	55.1 (55.6)	71.7 (58.5)	0.002	0.001
Fruits	12.3 (12.8)	13.5 (12.6)	20.8 (18.8)	32.1 (27.6)	<0.001	<0.001
Western sweets	25.2 (25.9)	26.0 (19.7)	22.8 (20.1)	15.1 (15.9)	0.520	0.157
Japanese sweets	2.5 (4.1)	3.0 (3.7)	3.6 (4.3)	3.5 (4.8)	0.194	<0.001
Sweetened beverages ^a	125.4 (135.9)	77.8 (87.4)	49.3 (56.5)	30.4 (50.4)	<0.001	0.045
Sugar	2.9 (3.7)	2.7 (3.1)	2.5 (3.1)	1.8 (2.6)	0.053	0.009
Salad dressing	2.3 (2.7)	3.1 (2.2)	4.1 (2.4)	4.2 (3.6)	<0.001	<0.001
Alcohol	7.0 (10.4)	5.8 (8.0)	5.0 (7.0)	3.2 (6.5)	0.005	<0.001

Q₁: < 57.2 g/4184 kJ; Q₂: 57.2–93.6 g/4184 kJ; Q₃: 93.6–143.7 g/4184 kJ; Q₄: ≥ 143.7 g/4184 kJ

^aSweetened beverages: includes carbonated sodas or coffee, such as colas, soft drinks, canned coffees, etc. ^bContinuous data: one-way analysis of variance ^cContinuous data: test of general linear trend

Table 3. Odds ratios for a one-year weight gain of ≥ 3 kg by energy-adjusted quartile of vegetable intake/day

	Q ₁ (n=110)	Q ₂ (n=108)	Q ₃ (n=110)	Q ₄ (n=109)	<i>p</i> for trend ^e
Weight gain of ≥ 3 kg (n)	16	12	8	6	
Model 1 ^a	1 (ref.)	0.73 (0.33, 1.64)	0.46 (0.19, 1.13)	0.35 (0.13, 0.92)	0.016
Model 2 ^b	1 (ref.)	0.73 (0.33, 1.63)	0.45 (0.18, 1.11)	0.33 (0.12, 0.93)	0.018
Model 3 ^c	1 (ref.)	0.72 (0.32, 1.62)	0.44 (0.19, 1.13)	0.34 (0.12, 1.01)	0.036
Model 4 ^d	1 (ref.)	0.69 (0.29, 1.68)	0.37 (0.13, 1.07)	0.27 (0.08, 0.99)	0.028

Q₁: < 57.2 g/4184 kJ; Q₂: 57.2–93.6 g/4184 kJ; Q₃: 93.6–143.7 g/4184 kJ; Q₄: ≥ 143.7 g/4184 kJ

Results are presented as odds ratios and 95% confidence intervals.

ref.: reference category

^aModel 1: unadjusted

^bModel 2: gender adjusted

^cModel 3: Model 2 + adjustment for age

^dModel 4: Model 3+ adjustment for all cofounding factors (marital status, weight at baseline, and energy-adjusted intake of fish, cereals, fruits, milk, Japanese sweets, sweetened beverages, sugar, salad dressing, and alcohol)

^e*p* for trend: The median intake values for each quartile were assigned and treated as a continuous variable.

Table 4. Percentage of participants who ate brown rice/multigrain rice by frequency tertile of rice intake/day

	Q ₁ ($\leq 125.4\text{g}/4184$ kJ) n=146	Q ₂ ($125.5\text{g}/4184$ kJ– $188.7\text{g}/4184$ kJ) n=146	Q ₃ ($\geq 188.8\text{g}/4184$ kJ) n=145	<i>p</i> value ^a	<i>p</i> for trend ^b
Always	6.2	4.1	2.8	0.844	0.282
Often	16.4	13.0	15.2		
Sometimes	17.8	20.5	19.3		
Not at all	59.6	62.3	62.8		

Q₁: $\leq 125.4\text{g} /4184$ kJ; Q₂: $125.4\text{--}188.8\text{g}/4184$ kJ; Q₃: ≥ 188.8 g/4184 kJ

^aTertile data: one-way analysis of variance

^bTertile data: test of general linear trends

Table 5. Baseline characteristics of the study population (n = 437) by white rice vs. brown/multigrain rice consumption and tertile of rice intake

	Tertile of rice with brown /multigrain intake at baseline					Tertile of white rice intake at baseline				
	Q1 (≤ 125.4 g / 4184kJ)	Q2 (125.5 - 188.7 g /4184kJ)	Q3 (≥ 188.8 g/4184kJ)	p - value ^a	p for trend ^b	Q1 (≤ 125.4 g / 4184kJ)	Q2 (125.5 - 188.7 g /4184kJ)	Q3 (≥ 188.8 g/4184kJ)	p - value ^a	p for trend ^b
	n=59	n=55	n=54			n=87	n=91	n=91		
Number of subjects										
	Mean $\pm$ SD					Mean $\pm$ SD				
Weight(kg)	57.8 (10.7)	60.1 (10.1)	62.6 (10.7)	0.055	0.016	61.1 (11.2)	61.2 (9.6)	61.6 (12.6)	0.943	0.738
Body mass index:BMI	22.2 (3.6)	22.1 (3.3)	22.6 (3.8)	0.760	0.583	22.4 (3.4)	21.7 (3.0)	21.9 (3.5)	0.345	0.358
Systolic blood pressure: SBP (mmHg)	119.1 (14.0)	121.0 (14.9)	122.4 (11.1)	0.428	0.195	122.0 (11.7)	123.9 (13.7)	123.6 (12.8)	0.553	0.395
Diastolic blood pressure: DBP (mmHg)	69.2 (11.6)	69.9 (13.0)	69.7 (9.6)	0.949	0.813	71.5 (9.7)	71.6 (11.8)	70.1 (11.6)	0.600	0.406
	Proportion (%)					Proportion (%)				
1 year weight gain ≥ 3 kg(%)	6.8	5.5	13.0	0.317	0.246	5.7	10.0	15.4	0.108	0.036
1 year weight gain ≥ 1 kg(%)	25.4	21.8	38.9	0.115	0.123	24.1	37.8	41.8	0.036	0.014
Sex : men (%)	39.0	65.5	72.2	0.001	<0.0001	60.9	78.0	80.2	0.007	0.004
Age : ≤ 29 (%)	35.6	47.3	31.5			28.7	30.8	41.8		
30-39 (%)	23.7	16.4	40.7			25.3	29.7	27.5		
40-49 (%)	16.9	16.4	9.3	0.135	0.658	17.2	20.9	14.3	0.227	0.030
50-59 (%)	20.3	16.4	11.1			27.6	17.6	13.2		
≥ 60 (%)	3.4	3.6	7.4			1.1	1.1	3.3		
Marriage status: Unmarried(%)	62.7	60.0	57.4	0.847	0.566	59.3	48.4	63.7	0.098	0.530
Occupation: General staff(%)	100.0	96.4	96.3	0.696	0.216	95.4	93.4	95.6	0.370	0.845
Sift: day and night work (%)	30.5	52.7	33.3			36.8	50.5	48.4		
only day work (%)	49.2	29.1	38.9	0.148	0.792	36.8	34.1	23.1	0.170	0.550
16.9	12.7	24.1				19.5	11.0	20.9		
others (%)	3.4	5.5	3.7			6.9	4.4	7.7		

^aTertile data: one-way analysis of variance

^bTertile data: test of the general linear trend

Table 6. Baseline food intake of the study population (n = 437) by white rice vs. brown/multigrain rice consumption and tertile of rice intake

	Tertile of rice with brown /multigrain intake at baseline					Tertile of white rice intake at baseline				
	Q1 (≤ 125.4 g / 4184kJ)	Q2 (125.5 - 188.7 g /4184kJ)	Q3 (≥ 188.8 g/4184kJ)	p - value ^a	p for trend ^b	Q1 (≤ 125.4 g / 4184kJ)	Q2 (125.5 - 188.7 g /4184kJ)	Q3 (≥ 188.8 g/4184kJ)	p - value ^a	p for trend ^b
	n=59	n=55	n=54			n=87	n=91	n=91		
Number of participants										
	Mean $\pm$ SD					Mean $\pm$ SD				
Total enagy(kcal)	1947.6 (648.6)	2051.5 (589.3)	1766.0 (516.4)	0.040	0.115	1911.4 (518.2)	1998.4 (527.0)	1869.3 (608.6)	0.278	0.598
Rice (g/4184kJ)	82.3 (28.0)	158.2 (17.3)	232.8 38.8	<0.0001	<0.0001	88.3 (25.1)	157.0 (17.0)	251.3 (52.8)	<0.0001	<0.0001
Meat (g/4184kJ)	40.0 (21.3)	39.7 (21.7)	30.6 (13.5)	0.016	0.012	42.4 (23.7)	39.7 (18.3)	32.4 (19.0)	0.004	0.001
Fish (g/4184kJ)	45.9 (34.8)	38.1 (19.0)	27.8 (13.3)	0.001	<0.0001	41.4 (25.7)	31.5 (18.3)	25.0 (17.6)	0.001	<0.0001
Vegetables (g/4184kJ)	145.6 (85.3)	113.4 (52.6)	112.7 (70.8)	0.020	0.014	126.8 (89.9)	95.2 (60.2)	75.6 (56.4)	<0.0001	<0.0001
Fruits (g/4184kJ)	25.3 (23.7)	25.5 (24.6)	20.4 (23.0)	0.444	0.281	23.6 (22.0)	14.6 (14.4)	13.4 (14.1)	<0.0001	<0.0001
Milk & milk products (g/4184kJ)	67.8 (49.9)	61.1 (50.1)	44.5 (48.5)	0.041	0.014	61.6 (63.1)	50.5 (56.0)	49.0 (53.4)	0.284	0.148
western sweets (g/4184kJ)	32.3 (24.8)	20.8 (17.1)	16.8 (16.4)	<0.0001	<0.0001	27.3 (25.4)	22.1 (21.7)	15.1 (13.3)	0.001	<0.0001
Japanese sweets (g/4184kJ)	13.4 (10.0)	8.5 (8.3)	5.9 (5.7)	<0.0001	<0.0001	10.4 (9.4)	8.5 (7.9)	4.4 (4.7)	<0.0001	<0.0001
Sweet beverage (kola etc.) (g/4184kJ)	67.7 (98.5)	55.3 (71.8)	65.0 (93.4)	0.739	0.858	67.9 (111.0)	81.9 (91.0)	77.2 (98.7)	0.641	0.545
Green tea (g/4184kJ)	121.5 (110.6)	100.1 (83.4)	147.4 (136.7)	0.091	0.240	122.8 (122.8)	107.4 (122.8)	110.6 (129.2)	0.688	0.521
Sugar(g/4184kJ)	1.9 (2.2)	1.9 (2.4)	1.8 (2.4)	0.963	0.942	2.7 (3.2)	3.3 (3.6)	2.7 (3.8)	0.392	0.954
Salad dressing (g/4184kJ)	3.9 (3.2)	4.2 (3.0)	3.1 (3.2)	0.169	0.200	3.7 (3.2)	3.2 (2.4)	2.7 (2.3)	0.047	0.013
Alcohol (g/4184kJ)	4.6 (9.4)	5.8 (7.6)	3.2 (6.3)	0.227	0.338	6.9 (10.3)	6.3 (7.5)	3.9 (6.8)	0.046	0.019

^a Tertile data: one-way analysis of variance

^b Tertile data: test of the general linear trend

Table 7. Odds ratios* for a one-year weight gain of ≥ 3 kg by white rice vs. brown/multigrain rice consumption and energy-adjusted tertile of rice intake

	Tertile of rice with brown /multigrain intake at baseline			Tertile of white rice intake at baseline		
	Q1 (≤ 125.4 g / 4184kJ) n=59	Q2 (125.5 - 188.7 g /4184kJ) n=54	Q3 (≥ 188.8 g/4184kJ) n=55	Q1 (≤ 125.4 g / 4184kJ) n=87	Q2 (125.5 - 188.7 g/4184kJ) n=91	Q3 (≥ 188.8 g/4184kJ) n=91
Clued OR	1 (ref.)	2.93	2.19	1 (ref.)	1.92	3.45
(95% CI)		(0.72 , 11.89)	(0.47 , 10.30)		(0.56 , 6.66)	(1.11 , 10.76)
<i>p</i> -value		0.133	0.322		0.302	0.045
Model I OR	1 (ref.)	2.81	1.91	1 (ref.)	1.93	3.36
(95% CI)		(0.68 , 11.67)	(0.40 , 9.20)		(0.55 , 6.74)	(1.05 , 10.82)
<i>p</i> -value		0.154	0.42		0.305	0.048
Model II OR	1 (ref.)	3.883	2.773	1 (ref.)	2.54	4.86
(95% CI)		(0.68 , 22.05)	(0.27 , 28.02)		(0.64 , 10.15)	(1.02 , 23.06)
<i>p</i> -value		0.126	0.387		0.187	0.034

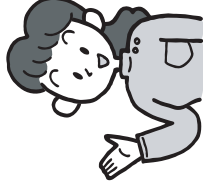
CI: confidence interval; OR: odds ratio; Q: tertile; ref.: reference category

*Statistical test: non-conditional logistic regression

Model I: Adjusted for sex, age (5 category), weight

Model II: Model I + adjustment for energy-adjusted intake of fish, meat, vegetables, fruits, milk & milk products, western sweets, japanese sweets, salad dressing, and alcohol

あなたの食習慣についておたずねします
最近1か月の食習慣について、お答え下さい



たくさん質問がありますが、あまり考え込まずに、第一印象でお答えくださいね。

- 質問の内容が難しい場合には、あなたの家庭で食事の準備をおもにしているひとと一っしょに考えながら、答えください。
- すべての質問にお答えいただいた場合には、あなたご自身の健康維持・増進に役立てていただけるように、簡単な結果【あなたの食事・栄養の特徴】を後日お返しいたします。

お答えいただいた内容は、食べ物と健康との関連を明らかにし、
だれもが健康な生活を送れるようにするための貴重な資料として活用させていただきます。
その場合、結果はたくさんの方のひとたちの平均値などの数値として公表されます。
あなた個人がわかるような形で公表されることは絶対にありません。



【記入の仕方】

- ・太い黒の鉛筆でご記入ください。
- ・この用紙は機械で読み取ります。文字は枠線にかからないように丁寧に記入ください。

担当者記入欄

[illegible]

数字の記入例

0	1	2	3	4	5	6	7	8	9
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Vの記入例

- ・ 枠線の中にある3点を結んでください。
- ・ まわりの枠線に線がふれないようにご記入ください。

悪い例 ☒ 悪い例

1

＜女性の方のみ＞

妊娠中・授乳中の方は下記該当に記載（もしくはチェック）下さい。

妊娠	週目	授乳中

必ずご記入ください。

性別(○を記入)	生年月日(年号は○を記入)
男性 ☐ 女性 ☐	大正 昭和 平成
今日(この質問に答える日)の日付	身長
平成 年 月 日	cm
	体重
	kg

あなたは、この1か月のあいだ、以下の食べ物をどのくらいの頻度で食べていましたか？もっともあてはまる回答をひとつ選んで、Vを記入してください。

肉を使った料理(ハンバーグ、ソーセージなどの肉加工品を含む)	
焼肉・ステーキ・グリル	ハンバーグ・カレー・ミートソースなど 洋風の料理
☐ 毎日2回以上	☐ 毎日2回以上
☐ 毎日1回	☐ 毎日1回
☐ 週4～6回	☐ 週4～6回
☐ 週2～3回	☐ 週2～3回
☐ 週1回	☐ 週1回
☐ 週1回未満	☐ 週1回未満
☐ 食べなかった	☐ 食べなかった
和風の煮物・鍋物・どんぶり物・汁物・みそ汁	炒め物
☐ 毎日2回以上	☐ 毎日2回以上
☐ 毎日1回	☐ 毎日1回
☐ 週4～6回	☐ 週4～6回
☐ 週2～3回	☐ 週2～3回
☐ 週1回	☐ 週1回
☐ 週1回未満	☐ 週1回未満
☐ 食べなかった	☐ 食べなかった

もっともあてはまる
回答をひとつ選んで、
Vを記入してください。

お肉(牛肉や豚肉)の 脂身は	好んで食べていた	や好んで食べていた	好きでも嫌いでもない	あまり食べなかった	ほとんど食べなかった
	☐	☐	☐	☐	☐

魚を使った料理(いか・たこ・えび・貝も含む)	
さしみ・すし 〔定食一人前 程度の量〕	煮魚・鰯物・ 汁物・みそ汁
毎日2回以上	毎日2回以上
毎日1回	毎日1回
週4～6回	週4～6回
週2～3回	週2～3回
週1回	週1回
週1回未満	週1回未満
食べなかった	食べなかった

種類のスープ・汁を 飲む量は	家庭での献付けは 外食と比べて
ほとんど全部	薄口
8割くらい	少し薄口
4〜6割	同じくらい
2割くらい	少し濃い口
ほとんど飲まない	濃い口

食事のときに使うようゆ・ソース		外食の定食1人前と、自分が普段食べている量を比べると		食べる速さは	
頻度は	量は	おかずの量は	ごはんの量は		
☐ 必ず使う	☐ かなり多め	☐ 家のほうがかなり多い	☐ 家のほうがかなり多い	☐ かなり速い	☐ かなり速い
☐ よく使う	☐ やや多め	☐ 家のほうが少し多い	☐ 家のほうが少し多い	☐ やや速い	☐ やや速い
☐ とどきを使う	☐ ふつう	☐ ほぼ同じくらい	☐ ほぼ同じくらい	☐ ふつう	☐ ふつう
☐ ほとんど使わない	☐ やや少なめ	☐ 外食のほうが少し多い	☐ 外食のほうが少し多い	☐ やや遅い	☐ やや遅い
☐ まったく使わない	☐ かなり少なめ	☐ 外食のほうがかなり多い	☐ 外食のほうがかなり多い	☐ かなり遅い	☐ かなり遅い

季節によって食べ方が大きくちがう食べ物	
この1年間でもっともよく食べた季節を思い出して、その頃の食べ方についてお答えください。	
みか・なんどの 柑橘かんざつ類	かき(柿)
毎日2回以上	毎日2回以上
毎日1回	毎日1回
週4~6回	週4~6回
週2~3回	週2~3回
週1回	週1回
週1回未満	週1回未満
食べなかった	食べなかった

最後にお答えください。
 もっともあてはまる回答をひとつ選んで、V を記入してください。

この1か月間に 栄養補助食品を 使いましたか	毎日2回以上	最近、 食事習慣を 意識的に 変えましたか	現在、 医師、栄養士、 その他専門家の 指導のもとで、 食事のコントロールを していますか	☐ はい ☐ いいえ	☐ 本人 ☐ 妻 ☐ 娘 ☐ その他
	毎日1回				
	週4～6回				
	週2～3回				
	週1回				
週1回未満	はい	3年以上前	1～2年前	1年前以内	はい
毎日がかった	いいえ				

これで終わりです。お疲れさまでした。

あなたは、この1か月のあいだ、以下の食べ物をもどくらの頻度で食べていましたか？
もっともあてはまる回答をひとつ選んで、Vを記入してください。

コップ1杯の牛乳・ヨーグルト1人前		鶏肉	豚肉・牛肉・羊肉	ハム・ソーセージ・ベーコンなどの加工肉	レバー
低脂肪	普通・高脂肪	(挽き肉を含む)	(挽き肉を含む)		
毎日2回以上	毎日2回以上	毎日2回以上	毎日2回以上	毎日2回以上	毎日2回以上
毎日1回	毎日1回	毎日1回	毎日1回	毎日1回	毎日1回
週4～6回	週4～6回	週4～6回	週4～6回	週4～6回	週4～6回
週2～3回	週2～3回	週2～3回	週2～3回	週2～3回	週2～3回
週1回	週1回	週1回	週1回	週1回	週1回
週1回未満	週1回未満	週1回未満	週1回未満	週1回未満	週1回未満
飲まなかった	飲まなかった	食べなかった	食べなかった	食べなかった	食べなかった

飲まなかったり、食べなかった場合は、ここにVを記入してください

いか・たこ・えび・貝	骨ごと食べる魚	ツナ缶 (まぐろの油漬け)	魚の干物・塩漬魚・魚介類製品 (塩ざば・塩鮭・あじの干物・ちくわ・かまぼこなど)	脂が乗った魚 (いわし・さば・さんま・ぶり・にしん・うなぎ・まぐろのトロなど)	脂が少なめの魚 (さけ・ます・白身の魚・淡水魚・かつおなど)	たまご (鶏の卵1個程度)
毎日2回以上	毎日2回以上	毎日2回以上	毎日2回以上	毎日2回以上	毎日2回以上	毎日2回以上
毎日1回	毎日1回	毎日1回	毎日1回	毎日1回	毎日1回	毎日1回
週4～6回	週4～6回	週4～6回	週4～6回	週4～6回	週4～6回	週4～6回
週2～3回	週2～3回	週2～3回	週2～3回	週2～3回	週2～3回	週2～3回
週1回	週1回	週1回	週1回	週1回	週1回	週1回
週1回未満	週1回未満	週1回未満	週1回未満	週1回未満	週1回未満	週1回未満
食べなかった	食べなかった	食べなかった	食べなかった	食べなかった	食べなかった	食べなかった

とうふ・厚揚げ・豆乳	納豆	いも (すべての種類)	漬物	生(サラダ)	トマト・トマトケチャップ・トマト煮込み・トマトシチュー
毎日2回以上	毎日2回以上	毎日2回以上	毎日2回以上	毎日2回以上	毎日2回以上
毎日1回	毎日1回	毎日1回	毎日1回	毎日1回	毎日1回
週4～6回	週4～6回	週4～6回	週4～6回	週4～6回	週4～6回
週2～3回	週2～3回	週2～3回	週2～3回	週2～3回	週2～3回
週1回	週1回	週1回	週1回	週1回	週1回
週1回未満	週1回未満	週1回未満	週1回未満	週1回未満	週1回未満
食べなかった	食べなかった	食べなかった	食べなかった	食べなかった	食べなかった

緑の濃い葉野菜 (ブロッコリー・ゴーヤーを含む)	キャベツ・白菜	にんじん・かぼちゃ	だいこん・かぶ	きのこ (すべての種類) (たまねぎ・ごぼう・れんこんなど)	海草 (すべての種類) (だし用は除く)
毎日2回以上	毎日2回以上	毎日2回以上	毎日2回以上	毎日2回以上	毎日2回以上
毎日1回	毎日1回	毎日1回	毎日1回	毎日1回	毎日1回
週4～6回	週4～6回	週4～6回	週4～6回	週4～6回	週4～6回
週2～3回	週2～3回	週2～3回	週2～3回	週2～3回	週2～3回
週1回	週1回	週1回	週1回	週1回	週1回
週1回未満	週1回未満	週1回未満	週1回未満	週1回未満	週1回未満
食べなかった	食べなかった	食べなかった	食べなかった	食べなかった	食べなかった

洋菓子・クッキー・ビスケット	和菓子	せんべい・スナック菓子・もち・お好み焼きなど	アイスクリーム	みかんなどの柑橘(かんきつ)類	かき・いちご・キウイ	その他のすべての果物 (りんご・バナナなど)
毎日2回以上	毎日2回以上	毎日2回以上	毎日2回以上	毎日2回以上	毎日2回以上	毎日2回以上
毎日1回	毎日1回	毎日1回	毎日1回	毎日1回	毎日1回	毎日1回
週4～6回	週4～6回	週4～6回	週4～6回	週4～6回	週4～6回	週4～6回
週2～3回	週2～3回	週2～3回	週2～3回	週2～3回	週2～3回	週2～3回
週1回	週1回	週1回	週1回	週1回	週1回	週1回
週1回未満	週1回未満	週1回未満	週1回未満	週1回未満	週1回未満	週1回未満
食べなかった	食べなかった	食べなかった	食べなかった	食べなかった	食べなかった	食べなかった

マヨネーズ・ドレッシング	パン (おかず・パン・菓子パンも含む)	そば	うどん・ひやむぎ・そうめん	インスタントラーメン	スパゲティ・マカロニなど	飲み物 緑茶
毎日2回以上	毎日2回以上	毎日2回以上	毎日2回以上	毎日2回以上	毎日2回以上	毎日4杯以上
毎日1回	毎日1回	毎日1回	毎日1回	毎日1回	毎日1回	毎日2～3杯
週4～6回	週4～6回	週4～6回	週4～6回	週4～6回	週4～6回	毎日1杯
週2～3回	週2～3回	週2～3回	週2～3回	週2～3回	週2～3回	週4～6杯
週1回	週1回	週1回	週1回	週1回	週1回	週2～3杯
週1回未満	週1回未満	週1回未満	週1回未満	週1回未満	週1回未満	週1杯
食べなかった	食べなかった	食べなかった	食べなかった	食べなかった	食べなかった	週1杯未満

紅茶・ウーロン茶(中国茶)	コーヒー	コーラ・ジュース(スポーツドリンクも含む)	100%果物ジュース 100%野菜ジュース	「主食のある朝食」を食べた頻度	「平均的な1日」に食べた“ごはん”と“みそ汁”
毎日4杯以上	毎日4杯以上	毎日4杯以上	毎日4杯以上	毎日4杯以上	毎日4杯以上
毎日2～3杯	毎日2～3杯	毎日2～3杯	毎日2～3杯	毎日2～3杯	毎日2～3杯
毎日1杯	毎日1杯	毎日1杯	毎日1杯	毎日1杯	毎日1杯
週4～6杯	週4～6杯	週4～6杯	週4～6杯	週4～6杯	週4～6杯
週2～3杯	週2～3杯	週2～3杯	週2～3杯	週2～3杯	週2～3杯
週1杯	週1杯	週1杯	週1杯	週1杯	週1杯
週1杯未満	週1杯未満	週1杯未満	週1杯未満	週1杯未満	週1杯未満
飲まなかった	飲まなかった	飲まなかった	飲まなかった	飲まなかった	飲まなかった

頻度	お酒(薬用酒は含めません)	ワイン(ワイングラスで)
毎日	焼酎・酎ハイ・泡盛(焼酎・泡盛水割り)	ワイン
週に6回	4合以上	4杯以上
週に5回	3合	3杯
週に4回	2合	2杯
週に3回	1合	1杯
週に2回	0.5合	0.5杯
週に1回	0.5合未満	0.5杯未満
週に1回未満	飲まなかった	飲まなかった

「飲まなかった」場合には、お酒の種類別の質問に答える必要はありません。