

Original

# Skipping Breakfast is Associated with Poor Vegetable Intake Among College Students in Japan

Hiroko Fujii<sup>1</sup>, Takashi Nakano<sup>2</sup>, Takashi Muto<sup>1</sup> and Kaoru Aikawa<sup>1,3</sup>

<sup>1</sup> Department of Public Health, Dokkyo Medical University School of Medicine, Mibu, Tochigi, 321-0293, Japan

<sup>2</sup> Medical Service Center, Dokkyo University, 1-1 Gakuen, Soka, Saitama, 340-0042, Japan

<sup>3</sup> Department of Nutrition, Dokkyo Medical University Hospital, Mibu, Tochigi, 321-0293, Japan

## SUMMARY

**Background** : Recently young adults in Japan frequently show several dietary lifestyle problems such as skipping breakfast and poor vegetable intake. The present study investigated whether skipping breakfast is associated with dietary intake, especially vegetable consumption, in college students.

**Methods** : A total of 151 Japanese college students aged 18–21 participated in this cross-sectional study. Of these, we selected 125 (57 males and 68 females) participants who provided complete responses to the questionnaire, the brief-type self-administered diet history questionnaire (BDHQ), for assessment of dietary intake during the past 1 month. The frequency of eating breakfast, weight and height were confirmed in the questionnaire. Breakfast in this study was defined as a meal in the morning that included grain dishes such as rice and bread. Subjects who frequently skipped breakfast were defined as those who skipped breakfast twice or more weekly, based on the median frequency of skipping breakfast among all data from 125 participants.

**Results** : The proportion of respondents who skipped breakfast was significantly higher among males (64.9%) than among females (44.1%) ( $p=0.020$ ). The multiple logistic regression analysis adjusted for gender, BMI category, drinking status and energy intake showed that the proportion of those with a vegetable intake of 350 g or more daily in the group that skipped breakfast was significantly lower than that in the group that ate breakfast (Odds ratio 0.22, 95% confidence interval 0.07–0.67).

**Conclusions** : The present findings suggest that Japanese college students who habitually skip breakfast also tend to have a poor vegetable intake.

**Key Words** : Breakfast, Diet, Vegetables, College Students

## INTRODUCTION

Recently young adults in Japan frequently show several dietary lifestyle problem such as skipping breakfast and poor vegetable intake<sup>1</sup>. Healthy Japan 21 tar-

gets primary prevention of lifestyle-related disease and expanding the period during which people spend their lives without disabilities such as dementia or becoming bedridden as a national health promotion program in Japan<sup>2</sup>. Healthy Japan 21 sets nutritional and dietary goals such as decreasing the proportion of population who regularly skip breakfast and increasing the average amount of vegetable intake<sup>2</sup>. Vegetable and fruit intake is recommended to prevent cardiovascular disease and cancer worldwide<sup>3,4</sup>. Several studies focusing on Japanese adults have shown that vegetable

Received March 16, 2010 ; accepted April 5, 2010

Reprint requests to : Hiroko Fujii

Department of Public Health, Dokkyo Medical University School of Medicine, Mibu, Tochigi, 321-0293, Japan

intake is one of the important factors related to diet quality and eating habits such as skipping meals and alcohol intake<sup>5,6</sup>.

It has been shown that those who skipped breakfast had less energy intake and less nutrient intake than those who did not skip breakfast in the Japanese population<sup>7</sup>. Eating breakfast is considered one of the factors that regulate an individual's internal biological clock in relation to circadian rhythm<sup>8</sup>. Several reports on Japanese college students have suggested the importance of eating breakfast, showing an association between skipping breakfast and increased subjective symptoms of fatigue<sup>9,10</sup> and cardiovascular disease risks in relation to poor dietary intake<sup>11</sup>. In female students, the relationship between habitually skipping breakfast and dysmenorrhea<sup>12</sup>, or poor sleep health<sup>13</sup> has been confirmed. Several reports for Japanese adults also showed that skipping breakfast was related to poor psychological health<sup>14</sup>, symptoms of health problems<sup>15</sup>, impaired fasting glucose<sup>16</sup> and cardiovascular disease risk factors<sup>17</sup>. In adult males, the relationship between skipping breakfast and weight cycling history<sup>18</sup>, or metabolic syndrome<sup>19</sup> has been reported. The relationships between beginning to eat breakfast and normalized diastolic blood pressure or normalized total cholesterol level over a 3-year period have been shown among adult males<sup>20</sup>.

According to the national health and nutrition survey of 2005 in Japan, almost 30% of young adults (aged 20–29 yrs) began to skip breakfast habitually after they graduated from high school<sup>21</sup>. It is important to clarify the association between dietary habits and dietary intake for evidence of health education for young adults who are in the process of establishing lifestyle habits that they will continue in the future.

The influence of skipping breakfast on daily nutrient intake in Japanese female college students has been shown in the literature<sup>22</sup>. However, the influence of skipping breakfast on estimated daily dietary intake, not on food intake frequency, has not previously been clarified in young adults including male college students who show more dietary problems than females in Japan. The present study investigated whether skipping breakfast is associated with the regularity of dietary intake, especially vegetable consumption, among college students.

## METHODS

### *Study design and participants*

In this cross-sectional study, 600 college students were conveniently recruited from 2127 freshmen and sophomores attending Dokkyo University in March 2009. A total of 151 students participated in the survey. Of these, we selected 125 participants who provided complete responses to the questionnaire. Ethical approval was given by the ethics committee at Dokkyo Medical University. All participants were informed of the objective of this study by leaflet. We considered that participants gave informed consent by answering and returning the questionnaire.

### *Assessment of dietary intake*

We measured dietary intake of the participants during the past 1 month using the brief-type self-administered diet history questionnaire (BDHQ)<sup>23</sup>. BDHQ was developed as a brief-type questionnaire based on the self-administered diet history questionnaire (DHQ)<sup>23</sup>. The validity of DHQ was confirmed in other literature<sup>24–26</sup>. We examined 7 nutritional factors (energy, protein, fat, carbohydrate, potassium, Vitamin C and dietary fiber) and vegetable intake. We selected 3 nutrients (potassium, vitamin C and dietary fiber), because the main source of these nutrients is considered vegetable intake<sup>2</sup>.

In this study, daily dietary intakes were described by substantial values for energy, potassium, vitamin C, dietary fiber and vegetable intake, and energy was adjusted to percent of energy intake (E%) for protein, fat and carbohydrate.

Excluding extremely high or low energy intake estimated by BDHQ, we used data of 57 males (1212–4040 kcal) and 68 females (885–2840 kcal). Subjects with preferable vegetable intake were defined as those with vegetable intakes of 350 g or more daily.

### *Assessment of physical state and lifestyle factors*

Information on height, weight, breakfast eating and alcohol drinking were obtained by the self-reported items on BDHQ. Body mass index (BMI) was calculated as weight (kg) divided by height squared (m<sup>2</sup>). Breakfast in this study was defined as a meal in the morning that includes grain dishes such as rice and

**Table 1** Gender differences in the characteristics of participating college students

	Total	Males	Females	P-value*
Number of participants, n	125	57	68	
Age, years, mean (SD)	19.2 (0.4)	19.1 (0.5)	19.1 (0.4)	0.172 <sup>†</sup>
BMI, kg/m <sup>2</sup> , mean (SD)	21.2 (2.5)	21.9 (2.7)	20.7 (2.2)	0.008
BMI category, %				
<18.5	11.2	7.0	14.7	0.410 <sup>‡</sup>
≥18.5 and <25.0	84.0	86.0	82.4	
≥25.0	4.8	7.0	2.9	
Smoker, %	0	0	0	—
Drinker, %	28.8	36.8	22.1	0.069 <sup>§</sup>
Skipping breakfast, %	53.6	64.9	44.1	0.020 <sup>§</sup>
Daily nutrient intake, mean (SD)				
Energy, kcal	1803 (596)	2103 (628)	1551 (434)	<0.001
Protein, E %	14.1 (2.7)	14.0 (3.0)	14.1 (2.3)	0.934
Fat, E %	28.1 (5.8)	26.4 (5.6)	29.6 (5.7)	0.002
Carbohydrate, E %	55.8 (7.6)	57.0 (8.0)	54.8 (7.2)	0.107
Potassium, mg	2195 (979)	2370 (1010)	2049 (935)	0.067
Vitamin C, mg	101 (58)	100 (50)	102 (64)	0.885
Dietary fiber, g	11.0 (5.3)	11.6 (5.2)	10.4 (5.3)	0.202
Daily vegetable intake, mean (SD)	217.5 (156.6)	220.8 (169.3)	214.8 (146.0)	0.831
Preferable vegetable intake <sup>  </sup> , %	20.8	17.5	23.5	0.412 <sup>§</sup>

Abbreviation : BMI, Body mass index ; E %, percent of energy intake.

\* Unless otherwise specified, p value was determined by Student's t test.

† P value was determined by Mann-Whitney U test.

‡ P value was determined by Chi-squared test in the two BMI categories : BMI ≥ 25 kg/m<sup>2</sup> and BMI < 25 kg/m<sup>2</sup>.

§ P value was determined by Chi-squared test.

|| Subjects with preferable vegetable intake were defined as those with an estimated vegetable intake of 350 g or more per day.

bread<sup>23)</sup>. Subjects who frequently skipped breakfast were defined as those who skipped breakfast twice or more weekly and subjects who ate breakfast were defined as those who skipped breakfast once or less weekly, according to the median of breakfast skipping frequency among all data from 125 participants. Drinkers were defined as those who had an alcoholic drink once or more during the previous month. Smoking status was confirmed by an additional questionnaire and categorized as yes or no.

#### Statistical analysis

We examined gender differences and differences between the non-skipping breakfast group and the skipping breakfast group. The results are shown as mean (SD) for numerical variables and as percentage for categorical variables. In case of numerical variables, statistical analysis was conducted by student's t test

or Mann-Whitney U test as appropriate. Differences in categorical variables were examined by Chi-squared test or Fisher's exact test as appropriate.

Multiple logistic regression analysis was used to investigate the prevalence of preferable vegetable intake in the group that skipped breakfast compared with that in the group that ate breakfast and the odds ratios (OR) with 95 % confidence intervals (95 % CI) were calculated. In conducting multiple logistic analyses, dependent variable was preferable vegetable intake (0 : Absence of preferable vegetable intake, 1 : Preferable vegetable intake). For independent variables, we defined the group allocation (0 : Breakfast eating group, 1 : Skipping breakfast group), gender (0 : Females, 1 : Males), BMI category (0 : BMI < 18.5 kg/m<sup>2</sup>, 1 : BMI > 18.5 kg/m<sup>2</sup> and BMI < 25.0 kg/m<sup>2</sup>, 2 : BMI > 25.0 kg/m<sup>2</sup>), drinking status (0 : Non-drinker, 1 : Drinker) and energy intake.

**Table 2** Comparison of the characteristics between the group that ate breakfast and the group that skipped breakfast

	Males			Females		
	Breakfast		P-value*	Breakfast		P-value*
	Eating	Skipping		Eating	Skipping	
Number of participants, n	20	37		38	30	
Age, years, mean (SD)	19.2 (0.4)	19.2 (0.5)	1.000 <sup>†</sup>	19.5 (0.2)	19.2 (0.5)	0.122 <sup>†</sup>
BMI, kg/m <sup>2</sup> , mean (SD)	22.6 (3.6)	21.4 (2.1)	0.120	20.6 (2.2)	20.8 (2.2)	0.743
BMI category, %						
<18.5	5.0	8.1	0.119 <sup>‡</sup>	18.4	10.0	1.000 <sup>‡</sup>
≥18.5 and <25.0	80.0	89.2		78.9	86.7	
≥25.0	15.0	2.7		2.6	3.3	
Drinker, %	45.0	32.4	0.348 <sup>§</sup>	15.8	30.0	0.161 <sup>§</sup>
Daily nutrient intake, mean (SD)						
Energy, kcal	2373 (539)	1957 (631)	0.015	1563 (380)	1537 (500)	0.805
Protein, E %	14.1 (3.0)	14.0 (3.1)	0.987	14.4 (2.0)	13.7 (2.7)	0.213
Fat, E %	25.6 (6.1)	26.8 (5.4)	0.425	30.8 (4.6)	28.0 (6.3)	0.038
Carbohydrate, E %	57.8 (8.5)	56.6 (7.8)	0.589	53.5 (5.7)	56.5 (8.5)	0.098
Potassium, mg	2734 (977)	2174 (985)	0.045	2215 (1026)	1838 (772)	0.100
Vitamin C, mg	113 (51)	93 (48)	0.151	108 (75)	93 (48)	0.327
Dietary fiber, g	13.5 (5.1)	10.6 (5.0)	0.038	11.1 (6.1)	9.5 (4.1)	0.201
Daily vegetable intake, mean (SD)	265.9 (184.5)	196.5 (157.8)	0.141	239.0 (163.2)	184.2 (116.9)	0.126
Preferable vegetable intake <sup>¶</sup> , %	40.0	5.4	0.002 <sup>  </sup>	28.9	16.7	0.266 <sup>  </sup>

Abbreviation : BMI, Body mass index ; E %, percent of energy intake.

\* Unless otherwise specified, p value was determined by Student's t test.

† P value was determined by Mann-Whitney U test.

‡ P value was determined by Fisher's exact test in the two BMI categories : BMI ≥25 kg/m<sup>2</sup> and BMI <25 kg/m<sup>2</sup>.

§ P value was determined by Chi-squared test.

|| P value was determined by Fisher's exact test.

¶ Subjects with preferable vegetable intake were defined as those with an estimated vegetable intake of 350 g or more per day.

For all tests, a value of  $p < 0.05$  was considered significant. All analyses were performed using the SPSS 15.0J for Windows (SPSS Japan Inc., Tokyo).

## RESULTS

Table 1 shows gender differences in the characteristics of participating college students. The average BMI was significantly higher in males than in females ( $p = 0.008$ ). The proportion of males skipping breakfast was significantly higher than that among females (64.9% and 44.1%, respectively,  $p = 0.020$ ). The mean energy intake was significantly greater in males than in females ( $p < 0.001$ ). The mean energy percent of fat intake (E %) was significantly greater in females than in males ( $p = 0.002$ ). There were no other significant differences between males and females.

Table 2 shows the comparison of characteristics in-

cluding dietary intake between the group that ate breakfast and the group that skipped breakfast. Among males, the average intakes of energy, potassium and dietary fiber were significantly greater in the group that ate breakfast than that in the group that skipped breakfast ( $p = 0.015$ ,  $p = 0.045$ ,  $p = 0.038$ , respectively). The proportion of males who had preferable vegetable intake in the group that skipped breakfast was significantly lower than that in the group that ate breakfast ( $p = 0.002$ ). Among females, the mean energy percent of fat intake in the group that ate breakfast was significantly higher than that in the group that skipped breakfast ( $p = 0.038$ ). Among both males and females, there were no other significant differences between the group that skipped breakfast and the group that ate breakfast.

Table 3 shows the odds ratios for the prevalence of

**Table 3** Odds ratios for the prevalence of preferable vegetable intake in the group that skipped breakfast compared with that in the group that ate breakfast

		Crude OR (95 %CI)	Adjusted* OR (95 %CI)
Breakfast	Eating	1.0	1.0
	Skipping	0.24 (0.09–0.62)	0.22 (0.07–0.67)

Abbreviation : OR, Odds ratio ; 95 %CI, 95 % confidence interval ; BMI, Body mass index.

\*Gender, BMI category, drinking status and energy intake were adjusted to obtain the multivariate odds ratio.

preferable vegetable intake in the group that skipped breakfast compared with that in the group that ate breakfast. The multiple logistic regression analysis adjusted for gender, BMI category, drinking status and energy intake showed that the proportion of subjects with preferable vegetable intake in the group that skipped breakfast was significantly lower than those in the group that ate breakfast (OR 0.22, 95 %CI 0.07–0.67).

## DISCUSSION

The present study showed that Japanese college students who habitually skipped breakfast had a poor vegetable intake. To our knowledge, this is the first study showing a positive association between skipping breakfast and poor vegetable intake in Japanese college students including male students.

In this study, the proportion of those who skipped breakfast was significantly higher in males than in females. These gender differences are congruent with these in several reports<sup>21)</sup>. According to the national health and nutrition survey of 2005 in Japan, the proportion of young adults (aged 20–29 yrs) who skipped breakfast twice or more per week was 46.1 % among males and 31.0 % among females<sup>21)</sup>. The survey also showed that the proportion of young adults (aged 20–29 yrs) who skipped breakfast on a weekday for the survey was 33.1 % in males and 23.5 % in females<sup>21)</sup>. These trends might have resulted from the characteristics of male students : compared with the eating habits of female students, eating habits in male students might have been more affected by whether or not they are given meals prepared by others<sup>27)</sup>.

Differences in the breakfast skipping rate between this study and other studies related to breakfast was dependent on how breakfast and breakfast skipping were defined<sup>28)</sup>. In this study, breakfast was defined as

a meal in the morning including grain dishes such as rice and bread. Subjects skipping breakfast in this study were defined as those who skipped breakfast twice or more per week, including weekdays and holidays. In annual reports of the national health and nutrition survey in Japan, breakfast skippers are defined as those who did not eat anything or who ate only confectionary, fruits or supplement, on a weekday morning<sup>17, 21)</sup>. In several Japanese studies, the content of breakfast was not defined clearly, namely the definition of breakfast was left to the responders<sup>9~16, 18~20)</sup>. Breakfast skippers were defined as those who skipped breakfast twice or more per week including weekdays and holidays in some literature<sup>19, 21)</sup>. The higher proportion of breakfast skipping in the present study compared with that in the Japanese national reports might have been due to these differences in the definition of breakfast.

There was no significant gender difference between males and females in the proportion of those who had a daily vegetable intake of 350 g or more (17.5 % and 23.5 %, respectively). While the results of analyses conducted separately for males and females showed that the significant relationship between breakfast skipping and poor vegetable intake was found only in males. Based on these findings, it is speculated that daily dietary intake in males was more affected by habitual breakfast eating than that in females. It remains unclear whether those who habitually eat breakfast consume vegetables at breakfast or whether they ate vegetables at other meals but not breakfast, because we did not examine dietary intake of breakfast apart from other meals. However, recommending that male college students eat breakfast may trigger a preferable vegetable intake.

Among males, the average intake of potassium was significantly greater in the group that ate breakfast

than that in the group that skipped breakfast, while there was no significant difference in the mean vegetable intake between the two groups. According to the national nutrition survey, vegetables were the primary source of potassium intake in young Japanese males (aged 20–29 yrs) (19.3%)<sup>7)</sup>. We assume that the other foods such as fish and meat might have been additionally major sources of potassium intake among participants of this study.

Among females, there was no significant difference in most nutrient intakes in this study, except for fat intake (E%) between those who skipped breakfast and those who did not. This finding is inconsistent with Yamamoto's report showing that with increased frequency of breakfast skipping, the total energy decreased significantly in 1740 females from all-first year nutrition students at various universities in Japan<sup>22)</sup>. Breakfast skippers might have a higher energy intake at lunch, supper or snack than those who eat breakfast.

Our study includes three main limitations: (1) the measures of dietary intake were self-reported by the participants, which might have resulted in some degree of measurement error. Underestimation and overestimation of dietary intake may be influenced by BMI<sup>29~31)</sup> and psychological factors of social desirability such as the desire for slenderness and dietary habit such as daily breakfast eating<sup>30)</sup>; (2) we did not examine physical activity and we could not deny the possibility of confounding factors such as physical activity that affected each participant's estimated energy requirement<sup>32)</sup>; (3) selection bias might have arisen, because the participants were convenient samples, namely the participants were not selected by random sampling and they voluntarily participated. The complete response rate was low, 20.8% and the number of subjects in this study was limited. The energy intakes in this study, which were estimated by BDHQ, were 2103 kcal in males and 1551 kcal in females and slightly lower than representative data for young Japanese adults, though the comparison demands consideration about difference of each method for dietary assessment. According to the national health and nutrition survey of 2008 in Japan, the mean daily energy intake in young adults (aged 20–29 yrs), which were evaluated by dietary survey that included weighing the

amount of food intake for one weekday in November by a household and individual household members, was 2134 kcal in males and 1652 kcal in females<sup>1)</sup>. This study included possible bias, so the findings should be generalized to Japanese college students.

The findings from the present study indicate that a dietary habit of skipping breakfast is associated with poor vegetable intake among Japanese college students including male students. We assume that the relationship between eating breakfast and vegetable intake indicates the importance of emphasizing dietary habits such as breakfast eating during health education for college students in order to promote their health status and prevent lifestyle-related diseases in later life.

*Acknowledgments.* We are grateful to all the volunteers who participated in this study. We thank Kyoko Kobayashi and Setsuko Takeuchi (Medical Service Center, Dokkyo University) for data collection. The present study was conducted as a joint research between Dokkyo Medical University and Dokkyo University.

## REFERENCES

- 1) Ministry of Health, Labour and Welfare, Japan: The National Health and Nutrition Survey in Japan, 2008. Summary of the results, 2009. Available from: <http://www.mhlw.go.jp/houdou/2009/11/dl/h1109-1b.pdf> [Accessed 2009 November 21].
- 2) Japan Health Promotion & Fitness Foundation: Healthy Japan 21. Tokyo: Japan Health Promotion & Fitness Foundation, 2000 (in Japanese).
- 3) WHO: Diet, nutrition and the prevention of chronic diseases, Report of the joint WHO/FAO expert consultation, WHO Technical Report Series, 916. Geneva: WHO, 2003.
- 4) World Cancer Research Fund & American Institute for Cancer Research: The second expert reports. Food, Nutrition, Physical Activity, and the Prevention of Cancer: a Global Perspective. Washington, DC: The American Institute for Cancer Research, 2007.
- 5) Wakita Asano A, Miyoshi M, Arai Y, et al: Association between vegetable intake and dietary quality in Japanese adults: a secondary analysis from the National Health and Nutrition Survey, 2003. *J Nutr Sci Vitaminol* **54**: 384–391, 2008.

- 6) Wakita Asano A, Hayashi F, Miyoshi M, et al : Demographics, health-related behaviors, eating habits and knowledge associated with vegetable intake in Japanese adults. *Eur J Clin Nutr* **63** : 1335-1344, 2009.
- 7) Ministry of health, labour and welfare, Japan : The national nutrition survey in Japan, 2002. Tokyo : Daiichi Shuppan Publishing Co., Ltd., 2004 (in Japanese).
- 8) Shibata S : Internal biological clock and health, internal biological clock and diet. *Rinsyo Eiyou* **112** : 177-182, 2008 (in Japanese).
- 9) Kobayashi H, Demura S, Goshi F, et al : The relationship among subjective symptoms of fatigue, subjective fatigue feeling and life habits of high school and college students. *Nihon Eisei Gakkai Zasshi* **54** : 552-562, 1999 (in Japanese).
- 10) Osako M, Takayama T, Kira S : Dietary habits, attitudes toward weight control, and subjective symptoms of fatigue in young women in Japan. *Nippon Koshu Eisei Zasshi* **52** : 387-398, 2005 (in Japanese).
- 11) Umemura U, Ishimori M, Kobayashi T, et al : Possible Effects of Diets on Serum Lipids, Fatty Acids and Blood Pressure Levels in Male and Female Japanese University Students. *Environmental Health and Preventive Medicine* **10** : 42-47, 2005.
- 12) Fujiwara T : Skipping breakfast is associated with dysmenorrhea in young women in Japan. *Int J Food Sci Nutr* **54** : 505-509, 2003.
- 13) Nakade M, Takeuchi H, Kurotani M, et al : Effects of Meal Habits and Alcohol/Cigarette Consumption on Morningness-Eveningness Preference and Sleep Habits by Japanese Female Students Aged 18-29. *J Physiol Anthropol* **28** : 83-90, 2009.
- 14) Ohira T, Nakamura C, Imano H, et al : Epidemiological study of preferable life style for psychological health promotion. *Nippon Koshu Eisei Zasshi* **54** : 226-235, 2007 (in Japanese).
- 15) Arai H, Anme T, Katakura N, et al : A study on the influence of daily life habits on people's health symptoms. *Nippon Koshu Eisei Zasshi* **50** : 435-445, 2003 (in Japanese).
- 16) Jin D, Ogushi Y, Yamata T, et al : Prediction Chart for the Impaired Fasting Glucose (IFG) Development Rates Using Risk Factor Categories. *Sougou Kenshin* **35** : 391-397, 2008.
- 17) Sakata K, Matumura Y, Yoshimura N, et al : Relationship between skipping breakfast and cardiovascular disease risk factors in the national nutrition survey data. *Nippon Koshu Eisei Zasshi* **48** : 837-841, 2001 (in Japanese).
- 18) Wakui S, Odagiri Y, Takamiya T, et al : Relation between self-reported weight cycling history, dieting and bio-behavioral health in Japanese adult males. *Environmental Health and Preventive Medicine* **6** : 248-155, 2002.
- 19) Kawada T, Otsuka T, Inagaki H, et al : Relationship between two indicators of coronary risk estimated by the Framingham risk score and the number of metabolic syndrome components in Japanese male manufacturing workers. *Metab Syndr Relat Disord* **7** : 435-440, 2009.
- 20) Yamamoto R, Kawamura T, Wakai K, et al : Favorable life-style modification and attenuation of cardiovascular risk factors. *Jpn Circ J* **63** : 184-188, 1999.
- 21) Ministry of health, labour and welfare, Japan : The national health and nutrition survey in Japan, 2005. Tokyo : Daiichi Shuppan Publishing Co., Ltd., 2008 (in Japanese).
- 22) Yamamoto M, Shimoda T, Suga Y, et al : The effects of skipping breakfast habits on total daily nutrition and food intake during adolescence. *Kenko Shien* **8** : 97-105, 2006 (in Japanese).
- 23) Sasaki S : Development and evaluation of dietary assessment methods using biomarkers and diet history questionnaires for individuals. 2004. In : Research for evaluation methods of nutrition and dietary lifestyle programs held on Healthy Japan 21 (head investigator : Tanaka H). Summary report. Ministry of health, labour and welfare, Japan, pp10-38, 2004 (in Japanese).
- 24) Sasaki S, Yanagibori R, Amano K : Self-administered diet history questionnaire developed for health education : a relative validation of the test-version by comparison with 3-day diet record in women. *J Epidemiol* **8** : 203-215, 1998.
- 25) Sasaki S, Yanagibori R, Amano K : Validity of a self-administered diet history questionnaire for assessment of sodium and potassium : comparison with single 24-hour urinary excretion. *Jpn Circ J* **62** : 431-435, 1998.
- 26) Sasaki S, Ushio F, Amano K, et al : Serum biomarker-based validation of a self-administered diet history questionnaire for Japanese subjects. *J Nutr Sci Vita-*

- minol **46** : 285-296, 2000.
- 27) Yokoyama H, Miyazaki M, Mizuta Y, et al : Analysis of factors affecting breakfast skipping by male students undergoing hard training for sports. *Nippon Koshu Eisei Zasshi* **49** : 902-910, 2002 (in Japanese).
- 28) Dialektakou KD, Vranas PB : Breakfast skipping and body mass index among adolescents in Greece : whether an association exists depends on how breakfast skipping is defined. *J Am Diet Assoc* **108** : 1517-1525, 2008.
- 29) Yanai R, Masuda T, Kitagawa S, et al : Relationship between under and overestimation of energy intake and physical and psychological factors and lifestyle characteristics in young Japanese men and women. *Kawasaki Iryou Fukushigaku Zasshi* **16** : 109-119, 2006 (in Japanese).
- 30) Okubo H, Sasaki S : Underreporting of energy intake among Japanese women aged 18-20 years and its association with reported nutrient and food group intakes. *Public Health Nutr* **7** : 911-917, 2004.
- 31) Murakami K, Sasaki S, Takahashi Y, et al : Misreporting of dietary energy, protein, potassium and sodium in relation to body mass index in young Japanese women. *Eur J Clin Nutr* **62** : 111-118, 2008.
- 32) Ministry of Health, Labour and Welfare, Japan : Dietary Reference intake for Japanese, 2005. Tokyo : Daiichi Shuppan Publishing Co., Ltd., 2005 (in Japanese).