

## Original Article

# Eating behavior in relation to prevalence of overweight among Japanese men

Yasumi Kimura PhD<sup>1</sup>, Akiko Nanri PhD<sup>2</sup>, Yumi Matsushita PhD<sup>2</sup>, Satoshi Sasaki PhD<sup>3</sup>, Tetsuya Mizoue PhD<sup>2</sup>

<sup>1</sup>Department of Nutrition and Life Science, Faculty of Life Science and Biotechnology, Fukuyama University, Hiroshima, Japan

<sup>2</sup>Department of Epidemiology and International Health, National Center for Global Health and Medicine, Tokyo, Japan

<sup>3</sup>Department of Social and Preventive Epidemiology, School of Public Health, The University of Tokyo, Tokyo, Japan

Obesity is an important risk factor for lifestyle diseases. There has been much interest in the role of eating behavior in the development of obesity, but findings from population-based epidemiologic studies are limited and inconsistent. The objective of our cross-sectional study was to examine the association between eating behavior and prevalence of overweight. Subjects were 290 men of two municipal offices in northeastern Kyusyu, Japan. A positive association was found between overweight and some eating behaviors; multivariate-adjusted odds ratios (95% confidence intervals) for overweight were 4.33 (2.46-7.64), 2.29 (1.22-4.32), and 2.01 (1.06-3.80) for the behaviors of eating quickly, eating until full and eating fatty foods, respectively. Moreover, the prevalence of overweight was further increased when these eating behaviors were combined; multivariate odds ratios (95% confidence intervals) of overweight for men with 1, 2 and  $\geq 3$  versus no high-risk eating behaviors were 2.66 (1.27-5.56), 4.32 (1.87-9.97) and 7.32 (3.01-17.84), respectively ( $p < 0.0001$  for trend). Our findings suggest that eating quickly, eating until full and eating fatty foods are related to overweight in Japanese men.

**Key Words:** overweight, eating behavior, eating quickly, eating until full, epidemiology

## INTRODUCTION

Obesity, a major risk factor for coronary heart disease, diabetes and cancer has been increasing worldwide.<sup>1</sup> According to World Health Organization (WHO), nearly 25% of adult populations in the world are overweight [body mass index (BMI)  $\geq 25$  kg/m<sup>2</sup>] and 6% of them are obese (BMI  $\geq 30$  kg/m<sup>2</sup>).<sup>2</sup> In Japanese aged 15 or over, 27% of men and 20% of women are classified as being overweight (BMI  $\geq 25$  kg/m<sup>2</sup>),<sup>3</sup> especially in middle age the overweight increase is found in men.<sup>3</sup> Such an increase of obesity has been ascribed primarily to an energy imbalance in this modern society and diet should be a major target for its prevention.<sup>1,4</sup> Recently, much interest has been given to eating behaviors in the role of the development of obesity. Eating behavior relates to food intake; what kind of food are usually consumed, frequency of eating, and style of eating.<sup>5</sup> Assessment of eating behavior is easier than that of calorie intake, which requires detailed information about food intake, and thus can be a practical tool for dietary intervention. Although it remains unclear whether a specific eating behavior cause weight gain,<sup>6</sup> there is evidence supporting a role of eating behaviors in the development of overweight.

Among various eating behaviors, eating quickly has shown to be associated with increased prevalence of obesity in many but not all studies.<sup>7-14</sup> Binge-eating patterns are also linked to overweight and obesity.<sup>1</sup> A positive

association between eating until full and BMI has been found in some studies.<sup>8,12</sup> In a report by the World Cancer Research Fund,<sup>4</sup> intake of high energy-dense foods is concluded as a cause of weight gain, overweight and obesity, especially when large portion sizes are consumed regularly. A randomized controlled trial of UK adolescents showed that weight loss was achieved by a behavioral intervention of slowing down eating speed and reducing portion size.<sup>15</sup> In a Swedish study, a potential association between avoidance of dietary fat and obesity was explored.<sup>16</sup> Drinking sweetened beverages and breakfast skipping have been shown to promote obesity. For other eating behaviors, such as eating between meals or post dinner snacking,<sup>4,17-20</sup> the association with obesity was not clear.

Although results of these studies generally support an idea that obesity is related to eating behaviors, the subjects

**Corresponding Author:** Dr Yasumi Kimura, Department of Nutrition and Life Science, Faculty of Life Science and Biotechnology, Fukuyama University, Sanzo 1, Gakuencho, Fukuyama, Hiroshima, 729-0292, Japan.

Tel: +81-84-936-2111; Fax: +81-84-936-2023

Email: kimura@fubac.fukuyama-u.ac.jp

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studied were students,<sup>7,9,13,18,19</sup> and findings from population-based study are limited and inconsistent.<sup>10-12</sup> In addition, many studies have not appropriately control confounding factors.<sup>13,14,17,21</sup> The aim of this cross-sectional study was to examine whether eating behaviors were associated with overweight in a Japanese working population. Our study results could provide evidence for behavioral approach in the prevention of obesity.

## MATERIALS AND METHODS

### Subjects

Our study was a cross-sectional study among municipal employees who work at two offices in northeastern Kyusyu, Japan. The survey was conducted in July and November 2006.<sup>22</sup> All employees were invited to participate in the survey (n=601). A total of 546 agreed to participate in the survey (response rate: 91%). After exclusion of subjects with missing information, 488 subjects (290 men and 198 women) remained for analysis. Since the overweight of middle aged men increases recently in Japan,<sup>3</sup> our study focuses on men and we excluded 198 women subjects, the final sample comprised 290 Japanese male subjects. The study was approved by the Ethics Committee of the National Center for Global Health and Medicine, and written informed consent was obtained from each subject.

### Eating behavior

Eating behaviors were self-reported in a lifestyle questionnaire, with yes/no response option. Items asked were: sometimes skip a meal, often eat until full, do not consider nutritional balance, often eat a late-night snack, tend to eat quickly, eat meat dishes regularly, often eat fatty foods, do not eat much vegetables, often eat salty food, often eat between meals, drink more than 2 bottles of soft drinks per day, and often eat a meal out.

### Other variables

Body height was measured to the nearest 0.1 cm without shoes. Body weight in light clothes was measured to the nearest 0.1 kg. Body mass index was calculated as body weight (kg) divided by the square of body height (m). We followed the WHO cut-off criteria on overweight with BMI, for men we used BMI  $\geq 25$  kg/m<sup>2</sup>.<sup>23</sup> Marital status, type of job and smoking status were self-reported in the lifestyle questionnaire. We classified occupational physical activities into sedentary work and active work based on the type of jobs; clerical jobs were categorized as sedentary work and other kind of jobs, such as child-care, school lunch cooking, and technical jobs were categorized as active work. The modified Brief Job Stress Questionnaire, in which a higher score indicates greater stress, was used to assess job stress score.<sup>24</sup> Moreover, using the lifestyle questionnaire, leisure-time physical activity was computed as average metabolic equivalent-hours (per week) on the basis of self-reported usual frequency and duration on five different physical activities,<sup>25,26</sup> walking, light exercise (other than walking), moderate exercise (with low panting), intense exercise (with heavy panting) and gardening. Dietary assessment was conducted using a brief self-administered diet history questionnaire (BDHQ) for the previous month.<sup>27</sup> This was based on the self-administered diet history questionnaire (DHQ).<sup>28</sup>

### Statistical analysis

All analyses were conducted using SAS statistical software version 9.1 (SAS Institute, Cary, NC, USA). Logistic regression analysis was used to examine the association between eating behaviors and overweight. Age-adjusted odds ratios (ORs), multivariate-adjusted odds ratios and 95% confidence intervals (CIs) were calculated with adjustment of confounders. Potential confounding factors taken into consideration were age (continuous), work place A (as of the surveyed date in July 2006) or B (as of the surveyed date in November 2006), marital status (married or unmarried), occupational physical activity (sedentary or active work), leisure-time physical activity low (<3 metabolic equivalent-h/wk) or high ( $\geq 3$  metabolic equivalent-h/wk), current smoking status (yes or no), current alcohol drinking status (yes or no), job stress score (tertile) and energy intake (quartile). The "No" category of an answer to the eating behaviors was used as a reference category. The mean differences of continuous variables between two categories were assessed with an independent t-test, and the differences in the proportion were assessed with chi-square test. Eating behavior score (0 to 5) was created as the total number of "Yes" response to 5 eating behaviors with the multivariate-adjusted ORs  $\geq 1.5$  (often eat until full, tend to eat quickly, eat meat dishes regularly, often eat fatty foods, often eat a meal out). We then estimated ORs (95% CIs) for each level of the eating behavior score. All reported *p*-values are two-sided, and a *p*-value of <0.05 was considered statistically significant.

## RESULTS

The mean $\pm$ SD of subjects characteristics were as follows: 43.6 $\pm$ 10.6 years for age, 23.5 $\pm$ 3.3 for BMI, 102.0 $\pm$ 60.0 for job stress score, and 1,870 $\pm$ 545 kcal/day for energy intake.

Table 1 summarizes the characteristics of overweight and non-overweight subjects. The proportion of overweight was 31.4%. Overweight subjects were characterized by higher mean age, higher marriage rate and higher intake of total energy. Smoking and alcohol drinking was not notably associated with overweight.

As shown in Table 2, some eating behaviors were significantly associated with overweight; multivariate-adjusted ORs (95% CIs) for overweight were 4.33 (2.46-7.64), 2.29 (1.22-4.32), and 2.01 (1.06-3.80) for eating quickly, eating until full and eating fatty foods, respectively. Moreover, the odds of being overweight was steadily increased as the eating behavior score increased: multivariate ORs (95% CIs) of overweight for 1, 2, and  $\geq 3$  versus no high-risk eating behaviors were 2.66 (1.27-5.56), 4.32 (1.87-9.97), and 7.32 (3.01-17.84), respectively (*p* for trend <0.0001, data not shown).

## DISCUSSION

In this cross-sectional study, each behaviors of eating quickly, eating until full and eating fatty foods were all statistically significantly associated with increased odds of being overweight in Japanese men. Moreover, the odds of overweight steadily increased as the eating behavior score increased. The present study showed a positive association between eating quickly and prevalence of over-

**Table 1.** Characteristics of subjects (n=290)

	Overweight subjects <sup>†</sup>		Non-overweight subjects <sup>‡</sup>		<i>p</i> -value <sup>§</sup>
Number of subjects (%)	91 (31.4)		199 (68.6)		
Age (years), (mean, SD)	45.8	10.1	42.6	10.7	0.02
Work place (% A)	40.7		29.7		0.06
Married (%)	82.4		68.8		0.02
Sedentary work (%)	91.2		89.5		0.64
Leisure-time physical activity <sup>¶</sup> (%)	49.5		46.7		0.67
Current smoking (%)	47.3		45.7		0.81
Current alcohol drinking (%)	85.7		85.9		0.96
Job stress score <sup>††</sup> , (mean, SD)	94.7	46.8	105.3	65	0.17
Total energy (kcal/day), (mean, SD)	1971	526	1824	548	0.03

<sup>†</sup>Subjects with body mass index (kg/m<sup>2</sup>) ≥25.

<sup>‡</sup>Subjects with body mass index (kg/m<sup>2</sup>) <25.

<sup>§</sup>For continuous variables, independent t-test was used; for categorical variables, chi-square test was used.

<sup>¶</sup>Leisure-time physical activity of high intensities (≥3 metabolic equivalent-h/wk) during commuting, leisure time and yard work.

<sup>††</sup>Range was 26-423.

**Table 2.** Odds ratios (ORs) and 95% confidence intervals (CIs) for overweight according to eating behavior (n=290) <sup>†</sup>

Eating behavior	Yes (%)	Age-adjusted	Multivariate-adjusted
		OR (95% CI)	OR (95% CI) <sup>‡</sup>
Sometimes skip a meal	25	0.57 (0.30-1.11)	0.77 (0.38-1.57)
Often eat until full	20	2.42 (1.33-4.41)	2.29 (1.22-4.32)
Do not consider nutritional balance	12	0.67 (0.29-1.56)	1.04 (0.41-2.61)
Often eat a late-night snack	6	0.64 (0.20-2.01)	0.55 (0.17-1.82)
Tend to eat quickly	50	3.88 (2.25-6.69)	4.33 (2.46-7.64)
Eat meat dishes regularly	18	1.85 (0.98-3.50)	1.77 (0.91-3.41)
Often eat fatty foods	19	2.01 (1.09-3.71)	2.01 (1.06-3.80)
Do not eat much vegetables	11	0.41 (0.16-1.05)	0.42 (0.16-1.13)
Often eat salty food	20	1.05 (0.56-1.96)	1.05 (0.55-2.01)
Often eat between meals	10	0.73 (0.30-1.79)	0.74 (0.28-1.94)
Drink more than 2 bottles of soft drinks per day	7	0.65 (0.21-2.04)	0.85 (0.25-2.89)
Often eat a meal out	17	1.41 (0.72-2.74)	1.87 (0.91-3.84)

OR: odds ratio, CI: confidence interval.

<sup>†</sup>Overweight is defined as body mass index (kg/m<sup>2</sup>) ≥25.

<sup>‡</sup>Adjusted for age (y, continuous), work place (A or B), marital status (married or unmarried), occupational physical activity (sedentary or active work), leisure-time physical activity [low (<3 metabolic equivalent-h/wk) or high (≥3 metabolic equivalent-h/wk)], current smoking (yes or no), current alcohol drinking (yes or no), job stress score (<71, 71 to <110, or ≥110) and energy intake (kcal/day, <1465, 1465 to <1881, 1881 to <2228 or ≥2228).

weight in men. A similar finding with respect to eating quickly in men and overweight has also been reported in previous studies.<sup>8,10,12,21,29</sup> In the study on male workers, a positive association between eating quickly and BMI was observed in a cross-sectional study on civil servants,<sup>10</sup> employees of a semiconductor factory in Japan and in a cross-sectional study for fire fighters in the USA.<sup>8,21</sup> In a randomized controlled trial of UK adolescents, a dietary advice to slow down the speed of eating and reduce portion size was effective in reducing weight.<sup>15</sup> Few studies have adjusted for total energy intake in the analysis of the association between eating quickly and BMI.<sup>9,10,12</sup> It is important to evaluate the energy intake in relation to overweight and eating behavior. In our study, the energy intake of overweight subjects is significantly higher than that of non-overweight subjects. Usually the reason of overweight caused by eating quickly is considered to be the high energy intake with overeating before feeling the fullness in the stomach. In a previous study, eating quickly was related to daily energy intake in men, energy intake becomes increases with the increase in the rate of eating.<sup>10</sup> These results show that energy intake is associated to eating quickly and that the overweight from high

energy intake is a result of eating quickly. On the other hand, we need to pay attention to the accuracy of energy intake from self-administered diet history questionnaires.<sup>30</sup> The energy intake by self-administered diet history questionnaires was reported to be 16% less than the accurate energy intake in men.<sup>31</sup> It is reported that overweight subjects would underreport energy intake, and the accuracy of absolute intake of energy significantly decreased with increasing BMI (*p* for trend <0.001).<sup>26,32</sup> In our study, eating behavior and overweight was estimated with the statistical method using energy adjustment, but energy adjusted value should carefully be interpreted since it is hard for overweight subjects to evaluate energy intake correctly.

The present results are in agreement with the existing data indicating that eating until full is associated with increased prevalence of overweight.<sup>8,12</sup> For example, increase of BMI was positively associated with eating until full in young male workers (mean age: 29.9 y).<sup>8</sup> This finding is generally consistent with those aforementioned studies in Japan. Eating until full is related to other dietary behaviors including overeating and binge-eating that have been linked to overweight.<sup>1</sup>

We found a positive association between eating fatty foods and the prevalence of overweight. This finding is in line with those in Japanese studies on the relation of overweight to the preference of fatty and rich taste or liking for fat-rich foods,<sup>33,34</sup> although some others did not detect an association between fat intake and overweight.<sup>9,35</sup> Moreover, persons with a greater intake of meat, whose consumption is correlated with fat intake ( $r=0.61$ ), tended to be overweight than those with a lower intake.<sup>36</sup> Overweight has also been linked to energy-density,<sup>37</sup> World Cancer Research Fund concluded that energy-dense foods are a probable cause of obesity based on epidemiologic evidence.<sup>4</sup> Because energy-dense foods are typical of a fat rich diet, eating fatty foods is probably an important determinant of obesity.

Many studies examined several eating behaviors at the same time as investigating the relationship between overweight and eating behaviors. In the present study, the odds ratio of overweight steadily increased as the eating behavior score increased in men. Both eating behaviors of eating until full and eating quickly are statistically significant factors of overweight.<sup>8,12</sup> One study examined an association with overweight in Japanese men and women aged 30-69 y by combining the two eating behaviors of eating until full/eating quickly; the result showed that the combined eating behaviors had closer association with overweight than that of the association with the individual eating behavior.<sup>12</sup> These factors may contribute to prove that overweight is closely related to the two eating behaviors. The risk of overweight can be found not only with the individual eating behavior but also with the combination of several eating behaviors. The risk would actually be higher by combining several eating behaviors each of which relates to the overweight.

Our study has some strengths. Firstly, the subjects were apparently healthy workers and thus results obtained might not be appreciably distorted by disease status, which would affect both dietary behavior and body weight. Second, selection bias would not account for the observed association since the response rate was high (91%). Finally, the present study controlled for potentially important confounding variables including diet and other life-style factors.

On the other hand, the present study also has several limitations. Firstly, the sample size is small and could not detect moderate associations with statistical significance. Second, due to the nature of cross-sectional study, we could not infer causality. Specifically, we cannot rule out the possibility that the observed associations reflected changes in eating behaviors as a result of obesity. Third, subjects were workers of two municipal offices in Japan, the results may not be applied to the general population. Fourth, dietary behavior questionnaire used has not been previously validated against objective measures. There may be some other important eating behaviors that could influence obesity.

We found statistically significant and positive association between specific eating behaviors, namely: eating quickly, often eat until full, as well as often eat fatty foods and overweight among Japanese adult men. Our results suggest that to intervene in eating behavior may be an important component for the prevention of obesity.

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## AUTHOR DISCLOSURES

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## Original Article

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Yasumi Kimura PhD<sup>1</sup>, Akiko Nanri PhD<sup>2</sup>, Yumi Matsushita PhD<sup>2</sup>, Satoshi Sasaki PhD<sup>3</sup>, Tetsuya Mizoue PhD<sup>2</sup>

<sup>1</sup>Department of Nutrition and Life Science, Faculty of Life Science and Biotechnology, Fukuyama University, Hiroshima, Japan

<sup>2</sup>Department of Epidemiology and International Health, National Center for Global Health and Medicine, Tokyo, Japan

<sup>3</sup>Department of Social and Preventive Epidemiology, School of Public Health, The University of Tokyo, Tokyo, Japan

## 日本男性飲食行為與過重盛行率的關聯

肥胖是生活型態相關疾病的重要危險因子。目前有很多關注於飲食行為在肥胖發展的角色，然而針對人群所做的流行病學研究相當有限且結果不一致。本篇橫斷面研究的目的是調查飲食行為和過重盛行率的關係。對象為日本九州東北部的兩個市政廳的 290 位男性員工。結果發現過重和某些飲食行為呈正相關；校正多變項後，吃得快、吃到飽和吃脂肪食物的體重過重勝算比(95%信賴區間)分別是 4.33 (2.46-7.64)、2.29 (1.22-4.32)和 2.01 (1.06-3.80)。此外，當這些飲食行為合併時，過重盛行率更增加；校正多變項後，不當飲食行為有 1 項、2 項、及 3 項含以上的男性過重勝算比(95%信賴區間)，相對於非高風險飲食行為，分別為 2.66 (1.27-5.56)、4.32 (1.87-9.97)和 7.32 (3.01-17.84)，趨勢上升有顯著意義 ( $p < 0.0001$ )。本篇研究結果顯示吃得快、吃到飽和吃脂肪食物與日本男性過重有關。

**關鍵字：**過重、飲食行為、吃得快、吃到飽、流行病學