J Nutr Health Aging
Volume 21, Number 5, 2017

RELATIONSHIP BETWEEN BREAKFAST SKIPPING AND OBESITY AMONG ELDERLY: CROSS-SECTIONAL ANALYSIS OF THE HEIJO-KYO STUDY

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Abstract: *Objective:* Breakfast skipping is reported to be associated with obesity in children and younger populations; however, few studies report the association among elderly. The purpose of this study was to investigate the relationships between breakfast skipping and obesity prevalence among elderly. *Design:* Cross-sectional study. *Setting:* Community-dwelling elderly in Nara, Japan. *Participants:* 1052 elderly participants (mean age: 71.6 years). *Measurements:* Obesity and breakfast skipping were defined as body mass index of ≥25 kg/m^2 and skipping breakfast one or more times per week, respectively. *Results:* Two hundred and seventy-two participants (25.9%) were classified as obese and forty-one (3.9%) were as breakfast skippers. Obesity prevalence was significantly higher in breakfast skippers than in breakfast eaters (43.9% vs. 25.1%, P = 0.007). In multivariable logistic regression analysis adjusted for potential confounders (age, sex and alcohol consumption), breakfast skippers showed significantly higher odds ratio (OR) for obesity than breakfast eaters (OR, 2.23; 95% confidence interval, 1.17–4.27; P = 0.015), which continued to be significant after further adjustment for socioeconomic status. In addition, breakfast skippers showed significantly lower daily potassium (P <0.001) and dietary fibre intakes (P = 0.001) and lower subjective physical activity (P = 0.035) than breakfast eaters. *Conclusions:* Breakfast skipping was significantly associated with obesity among elderly. Poor diet quality and physical inactivity may be potential intermediators underlying the association between breakfast skipping and obesity.

Key words: Breakfast skipping, obesity, elderly, physical activity, diet quality.

Introduction

Since the past 30 years, obesity prevalence not only young but among elderly has been increasing; according to the annual report of the National Health and Nutrition Survey Japan, at present, it is approximately 30% (1). Obesity is a commonly recognized major risk factor for hypertension, diabetes, poor physical performance, cardiovascular diseases, cancer and early mortality (2–8). Thus, obesity is a public health concern among the elderly population.

Physical inactivity, excessive food intake and poor diet primarily cause obesity. Physical activity during daytime is possibly increased (9, 10) and overall diet quality is improved because of breakfast consumption (11–13); therefore, breakfast consumption is considered an important behaviour for preventing obesity. Previous knowledge indicates that breakfast skipping is associated with overweight or obesity; however, these findings were limited to studies conducted in children and younger populations (11–19). Hence, few studies report associations between breakfast skipping and obesity among elderly.

In this cross-sectional study including 1052 community-dwelling elderly, we measured breakfast status, subjective and objective physical activity, self-reported diet quality and body mass index (BMI).

Methods

Study participants

Participants aged ≥60 years (n = 1127) were voluntarily enrolled between September 2010 and March 2014 in the HEIJO-KYO study. The study protocol has been previously described (20). Data from 1052 participants were available for this study after excluding 75 participants with missing data related to breakfast or BMI.

Ascertainment of obesity and breakfast skipping

Body weight and height were measured in the standing position. BMI was calculated as body weight (kg) divided by height (m^2). Obesity was defined as BMI of ≥25 kg/m^2. To inquire regarding breakfast status, a standardized questionnaire including the question "How many days do you skip breakfast in a week" was self-administered. Participants chose one answer from the following five categories: (1) every day, (2) 5–6 days/week, (3) 3–4 days/week, (4) 1–2 days/week and (5) never. Breakfast skippers were defined as those skipping breakfast one or more times per week, and breakfast eaters were defined as those who never skipped breakfast in a week.

Dietary assessment

Energy intake was assessed by a food frequency questionnaire based on food groups (FFQg) (21), containing 29 food groups and 10 types of cookery; average intake per week

Received January 13, 2016
Accepted for publication February 29, 2016

of each food group in commonly used units or portion sizes was estimated. FFQg was externally validated by comparison with weighed dietary records for 7 continuous days, in which minerals and dietary fibre intakes were adjusted for total energy using the density method and presented as grams/1000 kcal of total energy; macronutrients were presented as percent total energy (%E). Correlation between FFQg and dietary records for energy, protein, fat, carbohydrate, sodium, potassium and dietary fibre intakes was 0.47, 0.42, 0.39, 0.49, 0.43, 0.23 and 0.44, respectively.

Subjective and objective physical activity

Using the Japanese version of the International Physical Activity Questionnaire to query participants on the extent of moderate and vigorous physical activities and walking performed by them over the past 7 days, subjective physical activity was assessed (22).

Objective physical activity was measured at 1-min intervals during waking hours over 2 consecutive days using an actigraph (Actiwatch 2; Respironics Inc., PA, USA) worn on the nondominant wrist. The average physical activity count was automatically calculated by Actiware, version 5.5 (Respironics), with default algorithm.

Statistical analysis

Continuous variables were presented as means and standard deviation (SD), and were compared using unpaired t test. Chi square test was used to compare proportion in categorical data. Data on subjective physical activity were compared after natural log-transformation because of skewed distribution. Other continuous data were normally distributed. Odds ratio (OR) and 95% confidence intervals (CI) for obesity were estimated using logistic regression analysis. OR was adjusted for covariates, including age (per 5 years), gender (male vs. female), current smoking status (yes vs. no), alcohol consumption (≥30 vs. <30 g/day), educational level (≥13 vs. <13 years) and annual household income (≥4 vs. <4 million Japanese yen/year).

Multivariable-adjusted model 1 included age and gender as covariates; model 2, variables significantly associated with obesity in Table 1 and model 3, all variables in Table 1. Statistical analyses were performed using SPSS, version 20.0, for Windows (IBM SPSS Inc., Chicago, IL). A two-sided P value of <0.05 was statistically significant.

Results

The mean age of 1052 participants was 71.6 years (SD, 7.0), and 52.3% were females (Table 1); 25.9% (n = 272) were classified as obese. The mean BMI of the non-obesity and obesity groups were 21.8 kg/m^2 (2.2) and 26.9 kg/m^2 (1.9), respectively. Obesity was significantly associated with younger age, male sex and higher alcohol consumption.

Obesity prevalence and unadjusted OR for obesity were significantly higher in breakfast skippers (n =41) than in breakfast eaters (n = 1011) (43.9% vs. 25.1%, P = 0.007; Table 2 and OR: 2.33, 95% CI: 1.24–4.39, P = 0.009, respectively). In multivariable-adjusted models, breakfast skippers showed significantly higher adjusted OR for obesity than breakfast eaters (model 1: OR: 2.25, 95% CI: 1.18–4.30, P = 0.014; model 2: OR: 2.23, 95% CI: 1.17–4.27, P = 0.015; model 3: OR: 2.30, 95% CI: 1.20–4.41, P = 0.013).

Table 1
Basic characteristics according to obesity status

Characteristics	Non-Obesity (n = 780)	Obesity (n = 272)	P
BMI, kg/m^2, (mean, SD)	21.8 (2.2)	26.9 (1.9)	<0.001
Age, years, (mean, SD)	72.1 (7.0)	70.1 (6.5)	<0.001
Gender, male, number	346 (44.4%)	156 (57.4%)	<0.001
Current smoker, number	40 (5.1%)	13 (4.8%)	0.82
Alchol consumption ≥30g/day, number	104 (13.3%)	53 (19.5%)	0.014
Education ≥13years, number	208 (26.7%)	82 (30.1%)	0.27
Household income ≥4 million JPY/y, number	307 (42.5%)	118 (45.9%)	0.34

BMI, body mass index; SD, standard deviation; JPY, Japanese yen.

Breakfast skippers showed significantly lower daily protein, potassium and dietary fibre intakes than breakfast eaters (13.4 vs. 14.5% E, P = 0.002; 1086.0 vs. 1267.7 mg/1000 kcal, P < 0.001 and 6.4 vs. 7.3 g/1000 kcal, P = 0.001; respectively; Table 3); obesity group showed significantly lower potassium and dietary fibre intakes than non-obesity group (1232.1 vs. 1271.0 mg/1000 kcal, P = 0.028 and 7.1 vs. 7.4 g/1000 kcal, P = 0.008; respectively).

Table 2
Logistic regression analysis for the association between breakfast skipping and obesity

	Breakfast eater (n = 1011)	Breakfast skipper (n = 41)	P
No. of obeisty	254 (25.1%)	18 (43.9%)	0.007
Unadjusted OR for obesity (95% CI)	1.00 (ref)	2.33 (1.24, 4.39)	0.009
Adjusted OR for obesity (95% CI)			
Model 1	1.00 (ref)	2.25 (1.18, 4.30)	0.014
Model 2	1.00 (ref)	2.23 (1.17, 4.27)	0.015
Model 3	1.00 (ref)	2.30 (1.20, 4.41)	0.013

OR, odds ratio; CI, confidence interval; Model 1: adjusted for age and gender; Model 2: adjusted for variables significantly associated with obesity (age, gender, and alcohol consumption); Model 3: adjusted for all variables shown in Table 1 (age, gender, smoking, alcohol consumption, education, and household income).

Table 3
Dirtary assessment and physical activity according to the breakfast and obesity status

	Breakfast eater (n = 1011)	Breakfast skipper (n = 41)	P	Non-obesity (n = 780)	Obesity (n = 272)	P
Dietary assessment (mean, SD)						
Energy (kcal/day)	1989.5 (475.2)	1993.5 (643.1)	0.97	1992.6 (469.0)	1981.0 (518.6)	0.74
Protein (%E)	14.5 (2.2)	13.4 (2.5)	0.002	14.5 (2.2)	14.3 (2.3)	0.18
Fat (%E)	27.9 (4.9)	27.6 (4.2)	0.69	27.9 (4.9)	27.9 (4.6)	0.87
Carbohydrate (%E)	57.6 (6.2)	59.0 (5.5)	0.15	57.5 (6.3)	57.8 (6.0)	0.55
Sodium (mg/1000kcal)	2162.2 (578.8)	2059.0 (574.2)	0.28	2156.4 (568.3)	2164.0 (608.8)	0.86
Potassium (mg/1000kcal)	1267.7 (246.9)	1086.0 (213.4)	<0.001	1271.0 (252.5)	1232.1 (232.9)	0.028
Dietray fiber (g/1000kcal)	7.3 (1.6)	6.4 (1.5)	0.001	7.4 (1.7)	7.1 (1.5)	0.008
Physical activity (mean, SD)						
Subjective (log MET-h/wk)	2.9 (1.5)	2.4 (1.5)	0.035	3.0 (1.4)	2.7 (1.6)	0.042
Objective (counts/min)	300.8 (103.7)	288.8 (91.9)	0.46	309.6 (101.7)	274.0 (103.3)	<0.001

SD, standard deviation; MET, metabolic equivalent task.

Regarding physical activity, breakfast skippers exhibited significantly lower subjective physical activity than breakfast eaters (14.8 vs. 23.1 MET-h/week, P = 0.035); there were no significant differences in objective physical activity between the groups. Obesity group exhibited significantly lower subjective and objective physical activities than non-obesity group (19.8 vs. 23.1 MET-h/week, P = 0.042; 256.3 vs. 301.0 counts/min, P <0.001, respectively).

Discussion

To our knowledge, this is the first report on the association between breakfast skipping and obesity among elderly. Poor diet quality and physical inactivity may be potential intermediators underlying the association between breakfast skipping and obesity.

Association of breakfast skipping with obesity among elderly is consistent with findings of previous studies on Western and Asian younger populations. Breakfast skippers exhibited a 4.5-times higher OR for obesity than breakfast eaters in adult population of the US (14). Similar results were reported in other cross-sectional studies in Western and Asian countries (11, 12, 15, 16, 23) and were confirmed by a meta-analysis (24). A 5-year follow-up longitudinal study in adolescents showed that the frequency of consuming breakfast was inversely associated with BMI in a dose–response manner (25). Another longitudinal study in male adults aged ~55 years indicated that breakfast eaters showed a 13% lower risk for 5-kg weight gain than breakfast skippers (13). Our study demonstrated a 2.2-times higher OR for obesity than breakfast eaters.

Potential intermediators underlying the association between breakfast skipping and obesity may be poor dietary quality and physical inactivity. Here, breakfast skippers showed significantly lower daily protein, potassium and dietary fibre intakes and lower subjective physical activity than breakfast eaters, possibly contributing to body mass increase. Previous studies indicate that eating breakfast may increase physical activity and improve diet quality. In adolescents, breakfast eaters had higher morning physical activity than breakfast skippers (9). Eating breakfast increased physical activity in younger adults as per a randomized controlled trial (10). Regarding diet quality, breakfast eaters had higher dietary fibre intake than breakfast skippers (11-13). Although some previous studies indicated that breakfast skipping increased total energy intake, results were conflicting. Healthy lean women demonstrated that breakfast skipping significantly increased energy intake than eating breakfast (26). As reported in several observational studies, although energy intake was lower in breakfast skipper than in breakfast eaters, breakfast skipping modified subsequent energy intake on lunch and snacks (11, 12, 27). In the present study, no significant differences in energy intake between breakfast skippers and breakfast eaters were found.

This study has several limitations. Participants were not randomly selected, possibly leading to selection bias. However, BMI was similar to the corresponding national data for elderly Japanese (1). Also, the cross-sectional design limited causality inference for association between breakfast skipping and obesity. Further prospective studies among elderly investigating the influence of breakfast skipping on obesity are required. In the present study, the number of usual breakfast skippers was small (n = 41), possibly resulting in limited adjustment for covariates in the statistical model. However, the proportion of breakfast skippers was similar to the corresponding national data for elderly Japanese (1).

In conclusion, breakfast skipping was significantly

associated with obesity among elderly. The association between breakfast skipping and obesity may be intermediated by poor diet quality and physical inactivity.

Acknowledgements: We would like to thank Sachiko Uemura, Naomi Takenaka, and Keiko Nakajima for their valuable help with data collection.

Conflict of Interest: KO and KS received research grant from YKK AP Inc., Ushio Inc.; Tokyo Electric Power Company; EnviroLife Research Institute Co., Ltd.; and Sekisui Chemical Co., Ltd. NO, NT, and NK declare no conflict of interest.

Ethical Standards Disclosure: All participants had provided written informed consent. This study protocol was approved by the Ethics Committee of Nara Medical University.

Financial Sources: This work was supported by research funding from Department of Indoor Environmental Medicine, Nara Medical University; JSPS KAKENHI (grant numbers: 24790774, 22790567, 25860447, 25461393, 15H04776, and 15H04777); Mitsui Sumitomo Insurance Welfare Foundation; Meiji Yasuda Life Foundation of Health and Welfare; Osaka Gas Group Welfare Foundation; Japan Diabetes Foundation; Daiwa Securities Health Foundation; Japan Science and Technology Agency; YKK AP Inc.; Ushio Inc.; Nara Prefecture Health Promotion Foundation; and Nara Medical University Grant-in-Aid for Collaborative Research Projects; Tokyo Electric Power Company; EnviroLife Research Institute Co., Ltd.; and Sekisui Chemical Co., Ltd. The funders had no role in the study design, data collection and analysis, decision to publish, and preparation of the manuscript.

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