

Skipping Breakfast and Risk of Mortality from Cancer, Circulatory Diseases and All Causes: Findings from the Japan Collaborative Cohort Study

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ABSTRACT

Background Breakfast eating habits are a dietary pattern marker and appear to be a useful predictor of a healthy lifestyle. Many studies have reported the unhealthy effects of skipping breakfast. However, there are few studies on the association between skipping breakfast and mortality. In the present study, we examined the association between skipping breakfast and mortality from cancer, circulatory diseases and all causes using data from a large-scale cohort study, the Japan Collaborative Cohort Study (JACC) Study.

Methods A cohort study of 34,128 men and 49,282 women aged 40–79 years was conducted, to explore the association between lifestyle and cancer in Japan. Participants completed a baseline survey during 1988 to 1990 and were followed until the end of 2009. We classified participants into two groups according to dietary habits with respect to eating or skipping breakfast and carried out intergroup comparisons of lifestyle. Multivariate analysis was performed using the Cox proportional hazard regression model.

Results There were 5,768 deaths from cancer and 5,133 cases of death owing to circulatory diseases and 17,112 cases for all causes of mortality during the median 19.4 years follow-up. Skipping breakfast was related to unhealthy lifestyle habits. After adjusting for confounding factors, skipping breakfast significantly increased the risk of mortality from circulatory diseases [hazard ratio (HR) = 1.42] and all causes (HR = 1.43) in men and all causes mortality (HR = 1.34) in women.

Conclusion Our findings showed that skipping breakfast is associated with increasing risk of mortality from

circulatory diseases and all causes among men and all causes mortality among women in Japan.

Key words cancer; circulatory diseases; mortality; skipping breakfast; prospective study

It has been widely propounded that breakfast is the most important meal of the day.^{1–4} Various studies have reported that skipping breakfast is related to weight gain,^{5, 6} dyslipidemia,^{7, 8} hypertension,⁹ insulin sensitivity and diabetes mellitus^{7, 8, 10} and coronary heart disease.¹¹ However, there are few studies on the association between skipping breakfast and mortality.

Eating breakfast was associated with physical health status and mortality in a pioneer longitudinal study initiated in 1965 in Alameda County, California in the United States.¹³ In that study, multivariate analysis, including confounding factors, was not done because of the relatively low number of deaths among the study population.¹² Later, multivariate analysis of data from the Alameda County study showed that skipping breakfast was associated with an increased risk of total mortality.¹³ The association between skipping breakfast and causes of death has not been clarified. Therefore, in the present study, multivariate analysis of data from a large-scale cohort study in Japan was carried out, to investigate the association between skipping breakfast and mortality from cancer, circulatory diseases and all causes.

MATERIALS AND METHODS

JACC Study

The Japan Collaborative Cohort (JACC) Study for Evaluation of Cancer Risks, sponsored by the Ministry of Education, Sports, Science, and Technology of Japan, began between 1988 and 1990 and enrolled participants living in 45 areas throughout Japan. A total of 110,585 participants (46,395 men and 64,190 women) aged 40–79 years completed self-administered questionnaires about their lifestyles and medical histories. Informed consent was obtained from all participants prior to

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Abbreviations: BMI, body mass index; CI, confidence interval; FFQ, food frequency questionnaire; HR, hazard ratio; ICD-10, the international classification of diseases; JACC Study, the Japan Collaborative Cohort Study

completion of the questionnaire. Sampling methods and other details of the JACC study have been described elsewhere.^{14, 15}

Participants with a previous medical history of any cancer, stroke, or myocardial infarction at the baseline survey were excluded ($n = 4,407$; 1,817 men and 2,590 women). Additionally, participants were excluded who died within 5 years ($n = 3,609$; 2,228 men and 1,381 women) after the baseline survey and those who did not answer questions regarding their breakfast eating habits ($n = 19,159$; 8,222 men and 10,937 women). A total 83,410 participants (34,128 men and 49,282 women) were finally enrolled for the study. The study design and informed consent procedure were approved by the Ethics Review Committee of Nagoya University School of Medicine.

Mortality surveillance

Mortality surveillance was conducted by systematically reviewing death certificates, which were forwarded by the centers serving participants who had died. Mortality data were then centralized at the Ministry of Health and Welfare, and the underlying causes of death coded for National Vital Statistics according to the International Classification of Diseases, 10th Revision (ICD-10).

Participants were followed until death or through the end of 2009, except in 10 areas: participants were followed to the end of 1999 in four areas, to the end of 2003 in four areas, and to the end of 2008 in two areas. Deaths from cancer were classified as ICD-10 codes C00-C97, and deaths from circulatory diseases as codes I00-I99.

Questionnaire on dietary habits

Information about dietary habits was obtained using a self-administered questionnaire. The type of breakfast consumed was assessed according to the following five categories: Japanese style, Western style, Chagayu style (tea rice gruel) and no or nearly no breakfast eaten and others. We reclassified participants into two groups, as those who eat breakfast [including Japanese style, Western style, Chagayu style (tea rice gruel) and others] and those who skip breakfast (no or nearly no breakfast eaten). Total energy intake was estimated using a food frequency questionnaire (FFQ). The reproducibility and validity of the dietary questionnaire have been reported elsewhere.^{16, 17} The frequency of snacking was assessed using the following five categories: almost never, 1–2 times per month, 1–2 times per week, 3–4 times per week, and almost every day. Participants were then reclassified into two groups, as those who snacked every day and those who did not snack every day. Dinner time

was classified as regular time from five to eight p.m. and irregular time other than that.

Questionnaire on lifestyle

A broad set of potential confounding factors were determined from additional data obtained at baseline. These included age, sex, history of hypertension (yes or no) and history of diabetes mellitus (yes or no). Body mass index (BMI) was calculated as weight (kg) divided by the square of height (m²). Smoking status was classified into three categories: current smoker, past smoker, or never smoked. Alcohol status was classified into three categories: current alcohol use, past alcohol use and never consumed alcohol. Education level was assessed and classified into two categories: college level or higher and less than college level. The number of hours engaged in leisure-time physical activity was classified into 3 h or more per week or less than 3 h per week. Walking duration was classified as 60 min or more per day or less than 60 min per day. Sleep duration was assessed and classified into three categories: < 5 h, 5–9 h, and > 9 h. Marital status was classified as married, widowed, divorced and single. Participants were then reclassified into two groups, married or unmarried (including widowed, divorced and single). Work schedule was categorized as follows: day shift, night shift, or shift work.

Statistical analysis

First, baseline characteristics were categorized according to breakfast status using means (standard deviation) and proportions. To clarify the associations between breakfast status and potential confounders, we calculated the age adjusted proportions for each factor and analyzed the associations using multiple logistic regression. Finally, the multivariate Cox proportional hazards model by SAS PHREG with strata statement (difference of areas) was used to estimate hazard ratios (HR) and 95% confidence intervals (CIs) of mortality associated with skipping breakfast. HR₁ of the multivariate model was adjusted for age. HR₂ was adjusted for age, history of hypertension, history of diabetes mellitus, BMI, smoking status, alcohol status, education level, physical activity, walking duration, sleep duration, marital status and work schedule. There was no evidence that proportional hazard assumptions were violated. All statistical analyses were conducted using Statistical Analysis System version 9.1 software (SAS Institute, Cary, NC).

RESULTS

The baseline characteristics of participants according to breakfast status are shown in Table 1. Participants who skipped breakfast were significantly younger than those

Table 1. Baseline characteristics of demographic by breakfast status, 1988–1990, JACC Study

	Men			Women		
	Eating breakfast*	Skipping breakfast†	<i>P</i> value‡	Eating breakfast*	Skipping breakfast†	<i>P</i> value‡
Number of subjects	33,039	1,089		48,189	1,093	
Person years	550,548	17,880		815,168	18,698	
Age, y (mean ± SD)	56.0 ± 10.0	50.0 ± 9.0	< 0.0001	57.5 ± 10.0	51.6 ± 8.8	< 0.0001
40–49, <i>n</i>	8,875	620		11,893	536	
50–59, <i>n</i>	10,318	292		15,267	359	
60–69, <i>n</i>	9,908	137		14,831	150	
70–79, <i>n</i>	3,938	40		6,198	48	
History of hypertension, %	17.7	16	0.0669	19.9	19.2	0.4676
History of diabetes mellitus, %	5.5	4.4	0.0544	3.4	3.8	0.5756
Body mass index, kg/m ² , %			0.8988			0.0827
< 18.5	9.7	12.6		11.7	14.7	
18.5 = < and < 25.0	72.6	68.9		67	61.9	
25.0 = <	17.7	19.5		21.3	23.4	
Smoking status, %			< 0.0001			< 0.0001
Current	53.3	71.0		4.7	22.1	
Past	25.3	16.7		1.4	4.6	
Never	21.4	12.3		94.9	73.3	
Alcohol status, %			< 0.0001			< 0.0001
Current	76.2	69.5		23.1	32.0	
Past	5.5	7.3		4.3	4.3	
Never	18.3	24.2		72.5	63.7	
Education level, %			0.136			0.6265
College and more	14.4	15.9		8.4	9.4	
Physical activity, %			0.005			0.0003
3 h = < /week	14.6	10.6		10.0	6.8	
Walking duration, %			< 0.0001			< 0.0001
60 min = < /day	50.5	41.4		51.8	44.1	
Sleep duration, %			0.1906			0.003
< 5 h	4.0	4.6		5.5	8.2	
5 h = < and < 9 h	85.2	87.6		88.2	86.9	
> 9 h	10.8	7.8		6.3	4.9	
Marital status, %			< 0.0001			< 0.0001
Married	94.2	86.4		96.7	97.9	
Work schedule, %			< 0.0001			< 0.0001
Day shift	84.7	76.9		90.7	78.6	
Night shift	5.1	5.0		2.5	9.4	
Shift work (day and night shift)	10.2	18.1		6.8	12.0	
Total energy intake, kcal/day	1,756.4 ± 491.1	1,476.4 ± 422.3	< 0.0001	1,444.2 ± 363.0	1,193.1 ± 327.8	< 0.0001
Dinner time, %			< 0.0001			< 0.0001
Irregular	3.1	11.0		1.8	5.8	
Frequency of snack, %			0.0032			< 0.0001
Everyday	12.0	13.5		17.3	18.9	

Values were reported as number, mean (standard deviation) or percentage.

All proportions of potential confounding factors were age adjusted.

*Breakfast eating was defined as those having breakfast style of “Japanese style” or “Western style” or “Chagayu style (tea rice gruel)” or “others.”

†Breakfast skipping was defined as those having breakfast style of “no or nearly no breakfast eaten.”

‡Analyzed using multiple logistic regression except for means of age (*t*-test).

Table 2. The number of death, HRs and 95% CIs for mortalities from cancer, circulatory diseases and all causes by breakfast status, 1988–2009, JACC Study

Cause of death	Men			Women		
	Eating breakfast‡	Skipping breakfast§	<i>P</i> value	Eating breakfast‡	Skipping breakfast§	<i>P</i> value
Cancer mortality						
<i>n</i> of deaths	3,394	86		2,246	42	
HR ₁ * (95% CI)	1.0	1.35 (1.08–1.67)	0.0072	1.0	1.26 (0.93–1.72)	0.1363
HR ₂ † (95% CI)	1.0	1.27 (0.98–1.65)	0.0741	1.0	1.30 (0.87–1.94)	0.1890
Circulatory diseases mortality						
<i>n</i> of deaths	2,517	52		2,532	32	
HR ₁ * (95% CI)	1.0	1.48 (1.13–1.96)	0.0052	1.0	1.21 (0.85–1.71)	0.2901
HR ₂ † (95% CI)	1.0	1.42 (1.02–2.02)	0.0485	1.0	1.19 (0.71–1.05)	0.1828
All causes mortality						
<i>n</i> of deaths	9,180	219		7,596	117	
HR ₁ * (95% CI)	1.0	1.51 (1.32–1.73)	< 0.0001	1.0	1.32 (1.32–1.59)	0.0026
HR ₂ † (95% CI)	1.0	1.43 (1.21–1.69)	< 0.0001	1.0	1.34 (1.04–1.73)	0.0234

*HR₁: Adjusted for age.

†HR₂: HR₁ + history of hypertension, history of diabetes mellitus, body mass index, smoking status, alcohol status, education level, physical activity, walking duration, sleep duration, marital status and work schedule.

‡Breakfast eating was defined as those having breakfast style of “Japanese style” or “Western style” or “Chagayu style (tea rice gruel)” or “others.”

§Breakfast skipping was defined as those having breakfast style of “no or nearly no breakfast eaten.”

CI, confidence interval; HR, hazard ratio; JACC Study, the Japan Collaborative Cohort Study.

who did not. In men, breakfast status were associated with following confounding factor: smoking status, alcohol status, physical activity, walking duration, marital status, work schedule, total energy intake, dinner time, frequency of snack. In women, breakfast status were associated with following confounding factor: smoking status, alcohol status, physical activity, walking duration, sleep duration, marital status, work schedule, total energy intake, dinner time, frequency of snack. There was no difference in the proportion of BMI.

There were a total 9,399 deaths among men and 7,713 among women during the median 19.4 years follow-up: cancer deaths comprised 3,480 among men and 2,288 among women and circulatory diseases accounted for 2,569 deaths among men and 2,564 among women. The number of death, HRs and 95% CIs for mortalities from cancer, circulatory diseases and all causes by breakfast status are shown in Table 2. Age-adjusted HRs of the participant group that reported skipping breakfast were significantly higher than those who ate breakfast; for cancer among men (HR = 1.35, 95% CI 1.08–1.67, *P* = 0.0072) and circulatory diseases among men (HR = 1.48, 95% CI, 1.13–1.96, *P* = 0.0052) and all causes mortality among men (HR = 1.51, 95% CI 1.32–1.73, *P* < 0.0001) and women (HR = 1.32, 95% CI 1.32–1.59, *P* < 0.0026). Multivariate HRs of the group that skipped breakfast were significantly higher than those who ate breakfast,

for mortality from circulatory diseases among men (HR = 1.42, 95% CI, 1.02–2.02, *P* = 0.0485) and all causes among men (HR = 1.43, 95% CI 1.21–1.69, *P* < 0.0001) and women (HR = 1.34, 95% CI 1.04–1.73, *P* = 0.0234). In addition, skipping breakfast tended to be associated with cancer mortality among men (HR = 1.27, 95% CI, 0.98–1.65, *P* = 0.0741).

DISCUSSION

In the present study, participants who skipped breakfast had unhealthy lifestyle such as current smoker, physical activity less than 3 h per a week, walking duration less than 60 min per a day, low levels of total energy intake, eating dinner at irregular time and snacking every day. These findings support the notion that breakfast-eating habits are a dietary pattern marker^{3, 4} that is a useful predictor of a healthy lifestyle.^{18–20} Skipping breakfast was also related to sleep duration, marital status has a spouse and shift work. The multivariate models were adjusted for these confounding factors and known risk factors of lifestyle-related diseases. Our study represents the first investigation of an association between skipping breakfast and multivariate-adjusted mortality owing to lifestyle-related diseases including cancer and circulatory diseases. Skipping breakfast was associated with increasing risk of mortality from circulatory diseases and all causes in men and all causes mortality in wom-

en. Factors such as time of eating dinner and frequency of snacking had a large number of missing values. We added each of them to the models. The results were not affected.

Concerning the timing of meals, deviation of breakfast time leads to a disturbance of the phase peak of the clock gene, resulting in an inability to entrain to the day/night cycle and finally, disturbance of the circadian rhythm in experiments of mice.^{23, 24} Disturbance of the circadian rhythm may cause a reduction in exercise capacity, glucose tolerance disorder and metabolic disorder, which is associated with obesity and various lifestyle diseases.^{25–27} Furthermore these mechanisms may lead to increasing risk of mortality from circulatory diseases and all causes.

Recently, a large prospective study of middle-aged or older man health professionals in the United States found that skipping breakfast increased the risk of coronary heart disease.¹¹ That study suggested that the timing of meals might be directly responsible for metabolic effects, or alternatively, that breakfast consumption is a marker for an appropriate dietary pattern in terms of dietary fiber, macronutrients and micronutrients, particularly if breakfast cereals are included in the meal, or late night snack high in energy. Skipping breakfast has been reported to impair postprandial insulin sensitivity and fast lipids and could lead to weight gain in a multiple randomized crossover trial.⁷ In addition, some studies have indicated that a regular diet suppresses diet-induced obesity.^{21, 22} These studies support our results with regard to skipping breakfast and mortality from circulatory diseases.

The influence of the circadian rhythm on dietary habit, such as combination of nutrients and foods, nutrient balance, daily meal rhythm (time of eating, number of times, distribution rate, starvation interval and snack), marital status, shift work, sleep duration and its relationship with mortality risk requires further analysis.

Our study showed that skipping breakfast tended to be related to cancer mortality. Some kinds of cancers are known to be associated with lifestyle, including dietary habits. According to the World Health Organization's (WHO) International Agency for Research on Cancer (IARC), human epidemiologic evidence suggests that circadian disruption brought on by shift work is most likely carcinogenic to humans (IARC classification, Group 2A).²⁸ Therefore, the timing of meals related to circadian rhythm may be associated with some kinds of cancers. Further study is needed of the associations between skipping breakfast and different cancers.

The present study has some limitations. The baseline survey was conducted in 1988 to 1990 and eating

habits were queried only once. Lifestyles have changed in Japan since the time of the survey. According to recent data in Japan, trends in the percentage of subjects who skipped breakfast increased from 7.9% in 1990 to 11.4% in 2013.²⁹ The participants enrolled in the present study were aged 40–79 years and the rate of skipping breakfast was 2.0%. Therefore, our findings may vary among young people. Moreover, our study did not include other dietary confounding factors, such as nutrient intake, because the number of participants who skipped breakfast was too small to calculate these.

In conclusion, this study showed that skipping breakfast is associated with a risk of mortality from circulatory diseases and all causes among men and all causes mortality among women. In addition, skipping breakfast was found to be related to unhealthy lifestyle habits such as current smoker, physical activity less than 3 h per a week, walking duration less than 60 min per a day, low levels of total energy intake, eating dinner at irregular time and snacking every day. The findings of the present study may provide evidence to support the recommendation to eat breakfast daily, so as to prevent lifestyle-related diseases and improve overall health.

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