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

Yae Yokoyama,*† Kazunari Onishi,* Takenobu Hosoda,‡ Hiroki Amano,* Shinji Otani,§ Youichi Kurozawa* and Akiko Tamakoshi||

**Division of Health Administration and Promotion, Department of Social Medicine, School of Medicine, Tottori University Faculty of Medicine, Yonago 683-8503, Japan, †Tottori College, Kurayoshi 682-8555, Japan, ‡Tottori College of Nursing, Kurayoshi 682-8555, Japan, §International Platform for Dryland Research and Education, Tottori University, Tottori 680-0001, Japan and ||Department of Public Health, Hokkaido University Graduate School of Medicine, Sapporo 060-8638, Japan*

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

Corresponding author: Yae Yokoyama
yaeyae@ns.cygnus.ac.jp
Received 2015 December 9
Accepted 2016 January 4

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 (m^2). 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. HR_1 of the multivariate model was adjusted for age. HR_2 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†	*P* value‡	Eating breakfast*	Skipping breakfast†	*P* 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, *n*	8,875	620		11,893	536	
50–59, *n*	10,318	292		15,267	359	
60–69, *n*	9,908	137		14,831	150	
70–79, *n*	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
Irregurar	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§	*P* value	Eating breakfast‡	Skipping breakfast§	*P* value
Cancer mortality						
n 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						
n 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						
n 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

*HR_1: Adjusted for age.
†HR_2: HR_1 + history of hypertention, 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.

Acknowledgments: We wish to express our sincere thanks to the present members of the JACC Study Group: Dr. Akiko Tamakoshi (present chairperson of the study group), Hokkaido University Graduate School of Medicine; Drs. Mitsuru Mori and Fumio Sakauchi, Sapporo Medical University School of Medicine; Dr. Yutaka Motohashi, Akita University School of Medicine; Dr. Ichiro Tsuji, Tohoku University Graduate School of Medicine; Dr. Yoshikazu Nakamura, Jichi Medical School; Dr. Hiroyasu Iso, Osaka University School of Medicine; Dr. Haruo Mikami, Chiba Cancer Center; Dr. Michiko Kurosawa, Juntendo University School of Medicine; Dr. Yoshiharu Hoshiyama, Yokohama Soei University; Dr. Naohito Tanabe, University of Niigata Prefecture; Dr. Koji Tamakoshi, Nagoya University Graduate School of Health Science; Dr. Kenji Wakai, Nagoya University Graduate School of Medicine; Dr. Shinkan Tokudome, National Institute of Health and Nutrition; Dr. Koji Suzuki, Fujita Health University School of Health Sciences; Dr. Shuji Hashimoto, Fujita Health University School of Medicine; Dr. Shogo Kikuchi, Aichi Medical University School of Medicine; Dr. Yasuhiko Wada, Faculty of Nutrition, University of Kochi; Dr. Takashi Kawamura, Kyoto University Center for Student Health; Dr. Yoshiyuki Watanabe, Kyoto Prefectural University of Medicine Graduate School of Medical Science; Dr. Kotaro Ozasa, Radiation Effects Research Foundation; Dr. Tsuneharu Miki, Kyoto Prefectural University of Medicine Graduate School of Medical Science; Dr. Chigusa Date, School of Human Science and Environment, University of Hyogo; Dr. Kiyomi Sakata, Iwate Medical University; Dr. Youichi Kurozawa, Tottori University Faculty of Medicine; Drs. Takesumi Yoshimura and Yoshihisa Fujino, University of Occupational and Environmental Health; Dr. Akira Shibata, Kurume University; Dr. Naoyuki Okamoto, Kanagawa Cancer Center; and Dr. Hideo Shio, Moriyama Municipal Hospital. We thank all staff members involved in this study for their valuable help in conducting the baseline survey and follow-up. This work was supported by Grants-in-Aid for Scientific Research from the Ministry of Education, Science, Sports, and Culture of Japan (Monbusho), Grants-in-Aid for Scientific Research on Priority Areas of Cancer, and Grants-in-Aid for Scientific Research on Priority Areas of Cancer Epidemiology from the Japanese Ministry of Education, Culture, Sports, Science, and Technology (Monbu-Kagaku-

sho) (Nos. 61010076, 62010074, 63010074, 1010068, 2151065, 3151064, 4151063, 5151069, 6279102, 11181101, 17015022, 18014011, 20014026, and 20390156).

The authors declare no conflict of interest.

REFERENCES

1 Giovannini M, Agostoni C, Shamir R: Symposium overview: Do we all eat breakfast and is it important? Crit Rev Food Sci Nutr. 2010;50:97-9. PMID: 20112150.

2 Jackson LW: The most important meal of the day: why children skip breakfast and what can be done about it. Pediatr Ann. 2013;42:184-7. PMID: 23992210.

3 Reeves S, Halsey LG, McMeel Y, Huber JW: Breakfast habits, beliefs and measures of health and wellbeing in a nationally representative UK sample. Appetite. 2013;60:51-7. PMID: 23032303.

4 Ruxton CH, Kirk TR: Breakfast: a review of associations with measures of dietary intake, physiology and biochemistry. Br J Nutr. 1997;78:199-213. PMID: 9301411.

5 Song WO, Chun OK, Obayashi S, Cho S, Chung CE. Is consumption of breakfast associated with body mass index in US adults? J Am Diet Assoc. 2005;105:1373-82. PMID: 16129078.

6 van der Heijden AA, Hu FB, Rimm EB, van Dam RM. A prospective study of breakfast consumption and weight gain among U.S. men. Obesity(Silver Spring). 2007;15:2463-69. PMID: 17925472.

7 Farshchi HR, Taylor MA, Macdonald IA. Deleterious effects of omitting breakfast on insulin sensitivity and fasting lipid profiles in healthy lean women. Am J Clin Nutr. 2005;81:388-96. PMID: 15699226.

8 Jenkins DJ, Wolever TM, Vuksan V, Brighenti F, Cunnane SC, Rao AV,Jenkins AL, Buckley G, Patten R, Singer W, Corey P, Josse RG. Nibbling versus gorging: metabolic advantages of increased meal frequency. N Engl J Med. 1989;321:929-34. PMID: 2674713.

9 Stote KS, Baer DJ, Spears K, Paul DR, Harris GK, Rumpler WV, Strycula P, Najjar SS, Ferrucci L, Ingram DK, Longo DL, Mattson MP. A controlled trial of reduced meal frequency without caloric restriction in healthy, normal-weight, middle-aged adults. Am J Clin Nutr. 2007;85:981-8. PMID: 17413096; PMCID: PMC2645638.

10 Mekary RA, Giovannucci E, Willett WC, van Dam RM, Hu FB. Eating patterns and type 2 diabetes risk in men: breakfast omission, eating frequency, and snacking. Am J Clin Nutr. 2012;95:1182-9. PMID: 22456660; PMCID: PMC3325839.

11 Cahill LE, Chiuve SE, Mekary RA, Jensen MK, Flint AJ, Hu FB, et al. Prospective Study of Breakfast Eating and Incident Coronary Heart Disease in a Cohort of Male US Health Profession. Circulation. 2013;128:337-43. PMID: 23877060; PMCID: PMC3797523.

12 Breslow L, Enstrom JE. Persistence of health habits and their relationship to mortality. Prev Med. 1980;9:469-83. PMID: 7403016.

13 Kaplan GA, Seeman TE, Cohen RD, Knudsen LP, Guralnik J. Mortality among the elderly in the Alameda County Study: behavioral and demographic risk factors. Am J Public Health. 1987;77:307-12. PMID: 3812836; PMCID: PMC1646902.

14 Tamakoshi A, Ozasa K, Fujino Y, Suzuki K, Sakata K, Mori M, et al. Cohort profile of the Japan Collaborative Cohort Study at final follow-up. J Epidemiol. 2013;23:227-32. PMID: 23583921; PMCID: PMC3700254.

15 Ohno Y, Tamakoshi A; JACC Study Group. Japan collaborative cohort study for evaluation of cancer risk sponsored by Monbusho (JACC Study). J Epidemiol. 2001;11:144-50. PMID: 11512570.

16 Date C, Fukui M, Yamamoto A, Wakai K, Ozeki A, Motohashi Y, et al. Reproducibility and validity of a self-administered food frequency questionnaire used in the JACC study. J Epidemiol. 2005;15 Suppl 1:S9-23. PMID: 15881192.

17 H.Iso, C,Date, H,Noda, et al. Frequency of Food Intake and Estimated Nutrient Intake among Men and Women: The JACC Study. J Epidemiol. 2005;15 Suppl 1:S24-42. PMID: 15881193.

18 Chomistek AK, Chiuve SE, Jensen MK, Cook NR, Rimm EB. Vigorous physical activity, mediating biomarkers, and risk of myocardial infarction. Med Sci Sports Exerc. 2011; 43:1884-90. PMID: 21448079; PMCID: PMC3249756.

19 Cappuccio FP, Cooper D, D'Elia L, Strazzullo P, Miller MA. Sleep duration predicts cardiovascular outcomes: A systematic review and meta-analysis of prospective studies. Eur Heart J. 2011; 32:1484-92. PMID: 21300732.

20 Chen J, Cheng J, Liu Y, Tang Y, Sun X, Wang T, et al. Associations between breakfast eating habits and health-promoting lifestyle, suboptimal health status in Southern China: a population based,cross sectional study. Journal of Translational Medicine. 2014;12:348. PMID: 25496597; PMCID: PMC4269950.

21 Hatori, C. Vollmers, A. Zarrinpar, L. Di Tacchio, E. A. Bushong, S. Gill, M. Leblanc, A. Chaix, M. Joens, J. A.Fitzpatrick et al. Time-restricted feeding without reducing caloric intake prevents metabolic diseases in mice fed a high-fat diet. Cell Metab. 2012;15:848. PMID: 22608008; PMCID: PMC3491655.

22 Jakubowicz D, Barnea M, Wainstein J, Froy O. High caloric intake at breakfast vs. dinner differentially influences weight loss of overweight and obese women. Obesity. 2013;12:2504-12. PMID: 23512957.

23 Shibata S, Tahara Y, Hirao A. The adjustment and manipulation of biological rhythms by light, nutrition, and abused drugs. Adv Drug Deliv Rev. 2010;62:918-27. PMID: 20600408.

24 Hirao A, Tahara Y, Kimura I, Shibata S. A balanced diet is necessary for proper entrainment signals of the mouse liver clock. PLoS One. 2009;7;4:e6909. PMID: 19738906; PMCID: PMC2734168.

25 Sookoian S, Gemma C, Gianotti TF et al. Genetic variants of Clock transcription factor are associated with individual susceptibility to obesity. Am J Clin Nutr. 2008;87:1606-15. PMID: 18541547.

26 Prasai MJ, George JT, Scott EM. Molecular clocks, type 2 diabetes and cardiovascular disease. Diabetes and Vascular Disease Research. 2008;5:89-95. PMID: 18537095.

27 Ptácek LJ, Jones CR, Fu YH. Novel insights from genetic and molecular characterization of the human clock. Cold Spring Harb Symp Quant Biol. 2007; 72:273-7. PMID: 18419283.

28 K. Straif, R. Baan, Y. Grosse et al. Carcinogenicity of shift-work, painting, and fire-fighting. The Lancet Oncology. 2007:8:1065-1066. PMID: 26347774.

29 Office of Nutrition Cancer Measures and Health Promotion Division Health Service Bureau Ministry of Health, Labour and Welfare, Japan [Internet]. The National Health and Nutrition Survey in Japan. 2013:204 [cited 2015 Mar]. Available from: http://www.mhlw.go.jp/bunya/kenkou/eiyou/h25-houkoku.html.