Breakfast Type and Cardiovascular Mortality: The Japan Collaborative Cohort Study

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Aim: Little is known regarding the association between breakfast type and cardiovascular mortality. We examined the associations between breakfast type and risks of mortality from stroke, coronary heart disease (CHD), and total cardiovascular disease (CVD).

Methods: A total of 85,319 males and females aged 40 to 79 years who were free from CVD and cancers at baseline were involved in this study. The participants were divided into five groups according to their self-reported breakfast types: Japanese breakfast, Western breakfast, mixed Japanese–Western breakfast, other breakfast, and skipping breakfast groups. All hazard ratios (HRs) were estimated using Cox proportional hazards regression models after adjusting for the potential confounding factors.

Results: During the median 19-year follow-up, we identified CVD deaths of 5,870 subjects. Compared to the Japanese breakfast, the multivariable HRs (95% CIs) of total CVD were 0.64 (0.52–0.79) for mixed Japanese–Western breakfast, 0.90 (0.77–1.04) for Western breakfast, 1.24 (0.95–1.61) for other breakfast, and 1.31 (1.00–1.71) for skipping breakfast. The corresponding HRs (95% CIs) of total stroke were 0.67 (0.49–0.91), 0.83 (0.66–1.05), 1.15 (0.76–1.74), and 1.25 (0.82–1.92), and those of CHD were 0.73 (0.48–1.12), 1.08 (0.81–1.44), 1.09 (0.60–1.98), and 1.77 (1.11–2.83).

Conclusion: Compared to Japanese breakfast, mixed Japanese–Western breakfast may have a protective role in cardiovascular mortality whereas skipping breakfast may harm cardiovascular health.

Key words: Cohort study, Breakfast type, Japanese food, Cardiovascular disease, Stroke

Abbreviations used: BMI, body mass index; CI, confidence interval; CHD, coronary heart disease; CVD, cardiovascular disease; FFQ, food frequency questionnaire; HEI 2015, Healthy Eating Index 2015; HR, hazard ratio; the JACC study, The Japan Collaborative Cohort Study; NRF 9.3, Nutrient-Rich Food Index 9.3.

1. Introduction

Cardiovascular disease (CVD) is a leading cause of premature death worldwide and is a major challenge to sustainable human development3). Compared to people in Western countries, Japanese people have a higher stroke mortality rate but a lower coronary heart disease mortality rate2). Within Japan, stroke and coronary heart disease (CHD) remained the top causes of death from 1990 to 2015, despite the substantial decline in age-standardized mortality3).

Both the frequency and composition of breakfasts are implicated in cardiometabolic risk factors4). Breakfasts contribute 20%–25% of daily energy intake5), and different breakfast patterns accounted for 30.5% of the variance in total food
group consumption among Japanese breakfast consumers). The most commonly consumed combinations, including “rice, total vegetables, and tea and coffee,” were positively associated with diet quality for breakfast (Spearman $r \geq 0.46$) in Japanese, where diet quality was defined using Healthy Eating Index 2015 (HEI 2015) and Nutrient-Rich Food Index 9.3 (NRF 9.3) 

Previous Japanese population-based studies showed that skipping breakfast was associated with increased risks of incidents of stroke and CVD, and mortality from CVD in males. Similar results were observed on risks of incident CHD and mortality from CVD in other populations, and a recent meta-analysis of seven cohort studies reported that skipping breakfast was associated with an increased risk of CVD mortality. However, evidence regarding the impact of the breakfast type on CVD risk is very limited. A Japan nationwide study identified four breakfast patterns: rice/vegetable/fish/pulse/seasoning and coffee, “were positively associated with diet quality for breakfast (Spearman $r \geq 0.46$) in Japanese, where diet quality was defined using Healthy Eating Index 2015 (HEI 2015) and Nutrient-Rich Food Index 9.3 (NRF 9.3) 

The Japanese diet is characterized by high intakes of rice, fish, soybean products, plant food, seaweed, and sodium but low intakes of whole grains, nuts/seeds, and saturated fatty acid, which was inversely associated with the risk of total CVD mortality. Conversely, the Western dietary pattern, with a high intake of red and processed meat and high-fat dairy foods, was associated with increased risks of obesity, type 2 diabetes, asthma, and CVD. However, whether the associations could be observed for the Japanese and Western breakfast types among Japanese has not yet been investigated. Therefore, we aimed to investigate the association between different breakfast types and the risk of CVD mortality in the Japanese population.

2. Subjects and Methods

2.1. Study Population

The Japan Collaborative Cohort Study (JACC), which started in 1988–1990, involved 110,585 subjects (46,395 males and 64,190 females) aged 40–79 years from 45 communities throughout Japan. After the participants or community leaders provided informed consent, the participants completed self-administered questionnaires regarding their medical histories and lifestyles. The details of the JACC study purpose, methods, and data confidentiality have been explained previously. Of the subjects, 104,735 (46,395 males and 60,914 females) had no prior history of stroke, CHD, or cancer at baseline according to the questionnaire. Among these subjects, those who lived in regions where the question regarding breakfast was not presented ($n=16,794$) and those who did not respond to the question ($n=2,622$) were excluded. Accordingly, 85,319 participants (35,511 males and 49,808 females) were included in this study (Supplementary Fig. 1).

2.2. Ethical Approval

The JACC study was approved by the ethics committees of the Graduate Schools of Medicine in Hokkaido University (approval number 14-044) and Osaka University (approval number 14285).

2.3. Dietary Assessment

We used a food frequency questionnaire (FFQ) containing information on food and drink intake without specifying the portion size for the past year. There were five possible responses for 33 items: “rarely, 1–2 times/month, 1–2 times/week, 3–4 times/week, and almost every day.” There were four frequency categories for current alcohol consumers: “<once/week, 1–2 times/week, 3–4 times/week, and ≥ 5 times/week.” There were five frequency categories for tea, green tea, oolong tea, and coffee: “rarely or never, 1–2 cups/month, 1–2 cups/week, 3–4 cups/week, and almost daily (number/day).” For rice, the frequency category was “number of cups/day,” and for miso soup, the frequency categories were the following: “daily (number/day), every other day, several times a month, and never.” Total energy and nutrient intake were estimated according to the fifth revised edition of the Japan Food Table. The type of breakfast was determined according to the following question in the questionnaire: “What kind of breakfast do you eat most? You can choose up to two answers from below: Japanese food, Western food or bread, tea porridge (also called chagayu, a traditional tea rice porridge in western Japan), other breakfast, and almost eat no breakfast (skipping breakfast).”

2.4. Other Covariates

The participants answered questionnaires, and the following covariates were determined accordingly: history of hypertension and diabetes (yes or no), educational status (<13, 13–15, 16–18, and ≥ 19 years), perceived mental stress (low, moderate, and high), marital status (married, single, widowed, and divorced), and lifestyles such as alcohol intake and smoking status. Healthy lifestyle behavior scores, which were associated with the reduced risk of mortality from CVD in the same population, were calculated using eight lifestyle behaviors. We allocated 1 point for each of the following: noncurrent smoking,
alcohol intake <46.0 g/day, having exercise ≥ 5 hours/week and/or walking ≥ 1 hour/day, 21 kg/m² ≤ body mass index (BMI) <25 kg/m², sleeping 5.5–7.4 hours/day, consuming fruits every day, consuming fish every day, and consuming milk every day.

2.5. Mortality Surveillance

To confirm mortality surveillance, investigators systematically reviewed relevant death certificates. All mortality data were sent to the Ministry of Health and Welfare, and the causes of death were coded according to the International Classification of Diseases, 10th Revision. Registration of death is required by Japanese law and is followed nationwide. Therefore, all deaths that occurred in the cohort were ascertained by death certificates, except for those who died after moving out from their original communities and were treated as censored cases. Cause-specific mortality was coded individually for stroke (I60–I62, I63–I64, I690–I691, and I693–I694), hemorrhagic stroke (I60–I62 and I690–I692), cerebral infarction (I63 and I693), CHD (I20–I25), and total CVD (I01–I99).

2.6. Statistical Analysis

Statistical analyses were based on the mortality of stroke, hemorrhagic stroke, cerebral infarction, CHD, and total CVD during the follow-up period from 1988–1990 to the end of 2009 (4, 4, and 2 areas out of the 45 areas had terminated the follow-up in 1999, 2003, and 2008, respectively). Person-years of follow-up were calculated as the period from baseline (1988–1990) to whichever happened first of the following events: time of death, moving out from the original area, and the end of the follow-up.

The participants were divided into five groups with no overlap according to their responses to the question regarding breakfast: 1) Japanese breakfast (Japanese breakfast consumers), including those who chose Japanese food only for breakfast, those who chose Japanese food and tea porridge, and those who chose tea porridge only; 2) mixed Japanese–Western breakfast (those who eat both Japanese and Western breakfasts), including those who chose Japanese food and Western breakfast and those who chose tea porridge and Western breakfast; 3) Western breakfast (Western breakfast consumers), including those who chose Western breakfast only; 4) other breakfast, including those who chose “eat other breakfast;” and 5) skipping breakfast, including participants who chose “almost eat no breakfast.”

The age-adjusted p-values for the difference in mean values and proportions of characteristics, as well as known risk factors for CVD, were estimated according to breakfast type using the regression method (linear regression for continuous variables and logistic regression for categorical variables). Using the Japanese breakfast group as the reference, age and sex-adjusted hazard ratios (HRs) and 95% confidence intervals (CIs) for death from all endpoints were calculated using Cox’s proportional analysis in the first model. We adjusted further for histories of hypertension and diabetes (yes or no), healthy lifestyle behavior score [consisting of noncurrent smoking, alcohol intake <46.0 g/day, having exercise ≥ 5 hours/week and/or walking ≥ 1 hour/day, 21 kg/m² ≤ BMI <25 kg/m², sleeping 5.5–7.4 hours/day, consuming fruits every day, consuming fish every day, and consuming milk every day], educational status (<13, 13–15, 16–18, and ≥ 19 years), perceived mental stress (low, moderate, and high), marital status (married, single, widowed, and divorced), and total energy intake (sex-specific quintiles) in the multivariable model. The missing data for all confounding factors mentioned above were included as categorical variables in the model. All P-values reported were two-sided, and statistical significance was set at P<0.05. All analyses were performed using SAS software (version 9.4).

3. Results

The baseline characteristics of the participants according to breakfast type are shown in Table 1. The majority (79%) of the participants (67,388 out of 85,319) consumed Japanese breakfast.

Compared to Japanese breakfast consumers, mixed Japanese–Western and Western breakfast consumers had lower proportions of males and married participants, lower means of total energy and sodium intakes, higher proportions of histories of hypertension and diabetes, higher education, higher perceived mental stress, and higher healthy lifestyle behavior scores in spite of lower fish consumption and lower physical activity. Other breakfast consumers had older age, a lower proportion of married participants, and lower means of total energy and sodium intakes compared to Japanese breakfast consumers. Breakfast skippers had younger age, higher proportions of males, higher education, and high-perceived mental stress and lower proportion of married participants, and lower means of total energy and sodium intakes.

During a median follow-up of 19.3 years of 35,511 males and 49,808 females, we identified 2,550 stroke deaths (1,293 males and 1,257 females), 1039 hemorrhagic stroke deaths (479 males and 560 females), 1,424 cerebral infarction deaths (769 males and 655 females), and 1,220 CHD deaths (697 males and 523 females), with a total of 5,870 CVD deaths.
(3,009 males and 2,861 females).

The associations between breakfast type and mortality from total CVD, stroke, and CHD are presented in Table 2. Compared to Japanese breakfast, mixed Japanese–Western breakfast but not Western and other breakfast was associated with a decreased risk of CVD mortality, whereas skipping breakfast was associated with an increased risk of CVD mortality. The multivariable HRs (95% CIs) of total CVD mortality were 0.64 (0.52–0.79) for mixed Japanese–Western breakfast, 0.90 (0.77–1.04) for Western breakfast, 1.24 (0.95–1.61) for other breakfast, and 1.34 (1.03–1.76) for skipping breakfast (data not shown).

Similar results were observed after excluding those who died within the first five years (Supplementary Table 1). In addition, the associations of Western breakfast and other breakfast with the risk of CVD mortality became statistically significant; the HRs (95% CIs) were 0.84 (0.72–1.00) (p=0.04) and 1.35 (1.03–1.78), respectively.

### 4. Discussion

To the best of our knowledge, this is the first to investigate associations between breakfast type and risk of cardiovascular mortality. After adjusting for CVD risk factors, mixed Japanese–Western breakfast was associated with a decreased risk of CVD mortality compared to Japanese breakfast. Similar associations were observed with risks of mortality from total stroke and cerebral infarction. Skipping breakfast was associated with increased risks of CHD and CVD mortality.
Breakfast composition has been shown associated with cardiometabolic risk factors in previous studies^{10}. A cross-sectional study of 18,177 Italian males and females aged 35 years or above showed inverse associations of the score made up of the typical foods of Italian breakfast with the risk of metabolic syndrome and the estimated individual CVD risk (a dichotomous variable created by applying the risk equations of the CUORE project, Italy, which involved age, sex, systolic blood pressure, serum cholesterol, smoking habit, and diabetes history)\(^{20}\). A 25-year cohort study of 3,248 Japanese aged 40–59 years who were free from stroke and CHD found that intakes of energy, saturated fat, and monounsaturated fat from breakfast were inversely associated with the risk of intracerebral hemorrhage in males but not in females\(^{27}\). Furthermore, in a cross-sectional European study of 806 males and females aged 47–81 years, preferring vegetables or fruits, or avoiding red and processed meat at breakfast was associated with lower levels of cardiometabolic biomarkers such as HbAlc and C-reactive protein\(^{28}\). However, to our knowledge, no previous study has examined the associations between breakfast types/patterns and CVD mortality.

Western-related dietary patterns, such as dairy product pattern, westernized dietary pattern, and animal food pattern, have been investigated in some previous Japanese cohort studies. However, the results were not consistent. An association with decreased CVD mortality was observed for the dairy product pattern but not for the animal food pattern in the JACC study of 64,037 males and females aged 40–79 years during a 12.6-year median follow-up\(^{29}\). Westernized dietary pattern was inversely associated with stroke, CHD, and CVD mortality, whereas Japanese dietary pattern was not associated with all of these risks in another Japanese cohort study of 36,737 males and 44,983 females aged 45–74 years during a 14.8-year mean follow-up\(^{30}\). However, in a 7-year cohort study of 40,547 Japanese males and females aged 40–79 years, Japanese dietary and animal food dietary patterns were associated with lower and higher risks of CVD mortality, respectively\(^{19}\).

### Table 2. Hazard ratios (HRs) and 95% confidence intervals (CIs) of cardiovascular mortality outcomes according to breakfast type

<table>
<thead>
<tr>
<th>Breakfast type</th>
<th>Japanese</th>
<th>Mixed Japanese-Western</th>
<th>Western</th>
<th>Other</th>
<th>Skipping</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of subjects</td>
<td>67388</td>
<td>5019</td>
<td>9331</td>
<td>1349</td>
<td>2232</td>
</tr>
<tr>
<td>Person-years</td>
<td>1128772</td>
<td>76730</td>
<td>129921</td>
<td>20544</td>
<td>36711</td>
</tr>
<tr>
<td>Total stroke, (n)</td>
<td>2206</td>
<td>87</td>
<td>162</td>
<td>54</td>
<td>41</td>
</tr>
<tr>
<td>Age and sex-adjusted HR (95% CI)</td>
<td>1 0.64 (0.51-0.79)</td>
<td>0.72 (0.62-0.85)</td>
<td>1.17 (0.89-1.53)</td>
<td>1.25 (0.92-1.70)</td>
<td></td>
</tr>
<tr>
<td>Multivariable HR (95% CI)*</td>
<td>1 0.67 (0.49-0.91)</td>
<td>0.83 (0.66-1.05)</td>
<td>1.15 (0.76-1.74)</td>
<td>1.25 (0.82-1.92)</td>
<td></td>
</tr>
<tr>
<td>Cerebral infarction, (n)</td>
<td>1258</td>
<td>41</td>
<td>76</td>
<td>32</td>
<td>17</td>
</tr>
<tr>
<td>Age and sex-adjusted HR (95% CI)</td>
<td>1 0.53 (0.39-0.72)</td>
<td>0.61 (0.49-0.77)</td>
<td>1.18 (0.83-1.68)</td>
<td>1.06 (0.66-1.72)</td>
<td></td>
</tr>
<tr>
<td>Multivariable HR (95% CI)*</td>
<td>1 0.57 (0.36-0.90)</td>
<td>0.82 (0.60-1.12)</td>
<td>1.06 (0.60-1.88)</td>
<td>1.18 (0.61-2.28)</td>
<td></td>
</tr>
<tr>
<td>Hemorrhagic stroke, (n)</td>
<td>871</td>
<td>46</td>
<td>79</td>
<td>22</td>
<td>21</td>
</tr>
<tr>
<td>Age and sex-adjusted HR (95% CI)</td>
<td>1 0.84 (0.63-1.14)</td>
<td>0.86 (0.69-1.09)</td>
<td>1.25 (0.82-1.91)</td>
<td>1.28 (0.83-1.98)</td>
<td></td>
</tr>
<tr>
<td>Multivariable HR (95% CI)*</td>
<td>1 0.84 (0.55-1.30)</td>
<td>0.83 (0.58-1.18)</td>
<td>1.41 (0.77-2.56)</td>
<td>1.25 (0.70-2.24)</td>
<td></td>
</tr>
<tr>
<td>Coronary heart disease, (n)</td>
<td>1025</td>
<td>50</td>
<td>94</td>
<td>25</td>
<td>26</td>
</tr>
<tr>
<td>Age and sex-adjusted HR (95% CI)</td>
<td>1 0.82 (0.62-1.10)</td>
<td>0.95 (0.77-1.17)</td>
<td>1.18 (0.79-1.75)</td>
<td>1.63 (1.11-2.42)</td>
<td></td>
</tr>
<tr>
<td>Multivariable HR (95% CI)*</td>
<td>1 0.73 (0.48-1.12)</td>
<td>1.08 (0.81-1.44)</td>
<td>1.09 (0.60-1.98)</td>
<td>1.77 (1.11-2.83)</td>
<td></td>
</tr>
<tr>
<td>Total cardiovascular disease, (n)</td>
<td>5044</td>
<td>213</td>
<td>384</td>
<td>127</td>
<td>102</td>
</tr>
<tr>
<td>Age and sex-adjusted HR (95% CI)</td>
<td>1 0.69 (0.60-0.79)</td>
<td>0.77 (0.69-0.85)</td>
<td>1.21 (1.01-1.44)</td>
<td>1.37 (1.13-1.67)</td>
<td></td>
</tr>
<tr>
<td>Multivariable HR (95% CI)*</td>
<td>1 0.64 (0.52-0.79)</td>
<td>0.90 (0.77-1.04)</td>
<td>1.24 (0.95-1.61)</td>
<td>1.31 (1.00-1.71)</td>
<td></td>
</tr>
</tbody>
</table>

*Adjusted further for histories of hypertension and diabetes, healthy lifestyle behavior score, educational status (<13, 13-15, 16-18, and ≥ 19 years), perceived mental stress, marital status, and total energy intake.
elements on the same day. In the current study, Western breakfast was characterized by higher intakes of milk and dairy products, and lower intakes of seafood, fresh fish, seaweed, miso soup, and other soy products. The intake of meat, however, was not greatly larger in Western or mixed Japanese–Western groups (data not shown). Furthermore, the meat intake level of the Japanese population is much lower compared to that of the US population. Therefore, we assumed that instead of sticking to similar food types with breakfast, Japanese who consume mixed Japanese–Western or Western breakfast may have Japanese lunch or supper in compensation. Food diversity may contribute to an increased probability of nutrient adequacy. A higher dietary diversity score (DDS) was inversely associated with all-cause mortality and inversely associated with CVD mortality. According to a recent meta-analysis of longitudinal studies, total dietary diversity tended to be inversely associated with CVD mortality (RR: 0.83 (95% CI: 0.70–1.00)).

A 14.9-year cohort study involving 79,904 Japanese males and females aged 45 years or above found an inverse association between total DDS and CVD mortality in females (Q5 vs. Q1, HR: 0.65 (95% CI: 0.49–0.85), p trend=0.007) but not in males (Q5 vs. Q1, HR: 0.95 (95% CI: 0.77–1.16), p trend=0.586). This may explain why participants benefited from mixed Japanese–Western breakfasts in our study and may partly explain the borderline-significant inverse association between Western breakfast and CVD mortality risk.

In a cross-sectional study of 392 Japanese aged 20–69 years, the rice-based Japanese breakfast contained higher sodium and the bread-based Western breakfast contained higher added sugars and saturated fats. Higher sodium consumption was related to increased blood pressure levels, and it may impair endothelial function and may increase arterial stiffness. Thus, we assume that a high-sodium intake at breakfast may exacerbate the morning blood pressure surge and may increase the risk of cardiovascular mortality in the morning when cardiovascular events most frequently occur. In addition, mild-to-moderate salt-restricted diets based on Japanese cuisine were promising diets for hypertension treatment. Higher sodium consumption was associated with increased risks of mortality from stroke and CVD but not from CHD in a 12.7-year cohort study of 58,730 Japanese males and females aged 40–79 years with no history of stroke, CHD, or cancer. The corresponding HRs for the highest versus lowest quintiles of sodium consumption were 1.55 (95% CI: 1.21–2.00; p trend<0.001), 1.42 (95% CI: 1.20–1.69; p trend<0.001), and 1.19 (95% CI: 0.82–1.73; p trend=0.23). In a dose-response meta-analysis of 16 prospective cohort studies, an increase in sodium intake by 100 mmol/day was associated with increased risks of stroke incidence and mortality but not with risks of cardiac death and total mortality. A 3.7-year follow-up study of 101,945 persons in 17 countries showed a U-shaped association between urinary sodium excretion and risks of CVD events and total mortality.

In the current study, people with Japanese breakfast had the highest sodium intake. However, the lack of breakfast-specific sodium intake limited us from further analyses, although the results did not change substantially after adjusting for total sodium intake (data not shown in tables). Furthermore, we had no data on the exact food compositions for each type of breakfast.

In a long-term survey of 13,289 native Japanese and Japanese–Americans (first generation and second generation), a westernized lifestyle may contribute to the development of obesity, diabetes, hypertension, dyslipidemia, and the progression of atherosclerosis. Conversely, in our study, mixed Japanese–Western and Western breakfast consumers had higher healthy lifestyle behavior scores, which may help in reducing the mortality from CVD, whereas breakfast skippers had the lowest healthy lifestyle behavior scores. After controlling the healthy lifestyle score, associations between breakfast type and risk of CVD mortality remained.

Skipping breakfast has been associated with increased risks of incident CHD, incident stroke and CVD, and mortality from CVD. Our study showed a consistent result.

The strengths of our study included a prospective population-based study design, long-term follow-up, and importation of potential confounding factors, which enabled us to examine the impact of breakfast type on risks of mortality from stroke, CHD, and CVD. There were several limitations to our study. First, we had no data on the exact food compositions for each type of breakfast to examine breakfast quality. Second, we have no data on histories of other diet-related diseases, such as dyslipidemia, although we excluded participants who had a stroke, CHD, or cancer at baseline, adjusted for histories of diabetes and hypertension, and made a sensitivity analysis excluding participants dying within the first five-year of follow-up. In addition, without repeated measurements throughout the follow-up period, we used the baseline data on breakfast type for analysis. However, we assume that breakfast type was unlikely to change from the middle or older ages.
Conclusion

In this large and long-term prospective cohort study, we found that mixed Japanese–Western breakfast was associated with a lower risk of CVD mortality and skipping breakfast was associated with a higher risk in the Japanese general population, suggesting a protective role of mixed Japanese–Western breakfast and a harmful role of skipping breakfast on cardiovascular mortality.

Acknowledgements

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Authorship

The authors’ responsibilities were as follows—AT for the JACC study group: conceived and initiated the Japan Collaborative Cohort (JACC) Study, supervised its conduct, and reviewed and commented on the draft; HI, JT, and JD: coordinated the entire work and primary responsibility for the final content; JT: performed the statistical analysis and writing the draft; JD, RC, and EE: suggested on data analyses and commented on the draft; all other authors: provided comments on drafts of the manuscript; and all authors: read and approved the final manuscript. The authors declared they do not have any conflict of interest concerning this study.

Footnote

Restrictions apply to the availability of these data. Data were obtained from the JACC study group and are available at https://publichealth.med.hokudai.ac.jp/jacc/ with the permission of the JACC study group.

Conflict of Interest

The authors declared they do not have any conflict of interest concerning this study.

References


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men and women: the Japan collaborative cohort study. Eur Heart J, 2012; 33: 467-477
Supplementary Table 1. Hazard ratios (HRs) and 95% confidence intervals (CIs) of cardiovascular mortality outcomes according to breakfast type after excluding subjects dying within the first five years

<table>
<thead>
<tr>
<th>Breakfast type</th>
<th>Japanese</th>
<th>Mixed Japanese-Western</th>
<th>Western</th>
<th>Other</th>
<th>Skipping</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of subjects</td>
<td>64947</td>
<td>4890</td>
<td>9050</td>
<td>1279</td>
<td>2181</td>
</tr>
<tr>
<td>Person-years</td>
<td>1121856</td>
<td>76359.67</td>
<td>129118</td>
<td>20353.55</td>
<td>36571.32</td>
</tr>
<tr>
<td>Total stroke, n</td>
<td>1886</td>
<td>78</td>
<td>126</td>
<td>47</td>
<td>34</td>
</tr>
<tr>
<td>Age and sex-adjusted HR (95% CI)</td>
<td>0.69 (0.55-0.87)</td>
<td>0.70 (0.59-0.84)</td>
<td>1.22 (0.91-1.63)</td>
<td>1.23 (0.88-1.73)</td>
<td></td>
</tr>
<tr>
<td>Multivariable HR (95% CI)*</td>
<td>0.76 (0.55-1.05)</td>
<td>0.79 (0.61-1.03)</td>
<td>1.33 (0.87-2.03)</td>
<td>1.24 (0.77-1.99)</td>
<td></td>
</tr>
<tr>
<td>Cerebral infarction, n</td>
<td>1128</td>
<td>40</td>
<td>67</td>
<td>28</td>
<td>16</td>
</tr>
<tr>
<td>Age and sex-adjusted HR (95% CI)</td>
<td>0.59 (0.43-0.81)</td>
<td>0.63 (0.49-0.81)</td>
<td>1.18 (0.81-1.71)</td>
<td>1.13 (0.69-1.85)</td>
<td></td>
</tr>
<tr>
<td>Multivariable HR (95% CI)*</td>
<td>0.63 (0.39-0.99)</td>
<td>0.82 (0.59-1.15)</td>
<td>1.10 (0.61-2.01)</td>
<td>1.31 (0.67-2.54)</td>
<td></td>
</tr>
<tr>
<td>Hemorrhagic stroke, n</td>
<td>702</td>
<td>38</td>
<td>54</td>
<td>19</td>
<td>15</td>
</tr>
<tr>
<td>Age and sex-adjusted HR (95% CI)</td>
<td>0.90 (0.65-1.25)</td>
<td>0.80 (0.60-1.05)</td>
<td>1.39 (0.88-2.19)</td>
<td>1.14 (0.68-1.90)</td>
<td></td>
</tr>
<tr>
<td>Multivariable HR (95% CI)*</td>
<td>1.00 (0.64-1.57)</td>
<td>0.74 (0.48-1.14)</td>
<td>1.83 (1.00-3.34)</td>
<td>1.08 (0.53-2.20)</td>
<td></td>
</tr>
<tr>
<td>Coronary heart disease, n</td>
<td>909</td>
<td>47</td>
<td>68</td>
<td>23</td>
<td>24</td>
</tr>
<tr>
<td>Age and sex-adjusted HR (95% CI)</td>
<td>0.90 (0.67-1.20)</td>
<td>0.82 (0.64-1.04)</td>
<td>1.25 (0.83-1.90)</td>
<td>1.70 (1.13-2.55)</td>
<td></td>
</tr>
<tr>
<td>Multivariable HR (95% CI)*</td>
<td>0.79 (0.51-1.22)</td>
<td>1.04 (0.76-1.42)</td>
<td>1.01 (0.52-1.96)</td>
<td>1.87 (1.16-3.03)</td>
<td></td>
</tr>
<tr>
<td>Total cardiovascular disease, n</td>
<td>4317</td>
<td>188</td>
<td>284</td>
<td>110</td>
<td>84</td>
</tr>
<tr>
<td>Age and sex-adjusted HR (95% CI)</td>
<td>0.74 (0.64-0.85)</td>
<td>0.71 (0.63-0.80)</td>
<td>1.26 (1.04-1.53)</td>
<td>1.34 (1.08-1.67)</td>
<td></td>
</tr>
<tr>
<td>Multivariable HR (95% CI)*</td>
<td>0.72 (0.58-0.89)</td>
<td>0.84 (0.72-1.00)</td>
<td>1.35 (1.03-1.78)</td>
<td>1.34 (1.00-1.78)</td>
<td></td>
</tr>
</tbody>
</table>

*Adjusted further for histories of hypertension and diabetes, healthy lifestyle behavior score, educational status (<13, 13-15, 16-18, and ≥ 19 years), perceived mental stress, marital status, and total energy intake.