Epidemiology and Prevention

Western-Style Fast Food Intake and Cardiometabolic Risk in an Eastern Country

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Background—Western-style fast food contributes to a dietary pattern portending poor cardiometabolic health in the United States. With globalization, this way of eating is becoming more common in developing and recently developed populations.

Methods and Results—We examined the association of Western-style fast food intake with risk of incident type 2 diabetes mellitus and coronary heart disease mortality in Chinese Singaporeans. This analysis included men and women 45 to 74 years of age who enrolled in the Singapore Chinese Health Study from 1993 to 1998. For CHD mortality, 52,584 participants were included and 1,397 deaths were identified through December 31, 2009, via registry linkage. For type 2 diabetes mellitus, 43,176 participants were included and 2,252 cases were identified during the follow-up interview (1999–2004) and validated. Hazard ratios for incident type 2 diabetes mellitus and coronary heart disease mortality were estimated with thorough adjustment for demographic, lifestyle, and dietary factors. Chinese Singaporeans with relatively frequent intake of Western-style fast food items (≥2 times per week) had an increased risk of developing type 2 diabetes mellitus (hazard ratio, 1.27; 95% confidence interval, 1.03–1.54) and dying of coronary heart disease (hazard ratio, 1.56; 95% confidence interval, 1.18–2.06) relative to their peers with little or no reported intake. These associations were not materially altered by adjustments for overall dietary pattern, energy intake, and body mass index.

Conclusions—Western-style fast food intake is associated with increased risk of developing type 2 diabetes mellitus and of coronary heart disease mortality in an Eastern population. These findings suggest the need for further attention to global dietary acculturation in the context of ongoing epidemiological and nutrition transitions. (Circulation. 2012;126:182-188.)

Key Words: coronary disease ■ diabetes mellitus, type 2 ■ epidemiology ■ food ■ mortality

Western-style fast food is a factor in dietary patterns portending poor cardiometabolic outcomes in the United States and more recently in Southeast Asia. The food is calorically dense and served in large portions, typically features meat and processed meat, has highly refined carbohydrates, is generally high in sodium and cholesterol, and has a poor dietary fatty acid profile. Thus, the nutritional profile aligns with historical evidence linking diet with epidemic cardiovascular disease and type 2 diabetes mellitus. Despite fast food being widely linked with poor cardiometabolic health in both popular and scientific press, few studies have directly examined Western-style fast food and cardiometabolic risk, making this connection largely speculative.

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With globalization, Western-style fast food intake is becoming more common in developing and recently developed areas of the world. Research on cross-cultural factors contributing to the rising incidence of type 2 diabetes mellitus and coronary heart disease (CHD) mortality rates in recently developed populations may provide insight into global public health issues. Furthermore, there is a lack of research examining the association of Western-style fast food with any outcomes in populations outside the United States. We therefore examined associations between Western-style fast food intake habits and risk of CHD mortality and type 2 diabetes mellitus incidence in a cohort of middle-aged and older Chinese Singaporeans.

Methods

The design of the Singapore Chinese Health Study has previously been described. Briefly, the cohort was drawn from men and women 45 to 74 years of age who belonged to one of the major dialect groups (Hokkien or Cantonese) of Chinese in Singapore. Between April 1993 and December 1998, 63,257 individuals com-
pleted an in-person interview that included questions on usual diet, demographics, height and weight, use of tobacco, usual physical activity, menstrual and reproductive history (women only), medical history, and family history of cancer. A follow-up telephone interview took place between 1999 and 2004 for 52,322 cohort members (85% of recruited cohort). The institutional review boards at the National University of Singapore and the University of Minnesota approved this study.

Assessment of Diet and Covariates

A semiquantitative food frequency questionnaire specifically developed for this population assessed usual dietary intake through 165 commonly consumed food and beverage items during the baseline interview. The respondent was asked to select from 8 food frequency categories (ranging from ‘never or hardly ever’ to ‘2 or more times a day’) and 3 portion sizes with accompanying photographs. The food frequency questionnaire has been validated against 24-hour dietary recall interviews and biomarkers.17–19 A section from the food frequency questionnaire specifically inquired about intake of Western-style fast food items (hamburgers/cheeseburgers, French fries, pizza, other sandwiches, deep-fried chicken, and hot dogs), and another section specifically asked about 19 foods considered eastern snacks and dim sum. Most dim sum foods are savory pastries such as steamed or deep fried dumplings, filled buns, noodles, sweet pastries, and meat dishes. In conjunction with this cohort, the Singapore Food Composition Database was developed, a food-nutrient database accounting for raw and cooked foods that allows computation of the mean daily intakes of nutrients for each subject.17 Other risk factors assessed with the baseline questionnaire included age (years), smoking habits/status, highest educational level reached, body mass index (BMI; kg/m2) calculated from self-reported height and weight, amount (hours) of moderate (eg, brisk walking) and strenuous (eg, jogging) physical activity on a weekly basis, and sleep duration.

Assessment of Diabetes Mellitus

Self-reported diabetes mellitus diagnosed by a physician was evaluated at baseline, and participants with a history of diagnosed diabetes mellitus were excluded from analysis. Diabetes status was assessed again by the following question asked during the follow-up interview: “Have you been told by a doctor that you have diabetes (high blood sugar)?” If yes, “Please also tell me the age at which you were first diagnosed.” Participants were classified as having incident diabetes mellitus if they reported developing diabetes mellitus anytime between the initial enrollment interview and the follow-up interview, which occurred between July 1999 and October 2004.

A validation study of the incident diabetes mellitus cases used 2 different methods and was reported in detail previously.20,21 On the basis of linkage with hospital-based discharge summary database and subsequent interviews using a supplementary questionnaire on symptoms, diagnostic tests, and hypoglycemic therapy, we observed a positive predictive value of 99% with our interview question about symptoms, diagnostic tests, and hypoglycemic therapy, we observed subsequent interviews using a supplementary questionnaire on guidelines for the presence of diabetes mellitus.22 Thus, an estimated 94.4% of this sample who reported being free of diabetes mellitus at baseline and follow-up were below the hemoglobin A1c threshold for diabetes mellitus.21

Assessment of Mortality

Information on date and cause of death was obtained through linkage with the nationwide registry of birth and death in Singapore. Up to 6 different International Classification of Disease, version 9, codes were recorded in the registry. Primary cause of death was used for analysis. Vital status for cohort participants was updated through December 31, 2009. Follow-up for mortality is considered virtually complete as a result of linkage analysis and negligible emigration (0.0004%). The end point of the analysis is death resulting from CHD (codes 410.0–414.9, 427.5).

Analysis

For the analysis examining CHD mortality as the end point, we excluded 1936 subjects with a history of invasive cancer (except nonmelanoma skin cancer) or superficial, papillary bladder cancer at baseline because they did not meet study inclusion criteria. We further excluded those with a reported history of diabetes mellitus (5469) or cardiovascular disease (2399) at baseline, plus 869 who reported extreme sex-specific energy intakes (<600 or >3000 kcal for women, <700 or >3700 kcal for men). The analysis included 52,584 participants. For the analysis examining type 2 diabetes mellitus incidence, those who died before the follow-up interview (n = 7722), migrated out of Singapore (n = 17), had an unclear diabetes status after the validation effort (n = 20), or did not participate in the follow-up interview were excluded, leaving 43,176 participants in the analysis.

Intake frequencies of the 6 different Western-style fast food items were standardized, summed, and divided into categories that allowed logical cut points with a sufficient number of subjects. Report of any but less than monthly intake of Western-style fast food was categorized as 1 to 3 times per month. Baseline and dietary characteristics were calculated across intake frequency categories of Western-style fast food. Proportional hazards (Cox) regression was used to examine the association between categories of intake and CHD mortality and incident type 2 diabetes mellitus. We estimated the hazard ratio (HR) and corresponding 95% confidence interval (CI). For the outcome of CHD mortality, person-years were counted from the date of baseline interview to the date of death, date of last contact (for the few subjects who migrated out of Singapore), or December 31, 2009, whichever occurred first. For type 2 diabetes mellitus, person-years for each participant were calculated from the year of recruitment to the year of reported type 2 diabetes diagnosis or year of follow-up interview for those who did not report diabetes diagnoses. A tiered modeling approach was applied for both outcomes. The base model for both included adjustments for age (<50, 50–54, 55–59, 60–64, ≥65 years), sex, year of interview (1993–1995 and 1996–1998), dialect (Hokkien versus Cantonese), level of education (no formal schooling, primary school, secondary school or above), smoking (never, ever), alcohol intake (1–14 drinks per week, none, or >2 drinks a day), sleep (<6 or ≥9 h/d, 6–8 h/d), physical activity (<2 h/wk of moderate and no strenuous exercise, ≥2 h/wk moderate and/or any strenuous exercise), and BMI for CHD mortality, which was categorized as previously published.21 The second model further adjusted for nutritional factors, including intake of soft drinks and juice (drinks per month) and intake frequencies per month of Eastern snacks and dim sum, vegetables (excluding white potato), fruit, soy, rice and noodles (separate from dim sum), pork and red meat separate from Western-style fast food, and total energy intake. A third model for type 2 diabetes mellitus further adjusted for BMI as a continuous variable with a quadratic term. Sensitivity analyses included adjusted for hypertensive status (yes/no) and sodium (mg/1000 kcal) for both outcomes. Effect modification of the associations was considered by age, sex, BMI, smoking status, and educational level. We also examined whether weight change between baseline and follow-up mediated the associations for type 2 diabetes mellitus. Finally, to reduce potential bias in the CHD mortality analysis, participants who died within 3 and 5 years were excluded from sensitivity analyses. Similarly, participants with <2 years of follow-up were also excluded to account for confounding owing to antecedent disease with type 2 diabetes mellitus.

There was no evidence that proportional hazards assumptions were violated for either outcome as indicated by the lack of significant interaction between the Western-style fast food variable and a function of survival time in the models. Tests for trend were performed by assigning the median value of intake to the category and entering this as a continuous variable into the models. All analyses were conducted with SAS statistical software version 9.2 (SAS Institute, Cary, NC).
Results

We identified 1397 deaths resulting from CHD during 707 200 person-years of follow-up in the analysis of 52 584 participants and 2252 incident cases of type 2 diabetes mellitus during 246 898 person-years of follow-up in the analysis of 43 176 participants. Baseline characteristics according to Western-style fast food intake are presented in Table 1 for participants in the CHD mortality analysis. The baseline characteristics for those in the type 2 diabetes analysis mirrored those in the CHD analysis across all factors and are not presented. Participants who reported more frequent intake of Western-style fast food were younger, were less likely to be hypertensive, were more educated, smoked less, and were more likely to be physically active. Nutritionally, with more frequent intake of Western-style fast food, participants reported consuming fewer vegetables (excluding white potatoes), fewer dairy products, less rice, and overall less carbohydrate and dietary fiber. Conversely, there was a higher intake of noodles, Eastern snacks and dim sum, and sugar-sweetened beverages accompanied nutrient-wise by a greater intake of protein, saturated fatty acids and polyunsaturated fatty acids, dietary cholesterol, sodium, and total energy.

HRs for incident type 2 diabetes mellitus are presented in Table 2. In the fully adjusted model, relatively frequent intake of Western-style fast food items (≥2 times per week) was associated with a modest but significant 27% increased risk of developing type 2 diabetes mellitus compared with no intake of Western-style fast food (HR, 1.27; 95% CI, 1.03–1.54). Similarly, as presented in Table 3, intake of Western-style fast food items ≥2 times per week was significantly associated with a stronger 56% increased risk of dying of CHD relative to no intake after full adjustment (HR, 1.56; 95% CI, 1.18–2.06). In the Figure, we present data from a

Table 1. Participant Characteristics at Baseline According to Intake Frequency of Western-Style Fast Food Items

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>No Intake</th>
<th>Intake of 1–3 Times a Month</th>
<th>Intake of 1 Time a Week</th>
<th>Intake of ≥2 Times a Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>25,810</td>
<td>21,133</td>
<td>3006</td>
<td>2635</td>
</tr>
<tr>
<td>Age, y</td>
<td>57.1 (7.9)</td>
<td>55.0 (7.6)</td>
<td>52.5 (7.0)</td>
<td>52.9 (7.2)</td>
</tr>
<tr>
<td>Female sex, %</td>
<td>56.0</td>
<td>55.8</td>
<td>56.0</td>
<td>53.3</td>
</tr>
<tr>
<td>Hypertension, %</td>
<td>20.6</td>
<td>19.7</td>
<td>18.7</td>
<td>18.1</td>
</tr>
<tr>
<td>Education, %</td>
<td>23.8</td>
<td>31.0</td>
<td>48.2</td>
<td>49.6</td>
</tr>
<tr>
<td>Smoking, %</td>
<td>31.3</td>
<td>28.9</td>
<td>24.3</td>
<td>27.7</td>
</tr>
<tr>
<td>Alcohol, %</td>
<td>15.5</td>
<td>20.3</td>
<td>25.0</td>
<td>25.5</td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>22.9 (3.6)</td>
<td>23.1 (3.5)</td>
<td>23.0 (3.3)</td>
<td>22.8 (3.3)</td>
</tr>
<tr>
<td>Physical activity, %</td>
<td>21.3</td>
<td>21.7</td>
<td>25.1</td>
<td>24.8</td>
</tr>
<tr>
<td>Dietary</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetables, g/1000 kcal*</td>
<td>69.6 (35.1)</td>
<td>69.2 (31.2)</td>
<td>69.1 (30.2)</td>
<td>67.0 (30.6)</td>
</tr>
<tr>
<td>Fruit, g/1000 kcal</td>
<td>128.6 (101.4)</td>
<td>132.1 (93.8)</td>
<td>139.4 (90.2)</td>
<td>132.2 (88.9)</td>
</tr>
<tr>
<td>Dairy, g/1000 kcal</td>
<td>47.9 (78.9)</td>
<td>42.0 (66.1)</td>
<td>44.9 (62.2)</td>
<td>44.8 (60.6)</td>
</tr>
<tr>
<td>All red meats, g/1000 kcal</td>
<td>16.9 (10.9)</td>
<td>20.0 (10.6)</td>
<td>22.9 (10.1)</td>
<td>25.2 (11.9)</td>
</tr>
<tr>
<td>Rice, g/1000 kcal</td>
<td>289.9 (98.5)</td>
<td>264.9 (89.7)</td>
<td>228.8 (80.4)</td>
<td>213.1 (80.7)</td>
</tr>
<tr>
<td>Noodles, g/1000 kcal</td>
<td>32.8 (26.9)</td>
<td>35.3 (24.8)</td>
<td>37.3 (23.2)</td>
<td>36.0 (22.9)</td>
</tr>
<tr>
<td>Snacks/dim sum, n/mo</td>
<td>11.0 (11.0)</td>
<td>14.9 (12.7)</td>
<td>21.8 (15.0)</td>
<td>23.9 (18.2)</td>
</tr>
<tr>
<td>Soft drinks, n/mo</td>
<td>1.7 (7.5)</td>
<td>3.0 (9.5)</td>
<td>5.1 (11.9)</td>
<td>5.6 (12.1)</td>
</tr>
<tr>
<td>Carbohydrate, % kcal</td>
<td>60.7 (7.3)</td>
<td>58.4 (6.8)</td>
<td>56.1 (6.4)</td>
<td>53.8 (6.5)</td>
</tr>
<tr>
<td>Protein, % kcal</td>
<td>14.9 (2.6)</td>
<td>15.3 (2.3)</td>
<td>15.5 (2.1)</td>
<td>16.0 (2.2)</td>
</tr>
<tr>
<td>Saturated fat, % kcal</td>
<td>8.3 (2.5)</td>
<td>9.2 (2.4)</td>
<td>10.1 (2.3)</td>
<td>10.8 (2.4)</td>
</tr>
<tr>
<td>Polyunsaturated fat, % kcal</td>
<td>4.9 (2.5)</td>
<td>5.1 (1.8)</td>
<td>5.5 (1.8)</td>
<td>5.8 (1.8)</td>
</tr>
<tr>
<td>Omega-3 fat, g/d</td>
<td>0.82 (0.39)</td>
<td>0.91 (0.40)</td>
<td>1.07 (0.43)</td>
<td>1.21 (0.51)</td>
</tr>
<tr>
<td>Cholesterol, mg/1000 kcal</td>
<td>102.1 (47.1)</td>
<td>113.9 (43.2)</td>
<td>123.5 (40.1)</td>
<td>132.7 (46.0)</td>
</tr>
<tr>
<td>Dietary fiber, g/1000 kcal</td>
<td>8.3 (2.8)</td>
<td>8.1 (2.5)</td>
<td>8.2 (2.3)</td>
<td>7.9 (2.2)</td>
</tr>
<tr>
<td>Sodium, mg/1000 kcal</td>
<td>651.7 (208.3)</td>
<td>715.1 (194.4)</td>
<td>811.8 (184.4)</td>
<td>864.6 (195.8)</td>
</tr>
<tr>
<td>Total energy, kcal</td>
<td>1450 (483)</td>
<td>1599 (508)</td>
<td>1828 (527)</td>
<td>2005 (591)</td>
</tr>
</tbody>
</table>

BMI indicates body mass index. Data are means (SD) when appropriate. Definitions of characteristics: education, percent with secondary or greater; smoking, percent ever smokers; alcohol, percent light to moderate consumption (any up to 1 drink day per day for women, 2 drinks per day for men); hypertension, percent self-reported physician diagnosed; and physical activity, percent ≥2 hours a week of moderate exercise or any strenuous physical activity.

*Excluding white potatoes.
further evaluation of the dose-response association with CHD mortality and extended the highest category to ≥4 times per week. In the 811 participants who reported eating Western-style fast food items ≥4 a week, there were 17 deaths caused by CHD, and this group of participants had a nearly 80% greater risk of dying of CHD relative to their peers with no Western-style fast food consumption (HR, 1.79; 95% CI, 1.09–2.93). Of note, the levels of baseline characteristics of those in this extended top category of Western-style fast food intake are consistent with the data presented in Table 1. We did not observe a similar further dose-response association with type 2 diabetes mellitus (data not presented).

There was no evidence that the associations differed materially by age, sex, BMI, smoking status, educational level, or length of follow-up time for risk of either diabetes incidence or CHD death. Adjustment for self-reported physician-diagnosed hypertension did not materially alter the results for CHD mortality or type 2 diabetes mellitus. Furthermore, adjustment for weight change between baseline and follow-up did not alter the results for type 2 diabetes mellitus.

Model 1: adjusted for age, sex, year of interview, dialect, education, smoking, alcohol, sleep, and physical activity. Model 2: model 1 plus adjustment for nutritional factors (intake of soft drinks, juice, Eastern snacks and dim sum, vegetables, fruit, soy, rice, noodles, other pork and red meat, and total energy). Model 3: model 2 plus body mass index.

Discussion

Chinese Singaporeans with relatively frequent intake of Western-style fast food items (≥2 times per week) have an increased risk of developing type 2 diabetes mellitus and further evaluation of the dose-response association with CHD mortality and extended the highest category to ≥4 times per week. In the 811 participants who reported eating Western-style fast food items ≥4 a week, there were 17 deaths caused by CHD, and this group of participants had a nearly 80% greater risk of dying of CHD relative to their peers with no Western-style fast food consumption (HR, 1.79; 95% CI, 1.09–2.93). Of note, the levels of baseline characteristics of those in this extended top category of Western-style fast food intake are consistent with the data presented in Table 1. We did not observe a similar further dose-response association with type 2 diabetes mellitus (data not presented).

There was no evidence that the associations differed materially by age, sex, BMI, smoking status, educational level, or length of follow-up time for risk of either diabetes incidence or CHD death. Adjustment for self-reported physician-diagnosed hypertension did not materially alter the results for CHD mortality or type 2 diabetes mellitus. Furthermore, adjustment for weight change between baseline and follow-up did not alter the results for type 2 diabetes mellitus. Compared with the referent of no Western-style fast food intake, the HRs for frequencies of 1 to 3 times a month, 1 time a week, and ≥2 times a week after adjustment for weight change were 1.01 (95% CI, 0.93–1.11), 1.17 (95% CI, 0.96–1.41), and 1.26 (95% CI, 1.03–1.54), respectively. Consideration of type 2 diabetes case status based on the validation study did not vary the results. Of note, there was no association between increasing intake of Eastern snacks and dim sum and either outcome.

Finally, in a sensitivity analysis, we aimed to account for the overall dietary pattern, to determine whether the results observed may be due to residual confounding by other dietary factors, and to establish that greater Western-style fast food intake was merely a marker of a poorer overall dietary pattern. Thus, we derived an empirical dietary pattern from the 159 non–Western-style fast foods and beverages surveyed at baseline using principal components analysis as previously described. In line with our previous published work, a vegetable-, fruit-, and soy-rich pattern, in which a high adherence to the pattern is characterized by high intake of those foods and lower intake of meats, dim sum, and sugared soft drinks (and vice versa for a low score on the pattern), was included as a covariate in quintiles in the models instead of the aforementioned dietary adjustments. This approach yielded similarly significant estimates for both outcomes. For example, the HR associated with intake of Western-style fast food items ≥2 times per week relative to none was 1.50 (95% CI, 1.13–1.96) for CHD mortality and 1.23 (95% CI, 1.01–1.50) for type 2 diabetes mellitus (overall data not presented).

Table 2. Hazard Ratio and 95% Confidence Interval of Incident Type 2 Diabetes Mellitus According to Intake Frequency of Western-Style Fast Food Items: Singapore Chinese Health Study

<table>
<thead>
<tr>
<th>Intake Frequency</th>
<th>Cases, n/N</th>
<th>Rate</th>
<th>Model 1: HR (95% CI)</th>
<th>Model 2: HR (95% CI)</th>
<th>Model 3: HR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Intake</td>
<td>1102/20 761</td>
<td>918</td>
<td>1.00 (0.93–1.09)</td>
<td>1.02 (0.93–1.11)</td>
<td>1.02 (0.93–1.11)</td>
</tr>
<tr>
<td>Intake of 1–3 Times a Month</td>
<td>901/17 615</td>
<td>934</td>
<td>1.03 (0.94–1.13)</td>
<td>1.02 (0.95–1.14)</td>
<td>1.02 (0.93–1.11)</td>
</tr>
<tr>
<td>Intake of 1 Time a Week</td>
<td>131/25586</td>
<td>987</td>
<td>1.18 (0.97–1.40)</td>
<td>1.21 (1.00–1.47)</td>
<td>1.17 (0.97–1.41)</td>
</tr>
<tr>
<td>Intake of ≥2 Times a Week</td>
<td>118/2214</td>
<td>1250</td>
<td>1.22 (1.00–1.47)</td>
<td>1.29 (1.05–1.57)</td>
<td>1.27 (1.03–1.54)</td>
</tr>
</tbody>
</table>

Table 3. Hazard Ratio and 95% Confidence Interval of Coronary Heart Disease Mortality According to Intake Frequency of Western-Style Fast Food Items: Singapore Chinese Health Study

<table>
<thead>
<tr>
<th>Intake Frequency</th>
<th>CHD deaths, n/N</th>
<th>Rate</th>
<th>Model 1: HR (95% CI)</th>
<th>Model 2: HR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Intake</td>
<td>784/25 810</td>
<td>256</td>
<td>1.00 (0.89–1.11)</td>
<td>1.00 (0.92–1.16)</td>
</tr>
<tr>
<td>Intake of 1–3 Times a Month</td>
<td>503/21 133</td>
<td>245</td>
<td>1.09 (0.82–1.45)</td>
<td>1.19 (0.89–1.59)</td>
</tr>
<tr>
<td>Intake of 1 Time a Week</td>
<td>51/3006</td>
<td>235</td>
<td>1.36 (1.04–1.78)</td>
<td>1.56 (1.18–2.06)</td>
</tr>
<tr>
<td>Intake of ≥2 Times a Week</td>
<td>59/2635</td>
<td>313</td>
<td>0.046</td>
<td>0.0026</td>
</tr>
</tbody>
</table>

CHD indicates coronary heart disease; HR, hazard ratio; and CI, confidence interval. Rate indicates the crude CHD mortality rate per 10 000 person-years. Model 1: adjusted for age, sex, year of interview, dialect, education, smoking, alcohol, sleep, physical activity, and body mass index. Model 2: model 1 plus adjustment for nutritional factors (intake of soft drinks, juice, Eastern snacks and dim sum, vegetables, fruit, soy, rice, noodles, other pork and red meat, and total energy).
increased risk of type 2 diabetes mellitus. The Study found that greater frequency of consumption of burger with increased risk of type 2 diabetes mellitus and CHD,27,28,29 The decreas-Western-style fast food intake are components that could increase risk of diabetes mellitus and CHD.25,29 The contributions to weight gain.26 A small systematic review examined the ubiquity of the food and its contribution to usual dietary patterns in populations around the globe. One relevant study on the topic examined fast food data from the Coronary Artery Risk Development in Young Adults (CARDIA) study and observed strong, positive associations with weight gain and insulin resistance.5 Similarly, the Black Women’s Health Study found that greater frequency of consumption of burger and fried chicken meals in restaurants was associated with an increased risk of developing type 2 diabetes mellitus.24 The Nurses’ Health Study found that frequent French fry consumption was associated with a modest increased risk of type 2 diabetes mellitus.25 A combined analysis of the Nurses’ Health Study and Health Professionals Follow-Up Study found that French fried potatoes, processed meats, and unprocessed meats, all usual components of typical Western-style fast food fare, were among the greatest dietary contributions to weight gain.26 A small systematic review examined research on fast food consumption with caloric intake and weight gain and concluded that there was a positive association with both.12

The poor nutritional profile of Western-style fast food is the underlying hypothesized mechanism by which the risk of type 2 diabetes mellitus and CHD mortality may be increased. Evidence indicates that frequent Western-style fast food intake contributes to insulin resistance and weight gain, pathways central to both type 2 diabetes mellitus and cardiovascular risk.5 Related research has linked processed meats with increased risk of type 2 diabetes mellitus and CHD,27 identified red meat and high-fat dairy as protein sources with greater risk of CHD,28 and shown that the glycemic properties of fried potatoes and processed grains central to most Western-style fast food intake are components that could increase risk of diabetes mellitus and CHD.25,29 The decreasing dietary fiber intake may also contribute to cardiometabolic risk.30 Others have proposed that the high sodium content in most Western-style fast foods is another pathway leading to increased CHD risk.14 However, in a sensitivity analysis, adjustment for sodium intake did not affect the estimates for either outcome.

Figure. Hazard ratio (HR) and 95% confidence interval (CI) of coronary heart disease (CHD) mortality according to intake frequency of Western-style fast food items: further dose-response evaluation. Singapore Chinese Health Study (n = 52 584; 1397 deaths resulting from CHD), Respective numbers (CHD deaths) for fast food intake of 0 times a week, 1 to 3 times per month, 1 time per week, 2 to 3 times per week, and ≥4 times per week were 25 810 (784), 21 133 (503), 3006 (51), 1824 (42), and 811 (17). Results represent fully adjusted model (age, sex, year of interview, dialect, education, smoking, alcohol, sleep, physical activity, body mass index, and nutritional factors, ie, intake of soft drinks, juice, Eastern-style snacks and dim sum, vegetables, fruit, soy, rice, noodles, other pork and red meat, and total energy).

A more reductionist aspect to consider is that trans fatty acids are still a component of fast food, especially in unregulated developing areas of the globe.31 Indeed, there is no historical documentation of trans fat being regulated or required to be labeled in Singapore. The association of trans fatty acids with increased risk of CHD is considered established through a number of pathways,32 whereas the association with type 2 diabetes mellitus is plausible but the evidence is less clear.32,33 We were unable to address whether trans fatty acid intake in the cohort mediated the associations observed in this study owing to the aforementioned point and lack of measurement. Alternative reasons for our findings may be that frequent Western-style fast food intake is a prominent marker of a poor diet and lifestyle and not truly causal by itself. The lifestyle and demographic data, and in particular our sensitivity analysis aiming to account for the overall dietary pattern, suggest that this may not be the case.

The findings from our study may provide context for populations that have recently undergone or are undergoing nutrition transitions and are experiencing the parallel changes in health.13 Current and preceding generations in the United States have been widely exposed to Western-style fast foods throughout their lifetimes.14,15 However, Western-style fast food intake in east and southeast Asia started becoming somewhat prominent in the late 1980s and early 1990s, providing a chance to participate in American culture,14,15 which is very different from the historical dietary culture of these populations. Indeed, rapid international expansion of Western-style fast food outlets is ongoing and is a major contribution to the growth and prosperity of Western-style fast food holding companies in the United States.34 This increase in availability may be desirable to some people from a cultural perspective, but as noted,13 this aspect of the nutrition transition may have a down side owing to acculturation and increased noncommunicable disease risk as previously mentioned.35,36

This study has a number of strengths, including a large, non-Western population with ample events, prospective data,
and use of a food frequency questionnaire that was specifically developed for and validated in this population. Other strengths include the high participant response rate, detailed collection of data through face-to-face interviews, thorough assessment of potential lifestyle and demographic confounders, very low level of participants lost to follow-up, nearly complete mortality assessment with objectively obtained records on time and cause of death, and validated diabetes case status.

Limitations include some level of measurement error with the dietary assessment, although this would most likely result in nondifferential misclassification with respect to disease status and likely underestimation of risk. The self-report of other lifestyle-related data may also result in some misclassification and residual confounding in our models. Repeated assessment of dietary intake and other lifestyle factors would have allowed us to examine change in Western-style fast food habits in relation to the outcomes and would have complemented our data. Furthermore, the study lacked the ability to carry out further sensitivity analyses related to blood lipid levels. The results for the type 2 diabetes outcome may apply only to physician-diagnosed diabetes mellitus. Even with high levels of validity, there is potential for numerous undiagnosed cases of type 2 diabetes mellitus owing to the nature of the disease. If Western-style fast food intake led to increased or decreased physician diagnosis, the associations could have been affected.

Conclusions

Chinese Singaporeans with relatively frequent intake of Western-style fast food items have a modestly increased risk of developing type 2 diabetes mellitus and a strong and graded risk of dying as a result of CHD. These findings suggest the need for further attention to global dietary acculturation in the context of the epidemiological and nutrition transitions. The ubiquity of Western-style fast food intake and the emerging evidence that it contributes to the global type 2 diabetes mellitus and CHD/cardiovascular disease epidemic merit closer attention, and further research on the topic is indicated.

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Disclosures

None.

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**CLINICAL PERSPECTIVE**

With globalization, Western-style fast food intake is becoming more common in developing and recently developed areas of the world. Despite being widely linked with poor cardiometabolic health in both popular and scientific press, few studies have directly examined Western-style fast food intake and cardiometabolic risk, making this connection largely speculative. Furthermore, there is a lack of research examining the association of Western-style fast food intake with any outcomes in populations outside the United States. We therefore examined the associations between Western-style fast food intake habits and risk of incident type 2 diabetes mellitus and coronary heart disease mortality in a cohort of middle-aged and older Chinese men and women in the Singapore Chinese Health Study. Participants who reported more frequent intake of Western-style fast food were younger, less likely to be hypertensive, and more educated; smoked less; and were more physically active. In models with full adjustment for demographic, lifestyle, and dietary factors, Chinese Singaporeans with relatively frequent intake of Western-style fast food items (≥2 times per week) had a 27% increased risk of developing type 2 diabetes mellitus and a 56% increased risk of dying of coronary heart disease relative to their peers with little or no reported intake. These associations were not materially altered by adjustments for overall dietary pattern, energy intake, and body mass index. Overall, these findings suggest the need for further attention to global dietary acculturation in the context of ongoing epidemiologic and nutrition transitions.

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