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Original Article

Meat-fat dietary pattern may increase the risk of breast cancer—A case–control study in Taiwan

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ABSTRACT

Objectives: We investigated the association between dietary patterns and breast cancer risk in Taiwan.
Materials and Methods: This case–control study compared the dietary patterns between 98 breast cancer patients and 103 age-matched controls. A questionnaire survey about 27 frequently consumed food items was conducted among 201 patients in a general surgical ward. Serum albumin, triglyceride, and total cholesterol levels were also investigated.
Results: Five dietary patterns were defined via the principle component analysis: the meat-fat, pickle–vegetable, sugar–fried food, soy, and coffee–egg patterns. For the meat-fat dietary pattern, the third quartile and fourth quartile were significantly associated with higher breast cancer risk than the first quartile and second quartile with an odds ratio of 2.86 [95% confidence interval (CI) = 1.25–6.53] and 3.11 (95% CI = 1.33–7.27) respectively; $p = 0.002$. In addition, cooking with oil was reported significantly more often in the fourth meat-fat dietary pattern quartile, as shown by the responses to eight out of 12 questions about cooking methods.
Conclusion: These results revealed that meat was associated with a higher breast cancer risk, and a high fat intake might play an important role in this association.

1. Introduction

Genetic and environmental factors both contribute to the development of breast cancer. The higher incidence of breast cancer in Japanese immigrants and their descendants in the United States than in Japanese in their homeland implicates the importance of environmental factors [1]. Wynder and Gori [2] reported diet as the most important environmental factor. Ewertz et al [3] also suggested that diet factors were more important in breast cancer than genetic factors.

The association of nutrients and food components with breast cancer has widely been studied [4]. Obesity and alcohol consumption were found to be risk factors of breast cancer in postmenopausal women [5]. A high intake of fat and sugar increases the risk of breast cancer [5,6], whereas that of vegetables and fruits decreases this risk [5,7]. However, these results have been challenged by recent cohort studies [4,8,9]. Key et al [5] reported variations in the associations of individual nutrients and food components with breast cancer risk and could not propose adequate suggestions about food to decrease the incidence of cancer.

Inconsistencies in conclusions about the association between disease and individual nutrients or food components might be due to unrecognized effects of other factors, such as interactions between food components or cooking methods [10,11]. Dietary patterns have been considered more reasonable when investigating the association between food and chronic diseases [12–18]. Risks of heart disease, hypertension, and cancer have been associated with dietary patterns [19,20]. In recent decades, researchers have

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studied the association between breast cancer risk and dietary patterns in various regions of the United States, Europe [21–23], Uruguay [24], Japan [25], and China [26]. The aim of this study is to investigate possible dietary factors associated with breast cancer in Taiwan using the dietary pattern approach.

2. Materials and methods

2.1. Study design

This case–control study was conducted at Buddhist Tzu Chi General Hospital, Taipei Branch. Participants came mainly from northern Taiwan. The research protocol was approved by the institutional review board at Buddhist Tzu Chi General Hospital, Taipei Branch, and signed consent was obtained for each participant.

2.2. Study cohort

Enrolled participants included women younger than 75 years with a diagnosis of primary breast cancer who visited the hospital between April 2010 and December 2011, and who agreed to sign an informed consent and undergo an interview. A research team member contacted them to explain the study thoroughly and acquire their consent to participate. Interviews were scheduled for study cases. Of the eligible cases (110 breast cancer patients contacted), 12 patients (10%) declined, and 98 patients (90%) were interviewed. Individuals who underwent health examinations for breast cancer at the same hospital during the same period were recruited for the control group. Inclusion criteria for the control group were residence in a neighborhood similar to the study area, no prior breast cancer history, and age within 5 years of the age limit of the study group (cancer group). Individuals who were diagnosed with a psychiatric disease or were on diet control for diabetes or other diseases were excluded. As with the study group, candidates for the control group were contacted by our research team, and interviews were scheduled for those who agreed to participate. Among those eligible for the control group (281 contacted), 178 refused to answer the questionnaires and 103 (36.7%) were interviewed. All interviews took place in the same hospital and data were collected by dieticians who were trained interviewers.

2.3. Dietary intake

The daily dietary intake of the respondent was assessed by the Food-Frequency Questionnaire (FFQ), which was adopted from the Nutritional and Health Survey in Taiwan 1993–1994 [27]. The first part of the FFQ in this study consisted of questions about consumption of 27 separate food items and was assessed by the principle component of each food item. The principle components were sorted into five dietary patterns: meat-fat, pickle–vegetable, sugar–fried food, soy, and coffee–egg patterns. The second part of the FFQ comprised 12 questions about the consumption of dietary oil. The third part of the FFQ consisted of four questions about vegetarian dietary patterns; two questions about vitamins, minerals, and other supplements; and two questions about cigarette and alcohol use.

2.4. Statistical analyses

Descriptive statistics (mean, standard deviation, and frequency) were computed for all study variables by case–control status to describe the demographic and dietary characteristics of the study population. The independent sample *t* test was used to compare continuous variables of demographic data, and Fisher's exact test was used to analyze the categorical variables.

Dietary patterns were obtained by principal component analysis (PCA). Five dietary patterns with eigenvalues >1.5, which together accounted for 47.8% of the total variation, were extracted on the basis of a scree plot and evaluation of the factor loading matrix after orthogonal (varimax) rotation. Using this method, correlated variables were grouped together. The coefficients defining these linear combinations, called factor loadings, were the correlations between each food item and that factor. Factor scores were created by multiplying factor loadings with the corresponding standardized value for each food and summing across the food items. For each participant, the factor scores indicated the extent to which her diet conformed to the respective dietary patterns. A high factor score for a given pattern indicated a high intake of the foods that constitute the particular food pattern and a low score indicated a low intake of those foods.

Relative risks were estimated as odds ratios (OR) and calculated for quartiles of factor scores using logistic regression, and were adjusted for confounding using multiple logistic regression. All dietary patterns were entered into the same model. The model was adjusted for potential confounding by body mass index (BMI) and age, which have previously been shown to influence the risk of breast cancer and also be associated with the dietary pattern scores.

All analyses were conducted using SPSS version 12.0 (SPSS Inc., Chicago, IL, USA). Statistical tests were two sided, and $p < 0.05$ was considered statistically significant.

3. Results

Characteristics of the cancer and control groups are shown in Table 1. There were no significant differences in age, body height, body weight, education level, menarche status, primiparity, menopause status, oral contraceptive use, family history of breast cancer, regular exercise status, and types of exercise between groups, but the cancer group had a higher mean BMI (24.54 ± 4.43 vs. 23.36 ± 3.28, $p = 0.033$) and a higher percentage of patients using hormone replacement therapy after menopause (92.2% vs. 77.6%, $p = 0.016$). In addition, the cancer group had lower serum levels of albumin and total cholesterol than the control group. Fig. 1 shows the scree plot of PCA. A sharp drop in the plot after the fifth factor signaled that subsequent factors could be ignored. As a result, five factors were retrieved for further analysis. Table 2 shows the factor loadings for the food items in each dietary pattern in this study. Table 3 shows the adjusted OR and 95% confidence interval (CI) for each dietary pattern. Food intake of meat fat was positively associated with breast cancer risk, whereas the other dietary patterns were not. Higher consumption of meat fat had the strongest positive association (quartile 3: OR, 2.99; 95% CI, 1.33–6.73; quartile 4: OR, 2.90; 95% CI, 1.29–6.53). The *p* value for the linear trend was statistically significant ($p = 0.002$). After adjusting for age and BMI in the logistic regression model, breast cancer risk for the third quartile and the fourth quartile remained significantly higher (third quartile: OR, 2.86; 95% CI, 1.25–6.53; fourth quartile: OR, 3.11; 95% CI, 1.33–7.27; $p = 0.002$). The OR and 95% CIs of the other four dietary patterns (pickle–vegetable, sugar–fried food, soy, and coffee–egg) were not significant in either the original or the adjusted logistic regression model, except for the *p* value (for linear trend) of the sugar–fried food pattern ($p = 0.043$).

Table 4 shows a comparison of demographic data between the first quartile and fourth quartile of the meat-fat dietary pattern in breast cancer patients. Values for body height (1.57 ± 0.05 m vs. 1.55 ± 0.06 m), body weight (60.39 ± 10.45 kg vs. 55.42 ± 7.67 kg), and cigarette smoking (current smoker 10% and past smoker 4% vs. nonsmoker 100%; $p = 0.012$) were significantly higher in the fourth

Table 1
Characteristics of participants according to breast cancer group/control group.[a]

	Breast cancer N = 98	Control group N = 103	p
Age (y)	54.46 ± 9.33	53.43 ± 9.44	0.127
BH (cm)	1.55 ± 0.05	1.56 ± 0.06	0.398
BW (kg)	59.09 ± 10.64	56.83 ± 8.80	0.102
BMI (mean ± SD)	24.54 ± 4.43	23.36 ± 3.28	0.033
Education level			0.119
Illiteracy	2 (2.0)	1 (1.0)	
Literacy without diploma	4 (4.1)	1 (1.0)	
Elementary school	27 (27.6)	16 (15.5)	
Junior high	19 (19.4)	24 (23.3)	
Senior high	30 (30.6)	35 (34.0)	
College	16 (16.3)	23 (22.3)	
Master or PhD	0 (0)	3 (2.9)	
Menarche			0.088
11–14 y/o	66 (67.3)	69 (67.0)	
15 y/o	14 (14.3)	24 (23.3)	
≥16 y/o	18 (18.4)	10 (9.7)	
Primiparity			0.175
14–25 y/o	44 (46.0)	35 (34.0)	
25–29 y/o	29 (29.6)	46 (44.7)	
≥30 y/o	11 (11.2)	9 (8.7)	
Nulliparous	12 (12.2)	13 (12.6)	
Menopause			0.986
None	35 (35.7)	37 (35.9)	
≤55 y/o	42 (42.9)	46 (44.7)	
≤45 y/o	16 (16.3)	16 (15.5)	
≤35 y/o	2 (2.0)	2 (1.9)	
≤60 y/o	3 (3.1)	2 (1.9)	
Oral contraceptive			0.868
Current use	5 (5.1)	7 (6.8)	
Past use	17 (17.3)	16 (15.5)	
Never	76 (77.6)	80 (77.7)	
HRT			0.016
Never	76 (77.6)	95 (92.2)	
Have been used ≤55 y/o	13 (13.3)	6 (5.8)	
Have been used ≤55–59 y/o	8 (8.2)	2 (1.9)	
Have been used ≤60 y/o	1 (1.0)	0 (0)	
Family history of BC			0.703
Present	10 (10.2)	8 (7.8)	
Not present	88 (89.8)	95 (92.2)	
Regular exercise			0.884
Yes	35 (35.7)	38 (36.9)	
No	63 (64.3)	65 (63.1)	
Exercise frequency (times per week)			0.055
None	63 (64.3)	65 (63.1)	
1	1 (1.0)	4 (3.9)	
2	5 (5.1)	10 (9.4)	
3	3 (3.1)	9 (8.7)	
4	2 (2.0)	5 (4.9)	
5	10 (10.2)	3 (2.9)	
6	4 (4.1)	2 (1.9)	
7	10 (10.2)	5 (4.9)	
Mean (only "yes")	4.91 ± 1.87	3.45 ± 1.96	0.032
Median	5.00	3.00	
Mode	5	2	
Exercise time (min)			0.125
None	63 (64.3)	65 (63.1)	
30	18 (18.4)	19 (18.4)	
50	1 (1.0)	0 (0.0)	
60	12 (12.2)	11 (10.7)	
90	3 (3.1)	1 (1.0)	
120	0 (0.0)	6 (5.8)	
180	1 (1.0)	0 (0.0)	
240	0 (0.0)	1 (1.0)	
Mean (only "yes")	49.43 ± 30.77	59.21 ± 44.925	0.064
Median	30.00	45.00	
Mode	30	30	
Kinds of exercises			
Trot	23 (65.71)	19 (50.0)	0.237
Jogging	0 (0.0)	3 (7.89)	0.241
Swimming	0 (0.0)	1 (2.63)	1.000
Biking	3 (8.57)	4 (10.52)	1.000
Badminton	0 (0.0)	0 (0.0)	NA
Yoga	1 (2.85)	7 (18.42)	0.057
Yuanji dance	1 (2.85)	1 (2.63)	1.000
Climbing	3 (8.57)	4 (10.52)	1.000
Table tennis	1 (2.85)	1 (2.63)	1.000
Dance	1 (2.85)	3 (7.89)	0.616
Tai chi	1 (2.85)	0 (0.0)	0.479
Qi gong	2 (5.71)	0 (0.0)	0.226
Albumin (g/dL)[b]	3.92 ± 0.31	4.14 ± 0.25	<0.001
Triglyceride (mg/dL)[c]	118.62 ± 78.71	115.58 ± 76.62	0.778
Total cholesterol (mg/dL)[d]	175.34 ± 33.76	193.61 ± 35.45	0.001

Data are presented as *n* (%) or mean ± SD.
BC = breast cancer; BH = body height; BMI = body mass index (=BW/BH^2); BW = body weight; HRT = hormone replacement therapy; *N* = number; NA = not applicable; SD = standard deviation.
[a] Analysis of categorical variables was performed using Fisher's exact test and analysis of continuous variables using independent sample *t* test.
[b] Sample size (cancer group: 92/control group: 103).
[c] Sample size (cancer group: 84/control group: 103).
[d] Sample size (cancer group: 67/control group: 103).

quartile than in the first quartile, whereas the differences in other data did not reach statistical significance. Table 5 shows a comparison of dietary oil consumption between the first quartile and fourth quartile of the meat-fat dietary pattern in breast cancer patients. Answers to eight of the 12 questions showed a higher consumption of dietary oils in the fourth quartile ($p < 0.05$). This finding implied that those in the fourth quartiles of the meat-fat dietary pattern who consumed more meat also consumed more dietary oil.

4. Discussion

This study demonstrated a significant association between a meat-fat dietary pattern and breast cancer and also demonstrated that breast cancer patients with a meat-fat dietary pattern consumed more dietary oil than the control group. Key et al [5] reported that obesity and alcohol consumption increased the risk of breast cancer in postmenopausal women. In this study, BMIs of breast cancer patients were significantly higher than in the control group (24.62 ± 3.95 vs. 23.22 ± 2.66; $p = 0.02$). A similar result was reported by Edefonti et al [28] in Shanghai. No difference in alcohol consumption was noted. In this study, the meat-fat dietary pattern increased the risk of breast cancer. After adjusting for age and BMI, the third quartile and fourth quartile still had a higher cancer risk, with OR of 2.86 and 3.11, respectively. Similar results were reported in 2009 by Wu et al [29] who studied the dietary patterns of American-Asian breast cancer patients. In their study, dietary patterns were divided into three types: Western meat/starch, ethnic meat/starch, and vegetables/soy. Women who consumed high amounts of Western meat/starch and ethnic meat/starch had higher risks of breast cancer. Cottet et al [30] studied the food patterns of postmenopausal breast cancer patients in France and divided the individuals into two groups according to their dietary patterns: alcohol/Western and healthy/Mediterranean. Results showed that the alcohol/Western dietary pattern was associated with a higher breast cancer risk. Although that dietary pattern is not exactly the same as the meat-fat dietary pattern in our study, meat was the main component of these dietary patterns. The meat component plays an important role in breast cancer risk. Results of the fourth dietary pattern quartile in the meat-fat group in our study was associated with more use of oil in cooking, indicating that a high fat intake was associated with a high breast cancer risk. Clemmesen [31] studied the association of dietary pattern and

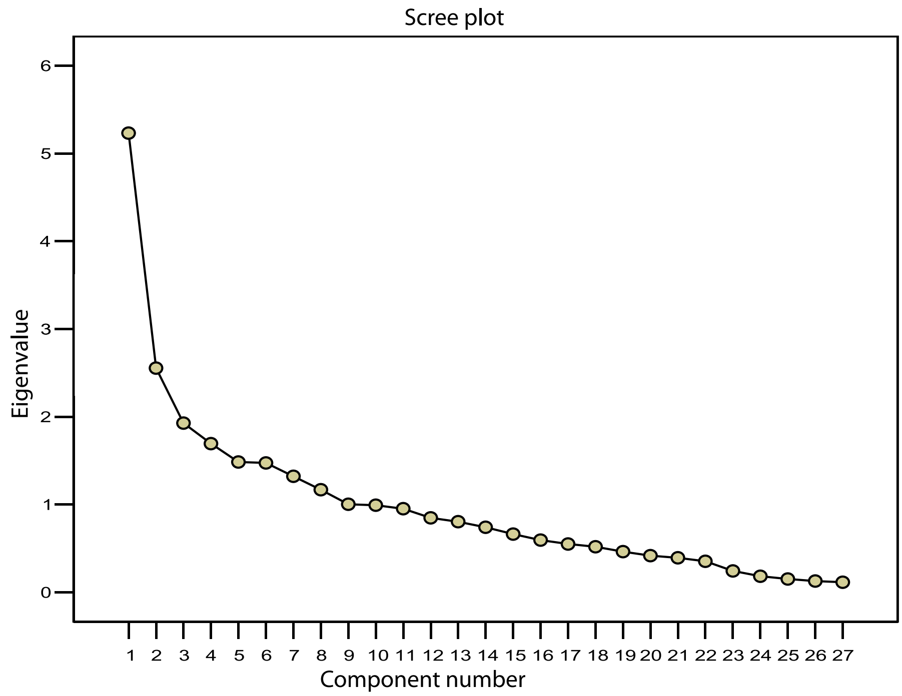

Fig. 1. Scree plot of principal component analysis.

breast cancer risk in Japan and found that a fatty dietary pattern was associated with a higher breast cancer risk. In addition, Sieri et al [32] reported that saturated fat increased the risk of breast cancer.

The pickle–vegetable dietary pattern did not show a decrease in breast cancer risk in our study, which is not consistent with some other reports. Butler et al [33] reported a vegetable–fruit–soy

Table 2
Factor loadings for the five major dietary patterns identified among controls in the breast cancer case–control study.

	Meat fat	Pickle–vegetable	Sugar–fried food	Soy	Coffee–egg
FFQ.A12 milk (low fat)	0.143				
FFQ.A26 smoked meat	0.476				
FFQ.A6 organ meat	0.577				
FFQ.A4 streaky meat	0.578				
FFQ.A25 sashimi	0.647				
FFQ.A1 fish	0.693				
FFQ.A5 processed meat	0.713				
FFQ.A7 shellfish (oyster clam)	0.762				
FFQ.A2 poultry (chicken)	0.796				
FFQ.A8 seafood (shrimp –crab)	0.797				
FFQ.A3 livestock (pork)	0.797				
FFQ.A21 tea (black tea, green tea)		0.451			
FFQ.A15 vegetable		0.540			
FFQ.A17 fruit		0.631			
FFQ.A28 fermentation food (miso)		0.714			
FFQ.A27 pickle		0.783			
FFQ.A23 beverage			0.220		
FFQ.A11 milk (whole fat)			0.374		
FFQ.A19 fried food			0.405		
FFQ.A22 sweets			0.605		
FFQ.A16 mushroom				0.489	
FFQ.A10 soybeans (soybean milk)				0.559	
FFQ.A9 soybeans (dried tofu)				0.626	
FFQ.A18 fresh fruit juice					0.123
FFQ.A14 eggs					0.281
FFQ.A20 coffee					0.380
FFQ.A24 sugar					0.386

Table 3
Adjusted OR and 95% CIs for breast cancer according to each dietary pattern intake.[a]

Dietary pattern	Breast cancer/ control	Minimal model	Full model[b]
		OR (95% CI)	OR (95% CI)
Meat fat			
1st quartile	18/32	1.00	1.00
2nd quartile	17/33	0.92 (0.40–2.08)	0.85 (0.37–1.96)
3rd quartile	32/19	**2.99 (1.33–6.73)**	**2.86 (1.25–6.53)**
4th quartile	31/19	**2.90 (1.29–6.53)**	**3.11 (1.33–7.27)**
p (for linear trend)		**0.002**[c]	**0.002**[c]
Pickle and vegetable			
1st quartile	23/27	1.00	1.00
2nd quartile	27/23	1.38 (0.63–3.03)	1.29 (0.58–2.88)
3rd quartile	25/26	1.13 (0.52–2.47)	1.18 (0.53–2.63)
4th quartile	23/27	1.00 (0.46–2.20)	0.93 (0.42–2.09)
p (for linear trend)		0.837	0.851
Sugar–fried food			
1st quartile	25/25	1.00	1.00
2nd quartile	17/33	0.52 (0.23–1.15)	0.51 (0.23–1.16)
3rd quartile	25/26	0.96 (0.44–2.10)	0.96 (0.43–2.14)
4th quartile	31/19	1.63 (0.74–3.62)	1.73 (0.76–3.96)
p (for linear trend)		0.053	**0.043**[c]
Soy			
1st quartile	26/24	1.00	1.00
2nd quartile	23/27	0.79 (0.36–1.72)	0.88 (0.39–1.97)
3rd quartile	20/31	0.60 (0.27–1.31)	0.63 (0.28–1.41)
4th quartile	29/21	1.27 (0.58–2.81)	1.34 (0.60–2.99)
p (for linear trend)		0.274	0.327
Coffee–egg			
1st quartile	29/29	1.00	1.00
2nd quartile	18/17	1.06 (0.46–2.45)	1.15 (0.49–2.72)
3rd quartile	19/28	0.68 (0.31–1.48)	0.70 (0.32–1.54)
4th quartile	32/29	1.10 (0.54–2.27)	1.15 (0.55–2.39)
p (for linear trend)		0.623	0.608

BMI = body mass index; CI = confidence interval; OR = odds ratio.
[a] Logistic regression was used for the analysis of categorical variables.
[b] Model adjusted for BMI and age.
[c] Statistically significant ($p < 0.05$).

Table 4
Comparison of demographic data between first and fourth quartiles of meat-fat dietary pattern in breast cancer patients.[a]

	Meat-fat dietary pattern		p
	Q1	Q4	
Age (y)	55.02 ± 8.31	51.36 ± 10.55	0.057
BH (cm)	1.55 ± 0.06	1.57 ± 0.05	0.041
BW (kg)	55.42 ± 7.67	60.39 ± 10.45	0.008
BMI	23.09 ± 2.73	24.48 ± 4.31	0.057
Education level			0.892
≤Elementary school	14 (28.0)	16 (32.7)	
High school	27 (54.0)	25 (51.0)	
≥College	9 (18.0)	8 (16.3)	
Menarche			0.674
11–14 y/o	34 (68.0)	35 (70.0)	
15 y/o	11 (22.0)	8 (16.0)	
≥16 y/o	5 (10.0)	7 (14.0)	
Primiparity			0.463
20–24 y/o	20 (40.0)	26 (53.1)	
25–29 y/o	20 (40.0)	13 (26.5)	
≥30 y/o	3 (6.0)	4 (8.2)	
Nulliparous	7 (14.0)	6 (12.2)	
Menopause			0.769
None	20 (40.0)	23 (46.0)	
≤35 y/o	1 (2.0)	1 (2.0)	
36–55 y/o	29 (58.0)	25 (50.0)	
56–60 y/o	0 (0.0)	1 (2.0)	
Oral contraceptive			0.489
Current use	1 (2.0)	2 (4.0)	
Past use	8 (16.0)	12 (24.0)	
Never	41 (82.0)	36 (72.0)	
HRT			0.414
Yes	6 (12.0)	10 (20.0)	
No	44 (88.0)	40 (80.0)	
Family history of BC			0.741
Yes	44 (88.0)	46 (92.0)	
No	6 (12.0)	4 (8.0)	
Regular exercise			1.000
Yes	17 (34.0)	18 (36.0)	
No	33 (66.0)	32 (64.0)	
Vitamin, minerals, or other supplements			0.846
No	27 (54.0)	30 (60.0)	
Yes and regular	16 (32.0)	14 (28.0)	
Yes and not regular	7 (14.0)	6 (12.0)	
Smoke			0.012
Nonsmoker	50 (100.0)	43 (86.0)	
Past smoker	0 (0.0)	2 (4.0)	
Current smoker	0 (0.0)	5 (10.0)	
Alcoholic			0.117
Never	50 (100.0)	46 (92.0)	
Quit	0 (0.0)	0 (0.0)	
Current	0 (0.0)	4 (8.0)	

Data are presented as n (%) or mean ± SD.
BC = breast cancer; BH = body high; BMI = body mass index (=BW/BH^2); BW = body weight; HRT = hormone replacement therapy; SD = standard deviation.
[a] Fisher's exact test was used for the analysis of categorical variables and independent sample t test for that of continuous variables.

Table 5
Comparison of dietary oil consumption between first and fourth quartiles of meat-fat dietary pattern in breast cancer patients.[a]

Eating habit	Meat-fat dietary pattern		p
	Q1	Q4	
Sauté meat in oil	1.10 ± 0.46	3.76 ± 1.19	<0.001
Fry meat in oil	1.08 ± 0.34	3.00 ± 1.01	<0.001
Sauté or fry fish in oil	1.14 ± 0.64	4.12 ± 0.94	<0.001
Sauté vegetables in oil	4.14 ± 0.90	4.72 ± 0.81	0.001
Fry vegetables in oil	1.98 ± 0.62	2.12 ± 0.63	0.265
Eat poultry (chicken) with fat and skin	1.14 ± 0.64	3.46 ± 1.40	<0.001
Eat livestock (pork) with fat and skin	1.06 ± 0.24	3.42 ± 1.50	<0.001
Eat rice with lard or gravy	1.42 ± 0.86	2.70 ± 1.30	<0.001
Eat rice or noodles with sauce	2.44 ± 1.05	2.48 ± 1.23	0.862
Eat fried soy products	2.40 ± 1.05	2.36 ± 0.96	0.843
Eat extra salt or seasoning	2.72 ± 1.03	3.12 ± 0.92	0.043
Eat pickles or fermentation foods with meal	3.18 ± 1.26	2.96 ± 0.86	0.309

[a] The analysis was carried out using independent two-sample t test. The range of scores is 1–6; higher scores represent higher frequency.

dietary pattern could lower the risk of breast cancer more than a meat-dim-sum dietary pattern. The different results may be due to different components of the so-called vegetable–fruit dietary pattern. Food components in the vegetable–fruit–soy dietary pattern in Butler et al's [33] study included 23 types of vegetables, five types of beans, and five types of fruits, which is different from the food components in the pickle–vegetable dietary pattern in our study. In addition, the Chinese style of cooking vegetables in oil is different from the Western style of cooking that includes fresh vegetables. Oil cooking may offset the preventive effect of vegetables.

In nutritional epidemiology, PCA is a useful tool to study the association between disease risk and dietary patterns. It transforms a large number of variations of an associated diet and nutrients into smaller and nonassociated variations and finds the principal component in effect. PCA can define a dietary pattern and reflect diet behavior, so it can be used as a scientific basis for recommendations in public health issues. PCA can be affected subjectively by the way the diet is evaluated, adjustment of total energy intake, and selection of the amount of food items. Nevertheless, using PCA to evaluate dietary patterns is becoming a main tool in studying the risk of chronic disease or cancer in a general population.

Two to four dietary patterns have been confirmed to be associated with breast cancer risk [26]. The Western dietary pattern has been defined in three ways. The first definition is characterized by high-fat dairy foods, refined grains, gravy and sauces, fast foods, red and processed meats, potatoes, margarine, polyunsaturated fats, and high-fat, high-sugar desserts [18]. The second definition is characterized by a high intake of processed and red meats, refined grains, sweets and desserts, and high-fat dairy products [29]. The third definition is characterized by the highest loadings on poly- and monounsaturated fats as well as saturated fat [22]. The high-sugar, high-oil dietary pattern includes the meat–sweet dietary pattern, which was studied by Cui et al [26] in China and the fatty dietary pattern by a Japanese study [31]. The high-fat dietary pattern was reported by a study in Uruguay [24]. The meat-fat dietary pattern of our study, which included food components from livestock, seafood, poultry, shellfish, processed meat, fish (sashimi), meat (streaky, organ, and smoked), and milk, increased the risk of breast cancer significantly.

In this study, serum levels of albumin and total cholesterol were significantly lower in the breast cancer group than in the control group. The reason might be different timings for blood sampling. Anxiety and poor appetite in breast cancer patients prior to surgery might have caused lower levels of albumin and total cholesterol than those in the control cases.

The limitations of this study include its small sample size and a lack of data about hormone receptors, which may be important indicators of breast cancer. Another limitation originates from the PCA method, as it captured the correlated profiles of variables that may or may not have any association with the disease.

Overall, our findings suggest a high correlation of the meat-fat pattern with female breast cancer and also demonstrate that oil consumption is increased in this dietary pattern for breast cancer patients. However, we failed to demonstrate a preventative role of a vegetarian dietary pattern on the occurrence of breast cancer. Large study samples in other areas are required to validate this association.

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