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Original Article

The role of tea and coffee in the development of gastroesophageal reflux disease

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Abstract

Objective: The incidence of gastroesophageal reflux disease (GERD) is increasing, and the disease has a close association with dietary habits. This study aims to investigate the role of tea and coffee drinking in the development of GERD. **Materials and Methods:** This study prospectively enrolled individuals who underwent an upper gastrointestinal endoscopy during a health checkup. Each participant completed the reflux disease questionnaire (RDQ). Coffee or tea drinking was defined as drinking the beverage at least 4 days/week for 3 months. Heavy coffee or tea consumption was defined as drinking at least two cups every day. **Results:** A total of 1837 participants (970 men; age 51.57 ± 10.21 years), who had data on clinical characteristics and consumption of coffee and tea with or without additives such as milk or sugar were included for final analysis. Among them, 467 (25.4%) were diagnosed as having symptomatic GERD based on the RDQ score, and 427 (23.2%) had erosive esophagitis (EE) on endoscopy. Drinking coffee or tea was not associated with reflux symptoms or EE in univariate and multivariate analyses. In contrast, drinking coffee with milk was associated with reflux symptoms and drinking "tea and coffee" was associated with EE in univariate analysis. However, these associations became insignificant after multivariate analysis. **Conclusion:** Drinking coffee or tea and adding milk or sugar was not associated with reflux symptoms or EE.

Keywords: *Coffee, Gastroesophageal reflux disease, Helicobacter pylori, Hiatus hernia, Tea*

Introduction

Gastroesophageal reflux disease (GERD) is a common disorder and requires substantial medical resources worldwide [1]. The incidence is increasing in most western and some Asian countries [2]. The prevalence is as high as 25% in Taiwan [3]. It can affect the quality of life, with complications such as esophagitis, ulcers, bleeding, strictures, Barrett's esophagus, and adenocarcinoma [4-6]. The diagnosis depends on typical symptoms such as heartburn and acid regurgitation. However, not all symptomatic patients have esophageal mucosal injury on endoscopy [7]. The pathogenesis may be multifactorial affecting mainly the lower esophageal sphincter [8]. The use of a proton pump inhibitor is the gold standard treatment for relief of reflux symptoms and healing of the mucosal injury. However, the therapeutic response is still unsatisfactory especially for those patients with nonacidic reflux or esophageal hypersensitivity. Research on new compounds and identifying the risk factors of GERD would be helpful in the treatment of refractory GERD [9-11].

Several risk factors such as obesity and hiatus hernia have been associated with the development of GERD [9-11]. However, the role of popular beverages in the development of GERD is still controversial. Coffee and tea are the most popular beverages in the world. People initially drink coffee or tea because of the taste and fragrance. The health benefits of these beverages have been explored in recent years. Coffee had been reported to reduce the risk of metabolic syndrome (MS), Alzheimer's disease, and colon cancer [12-15]. Health benefits have also been found from green and black tea [16]. Green tea can improve MS and obesity [17]. However, studies assessing the association of coffee and tea with GERD are scarce and findings have been inconsistent [18]. In addition, whether additives such as milk or sugar have any impact on GERD has never been discussed. Thus, we performed a cross-sectional study using a large-scale health checkup cohort to clarify

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whether the consumption of tea and coffee and additives affects the development of GERD.

Materials and methods

Study participants

A total of 2604 participants who underwent an upper gastrointestinal endoscopy during a health checkup at the Health Examination Center of Taipei Tzu Chi Hospital from March 2012 to August 2013 were enrolled prospectively. Participants with missing clinical or biochemical data (n = 445) or incomplete answers about their coffee or tea consumption (n = 322) were excluded from the study. Each participant completed the reflux disease questionnaire (RDQ). The RDQ was previously validated as an instrument for the diagnosis of symptomatic GERD [10,11,19]. The Clinical and biochemical data and information on coffee and tea consumption were collected. Coffee or tea drinking was defined as drinking the beverage at least 4 days/week for 3 months. Heavy coffee or tea consumption was defined as drinking at least two cups every day. Sugar or milk use was defined t as use of the additive more than 80% of the time. The Ethics Committees of Taipei Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation approved this study and each participant provided informed consent (01-XD08-013).

Reflux disease questionnaire and endoscopic findings

In our study, a face-to-face interview was performed during the health checkup, and the questionnaire was completed at the same interview. The RDQ was designed to assess the symptoms of heartburn, acid regurgitation, and dyspepsia. It includes 12 questions on the frequency and severity of burning and pain behind the breastbone, an acid taste in the mouth, movement of materials upward from stomach, and burning and pain in the upper stomach [20,21]. Responses range from 0 to 5 points. After excluding the dyspepsia scale, scores for the RDQ range from 0 to 40. Symptomatic GERD is defined as mild reflux symptoms at least two times/week or moderate reflux symptoms at least once per week. An esophagogastroduodenoscopy was performed on each participant under sedation. Experienced endoscopists were performed all procedures and were blinded to the results of the questionnaire. Erosive esophagitis (EE) on endoscopy was graded from A to D according to the Los Angeles classification [22]. Another experienced endoscopist reviewed the endoscopic imaging to confirm a diagnosis of EE. If there was disagreement on the diagnosis, the final diagnosis was made by consensus of three experienced endoscopists.

Personal and medical information

Personal data, including age, gender, body mass index (BMI), and history of hyperlipidemia, diabetes mellitus, hypertension, smoking, alcohol drinking, and use of aspirin and a nonsteroidal anti-inflammatory drugs (NSAIDs), were collected. The definition of alcohol drinking in our study was drinking alcohol at least once per week. The use of aspirin and an NSAID was defined as having taken these drugs in the previous 3 months. An automatic analyzer measured serum fasting blood glucose, total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL), and triglycerides (TGs) (Roche Analytics; Roche Professional Diagnostics, Penzberg, Germany). *Helicobacter pylori* infection was assessed by a rapid urease test during the esophagogastroduodenoscopy.

Statistical analysis

We used SAS Version 9.2 (SAS Institute, Cary, NC, USA) to perform all analyses. Continuous data were presented as mean with standard deviations while categorical data were presented as percentages. The Chi-square test and Student's t-test were applied to analyze continuous and categorical variables. The association of potential risk factors with symptomatic GERD or EE was determined using multivariate analysis. $P < 0.05$ was considered statistically significant.

Results

Personal and clinical data from the study samples

A total of 1837 participants were recruited for the final analysis. Of these, 1197 (65.2%) drank coffee, of which 185 (15.5%) participants were heavy coffee drinkers. In total, 538 (44.9%) subjects added milk to their coffee and 340 (28.4%) participants added sugar. A total of 1215 (66.1%) participants drank tea. Of these, 275 (22.6%) participants were defined as heavy tea drinkers. In total, 49 (4%) participants added sugar to their tea. *H. pylori* were positive in 493 (26.8%) participants. Altogether 467 (25.4%) participants were diagnosed with symptomatic GERD based on RDQ scores and 427 (23.2%) participants had EE on endoscopy. The relationship between reflux symptoms and EE is presented in Table 1. The percentage of consistence between reflux symptoms and EE EE was 65.6%. Personal and clinical data stratified by gender are shown in Table 2. In our study samples, men had higher percentages of heavy tea drinking, smoking, alcohol consumption, use of aspirin, hypertension, hyperlipidemia, *H. pylori* infection, hiatus hernia, and EE; however, a lower percentage of adding milk to coffee than women. Furthermore, men had higher BMIs, and glucose and TG levels, but lower HDL levels than women.

Clinical characteristics of patients with gastroesophageal reflux disease and erosive esophagitis

There were significant differences regarding adding milk to coffee, serum TG level <150, serum LDL level <130, and the presence of *H. pylori* between those with and without symptomatic GERD. There were no significant differences in these groups for tea drinking, heavy tea drinking, adding sugar to tea, coffee drinking, heavy coffee drinking, adding sugar to coffee or drinking "tea and coffee." There were significant differences regarding gender, BMI <25, drinking "tea and coffee," smoking, hypertension, hyperlipidemia, TG levels <150, HDL levels >40, HbA1c levels <6, *H. pylori*, and hiatus hernia between subjects with and without EE. There were no significant differences in tea drinking, heavy tea drinking, adding

Table 1: Relationship between reflux symptoms and erosive esophagitis in the study samples

Gastroesophageal reflux disease	Erosive esophagitis (n=427), n (%)	No erosive esophagitis (n=1410), n (%)
Yes, n=467	131 (28.05)	336 (71.95)
No, n=1370	296 (21.61)	1074 (78.39)

Table 2: Personal and clinical data of the study samples stratified by gender

	n=1837	Male, *n*=970	Female, *n*=867	*P*
Age				
Mean±SD	51.57±10.21	51.72±10.38	51.41±10.03	0.508
Median (range)	53 (20.03-70)	53 (20.03-70)	52.93 (20.97-70)	
Age <65	1704 (92.76)	887 (91.44)	817 (94.23)	0.021
BMI				
Mean±SD	23.85±3.55	24.75±3.43	22.85±3.42	<0.001
Median (range)	23.53 (15.32-45.48)	24.38 (15.32-39.89)	22.39 (15.60-45.48)	
BMI <25	1239 (67.45)	566 (58.35)	673 (77.62)	<0.001
Tea, *n* (%)				
No	622 (33.86)	277 (28.56)	345 (39.79)	<0.001
Yes	1215 (66.14)	693 (71.44)	522 (60.21)	
Heavy tea (>2/day), *n* (%)				
No	1562 (85.03)	796 (82.06)	766 (88.35)	<0.001
Yes	275 (14.97)	174 (17.94)	101 (11.65)	
Sugar with tea, *n* (%)*				
No	1138 (93.66)	644 (92.93)	494 (94.64)	0.277
Yes (≥4)	77 (6.34)	49 (7.07)	28 (5.36)	
Coffee, *n* (%)				
No	640 (34.84)	329 (33.92)	311 (35.87)	0.380
Yes	1197 (65.16)	641 (66.08)	556 (64.13)	
Heavy coffee (>2/day), *n* (%)				
No	1652 (89.93)	865 (89.18)	787 (90.77)	0.256
Yes	185 (10.07)	105 (10.82)	80 (9.23)	
Milk with coffee (%)*				
No	651 (54.39)	367 (57.25)	284 (51.08)	0.032
Yes (≥4)	546 (45.61)	274 (42.75)	272 (48.92)	
Sugar with coffee, *n* (%)*				
No	846 (70.68)	439 (68.49)	407 (73.20)	0.074
Yes (≥4)	351 (29.32)	202 (31.51)	149 (26.80)	
Smoking, *n* (%)				
No	1646 (89.60)	803 (82.78)	843 (97.23)	<0.001
Yes	191 (10.40)	167 (17.22)	24 (2.77)	
Alcohol, *n* (%)				
No	1715 (93.36)	868 (89.48)	847 (97.69)	<0.001
Yes	122 (6.64)	102 (10.52)	20 (2.31)	
Diabetes mellitus, *n* (%)				
No	1715 (93.36)	898 (92.58)	817 (94.23)	0.155
Yes	122 (6.64)	72 (7.42)	50 (5.77)	
Hypertension, *n* (%)				
No	1488 (81.00)	746 (76.91)	742 (85.58)	<0.001
Yes	349 (19.00)	224 (23.09)	125 (14.42)	
Hyperlipidemia, *n* (%)				
No	1663 (90.53)	863 (88.97)	800 (92.27)	0.016
Yes	174 (9.47)	107 (11.03)	67 (7.73)	
Aspirin, *n* (%)				
No	1783 (97.06)	931 (95.98)	852 (98.27)	0.004
Yes	54 (2.94)	39 (4.02)	15 (1.73)	
NSAID, *n* (%)				
No	1744 (94.94)	916 (94.43)	828 (95.50)	0.297
Yes	93 (5.06)	54 (5.57)	39 (4.50)	
TG				
Mean±SD	112.16±71.43	123.36±79.71	99.63±58.39	<0.001
Median (range)	93 (19-641)	102.5 (20-641)	85 (19-421)	
TG <150	1447 (78.77)	711 (73.30)	736 (84.89)	<0.001
Cholesterol				
Mean±SD	188.50±38.46	185.69±38.48	191.65±38.21	0.001

Contd...

Table 2: Contd...

	n=1837	Male, *n*=970	Female, *n*=867	*P*
Median (range)	186 (79-384)	182 (97-384)	189 (79-353)	
Cholesterol <200	1176 (64.02)	636 (65.57)	540 (62.28)	0.143
HDL				
Mean±SD	50.76±15.39	44.80±12.51	57.42±15.57	<0.001
Median (range)	49 (16-178)	43 (16-102)	56 (22-178)	
HDL ≥40	1357 (73.87)	587 (60.52)	770 (88.81)	<0.001
LDL				
Mean±SD	120.53±33.02	121.88±32.99	119.01±33.01	0.062
Median (range)	119 (22-281)	120 (26-281)	117 (22-255)	
LDL <130	1186 (64.56)	611 (62.99)	575 (66.32)	0.136
Glucose				
Mean±SD	97.86±22.14	98.94±24.69	96.65±18.82	0.025
Median (range)	94 (60-318)	94 (60-318)	93 (60-284)	
Glucose <100	1299 (70.71)	672 (69.28)	627 (72.32)	0.153
HbA1C				
Mean±SD	5.62±1.33	5.68±1.71	5.56±0.69	0.032
Median (range)	5.5 (3.9-50)	5.5 (3.9-50)	5.5 (3.9-13)	
HbA1C <6	1526 (83.07)	795 (81.96)	731 (84.31)	0.179
Helicobacter pylori, *n* (%)				
Negative	1344 (73.16)	688 (70.93)	656 (75.66)	0.022
Positive	493 (26.84)	282 (29.07)	211 (24.34)	
Hiatus hernia, *n* (%)				
Negative	1772 (96.46)	926 (95.46)	846 (97.58)	0.014
Positive	65 (3.54)	44 (4.54)	21 (2.42)	
GERD, *n* (%)				
No	1370 (74.58)	727 (74.95)	643 (74.16)	0.700
Yes	467 (25.42)	243 (25.05)	224 (25.84)	
Erosive esophagitis, *n* (%)				
No	1410 (76.76)	693 (71.44)	717 (82.70)	<0.001
Yes	427 (23.24)	277 (28.56)	150 (17.30)	

*Percentages were obtained from the population that drank tea or coffee. BMI: Body mass index, NSAID: Nonsteroid anti-inflammatory drug, TG: Triglyceride, HDL: High-density lipoprotein, LDL: Low-density lipoprotein, HbA1C: Glycated hemoglobin, GERD: Gastroesophageal reflux disease, SD: Standard deviation

sugar to tea, coffee drinking, heavy coffee drinking, adding milk to coffee, adding sugar to coffee, or drinking "tea and coffee" [Table 3].

Factors associated with reflux symptoms and erosive esophagitis on endoscopy using multivariate analysis

Multivariate analysis showed that LDL levels <130 and *H. pylori* infection were associated with reflux symptoms. Female gender, BMI <25, *H. pylori* infection, and hiatus hernia were associated with EE [Table 4].

Factors associated with erosive esophagitis using multivariate analysis stratified by gender

In our study samples, *H. pylori* infection and hiatus hernia were associated with EE in men. BMI <25, use of aspirin and hiatus hernia were associated with EE in women [Table 5].

Discussion

In this study of 1837 participants from a health examination center, 467 (25.4%) were diagnosed as having symptomatic GERD according to RDQ scores and 427 (23.3%) had EE on endoscopy. Serum LDL levels and *H. pylori* infection were associated with reflux symptoms. Gender, BMI, *H. pylori* infection, and hiatus hernia were associated with EE on endoscopy. Our data concluded that drinking tea or coffee, and adding sugar or milk was not associated with reflux symptoms or EE.

GERD is diagnosed based on typical reflux symptoms including heartburn and/or regurgitation. The prevalence of GERD ranges from 2.5% to 33.1% in different areas of the world [23]. A previous Taiwanese study reported that the prevalence of GERD was 25% in the community [3]. The prevalence of GERD in our study was 25.4%, which is consistent with the previous report. In GERD patients, reflux symptoms had incomplete correspondence with EE on endoscopy. A population-based endoscopic study showed that two-thirds of the patients reporting reflux symptoms had no EE [24]. Our previous study found that 14.5% of an asymptomatic population had EE [11]. In our study samples, 71.95% of symptomatic GERD patients had nonerosive reflux disease and asymptomatic EE was found in 21.61% of the asymptomatic population. Our study similarly found incomplete correspondence between reflux symptoms and EE.

Food, beverages, and lifestyle have impacts on the development of GERD [25-28]. Some previous studies reported a therapeutic effect of tea on *H. pylori* infection and peptic ulcer [29-31]. However, the role of tea, and coffee in the development of GERD is controversial [32,33] For example,

Table 3: Comparison of clinical characteristics of between patients with and without symptomatic gastroesophageal reflux disease or erosive esophagitis

	Symptomatic GERD			Erosive esophagitis		
	Yes (*n*=467), *n* (%)	No (*n*=1370), *n* (%)	*P*	Yes (*n*=427), *n* (%)	No (*n*=1410), *n* (%)	*P*
Age<65	442 (94.65)	1262 (92.12)	0.068	395 (92.51)	1309 (92.84)	0.817
Sex, male	243 (52.03)	727 (53.07)	0.700	150 (35.13)	717 (50.85)	<0.001
BMI<25	303 (64.88)	936 (68.32)	0.171	249 (58.31)	990 (70.21)	<0.001
Tea, yes	319 (68.31)	896 (65.40)	0.252	274 (64.17)	941 (66.74)	0.326
Heavy tea (>2/day), yes	68 (14.56)	207 (15.11)	0.774	64 (14.99)	211 (14.96)	0.990
Sugar with tea (≥4), yes*	23 (7.21)	54 (6.03)	0.456	19 (6.93)	58 (6.16)	0.645
Coffee, yes	317 (67.88)	880 (64.23)	0.153	269 (63.00)	928 (65.82)	0.284
Heavy coffee (>2/day), yes	48 (10.28)	137 (10.00)	0.863	43 (10.07)	142 (10.07)	1.000
Milk with coffee (≥4), yes*	161 (50.79)	385 (43.75)	0.031	117 (43.49)	429 (46.23)	0.428
Sugar with coffee (≥4), yes*	105 (33.12)	246 (27.95)	0.083	78 (29.00)	273 (29.42)	0.894
Tea and coffee, yes	257 (55.03)	694 (50.66)	0.102	202 (47.31)	749 (53.12)	0.035
Smoking	55 (11.78)	136 (9.93)	0.258	62 (14.52)	129 (9.15)	0.001
Alcohol	33 (7.07)	89 (6.50)	0.669	36 (8.43)	86 (6.10)	0.090
Diabetes mellitus	33 (7.07)	89 (6.50)	0.669	32 (7.49)	90 (6.38)	0.419
Hypertension	78 (16.70)	271 (19.78)	0.143	97 (22.72)	252 (17.87)	0.025
Hyperlipidemia	48 (10.28)	126 (9.20)	0.491	54 (12.65)	120 (8.51)	0.011
Aspirin	16 (3.43)	38 (2.77)	0.471	12 (2.81)	42 (2.98)	0.857
NSAID	27 (5.78)	66 (4.82)	0.412	20 (4.68)	73 (5.18)	0.684
TG (<150)	352 (75.37)	1095 (79.93)	0.038	304 (71.19)	1143 (81.06)	<0.001
Cholesterol (<200)	289 (61.88)	887 (64.74)	0.266	261 (61.12)	915 (64.89)	0.155
HDL (≥40)	339 (72.59)	1018 (74.31)	0.466	281 (65.81)	1076 (76.31)	<0.001
LDL (<130)	275 (58.89)	911 (66.50)	0.003	265 (62.06)	921 (65.32)	0.218
Glucose (<100)	327 (70.02)	972 (70.95)	0.704	308 (72.13)	991 (70.28)	0.462
HbA1C (<6)	388 (83.08)	1138 (83.07)	0.993	339 (79.39)	1187 (84.18)	0.021
Helicobacter pylori	107 (22.91)	386 (28.18)	0.027	77 (18.03)	416 (29.50)	<0.001
Hiatus hernia	17 (3.64)	48 (3.50)	0.890	53 (12.41)	12 (0.85)	<0.001

*Percentages were obtained from the population that drank tea or coffee. GERD: Gastroesophageal reflux disease, BMI: Body mass index, NSAID: Nonsteroid anti-inflammatory drug, HDL: High-density lipoprotein, LDL: Low-density lipoprotein, HbA1C: Glycated hemoglobin, TG: Triglyceride

a cross-sectional questionnaire study found 23.4% of 2853 participants had GERD. They found green tea drinkers had a higher risk of GERD with an odds ratio of 1.44 [34]. However, a Chinese cohort study including 8831 retirees found no significant association between tea and reflux symptoms [35]. In addition, an Indian study in a high altitude area revealed that salt tea had a protective effect against GERD [36]. Another German study using an ambulatory pH meter showed that coffee, but not tea increased gastroesophageal reflux [37]. Coffee was found to be a risk factor for GERD in some studies [32,33]. In contrast, a case–control study including 3153 individuals showed a negative association between exposure to coffee and reflux symptoms [25]. These inconsistent findings can be attributed to the different types of tea and coffee or the study population. In addition, additives, such as sugar or milk, were not discussed. Our survey revealed that tea, coffee, and added sugar or milk were not associated with reflux symptoms or EE.

H. pylori infection may protect against the development of GERD and its complications [38,39]. Hiatus hernia is known to be a major risk factor in GERD development [40-43]. Our study consistently found that the presence of hiatus hernia increased the risk of EE. In contrast, *H. pylori* infection seems to protect an individual from development of reflux symptoms and EE.

A Taiwanese study recruiting 1238 residents in a community revealed female gender, age of 40–49 years, and age of 50–59 years were independent risk factors for GERD [3]. However, a systemic review did not find that female gender was a risk factor of GERD [1]. Our results showed that women had a lower risk of EE, but not associated with reflux symptoms. Except for hiatus hernia, the risk factors for EE were different between *t* genders. *H. pylori* infection was associated with EE in men, but BMI and use of aspirin showed an association in women. The complex associations among gender, risk factors, and GERD need further investigation. Although older patients may underreport reflux symptoms, two European studies revealed a trend of older patients with a high prevalence of GERD [44,45]. Our results showed that older age was not associated with reflux symptoms and EE.

Obesity, especially abdominal obesity may increase intragastric pressure, the gastroesophageal gradient, transient lower esophageal sphincter relaxation, and the duration of esophageal acid exposure and is currently considered a risk factor of for EE [9,46]. Our study found that BMI was associated with EE in women.

Our study has several strengths. This is the first study to investigate tea, coffee, and additives such as sugar or milk in the development of GERD. In addition, since our study included the results of a questionnaire and endoscopic findings,

Table 4: Factors associated with gastroesophageal reflux disease and erosive esophagitis using multivariate analysis

	GERD				Erosive esophagitis			
	Crude OR (95% CI)	*P*	Adjusted OR (95% CI)	*P*	Crude OR (95% CI)	*P*	Adjusted OR (95% CI)	*P*
Age <65	1.51 (0.97-2.37)	0.070			0.95 (0.63-1.44)	0.817		
Sex, female	1.04 (0.84-1.29)	0.700			0.52 (0.42-0.66)	<0.001	0.60 (0.46-0.77)	<0.001
BMI <25	0.86 (0.69-1.07)	0.171			0.59 (0.47-0.74)	<0.001	0.73 (0.56-0.94)	0.016
Tea, yes	1.14 (0.91-1.43)	0.252	1.13 (0.87-1.46)	0.362	0.89 (0.71-1.12)	0.326	0.86 (0.65-1.13)	0.284
Heavy tea (>2/day), yes	0.96 (0.71-1.29)	0.774	0.91 (0.66-1.25)	0.561	1.00 (0.74-1.36)	0.990	0.93 (0.65-1.31)	0.663
Sugar with tea (≥4), yes	1.21 (0.73-2.01)	0.457			1.13 (0.66-1.94)	0.645		
Coffee, yes	1.18 (0.94-1.47)	0.153	1.11 (0.86-1.43)	0.410	0.88 (0.71-1.11)	0.284	0.90 (0.69-1.18)	0.463
Heavy coffee (>2/day), yes	1.03 (0.73-1.46)	0.863	0.99 (0.69-1.43)	0.974	1.00 (0.70-1.43)	1.000	0.97 (0.65-1.46)	0.887
Milk with coffee (≥4), yes	1.33 (1.03-1.72)	0.031			0.90 (0.68-1.18)	0.428		
Sugar with coffee (≥4), yes	1.28 (0.97-1.68)	0.083			0.98 (0.73-1.32)	0.894		
Tea and coffee, yes	1.19 (0.97-1.47)	0.102			0.79 (0.64-0.98)	0.035		
Smoking	1.21 (0.87-1.69)	0.258			1.69 (1.22-2.33)	0.002	1.32 (0.92-1.90)	0.136
Alcohol	1.09 (0.72-1.66)	0.669	1.07 (0.70-1.62)	0.751	1.42 (0.95-2.13)	0.091		
Diabetes mellitus	1.09 (0.72-1.66)	0.669			1.19 (0.78-1.81)	0.420		
Hypertension	0.81 (0.62-1.07)	0.144			1.35 (1.04-1.76)	0.026	1.02 (0.75-1.38)	0.911
Hyperlipidemia	1.13 (0.80-1.61)	0.491			1.56 (1.11-2.19)	0.011	1.11 (0.75-1.65)	0.591
Aspirin	1.24 (0.69-2.25)	0.472			0.94 (0.49-1.81)	0.857		
NSAIDs	1.21 (0.76-1.92)	0.412			0.90 (0.54-1.49)	0.684		
TG <150	0.77 (0.60-0.99)	0.038	0.80 (0.62-1.03)	0.086	0.58 (0.45-0.74)	<0.001	0.78 (0.58-1.04)	0.091
Cholesterol <200	0.88 (0.71-1.10)	0.266			0.85 (0.68-1.06)	0.155		
HDL ≥40	0.92 (0.72-1.16)	0.466			0.60 (0.47-0.76)	<0.001	0.92 (0.69-1.22)	0.546
LDL <130	0.72 (0.58-0.90)	0.003	0.74 (0.59-0.92)	0.006	0.87 (0.69-1.09)	0.218		
Glucose <100	0.96 (0.76-1.20)	0.704			1.09 (0.86-1.39)	0.462		
HbA1C <6	1.00 (0.76-1.32)	0.993			0.72 (0.55-0.95)	0.021	0.84 (0.62-1.14)	0.256
Helicobacter pylori	0.76 (0.59-0.97)	0.027	0.75 (0.59-0.96)	0.023	0.53 (0.40-0.69)	<0.001	0.53 (0.40-0.70)	<0.001
Hiatus hernia	1.04 (0.59-1.83)	0.890			16.51 (8.73-31.21)	<0.001	13.80 (7.20-26.45)	<0.001

GERD: Gastroesophageal reflux disease, BMI: Body mass index, NSAIDs: Nonsteroid anti-inflammatory drugs, HDL: High-density lipoprotein, LDL: Low-density lipoprotein, HbA1C: Glycated hemoglobin, OR: Odds ratio, CI: Confidence interval, TG: Triglyceride

Table 5: Factors associated with erosive esophagitis on endoscopy using multivariate analysis stratified by gender

	Male				Female			
	Crude OR (95% CI)	*P*	Adjusted OR (95% CI)	*P*	Crude OR (95% CI)	*P*	Adjusted OR (95% CI)	*P*
Age <65	0.98 (0.60-1.61)	0.940			1.10 (0.51-2.40)	0.802		
BMI <25	0.89 (0.67-1.18)	0.417			0.39 (0.26-0.56)	<0.001	0.42 (0.27-0.65)	<0.001
Tea, yes	0.87 (0.64-1.17)	0.354	0.94 (0.66-1.35)	0.744	0.76 (0.53-1.08)	0.128	0.78 (0.50-1.21)	0.263
Heavy tea (>2/day), yes	0.88 (0.61-1.27)	0.495	0.89 (0.59-1.36)	0.594	1.04 (0.61-1.79)	0.883	1.05 (0.57-1.93)	0.869
Sugar with tea (≥4), yes	0.84 (0.43-1.64)	0.602			1.86 (0.76-4.53)	0.171		
Coffee, yes	0.89 (0.67-1.20)	0.449	0.86 (0.61-1.22)	0.407	0.84 (0.58-1.20)	0.331	0.98 (0.63-1.52)	0.924
Heavy coffee (>2/day), yes	0.95 (0.60-1.49)	0.822	0.86 (0.52-1.43)	0.558	1.02 (0.55-1.86)	0.961	1.16 (0.60-2.26)	0.658
Milk with coffee (≥4), yes	1.13 (0.80-1.60)	0.486			0.67 (0.43-1.06)	0.086		
Sugar with coffee (≥4), yes	1.00 (0.69-1.45)	0.986			0.85 (0.50-1.43)	0.537		
Tea and coffee, yes	0.88 (0.66-1.16)	0.354			0.60 (0.42-0.87)	0.006		
Smoking	1.51 (1.06-2.15)	0.021	1.43 (0.97-2.09)	0.070	0.43 (0.10-1.84)	0.253	0.62 (0.14-2.71)	0.527
Alcohol	1.10 (0.71-1.73)	0.664			1.61 (0.58-4.51)	0.361		
Diabetes mellitus	0.89 (0.52-1.53)	0.672			1.74 (0.90-3.37)	0.098		
Hypertension	1.00 (0.72-1.39)	0.996			1.92 (1.23-2.99)	0.004	1.27 (0.77-2.09)	0.356
Hyperlipidemia	1.51 (0.99-2.29)	0.057			1.42 (0.78-2.60)	0.254		
Aspirin	0.44 (0.18-1.07)	0.070			3.28 (1.15-9.35)	0.026	3.79 (1.26-11.34)	0.017
NSAID	0.78 (0.41-1.49)	0.454			1.05 (0.45-2.42)	0.913		
TG <150	0.64 (0.47-0.87)	0.004	0.72 (0.51-1.01)	0.059	0.62 (0.40-0.97)	0.038	0.85 (0.52-1.41)	0.531
Cholesterol <200	0.76 (0.57-1.01)	0.059			0.95 (0.66-1.37)	0.792		
HDL ≥40	0.75 (0.57-0.99)	0.048	0.88 (0.64-1.21)	0.435	0.64 (0.38-1.05)	0.079		
LDL <130	0.89 (0.67-1.18)	0.420			0.88 (0.61-1.28)	0.509		
Glucose <100	1.10 (0.81-1.50)	0.528			1.16 (0.77-1.73)	0.480		
HbA1C <6	0.74 (0.52-1.05)	0.096			0.73 (0.46-1.15)	0.178		
Helicobacter pylori	0.44 (0.31-0.62)	<0.001	0.47 (0.33-0.67)	<0.001	0.64 (0.41-0.99)	0.048	0.67 (0.42-1.07)	0.092
Hiatus hernia	15.11 (6.65-34.34)	<0.001	13.20 (5.75-30.32)	<0.001	17.00 (6.13-47.20)	<0.001	15.86 (5.54-45.40)	<0.001

BMI: Body mass index, NSAID: Nonsteroid anti-inflammatory drug, HDL: High-density lipoprotein, LDL: Low-density lipoprotein, HbA1C: Glycated hemoglobin, TG: Triglyceride, OR: Odds ratio, CI: Confidence interval

the risk factors for reflux symptoms or EE could be identified. However, some limitations should be acknowledged. First, we only recorded the number of cups of coffee or tea per day, but not the strength of the coffee or tea. Furthermore, the types of tea such as green, black, or salt tea were not included in our questionnaire. Second, some medications are known to increase the risk of reflux symptoms and esophageal mucosal injury [47]. Although the medication history, except for aspirin and NSAIDS, was not recorded in our study, this confounding effect might be minimal due to the relatively healthy condition of our study samples from a health examination center. Finally, since our study was cross-sectional, causal relationships cannot be determined.

In summary, drinking tea or coffee and adding sugar or milk was not associated with reflux symptoms or EE. Factors associated with reflux symptoms and EE included metabolic factors and hiatus hernia. In contrast, female gender and *H. pylori* infection seem to have a protective to against the development of EE.

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Conflicts of interest

There are no conflicts of interest.

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