



Heartburn, Functional Dyspepsia, Anxiety/Depression, and Sleep Disturbances Are Associated With Clinically Significant Belching

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Background/Aims

Belching is the act of expelling gas from the stomach or esophagus noisily through the oral cavity. Although it is a physiological phenomenon, belching may also be a symptom of upper gastrointestinal diseases such as reflux esophagitis and functional dyspepsia (FD). A detailed epidemiology of belching has not yet been reported. The aim of this study is to examine the prevalence and clinical characteristics of clinically significant belching (CSB) in adults.

Methods

We analyzed 1998 subjects who visited the hospital for annual health checkups. Belching was evaluated by a simple question “Do you burp a lot?” and scored as 0 (never), 1 (occasionally), 2 (sometimes), 3 (often), or 4 (always). Subjects with CSB were defined as having scores ≥ 3 . We also collected the clinical parameters, endoscopic findings, and data according to the Athens Insomnia Scale, Rome IV questionnaire, and Hospital Anxiety and Depression Scale (HADS).

Results

Of the 1998 subjects, 121 (6.1%) had CSB. Subjects with CSB had FD more commonly than reflux esophagitis, but presence of heartburn was high (10.7% vs 3.1%). In addition, the HADS and Athens Insomnia Scale scores in subjects with CSB were significantly higher than those in subjects without CSB. Presence of heartburn (OR, 2.07; 95% CI, 1.05-4.09), presence of FD (OR, 2.12; 95% CI, 1.33-3.36), anxiety/depression (OR, 2.29; 95% CI 1.51-3.45), and sleep disturbances (OR, 1.73; 95% CI, 1.14-2.61) were significantly associated with CSB.

Conclusion

The detailed epidemiology of belching in the general adult population was clarified.

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Key Words

Anxiety; Depression; Dyspepsia; Eructation; Sleep

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Introduction

Belching is the act of expelling gas from the stomach or esophagus noisily through the oral cavity,^{1,2} and healthy adults experience belching as a physiological phenomenon. Belching is not a specific symptom of upper gastrointestinal (GI) diseases, but patients with reflux esophagitis (RE) commonly complain of belching³ since gastroesophageal reflux and gastric belching are caused by transient lower esophageal sphincter relaxation.⁴ In addition, 59-80% of patients with functional dyspepsia (FD) reported frequent belching.^{5,6} Several studies have reported the prevalence and clinical characteristics of reflux and dyspeptic symptoms in the general population.⁷⁻¹⁰ However, a detailed epidemiology of belching has not been established. The aim of this study is to examine the prevalence and clinical characteristics of clinically significant belching (CSB) and the association between CSB and RE, FD, psychological stress, and sleep disturbances in adults.

Materials and Methods

Data

This study was performed using data from our previous study. A detailed methodology has been previously described.⁸ Data of 1998 Japanese subjects with annual health checkups at Kashiwara Municipal Hospital were analyzed. These included clinical parameters such as age, sex, smoking and alcohol drinking status, upper GI endoscopy findings, and the results of a self-report questionnaire comprising a frequency scale for the symptoms of gastroesophageal reflux disease (FSSG),¹¹ Athens Insomnia Scale (AIS),¹² Rome IV questionnaire,¹³ and Hospital Anxiety and Depression Scale (HADS).¹⁴ Patients who continuously used acid-suppressing drugs, had active peptic ulcer disease, or had a history of upper GI surgery were excluded. This study was approved by the Ethics Committee of Kashiwara Municipal Hospital (IRB No. 23-18). Written informed consent was obtained from all subjects, and all procedures were performed in accordance with the Declaration of Helsinki.

Definition of Reflux Esophagitis and Functional Dyspepsia

RE was defined as the presence of an esophageal mucosal break, according to the Los Angeles classification (grade A and above).¹⁵ FD was defined as the absence of gastric lesions such as

ulcers and erosions during upper GI endoscopy and fulfilled criteria according to the Rome IV.¹³ FD was subdivided into epigastric syndrome (EPS) and postprandial distress syndrome (PDS) based on the symptoms.¹³

Assessment of Belching and Heartburn

We evaluated the presence of belching by a simple question, "Do you burp a lot?", which is the 11th question on the FSSG. Belching was scored by its frequency: 0 (none), 1 (occasionally), 2 (sometimes), 3 (often), and 4 (always).¹¹ Subjects with CSB were defined as having scores ≥ 3 . Frequency of heartburn was assessed by the first question "Do you have heartburn?" in the FSSG and scored using the same scale of belching.¹¹ Similarly, presence of significant heartburn was defined as scores ≥ 3 .

Statistical Methods

Values are expressed as mean \pm SD and numbers (percentages) for continuous and categorical variables, respectively. Categorical data were compared between groups using the chi-square test, while data from each group were statistically analyzed using the Kruskal-Wallis test. *P*-values < 0.05 were considered significant. The association between belching and heartburn frequency was assessed using the Pearson correlation coefficient. A backward stepwise multiple logistic regression model was created to identify the independent factors associated with CSB. First, we analyzed several factors including age (< 65 or ≥ 65 years), sex (male or female), body mass index (BMI) calculated by body weight divided by the squared height (< 25 kg/m² or ≥ 25 kg/m²), waist circumference (< 85 cm or ≥ 85 cm), smoking habits (current smoker or nonsmoker), alcohol consumption habits (frequent drinker or infrequent/nondrinker), RE (present or absent), heartburn (present or absent), AIS scores (< 6 or ≥ 6 , absence or presence of sleep disturbances),⁸ FD (present or absent based on Rome IV criteria),⁹ and HADS scores (< 8 or ≥ 8 , absence or presence of anxiety/depression).¹⁰ We calculated the odds ratio (OR) with 95% confidence intervals (CI) and excluded statistically insignificant factors using the Wald test. All statistical analyses were performed using EZR (Saitama Medical Center, Jichi Medical University, Saitama, Japan), a graphical user interface for R (The R Foundation for Statistical Computing, Vienna, Austria). More precisely, it is a modified version of R commander designed to add statistical functions frequently used in biostatistics.¹⁶

Results

Prevalence of Belching and Clinical Characteristics in Adults

Figure 1 shows the prevalence of belching in adults. Among 1998 subjects, 28 (1.4%) always experienced belching, 93 (4.7%) often, 226 (11.3%) sometimes, and 463 (23.2%) occasionally. This shows that 121 (6.1%) subjects had CSB. The clinical parameters of the subjects according to the frequency of belching are shown in Table 1. When we compared clinical factors between subjects with and without CSB, we found that subjects with CSB had FD more commonly than RE. However, presence of heartburn was significantly higher in subjects with CSB compared with those without CSB. There were no significant differences in age, sex, BMI, waist circumference, and smoking or alcohol consumption habits between

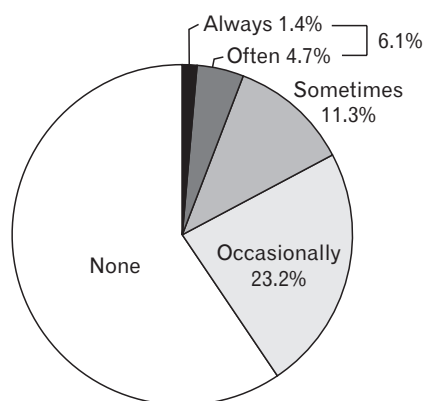


Figure 1. Prevalence of belching in adults.

Table 1. Clinical Characteristics of the Study Subjects

Factors	Frequency of belching				
	None (n = 1188)	Occasionally (n = 463)	Sometimes (n = 226)	Often (n = 93)	Always (n = 28)
Age (yr)	61.7 ± 11.9	60.2 ± 11.8	60.7 ± 12.0	60.5 ± 13.1	54.6 ± 15.2
Male sex	654 (55)	265 (57)	154 (68)	51 (5)	13 (46)
BMI (kg/m ²)	23.0 ± 3.3	23.0 ± 3.3	22.7 ± 3.7	23.2 ± 3.3	22.4 ± 3.4
Waist circumference (cm)	84.1 ± 25.5	83.3 ± 9.6	82.6 ± 10.4	83.7 ± 8.8	80.4 ± 11.4
Alcohol drinkers	252 (21)	109 (24)	52 (23)	24 (26)	10 (25)
Cigarette smokers	190 (16)	69 (15)	44 (19)	11 (12)	7 (25)
Presence of RE	151 (13)	69 (15)	35 (15)	8 (9)	2 (7)
Presence of FD	93 (8)	61 (13)	42 (19)	23 (25)	10 (36)

BMI, body mass index; RE, reflux esophagitis; FD, functional dyspepsia. Data are presented as mean ± SD or n (%).

the 2 groups (Table 2).

Association Between Belching and Severity of Reflux Esophagitis or Heartburn

RE was found in 265 (13.3%) subjects, including 204 (10.2%) with grade A, 53 (2.7%) with grade B, and 8 (0.4%) with grade C. The prevalence of RE and its severity according to the frequency of belching is shown in Figure 2A. The prevalence of RE did not change among subjects with belching ($P = 0.312$), and the severity of RE did not correlate with the frequency of belching. Figure 2B shows the association of frequency between belching and heartburn. There was a weak positive correlation between the frequency of belching and heartburn ($r = 0.338$).

Table 2. Clinical Characteristics of Clinically Significant Belching

Factors	CSB (–) (n = 1877)	CSB (+) (n = 121)	P-value
Age (yr)	61.2 ± 11.9	59.7 ± 13.7	0.062
Male sex	1073 (57)	64 (53)	0.394
BMI (kg/m ²)	23.0 ± 3.3	23.0 ± 3.3	0.954
Waist circumference (cm)	83.8 ± 21.2	82.9 ± 9.2	0.673
Alcohol drinkers	416 (22)	31 (26)	0.369
Cigarette smokers	303 (16)	18 (15)	0.799
Presence of RE	255 (14)	10 (8)	0.098
Presence of heartburn	59 (3)	13 (11)	< 0.001
Presence of FD	196 (10)	33 (27)	< 0.001
HADS score	6.8 ± 5.5	10.1 ± 6.2	< 0.001
AIS score	5.2 ± 3.3	3.5 ± 3.1	< 0.001

CSB, clinically significant belching; BMI, body mass index; RE, reflux esophagitis; FD, functional dyspepsia; HADS, Hospital Anxiety and Depression Scale; AIS, Athens Insomnia Scale.

Data are presented as mean ± SD or n (%).

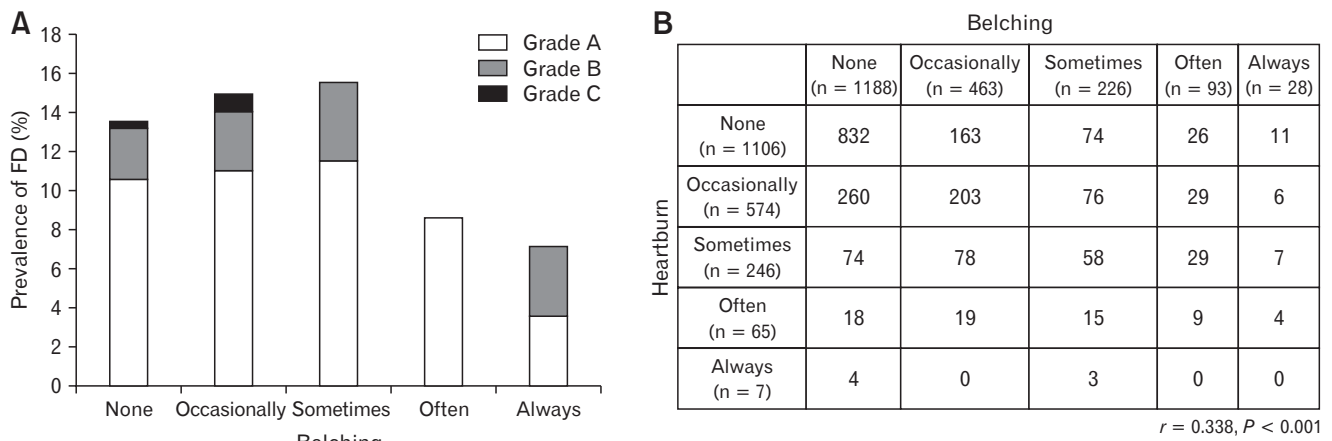


Figure 2. Association between belching and severity of reflux esophagitis or heartburn. (A) Prevalence of reflux esophagitis and its severity according to frequency of belching. (B) Frequency of belching is weakly correlated with the frequency of heartburn. FD, functional dyspepsia.

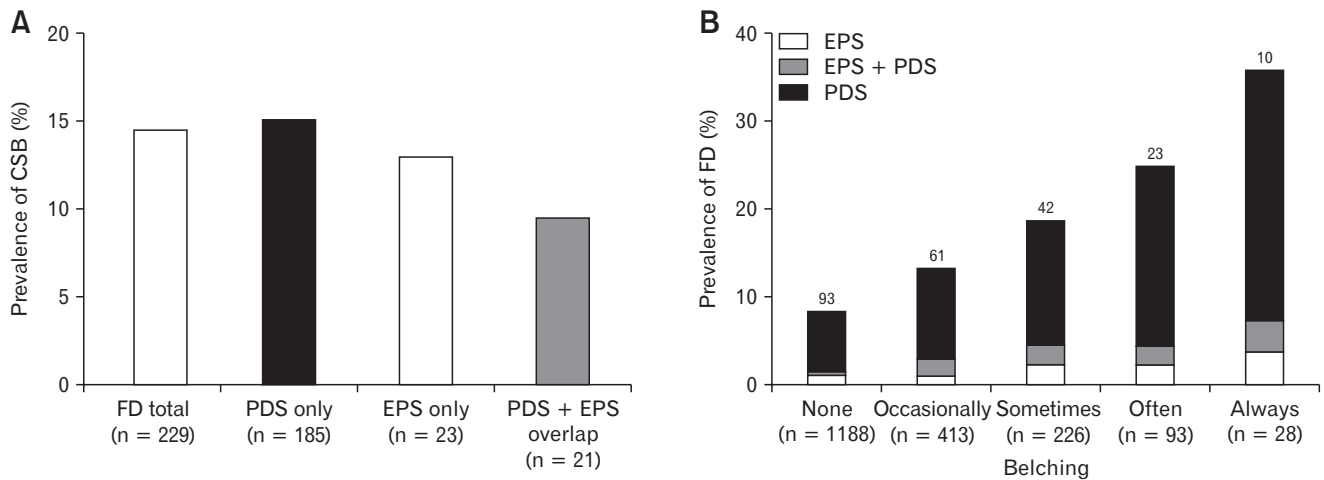


Figure 3. Prevalence of belching in functional dyspepsia (FD) subtypes and prevalence of FD according to frequency of belching. (A) There is no difference in the prevalence of clinically significant belching (CSB) in subjects with FD subtypes. (B) The prevalence of FD increased with the frequency of belching but the proportion of FD subtypes do not change. Number of cases with FD is shown in top of the bars. PDS, postprandial distress syndrome; EPS, epigastric pain syndrome.

Prevalence of Belching in Functional Dyspepsia Subtypes and Prevalence of Functional Dyspepsia According to Frequency of Belching

Among 229 FD subjects, FD subtypes included PDS (n = 206), EPS (n = 44), and PDS + EPS (n = 21). The prevalence of CSB was 30 (14.6%) of 206 subjects with PDS, 5 (11.4%) of 44 with EPS, and 2 (9.5%) of 21 with overlap of PDS and EPS. There was no difference in belching among FD subtypes (Fig. 3A). The prevalence of FD increased with the frequency of belching, but the proportion of FD subtypes did not change (Fig. 3B).

Association Between Frequency of Belching and Anxiety/Depression or Sleep Disturbances

HADS and AIS scores in subjects with CSB were significantly higher than those in subjects without CSB (Table 2). Both the HADS and AIS scores were significantly higher in subjects with each frequency of belching but did not correlate with their frequencies (Fig. 4).

Factors Associated With Belching

Table 3 shows an analysis of the logistic regression model. Uni-

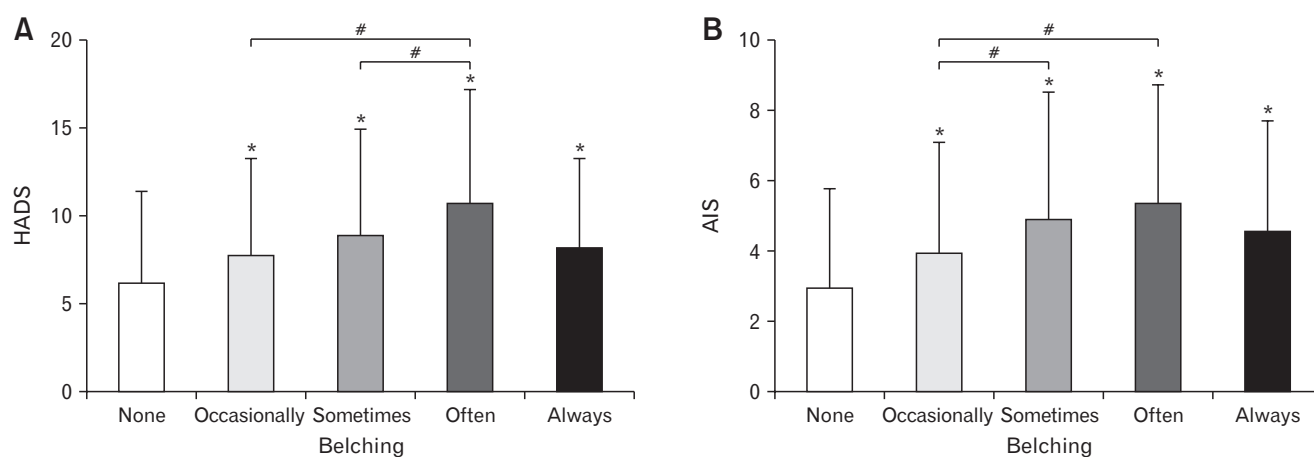


Figure 4. Association between frequency of belching and anxiety/depression or sleep disturbances. (A) Hospital Anxiety and Depression Scale (HADS) and (B) Athens Insomnia Scale (AIS) according to the frequency of belching. * $P < 0.001$ belching present vs none. # $P < 0.001$.

Table 3. Risk Factors for Clinically Significant Belching

Factors	CSB (-) (n = 1877)	CSB (+) (n = 121)	Uni-variant analysis			Multiple-adjusted analysis		
			OR	95% CI	P-value	OR	95% CI	P-value
Age \geq 65 yr	938	61	1.02	0.69-1.50	> 0.999			
Male gender	1073	64	0.84	0.57-1.24	0.394			
BMI \geq 25 kg/m ²	445	31	1.11	0.70-1.71	0.66			
Waist circumference \geq 85 cm	789	57	1.28	0.83-1.81	0.297			
Alcohol drinker	413	34	1.39	0.89-2.12	0.143			
Current smoker	303	18	0.91	0.51-1.53	0.799			
Presence of RE	255	10	0.57	0.26-1.11	0.098			
Presence of heartburn	59	13	3.70	1.81-7.10	< 0.001	2.07	1.05-4.09	< 0.001
Presence of FD	196	33	3.21	2.03-4.99	< 0.001	2.12	1.33-3.36	< 0.001
HADS score \geq 8	699	78	3.05	2.05-4.60	< 0.001	2.29	1.51-3.45	< 0.001
AIS score \geq 6	401	52	2.77	1.86-4.11	< 0.001	1.73	1.14-2.61	< 0.001

CSB, clinically significant belching; BMI, body mass index; RE, reflux esophagitis; FD, functional dyspepsia; HADS, hospital anxiety and depression scale; AIS, Athens Insomnia Scale.

Table 4. Risk Factors for Belching According to Its Frequency

Factors	Definition of belching			
	\geq Occasionally	\geq Sometimes	\geq Often	Always
Male gender	1.23 (1.02-1.49)	1.41 (1.10-1.80)	NT	NT
Presence of heartburn	2.35 (1.38-4.01)	2.39 (1.42-4.05)	2.07 (1.05-4.09)	
Presence of FD	1.78 (1.32-2.39)	1.82 (1.31-2.54)	2.12 (1.33-3.36)	4.44 (2.02-9.75)
HADS score \geq 8	1.56 (1.28-1.90)	1.66 (1.29-2.15)	2.29 (1.51-3.45)	NT
AIS score \geq 6	1.71 (1.36-2.15)	2.22 (1.69-2.91)	1.73 (1.14-2.61)	NT

FD, functional dyspepsia; HADS, hospital anxiety and depression scale; AIS, Athens Insomnia Scale; NT, not tested. Data are presented as multiple-adjusted ORs (95% CIs).

ivariate analysis showed that presence of heartburn, presence of FD, anxiety/depression (HADS score ≥ 8), and sleep disturbances (AIS score ≥ 6) were significantly associated with CSB. After adjustment for statistical factors by univariate analysis, presence of heartburn, presence of FD, anxiety/depression, and sleep disturbances were significantly associated with CSB. We calculated the OR for belching according to its frequency. Subjects with belching \geq occasionally or \geq sometimes were associated with male sex in addition to same factor associated with CSB (\geq often), while only presence of FD was associated with belching always (Table 4).

Discussion

This is the first epidemiological study of belching in adults in detail. We found that the prevalence of CSB defined as \geq often in frequency was 6.1%. Presence of heartburn, presence of FD, anxiety/depression, and sleep disturbances were significantly associated with CSB, while age, sex, BMI, waist circumference, presence of RE, alcohol consumption, and smoking status were not. Particularly, the presence of FD was significantly associated with belching regardless of its frequency.

Although not specific, belching is a symptom in patients with FD. The present study showed that about 14.0% of subjects with FD reported CSB, and there was no difference in the prevalence of CSB among FD subtypes. Pissevaux et al¹⁷ reported that 189 (50.0%) of 378 subjects with dyspepsia complained of belching (104 mild, 64 moderate, and 21 severe). Carbone et al⁶ reported that the prevalence of belching in FD patients was 59.0% and a similar prevalence of belching among FD subtypes was observed (54.0% in PDS, 44.0% in EPS, and 62.0% in overlap of PDS and EPS). Lower prevalence of belching in subjects with FD in this study was due to strict definition. Similar prevalence of belching among subjects with FD was observed when belching was defined as \geq occasionally in this study (136/229, 59.3%).

The mechanism of the high prevalence of belching in subjects with FD should be discussed. Conchillo et al¹⁸ examined 10 patients with FD and 10 controls using esophageal impedance pH monitoring. They found that the incidence of air swallowing in patients with FD was significantly higher than that in controls.¹⁸ Gastric dysfunction in addition to air swallowing may be responsible for the high prevalence of belching in subjects with FD.

Although gastric belching is caused by transient lower esophageal sphincter relaxation, which is a major pathogenesis of RE,⁴ our study did not reveal a significantly high prevalence of belching in subjects with RE. Although a weak correlation of frequency

between belching and heartburn was observed, presence of heartburn was significantly associated with CSB. The reasons for this discrepancy may be due to fact that belching with acid reflux causes heartburn in patients with non-erosive reflux diseases.

A high prevalence of anxiety disorders has been described in patients with excessive belching. Among such patients, belching often increases during stressful events.^{1,19} These findings may explain the positive association between anxiety/depression and the belching observed in this study. Anxiety/depression has been reported to be present in functional GI diseases and affects poorer health-related quality of life including sleep quality.²⁰⁻²²

Sleep disturbances are associated with several GI diseases, especially gastroesophageal reflux disease²³ and FD.^{24,25} Although belching rarely occurs during sleep, we found a significant association between belching and sleep disturbances. Similarly, a recent study by Hyun et al²⁶ demonstrated that sleep disturbances were associated with belching (OR, 1.59; 95% CI, 1.24-2.03) in a cross-sectional study of 4948 subjects. This may be related to the brain-gut axis, which is involved in the pathogenesis of functional GI disorders.

Male gender was identified as a significant risk factor of belching defined as \geq occasionally or \geq sometimes. The reasons for the male predominance in belching remain unclear. Saito et al²⁷ reported that men eat food faster than women, suggesting that men may swallow air more often during eating. In addition, men may prefer carbonated alcoholic drinks, and they do not hesitate to belch when compared to women. Although there is no sex difference in excessive supragastric belching,^{1,2} male predominance may be seen in gastric belching, possibly physiological belching.

This study has some limitations. First, we assessed belching by exploring only the frequency of belching, but not whether belching is bothersome or not. We defined CSB as \geq often, thus most of physiological belching may be excluded. In addition, there is currently no specific questionnaire for belching. It is difficult to evaluate the number of daily belches in an epidemiological study. Further study using a validated questionnaire for belching would be required. Second, we did not include other confounding factors that could affect belching. Factors such as intake of carbonated drinks and speed of food intake should be included in future studies. Third, belching is divided into 2 distinct types, namely gastric belching and supragastric belching.^{1,2} It is difficult to distinguish these 2 types of belching without esophageal impedance pH monitoring,^{1,2,28} although excessive supragastric belching could be diagnosed by medical interview such as frequency of belching (20-30 times per minute) and absence of belching during speech.²⁸

However, it is especially impossible in an epidemiological study.

In conclusion, to our knowledge, this is the first report on the epidemiology of belching in adults in detail. We also clarified several clinical characteristics of CSB. Since excessive belching was associated with resistance against therapy, understanding the epidemiology of belching is important.

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Conflicts of interest: None.

Author contributions: Yasuhiro Fujiwara designed the study protocol, performed data analysis, and wrote the draft of the manuscript; Masatsugu Okuyama collected data, performed data analysis, and participated in the manuscript writing; and Yasuaki Nagami, Koichi Taira, Hirota Ishizu, Osamu Takaishi, Hiroyuki Sato, and Toshio Watanabe supervised the entire project and reviewed the critical version of the manuscript. All authors approved the final version of the manuscript.

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