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ISG TASK FORCE REPORT

Epidemiology and symptom profile of gastroesophageal reflux in the Indian population: Report of the Indian Society of Gastroenterology Task Force

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Abstract
Background Gastroesophageal reflux disease (GERD) and its complications are thought to be infrequent in India; there are no data from India on the prevalence of and risk factors for GERD. The Indian Society of Gastroenterology formed a task force aiming to study: (a) the frequency and profile of GERD in India, (b) factors including diet associated with GERD.
Methods In this prospective, multi-center (12 centers) study, data were obtained using a questionnaire from

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3224 subjects regarding the frequency, severity and duration of heartburn, regurgitation and other symptoms of GERD. Data were also obtained regarding their dietary habits, addictions, and lifestyle, and whether any of these were related or had been altered because of symptoms. Data were analyzed using univariate and multivariate methods.

Results Two hundred and forty-five (7.6%) of 3224 subjects had heartburn and/or regurgitation at least once a week. On univariate analysis, older age (OR 1.012; 95% CI 1.003–1.021), consumption of non-vegetarian and fried foods, aerated drinks, tea/coffee were associated with GERD. Frequency of smoking was similar among subjects with or without GERD. Body mass index (BMI) was similar in subjects with and without GERD. On multivariate analysis, consumption of non-vegetarian food was independently associated with GERD symptoms. Overlap with symptoms of irritable bowel syndrome was not uncommon; 21% reported difficulty in passage of stool and 9% had mucus in stools. About 25% of patients had consulted a doctor previously for their gastrointestinal symptoms.

Conclusion 7.6% of Indian subjects have significant GERD symptoms. Consumption of non-vegetarian foods was an independent predictor of GERD. BMI was comparable among subjects with or without GERD.

Keywords Asia · Epidemiology · Esophagus · Heartburn · Risk factors

Introduction

Gastroesophageal reflux disease (GERD) is a common problem worldwide [1–5]. The frequency and severity of GERD and its complications such as Barrett's esophagus and esophageal adenocarcinoma, however, may have ethnic and geographic variations [6]; most studies from India suggest that these might be less in the Indian population [7, 8]. On the other hand, studies in a multi-ethnic population showed that people of Indian origin are at higher risk of GERD than ethnic Malay and Chinese [6]. The high prevalence of *H. pylori* infection, which is known to protect from severe GERD and its complications, might be one of the explanations for the lower frequency of complications of GERD in the Indian population [9, 10]. The role of dietary and genetic factors is not clear.

The Indian Society of Gastroenterology (ISG), formed a Task Force on Gastroesophageal Reflux Disease to study: (a) the frequency of GERD in the Indian population, (b) the symptom profile of GERD, and (c) dietary and lifestyle factors associated with GERD.

Methods

A detailed proforma in English was prepared by the Task Force members and uploaded on the websites of the ISG (www.isg.org.in) and the (www.indianjgastro.com), and published in the March–April 2005 issue of the Indian Journal of Gastroenterology. The Journal is mailed to all members of the Society. Members who desired to participate in data collection were provided with adequate numbers of a printed version of the proforma, or downloaded or photocopied the proforma from any of the above locations. Participating centers included academic centers, tertiary care corporate hospitals and community centers from both rural and urban areas around these centers. Figure 1 shows the regional distribution of data collection in the country. Study subjects included volunteers or attendants of patients who visited the hospital, and who were willing to participate in the study. Pregnant women and children less than 18 years of age were excluded. Physicians or their nurse assistants administered the questionnaire. Data obtained from all centers were entered in a spreadsheet for analysis.

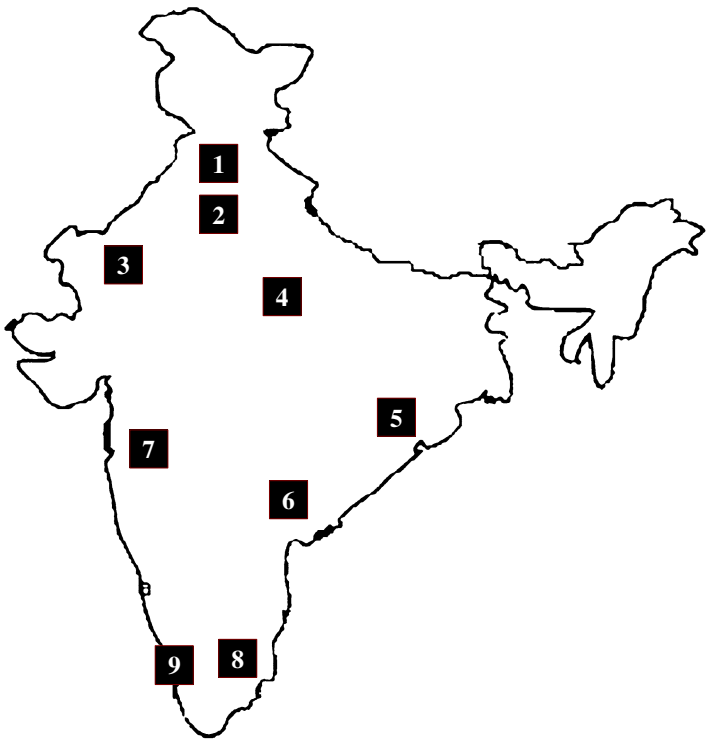
Permission for the study was obtained from the Ethics Committee of participating centers. Permissions were available from centers in Ludhiana, Vishakhapatnam, Chennai, Jodhpur, Cuttack, and Lucknow. For the rest, a permission was obtained from the Ethics Committee at B Y L Nair Hospital at Mumbai. Informed written consent was obtained from all volunteering subjects.

Questionnaire

Demographic, clinical, dietary and lifestyle factors that might be associated with GERD were recorded. Presence and severity of symptoms of GERD was also recorded. Subjects were asked about symptoms suggestive of functional lower gastrointestinal disorder and about previous consultation with physicians for either gastrointestinal or non-gastrointestinal symptoms. In case a subject had undergone upper GI endoscopy, the findings were recorded according to the LA classification. In addition, presence of hiatus hernia, stricture, Barrett's mucosa, and Schatzki's ring was noted.

Symptoms

Subjects were asked about the presence and frequency of heartburn, sour regurgitation, chest pain and dysphagia. The question for heartburn was 'Do you feel a sensation of burning in the chest', and that for regurgitation was 'Do you have a feeling of sour food/liquid coming into your



1. Punjab (483)
2. New Delhi (386)
3. Rajasthan (569)
4. Uttar Pradesh (134)
5. Odissa (123)
6. Andhra Pradesh (282)
7. Maharashtra (403)
8. Tamil Nadu (667)
9. Kerala (177)

Fig. 1 The map shows the regions of the India from where subjects were recruited for the study. Values in parenthesis indicate number of subjects recruited from each state

throat'. Subjects were also asked about symptom, duration and severity. Subjects were asked to grade their symptoms as mild, moderate or severe, on a subjective basis. The frequency of symptoms was recorded as daily, weekly, once every fortnight and once a month. GERD was defined as heartburn and/or sour regurgitation at least once a week [3] for at least one month. Subjects with symptoms occurring less than once a week were classified as having infrequent symptoms; subjects with infrequent symptoms and those with no symptoms were classified as not having GERD.

The questionnaire included atypical/extra-esophageal reflux symptoms (hoarseness, cough at night) and those of functional bowel disease (abdominal pain, mucus in stools, difficulty in passing stools); these symptoms were assessed as present or absent. Details regarding factors that aggravated symptoms, change in lifestyle and food habits, previous investigations and medications, and impact of symptoms on everyday life were obtained only from subjects who had at least one symptom of GERD (heartburn, regurgitation). Subjects were asked whether they had symptoms at night, and the frequency of symptoms disturbing sleep. They were also asked about whether they missed work due to symptoms.

Dietary intake

The average daily tea or coffee use was categorized into 1–3 cups and more than 3 cups/day. Subjects were asked about the consumption of vegetarian food and frequency of consumption of meat, fruits, and aerated drinks. For all dietary items, the frequency was categorized as never (reference), 1–3 times per week (infrequent), and >3 times per week (frequent). Subjects were asked about whether they took spices in their diet; they were asked to classify the intensity of spicy diet on a subjective basis as mild, moderate or severe.

Southern India was considered as the area encompassing the states of Andhra Pradesh, Karnataka, Kerala, and Tamil Nadu, and the union territories of Lakshadweep and Puducherry and the peninsular Deccan plateau [11]. The rest of the country was considered as northern India.

Statistical analysis

Distribution of data was checked using the Shapiro-Wilk test. Categorical variables were presented as proportion, normally distributed continuous data as mean (standard deviation), and non-parametric continuous variables as median (inter-quartile [IQR]) range. Categorical variables were compared using the chi-squared test. Continuous data that were not normally distributed were analyzed using non-parametric tests. Normally distributed continuous variables were compared using t test. Logistic regression analysis was used for multivariate modeling. Two-tailed *p*-values less than 0.05 were considered significant. Statistical

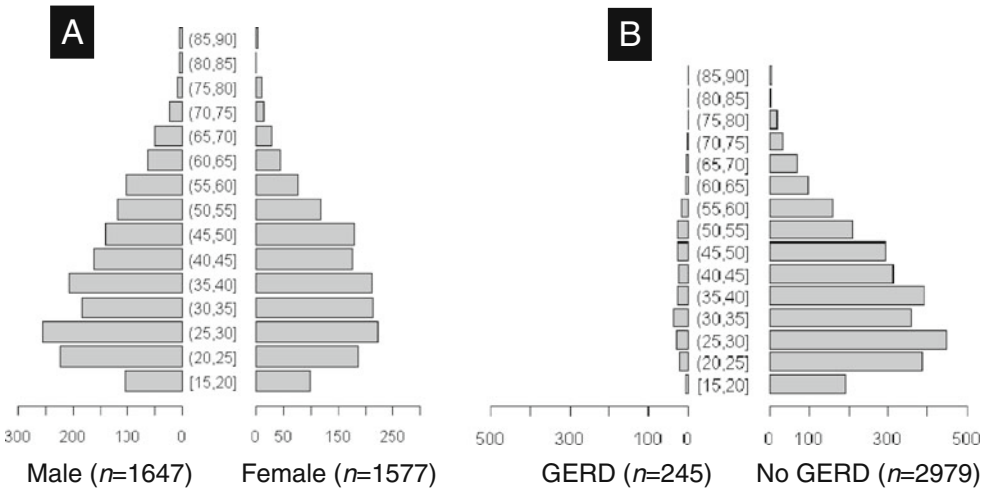


Fig. 2 **a** Population pyramid of age of male and female subjects in the study population. **b** Population pyramid of age of subjects with and without GERD. The values within the second bracket indicate age range in years

analysis was done using R and Epicalc software version R2.9.0 (R development core team, Vienna, Austria).

Results

Demographic, clinical and lifestyle parameters

The 3,224 subjects included in the study were recruited from 12 centers from different regions of the country (Fig. 1). Eleven of these centers were from urban areas. Two centers had collected data from the slums within the city limits, and two were from rural areas. One thousand five hundred and seventy-two subjects (48.8%) were from centers in northern India and 1652 were subjects from those in southern India. Most of the 3224 subjects (1647, 51.7% men) were young (Fig. 2).

Two thousand five hundred and thirty-five (78.6%) subjects had no symptoms. Five hundred and ninety-nine subjects (18.6%; 367 men) complained of heartburn, and 440 (13.6%) had regurgitation, at least once a month (Table 1); 700 subjects (21.7%) had heartburn regurgitation at least once a month, and 350 subjects (10.9%) had both. Four hundred and fifty-five subjects had infrequent symptoms. Two hundred and forty-five subjects (7.6%) had frequent (weekly or more frequent) heartburn and/or regurgitation The median (range) duration of symptoms was 12.0 (1–120) months. The maximum duration of symptoms was 10 years. Heartburn occurred on median (range) 3.0 (1–7) days in a week, and regurgitation occurred 2.5 (1–7) days in a week.

Demographic, clinical and lifestyle parameters of subjects who had symptoms considered as GERD and those who did not have these are shown in Table 2. Subjects with GERD were older. There was no difference in the BMI between subjects with GERD and those without. The frequency of GERD was similar in subjects with BMI <25 (n=156, 7.08%) as compared to those with BMI >25 (n=87, 8.85%; p=0.08).

Most subjects had mild (50.5%) or moderate (41.9%) symptoms; few subjects had severe symptoms (7.5%).

Two hundred and nine women had children (64 with GERD [30.6%]); of them, 170 reported heartburn during pregnancy (123 of 145 [84.8%] without GERD and 47 of 64 [73.4%] with GERD; p=0.05).

One hundred and six (6.74%) of 1,572 subjects from centers in northern India had GERD symptoms, as compared to 139 of 1,652 (8.35%) from southern India (OR 0.81, 95% CI 0.63–1.02, p=ns).

Diet

Table 3 summarizes the data on dietary and lifestyle parameters associated with GERD. On univariate analysis, frequent consumption of meat and fried food, was higher amongst subjects with GERD. Subjects with GERD also tended to have higher intensity of spices. Tea/coffee

Table 1 Frequency of heartburn and regurgitation among study subjects

	Never	Once a month	Once a fortnight	At least weekly*	Daily
Heartburn	2625 (81.4)	237 (7.4)	172 (5.3)	102 (3.2)	88 (2.7)
Regurgitation	2784 (86.4)	201 (6.2)	98 (3.0)	75 (2.3)	66 (2.0)
Heartburn and/or regurgitation	2535 (78.6)			206 (6.4)	39 (1.2)

Data are as n (%). *444 (13.8%) subjects had heartburn and/or regurgitation less than once a week

Table 2 Demographic and clinical parameters of study subjects with or without gastroesophageal reflux disease (GERD)

Parameters	No GERD (n=2978 [92.4])	GERD (n=245 [7.6])	OR (95% CI)	p-value
Age (years) Median (25, 75 percentile)	38.4 (28, 48.5)	40 (30, 52)	1.012 (1.003–1.021)	0.003
Age >40 y	1205 (40.4)	118 (48.2)	1.025 (1.004–1.046)	
Gender (male/female)	1534/1444	112/133	1.018 (0.998–1.038)	0.084
Height (meters)	1.53 (0.08)	1.54 (0.08)	0.998 (0.996–1.011)	0.654
Weight (kg)	59 (1.3)	59.5 (1.8)	1.006 (0.995–1.018)	0.401
BMI (kg/m^2)	23.1 (4.44)	24.03 (5.08)	1.021 (0.990–1.053)	0.151
BMI grade <19	265 (8.9)	26 (10.6)	Reference	0.142
19–24.9	1818 (61.0.)	132 (53.9)	1.158 (0.627–2.139)	
25–29.9	720 (24.2)	67 (27.3)	1.565 (0.954–2.568)	
≥30	176 (5.9)	20 (8.2)	1.221(0.722–2.066)	
BMI <25 kg/m^2	2047 (69.6)	156 (64.2)	0.785 (0.597–1.032)	0.08
≥25 kg/m^2	896 (30.4)	87 (35.8)		
Heartburn: None	2596 (87.1)	29 (11.8)		
< 1/week	383 (12.9)	26 (12.9)		
≥ 1/week	0 (0)	190 (77.6)		
Regurgitation: None	2704 (90.8)	80 (32.7)		
< 1/week	275 (9.2)	24 (9.8)		
≥ 1/week	0 (0)	141 (57.6)		
Presence of chest pain	118 (4.0)	55 (22.4)	7.014 (4.932–9.974)	0.001
Frequent chest pain (>1/week)	13 (0.4)	17 (7.0)	4.688 (1.984–11.076)	0.001
Presence of dysphagia	51 (1.7)	46 (18.8)	13.262 (8.682–20.257)	0.001
Water brash	58 (1.9)	50 (20.4)	12.905 (8.606–19.349)	0.0001
Other symptoms				
Breathlessness	57 (1.9)	17 (6.9)	3.820 (2.186–6.675)	0.0001
Vomiting	62 (2.1)	44 (18.6)	10.719 (7.093–16.198)	0.0001
Previous hematemesis	19 (0.7)	10 (4.1)	6.625 (3.046–14.411)	0.001
Hoarseness of voice	28 (0.9)	15 (6.1)	6.869 (3.619–13.044)	0.0001
Cough at night	87 (2.9)	38 (15.5)	6.098 (4.062–9.155)	0.001
Abdominal pain	239 (8.0)	84 (34.3)	5.979 (4.450–8.029)	0.001
Symptoms of functional lower GI disease				
Difficulty in stool passage	199 (6.7)	52 (21.2)	3.761 (2.682–5.275)	0.001
Mucus in stools	105 (3.5)	22 (9.0)	2.698 (1.671–4.358)	0.001
Doctor visit	307 (10.3)	76 (32.1)	4.11 (3.05–5.53)	0.001
Doctor visit for GI complaint	197 (64.2)	61 (80.3)	0.19 (0.14–0.26)	<0.001

Data are as n (%) or median (range)

consumption was more frequent amongst subjects with GERD.

There was no relationship between tobacco use or alcohol consumption and GERD. Subjects with GERD more often visited doctors for a gastrointestinal complaint.

Aggravating factors and treatment (Table 4)

Symptoms were aggravated by meals (49.2%) bending or stooping forward (38%), and non-vegetarian food (20.8%); 77 subjects (34.7%) had nocturnal symptoms.

Eighty-eight (34.6%) subjects with GERD symptoms had modified their diet and 15% had elevated the head-end of the bed; 20 (8.5%) missed work because of symptoms on median (IQR) 4 (4) days a month. Fifty-three subjects had had received a proton-pump inhibitor, and 41 were receiving medication at the time of filling the questionnaire.

Results of multivariate analysis

Table 5 shows the results of multivariate analysis using a step-wise logistic regression model. On multivariate anal-

Table 3 Lifestyle and dietary parameters of study subjects with or without gastroesophageal reflux disease (GERD)

Parameters		No GERD (n=2978)	GERD (n=245)	OR (95% CI)	p-value
Diet	Vegetarian	1128 (37.9)	98 (40.0)	1.094 (0.838–1.427)	0.50
	Non-vegetarian	1851 (62.1)	147 (60.0)		
Meat/fish	Never	988 (33.2)	79 (32.2)	Reference	0.011
	Infrequent	1800 (60.4)	138 (56.3)	1.833 (1.160–2.899)	0.009
	Frequent	191 (6.4)	28 (11.4)	1.912 (1.124–2.948)	0.003
Predominant cereal	Mixed	1935 (65.0)	146 (59.6)	Reference	0.260
	Rice	572 (19.2)	52 (21.2)	0.830 (0.597–1.154)	0.24
	Wheat	472 (15.8)	46 (18.8)	0.774 (.548–1.095)	0.148
Fruits	None	162 (5.4)	12 (4.9)	Reference	0.001
	Infrequent	1929 (64.8)	121 (49.4)	1.703 (0.917–3.16)	0.092
	Frequent	888 (29.8)	112 (45.7)	2.011 (1.536–2.631)	
Fried food	None	248 (8.3)	22 (9)	1.75 (1.33–2.30)	0.0001
	Infrequent	2062 (69.2)	137 (55.9)	1.449 (0.887–2.366)	
	Frequent	669 (22.5)	86 (35.1)	1.935 (1.457–2.569)	0.0001
Spices	None	162 (5.4)	15 (6.1)	Reference	0.394
	Infrequent	1534 (51.5)	114 (46.5)	0.927 (0.530–1.623)	0.792
	Frequent	1283 (43.0)	116 (47.3)	0.836 (0.647–1.081)	0.173
Intensity of spices	Mild	248 (8.8)	9 (3.9)	Reference	0.0001
	Moderate	2456 (87.2)	186 (80.9)	8.535 (3.969–18.352)	0.0001
	Severe	113 (4.0)	35 (15.2)	4.09 (2.721–6.147)	0.0001
Aerated drinks	None	1527 (51.3)	84 (34.3)	Reference	0.0011
	Infrequent	1128 (37.9)	139 (56.7)	1.234 (0.76–2.004)	0.3
	Frequent	324 (10.9)	22 (9)	0.551 (0.346–0.878)	0.012
Tea/Coffee	None	870 (29.2)	39 (15.9)	Reference	0.0001
	1–3 cups/day	1686 (56.6)	151 (61.6)	2.901 (1.894–4.443)	0.0001
	>3	423 (14.4)	55 (22.4)	1.452 (1.047–2.012)	0.025
Tobacco		424 (14.3)	45 (16.7)	1.02 (0.99–1.05)	0.332
Tobacco type	Smoking	219	21		
	Chewing	105	7		
	Smoking+chewing	100	17		
Alcohol		450 (15.2)	44 (16.4)	0.93 (0.68–1.26)	0.687

Data are as n (%)

ysis, taking non-vegetarian food was associated with GERD.

Discussion

The present study used a health facility-based approach to determine frequency of GERD symptoms in apparently healthy individuals in different parts of India and showed that 7.6% of the respondents reported symptoms of heartburn and/or regurgitation at least once a week. Subjects with GERD were older, frequently consulted doctors, and often had overlapping functional lower GI symptoms. Frequency of consumption of meat, fried food, and fruits was higher amongst subjects with GERD; also, meat, fried food, spice, and tea/coffee were often associated with worsening of symptoms. Frequency of GERD was comparable in subjects from northern and southern India.

Most reports on prevalence of GERD are from the Western world and only a few from Asia [1, 12–16]. In the early 1990s, the prevalence rates in South Asian countries were lower than those of Western populations. A cross-sectional survey of randomly selected adults in Singapore in the 90s found that less than 2% of 696 persons reported heartburn more than once a month, suggesting that reflux-type symptoms were uncommon in Asians [6]. A similar study among a random sample of 5,000 adult residents in Shanghai and Beijing [14] showed prevalence rates of symptomatic GERD as 7.76% and 10.19%, respectively. In

Table 4 Comparison of associated and aggravating factors, and medications in subjects with gastroesophageal reflux disease (GERD) and those with infrequent and mild symptoms

	Infrequent symptoms	GERD	*p*-value	OR (95% CI)
Age >40 y	217 (48.9)	118 (48.2)		
Gender (M/F)	222/222	112/133		
Severity of symptoms				
Mild	246 (44.4)	94 (50.5)		
Moderate	290 (51.9)	78 (41.9)		
Severe	23 (4.1)	14 (7.5)		
Symptoms after meals	184/431 (29.2)	117/250 (49.2)	0.001	0.628 (0.531–0.741)
Relation to type of food				
Spicy	312/444 (70.3)	176/237 (74.3)	0.285	0.819 (0.574–1.169)
Fried	146/444 (32.9)	92/237 (38.8)	0.129	0.772 (0.556–1.072)
Non-vegetarian	123/444 (37.3)	35/168 (20.8)	0.0001	2.264 (1.458–3.514)
Aerated drinks	12/205 (2.7)	8/160 (5.0)	0.611	0.772 (0.283–2.103)
Symptoms after smoking	21/39(29.6)	19/32 (26.3)	0.64	0.798 (0.310–2.055)
Symptoms after bending	65/444 (14.6)	90/237 (38.0)	0.001	3.858 (2.647–5.623)
Nocturnal heartburn/regurgitation	70/384 (18.2)	77/222 (34.7)	0.0001	2.382 (1.631–3.471)
Change in lifestyle				
Missed work	17/439 (3.9)	20/234 (8.5)	0.020	1.606 (1.171–2.205)
Altered diet due to symptoms	121/442 (27.4)	82/241 (34.0)	0.069	0.731 (0.521–1.026)
Raised head end of bed	54/442 (12.2)	36/241 (14.9)	0.315	0.793 (0.503–1.248)
Treatment				
Visited a doctor	188/442 (42.5)	86/235 (36.6)	0.134	1.282 (0.926–1.776)
Antacids	253/437 (57.8)	120/233 (51.5)	0.120	1.295 (0.941–1.782)
Proton pump inhibitor (past or present)	85/434 (19.3)	53/245 (22.0)	0.402	0.847 (0.575–1.249)
Current treatment for GERD symptoms	81/442 (18.3)	41/243 (16.9)	0.67	1.105 (0.731–1.671)
Previous endoscopy	11/442 (2.5)	25/241 (10.4)	0.0001	2.08 (1.63–2.651)

Data are as *n* (%)

this multi-centric pan-Indian study using a questionnaire, 7.6% of Indian subjects had GERD, a value somewhat comparable to that in other Asian countries [1, 6] and slightly lower than that in the Western population [17], where the prevalence of weekly symptoms was reported in almost 20% of subjects. It must be noted that the present study was conducted in urban centers and urban slums and that most of the population sampled included attendants of patients and other volunteers in the facility. The majority of Indians reside in rural areas and thus the estimate of prevalence in the present study cannot be extrapolated to the country as a whole.

Patients with GERD were older. This is in accordance with several other studies [18]. The median age of patients with GERD was 40 years, somewhat older than those without GERD.

The prevalence of weekly heartburn was 5.9%, a frequency midway between other Asian studies. A recent study from Delhi showed that 16.2% of hospital employees had heartburn/regurgitation at least twice a week [19]. An

Table 5 Factors independently associated with gastroesophageal reflux disease on multivariate analysis

	Crude OR (95% CI)	Adjusted OR (95% CI)	*p*-value (LR-test)
Age >40 vs. age ≤40 years	1.115 (0.808, 1.539)	1.046 (0.746, 1.467)	0.7932
Sex: female vs. male	0.897 (0.65, 1.237)	0.756 (0.53, 1.078)	0.1213
Spicy food: no vs. yes	1.216 (0.848, 1.745)	0.902 (0.601, 1.355)	0.621
Fried food: no vs. yes	1.206 (0.862, 1.686)	1.148 (0.803, 1.641)	0.4486
Aerated drink: no vs. yes	1.778 (0.772, 4.096)	2.021 (0.835, 4.894)	0.1218
Tea/Coffee: no vs. yes	0.9 (0.416, 1.945)	0.659 (0.291, 1.495)	0.3094
Non-vegetarian food: no vs. yes	0.352 (0.225, 0.551)	0.34 (0.211, 0.545)	< 0.001

OR: odds ratio, *LR-test*: likelihood ratio test

earlier study from Mumbai had shown that 943 of 5,000 (18.9%) had heartburn at least once a month, and 210 (4.2%) subjects had frequent (≥weekly) heartburn [7]. The latter figures are comparable to those reported from China (frequency of weekly heartburn 4%) [20] and from Singapore (10%) [6], which was lower than those of non-Asian populations, such as the rate of 17.8% in Americans [17], 14.7% in Australians [21], 10.3% in Finlanders [22] and 12% in Belgians [23]. The prevalence of daily heartburn in our study was 2.7%, and 7.6% had GERD symptoms. Moayyedi and Axon [24] identified 9 studies assessing period prevalence of heartburn on a daily basis, and found that 5% (95% CI 4–6%) of 17,006 subjects reported on the heartburn occurring daily.

The overlap of GERD and IBS was common. This is in accordance with several other studies. In a community study from northwest China [20], significantly more subjects with GERD symptoms experienced constipation (22%) and diarrhea (14%) as compared to subjects without GERD symptoms (10% and 5%, respectively). In a previous study from Mumbai [25] the prevalence of dyspeptic symptoms was 30%, while among subjects with IBS, the prevalence of dyspepsia was 58%. A study from an urban population of Sydney residents in Penrith [21] showed that 36.8% of the dyspeptic subjects had ulcer-like and reflux-like dyspepsia. In the reflux group, irritable bowel syndrome and dyspepsia were the highest functional disorders. In a pan-Indian study on IBS, 37% of 1,301 patients reported heartburn [26].

A few studies have implicated foods that may precipitate reflux symptoms including dietary fat, chocolates, coffee, onions, citrus fruits, tomatoes and mints; it has been postulated that these foods mediate their effects through relaxation of the lower esophageal sphincter. Nandurkar et al. found no association between fat consumption and reflux symptoms [27]. Dietary fat has been postulated to be associated with higher risk of GERD. As found in our study, Terry et al. in a population-based case-controlled study from Sweden failed to detect any association between foods that could potentially relax the lower esophageal sphincter and symptoms of reflux disease [28]. However, high dietary fat may aggravate symptoms leading to a reduced fat intake in people with reflux symptoms, accounting for the lack of association observed in the present study. In a Swedish study, Nilsson et al. found negative associations between the risk of reflux symptoms and exposure to coffee, bread high in dietary fiber content, and frequent physical exercise. Intake of alcohol or tea did not affect the risk of reflux [29]. We found that several foods were associated with GERD on univariate analysis; but on multivariate analysis, only intake of non-vegetarian food was positively associated with GERD.

We noted that tea/coffee consumption of >3 cups/day was higher in those with reflux symptoms; however this was not significant on multivariate analysis. Boekema et al. found that coffee did not alter postprandial acid reflux time or number of acid reflux episodes in seven patients with GERD [30].

A strong association between increasing BMI and GERD has been reported although not uniformly [27, 31]. Nandurkar et al. reported that when the overall mean BMI was 26.6 (5.7), 79 (37%) individuals had infrequent (<weekly) reflux and 16 (8%) reported frequent (≥weekly) reflux [27]. Among those with BMI >25, 10% reported frequent reflux compared to 4% of those with BMI ≤25. A community study in Sweden reported no association between BMI and reflux symptoms in a randomly selected group of middle aged and elderly persons [32]. However, another well-conducted population-based case-control study with reflux esophagitis found a strong association between BMI and severity of reflux esophagitis in women; a similar association was not identified in men [33]. Overall, the evidence supports the findings that BMI is a significant risk factor for symptomatic GERD. In our study, the BMI was similar in subjects with and those without GERD; this may be because only one-third of subjects had BMI >25.

Our study had some limitations. We did not perform endoscopy in the community subjects. Our questionnaire included various questions on frequency, and severity of heartburn and regurgitation; we did not use a symptom score [34]. Also, our questionnaire has not been validated earlier. However, it contained questions regarding symptoms, and details of their frequency and severity, which are basic elements of all validated questionnaires available currently [34]. Moreover, the established questionnaires have been shown to poorly correlate with pathologic reflux [35]. We did not assess the socioeconomic status of our subjects. It is known that GERD is a disease of the affluent.

Our study is not truly representative of the Indian population, as the sample was based on volunteers willing to participate in the study. It is likely that subjects with symptoms were more likely to participate in the study (Berkson's bias). Given that India is a vast country with heterogeneous populations, an ideal study should include representative population samples from different regions of the country. The data we collected was obtained from centers located in 9 states; however the eastern states were not represented.

We did not translate the proforma into various Indian languages. Our proforma was made in English, and the nurse assistant or physician administered the questionnaire. This was done to avoid multiple translations, as also to maintain uniformity of administration of questionnaire uniformly to illiterate subjects.

In conclusion, the present study showed that 7.6% of the Indian reported symptoms of GERD frequent enough to diagnose GERD. Subjects with GERD were older, frequently consulted doctors, more often had overlapping functional lower GI symptoms. Frequency of consumption of meat, fried food and spices was higher and fruit consumption lower amongst subjects with GERD; also, consumption of some of these food items aggravated symptoms.

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