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Community-based Descriptive Cross-sectional Study on Prevalence, Clinical Manifestation, Beliefs and Management Approach of Gastroesophageal Reflux Disease (GERD) Among Young Bangladeshi Population

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Abstract

Despite being a common public health problem, there are few population-based research available to learn about the epidemiology and management of gastrointestinal reflux disease (GERD) in Bangladesh. The tenacity of this study was to investigate the prevalence, potential predisposing factors, clinical representation, therapeutic management of GERD among the young Bangladeshi population along with their beliefs regarding the disease. A descriptive cross-sectional study was conducted during 13th June 2022 to 10th December 2022 among 925 individuals (16-35 years of age) from various parts of Bangladesh. A standardized online questionnaire in both English and the local language (Bengali) was utilized to collect all the desired data that were analyzed using either Microsoft Excel 2019 or, IBM SPSS Statistics, v26.0. The prevalence of GERD was 55.7% which was not significantly associated with different socio-demographic parameters. However, family history (Odds ratio (OR) = 2.512), irregular meal (OR = 1.527) and spicy/junk food (OR = 1.495) were significantly associated with GERD prevalence in binary logistic regression analysis. Heart burn (94.0%) and regurgitation (83.3%) were the major symptoms observed and the average number of symptoms was higher in patients with relevant family history ($p < 0.0005$). Omeprazole (42.5%) was the most used medication to treat GERD followed by other proton pump inhibitors and H_2 blockers. Self-medication was practiced by 52.6% of the patients which was associated with duration of treatment ($p < 0.0005$). The study has found a high prevalence of GERD in Bangladesh. Family history, irregular meal and spicy/junk foods have been identified as potential risk factors and only half the participants had the right belief regarding the effectiveness of lifestyle modification against GERD. Further cohort studies are advised to solidify the findings of this study.

Key words: GERD, prevalence, risk factors, family history, clinical manifestations, beliefs, managements, young Bangladeshis.

Introduction

Gastroesophageal reflux disease (GERD) is characterized by abnormal reflux of gastric stomach contents at least weekly (Johansson *et al.*, 2008). Acid regurgitation and heartburn are communal symptoms of GERD (Festi *et al.*, 2009; Lagergren *et al.*, 1999). This irritating condition significantly intervenes with physical comfort, impairs social deeds, increases economic burden, disturbs sleep and reduces concentration at daily work (Wiklund, 2004; Sandler

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et al., 2002; Wiklund and Talley, 2003). Some study suggested that acid reflux worsens the asthma symptoms (Khoshoo *et al.,* 2003; Kiljander *et al.,* 2006) . Lifestyle related factors like alcohol, spicy food, weight loss, smoking, citrus, obesity, chocolate, spicy food, late-evening meal etc. are believed to be associated with GERD (Yamamichi *et al.,* 2012). GERD can be caused by a decrease in lower esophageal sphincter (LES) basal tone, an increase in transient lower esophageal sphincter relaxation (TLESR) episodes and gastric or esophageal motor dysfunction (Dughera *et al.,* 2007). These factors may lead to GERD collectively or separately. However, the underlying reason of these functional chaos are still not clear (Mueller-Lissner *et al.,* 1981). Specific symptoms for the diagnosis of GERD are generally considered to be heart burn, chest pain, acid regurgitation etc (Klauser *et al.,* 1990).

In controlling GERD, proton pump inhibitors (PPIs) and H_2-receptor antagonists (H_2RAs) are also widely used (Hassan, 2020). H_2RAs in higher and more frequent dosages appear to be useful in reducing GERD, although they are still inferior to PPIs (Dughera *et al.,* 2007). As a result, PPIs (omeprazole, esomeprazole, rabeprazole, pantoprazole, lansoprazole) are empirically recommended as a pragmatic initial diagnostic strategy for patients with both classic and atypical GERD symptoms (whiffing, persistent cough, non-cardiac chest pain, etc.) (Katz *et al.,* 2013).

GERD is most likely caused by lifestyle and environmental factors (Cameron *et al.,* 2001). Overweight people have a higher risk of esophagitis, according to several research studies (Labenz *et al.,* 2004). Several studies have found that fatty foods are also linked to GERD (Shaha *et al.,* 2012; Rahman *et al.,* 2020; Rouf *et al.,* 2017). Again, many sufferers and experts associate the incidence of reflux symptoms with dietary components (Oliveria *et al.,* 1999). As a result, people with GERD are frequently advised to avoid fatty meals, sweets, coffee and tea, or to eat less. Cessation of smoking is also helpful to reduce reflux (Waring *et al.,* 1989). Some case-control studies reported that people with stressful conditions are more prone to develop peptic ulcer (PU) disease than normal people (Sugisawa and Uehata, 1998). Association of this lifestyle and environment related factors with GERD are still not clear and may vary from person to person (Sekiguchi *et al.,* 1997).

Now-a-days, for individuals of all ages and each sex GERD may be a common problem with calculable prevalence rates of 8% to 33% worldwide (Bor *et al.,* 2017). GERD may vary with geography and ethnicity, for instance 8.8-25.9% in Europe, 18.1-27.8% in North America, 5-10% in Asia and 5-7.8% in East Asia (El-Serag *et al.,* 2014; El-Serag, 2007). Therefore, it can be stated that hat GERD is relatively less severe in Asia and East Asia than Europe and Northern America. Bangladesh is a densely populated and developing country and its people are suffering from this disease from acute to severe. But we have very little knowledge on the gravity of the problem (Shahed, 2006; Rahman *et al.,* 2005). Solely population based study reported a prevalence of 40.9% (Shahed, 2006).

This study aimed to evaluate the prevalence of the GERD among young Bangladeshi people as well as their beliefs regarding GERD, the type of difficulties they are facing from this disease, the duration of their problem, the association of GERD with family history and lifestyle and the overall management scenario with the level of patients' satisfaction achieved by using an online questionnaire as an investigative tool among people of different age, sex, occupation and resident area (urban and rural) all over Bangladesh. This study focused on finding out how people deal with acidity and how effective their management technique is.

Materials and Methods

Ethical statement: No ethical permission was required to conduct the research work as this was only questionnaire based cross-sectional study. The study was performed while sticking to the principles of the World Medical Association (WMA) Declaration of Helsinki. Well-informed, voluntary consent was

received from each participant before his/her participation in the study.

Study design: An online cross-sectional study was planned and performed among the young Bangladeshi population to collect and analyze population-based information regarding the prevalence, clinical manifestations, perception and therapeutic management of gastrointestinal acidity (GERD). The study questionnaire was developed using Google form and after sufficient validation, the form's URL was generated and distributed on various social media platforms such as facebook, messenger, whatsapp and Email. The submitted data were automatically organized in google spreadsheet from which it was extracted as an excel file. Data screening was performed to remove the inconsistent and incomplete ones and the final data set was analyzed using either Microsoft Excel 2019 or SPSS v26 software.

Sample selection: Participants were young Bangladeshi people with an age of 16≤age≤35 who could read and understand English or Bangla. All the participants had access to social media sites such as Facebook, Messenger, WhatsApp, and email, as well as a personal Google account through which they had to submit their questionnaire responses. Any individuals who refused to participate in the study have been excluded. A total of 925 participants were included in this study.

Duration of the study: The research work was planned and carried out from June 13, 2022 to December 10, 2022.

Questionnaire development: The study questionnaire was written in English before being translated into Bangla. The translated questions were then translated back into English by another individual to ensure the consistency of the translation.

The questionnaire was developed after extensive literature review and group discussion by the co-authors and contained close-ended questions only. Most of the questions were single answer questions and the rest of them allowed multiple answer choices. Overall, the questionnaire comprised of six sections: 1. Background information 2. Demographic data 3. General knowledge and perception on GERD 4. Family history and lifestyle of GERD patients 5. Clinical manifestations of GERD and 6. Therapeutic management of GERD. The first section provided the participants with a clear statement on the conductors of the study, purpose of the study while ensuring complete maintenance of their anonymity and use of the study outputs for scientific publication only. At the end of this section, approval was requested from the participants to explore further sections. The second section was designed to obtain information about the age, gender, completed education level and residential area of the participants. All the participants were classified as young (≤ 25) or young adults (> 25 to ≤ 35) following a recent study by Gjaka *et al.* (2021). The following section looked to collect information about family history of the participants as well as different lifestyle characteristics that might affect the occurrence of GERD. The 4^{th} and 5^{th} sections gather information about the clinical pattern and symptoms experienced by the participants suffering from GERD and the way and outcome of their therapeutic management. The final section was designed to observe peoples' beliefs about the most frequent age to experience GERD, its clinical presentation and the effectiveness of modified lifestyles on GERD management.

GERD case definition: A participant was considered to be suffering from GERD if he/she experienced heartburn (burning sensation in the retro-sternum region), regurgitation (sour taste of the mouth or presence of sour fluid at the end of the throat) or both at least once a week over the past year (Shaha *et al.*, 2012; Vakil *et al.*, 2014; Kumar and Shivalli, 2014).

Validation of the questionnaire: To assure the reliability and efficiency of the questionnaire, it was initially sent to 5 expert individuals from pharmacy backgrounds who were eventually removed from the study sample. They were requested to examine the questionnaire and their feedback was used to update the questionnaire. The updated questionnaire was pre-tested by sharing it with 30 primary participants to ensure the clarity and unambiguity of it. The internal

consistency dependability was found to be adequate and outstanding.

Data analysis: All kinds of data analyses were performed using either Microsoft Excel 2019 or, IBM SPSS Statistics (for windows), version 26.0. At first, all the collected data were analyzed and inconsistent & incomplete data cases were excluded from the study. Various categorical variables were analyzed for descriptive statistics like frequency (prevalence) along with valid percentage. 95% confidence interval (CI) for the prevalence of any data of categorical variables was calculated using Microsoft Excel 2019; rest of the inferential statistical analysis was performed using SPSS v26 only. All the figures (both bar charts and pie charts) were constructed through Microsoft Excel 2019 using the data obtained through SPSS v26. Data obtained from the questions with multiple answer choices were also demonstrated using Pareto bar chart using Microsoft Excel 2019. Cross-tabulation was performed between two categorical variables to determine the chi-square ($\chi 2$) statistic to investigate the significance of association among those variables. All statistical comparisons were two-sided and used the 0.05 significance level. Effect size Phi (ϕ) and Cramer's V (v) were measured for categorical variables with two and more than two categories respectively indicating very strong (>0.25), strong (>0.15), moderate (>0.10), weak (>0.05) or very weak (>0) relationship between the two variables (Akoglu, 2018). A binary logistic regression was also constructed to predict the likelihood of reporting the presence of GERD based on different demography, family history and lifestyle characteristics while demonstrating the odds ratios with 95% CIs.

Results

Prevalence of GERD: Out of the total 925 study population, 771 (83.4%; 95%CI: 81.0-85.8) of the participants claimed to be familiar with GERD whereas 515 (55.7%; 95%CI: 52.5-58.9) of the participants claimed to suffer or have suffered from GERD. Maximum of the participants were young, but both the familiarity and prevalence of GERD were slightly higher in young adults (83.9% and 57.7% respectively). Although familiarity about GERD was higher in females (84.1%), its prevalence was slightly higher in male participants (57.2%) compared to the females (53.6%). Familiarity of GERD was highest in participants with completed graduation (86.1%; 95% CI: 82.1-90.1) followed by those who completed their higher secondary level only (84.3%; 95%CI: 80.5-88.1). However, a maximum of 59% (95%CI: 50.1-67.9) of the participants with completed post-graduation claimed to suffer or have suffered from GERD followed by a 56.9% (95% CI: 51.2-62.6) of claimed GERD prevalence in participants with completed graduation. Both familiarity and prevalence of GERD were found to be higher among the urban population (84.1% and 55.8% respectively) compared to the rural participants. However, neither the familiarity nor prevalence of the disease was found to be significantly associated with any of the socio-demographic factors ($p > 0.05$) (Table 1).

Family history and lifestyle characteristics as potential precipitators of GERD: 696 subjects out of total 925 participants had a previous family history of GERD and of them 427 (61.4%) subjects claimed to suffer from GERD. A significant association was found between the family history of patients regarding GERD and the presence of this disease in them ($p < 0.0005$) with a Phi (ϕ) coefficient of 0.199 indicating a strong to very strong relationship. Prevalence of GERD was also significantly associated with irregular consumption of meal ($p = 0.013$) where participants with irregular meals demonstrated a higher GERD prevalence (62.2%) compared to ones with regular meal consumptions (51.4%) as well as with the amount of daily intake of tea/coffee ($p = 0.005$). A significant, very weak to weak association was also found between the intake of spicy/ junk foods and the prevalence of GERD in the study population ($p = 0.010$, $v = 0.111$). Although only 130 out of 925 participants frequently consumed spicy/junk foods, a highest of 63.1% of them reported suffering from GERD (Table 2).

Table 1. Familiarity and prevalence of GERD among the study participants according to different demographic characteristics (n= 925).

	Total number of participants	Participants familiar with GERD			Participants suffering from GERD		
		Frequency	Prevalence (%)	95% CI	Frequency	Prevalence (%)	95% CI
Total	925	771	83.4	81.0-85.8	515	55.7	52.5-58.9
Age							
Young	651	541	83.1	80.2-86.0	357	54.8	51.0-58.6
Young adults	274	230	83.9	79.5-88.3	158	57.7	51.9-63.5
Gender							
Male	536	443	82.8	79.5-86.1	306	57.2	53.0-61.4
Female	390	328	84.1	80.4-87.8	209	53.6	48.7-58.5
Completed education level							
Secondary	120	89	74.2	66.2-82.2	66	55.0	46.1-63.9
Higher Secondary	363	306	84.3	80.5-88.1	195	53.7	48.6-58.8
Graduate	295	254	86.1	82.1-90.1	168	56.9	51.2-62.6
Post-graduate	117	98	83.8	77.0-90.6	69	59.0	50.1-67.9
M. Phil/PhD	30	24	80.0	65.4-94.6	17	56.7	39.0-74.4
Residential area							
Urban	703	591	84.1	81.3-86.9	392	55.8	52.1-59.5
Rural	222	180	81.1	75.8-86.4	123	55.4	48.9-61.9

Prevalence of GERD was also analyzed for other potential precipitating factors like eating just before bed, drinking carbonated beverages, smoking, obesity, consuming outside foods, physical exercise and perceived stress by the participants but no significant association was identified ($p > 0.05$). However, a maximum prevalence of GERD was found in participants who eat just before bed (59.4%), never drink carbonated beverages (59.6%), currently smoke regularly (61.4%), manifest obesity (62.8%), have outside foods regularly (59.2%) and never do any physical exercise (56.9%) (Table 2).

Binary logistic regression was performed to weigh the influence of several demographic, lifestyle factors along with family history on the likelihood of presence of GERD in the participants. The model contained a total of 15 independent variables including demographic factors like age, gender, education and residence along with family history and other lifestyle characteristics (Table 2). The overall model containing all the predictors was statistically significant, $\chi 2$ (15, 925) = 60.498, $p < 0.0005$, indicating that this model was able to distinguish between the respondents based on the presence of GERD. Only 3 of the independent variables made a unique statistically significant contribution to the model. The strongest predictor of GERD was family history with an odds ratio of 2.512 ($p < 0.0005$) indicating that participants with a positive family history were 2.512 times more likely to have suffered from GERD controlling for all other factors in the model. The other two unique significant predictors were skipping/irregular meal and eating spicy and junk food with an odds ratio of 1.527 ($p = 0.007$) and 1.495 ($p = 0.011$) respectively. Overall, 62.8% of the cases were correctly predicted by the model (Table 3).

Table 2. Family history and lifestyles as potential risk factors for GERD.

Potential risk factor	Number of participants	Patients suffering from GERD		
		Frequency	Prevalence (%)	95% CI
Family history ($\chi2$=36.688; p < 0.0005; ϕ= 0.199)				
Yes	696	427	61.4	57.8-65.0
No	229	88	38.4	32.1-44.7
Irregular meal ($\chi2$=8.747; p = 0.013; v= 0.097)				
Yes	328	204	62.2	57.0-67.4
No	313	161	51.4	45.9-56.9
Sometimes	283	150	53.0	47.2-58.8
Eating just before bed ($\chi2$=3.422; p = 0.181)				
Yes	219	130	59.4	52.9-65.9
No	447	252	56.4	51.8-61.0
Sometimes	258	132	51.2	45.1-57.3
Eating spicy and junk foods ($\chi2$=11.449; p = 0.010; v= 0.111)				
Frequently	130	82	63.1	54.8-71.4
Sometimes	521	296	56.8	52.5-61.1
Hardly I eat	222	104	46.8	40.2-53.4
Never	52	32	61.5	50.4-76.6
Daily intake of tea or coffee ($\chi2$=12.778; p = 0.005; v= 0.120)				
None	44	27	61.4	47.0-75.8
1 cup	216	101	46.8	40.1-53.5
2 cups	396	242	61.1	56.3-65.9
3 cups	202	112	55.4	48.5-62.3
> 3 cups	67	33	49.3	37.3-61.3
Drinking carbonated beverages ($\chi2$=2.033; P = 0.566)				
Frequently	89	44	49.4	39.0-59.8
Sometimes	508	288	56.7	52.4-61.0
Hardly	257	141	54.9	48.8-61.0
Never	71	42	59.6	48.2-71.0
Smoking ($\chi2$=5.704; P = 0.127)				
Never	381	197	21.7	17.6-25.8
Sometimes	310	188	60.6	55.2-66.0
Former	177	97	54.8	47.5-62.1
Current	57	35	61.4	45.1-70.7
Obesity ($\chi2$=4.740; P = 0.093)				
Yes	180	113	62.8	55.7-69.9
No	577	309	53.6	49.5-57.7
Moderate	168	93	55.4	47.9-62.9
Having outside foods ($\chi2$=1.916; P = 0.384)				
Regularly	125	74	59.2	50.6-67.8
Sometimes	702	392	55.8	52.1-59.5
Never	98	49	50	40.1-59.9
Physical exercise ($\chi2$=0.159; P = 0.924)				
Regularly	139	77	55.4	47.1-63.7
Sometimes	575	318	55.3	51.2-59.4
Never	211	120	56.9	50.2-63.6
Stress ($\chi2$=0.151; P = 0.927)				
Yes	308	170	55.2	49.6-60.8
No	388	215	55.4	50.5-60.3
May be	229	130	56.8	50.4-63.2

$\chi2$= Pearson Chi-Square, p= P value, ϕ= Phi (effect size), v= Cramer's V (effect size).

Table 3. Binary logistic regression predicting the likelihood of reporting the presence of GERD based on different demography, family history and lifestyle characteristics.

	B	*S.E.*	Wald	df	P	*OR*	95% CI for *OR*	
							Lower	Upper
Age (16-25 y)	.004	.206	.000	1	.986	1.004	.670	1.503
Gender (Male)	.173	.146	1.403	1	.236	1.189	.893	1.583
Education (Graduation & above)	-.044	.191	.054	1	.816	.957	.658	1.391
Resident area (Urban)	-.121	.166	.533	1	.465	.886	.640	1.227
Family history (Positive)	.921	.161	32.789	1	.000	2.512	1.833	3.443
Skipping/irregular meal (Y)	.423	.157	7.248	1	.007	1.527	1.122	2.078
Eating just before bed (Y)	-.127	.145	.760	1	.383	.881	.663	1.171
Eating spicy & junk foods (Y)	.402	.158	6.440	1	.011	1.495	1.096	2.040
Drinking tea/coffee (Y)	-.269	.162	2.760	1	.097	.764	.556	1.050
Drinking carbonated drinks (Y)	-.176	.152	1.337	1	.248	.839	.623	1.130
Smoking (Y)	.288	.159	3.283	1	.070	1.334	.977	1.822
Obesity (Y)	.260	.144	3.267	1	.071	1.296	.978	1.718
Eating outside food (Y)	.172	.227	.572	1	.449	1.188	.761	1.855
Doing physical exercise (Y)	-.059	.167	.125	1	.724	.943	.680	1.307
Stress (Y)	.033	.148	.050	1	.823	1.034	.774	1.381

S.E.= Standard error; df= Degree of freedom, p= p-value, *OR*= Odds ratio, Y= Yes. Percent correct: 62.8% symptoms like regurgitation (83.3%), epigastric pain (50.1%), nausea or vomiting (36.9%), globus (36.6%), bloating (31.8%), diarrhea (25.5%) and decreased appetite (17.1%) (Fig 1).

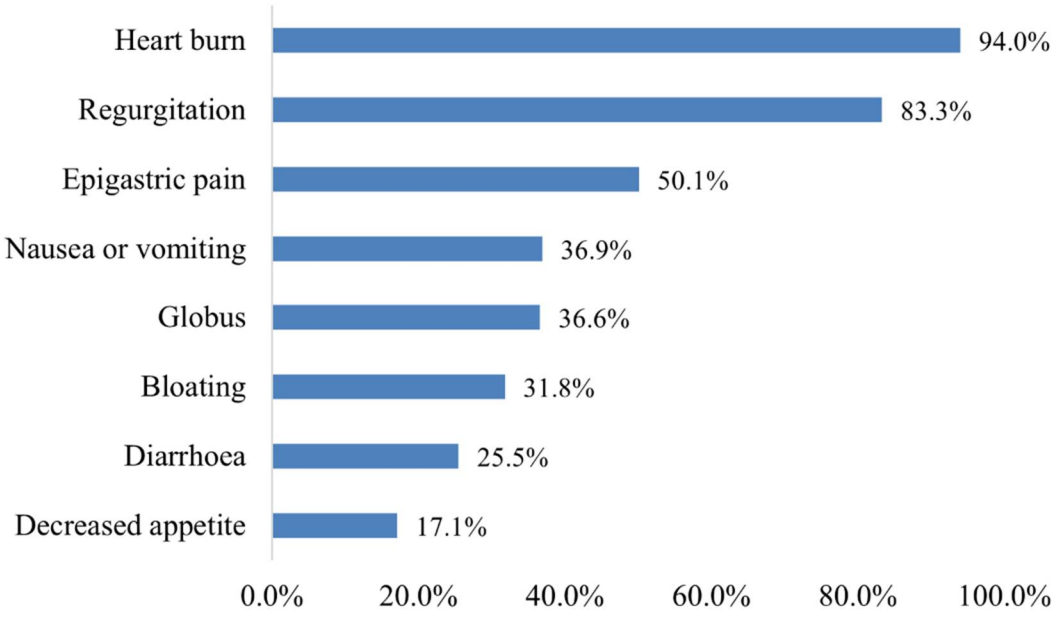

Figure 1. Common symptoms in patients suffering from GERD.

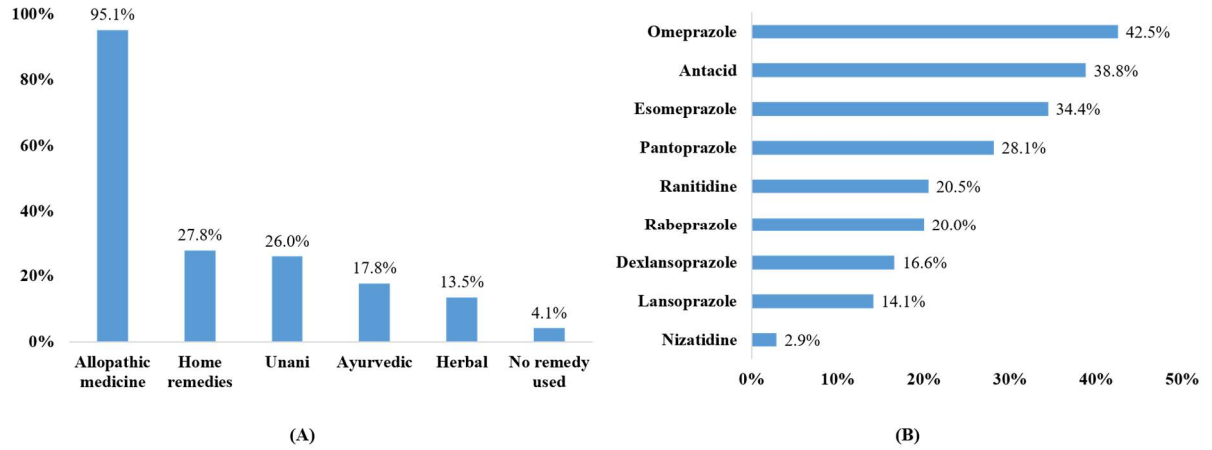

Figure 2. Different classes of therapeutic management against GERD (A) Different types of remedies used by the participants suffering from GERD. (B) Different allopathic medicines used by the participants suffering from GERD.

Clinical presentation of GERD: Among the study participants with GERD, a maximum of 33.4% of the individuals reported to have been suffering from GERD for around 2 years. 30.5% and 22.9% of the participants had been suffering from GERD for around 3 years and more than 3 years respectively. Only 13.2% of the participants had a history of GERD for around 1 year (Figure S1).

Heart burn (94.0%) was the most prevalent clinical manifestations of GERD followed by other symptoms such as regurgitation (83.3%), epigastric pain (50.1%), nausea or vomiting (36.9%), globus (36.6%), bloating (31.8%), diarrhea (25.5%) and decreased appetite (17.1%) (Figure 1).

Patients encountered a total of 2.2 symptoms on average while suffering from GERD. Interestingly, mean total number of symptoms was significantly higher (mean difference = 0.811, 95%CI= 0.556-1.065, p <0.0005) in patients with a positive family history of GERD. However, no significant association was found in between mean total number of symptoms vs. other socio-demographic factors as well as risk factors (p > 0.05) (Figure S2).

Clinical management of GERD

Allopathic medicine was the most prominent management therapy against GERD used by 95.1% of our study participants. Home remedy (27.8%) was the second most largely observed approach followed by unani (26.0%), ayurvedic (17.8%) and herbal (13.5%) medicines. 4.1% of our study participants with GERD used no remedies against this illness (Figure 2A). Our study also shows that the most widely used allopathic medicine against GERD was omeprazole (42.5%) followed by antacid (38.8%), esomeprazole (34.4%), pantoprazole (28.1%) and others (Figure 2B).

However, 52.6% of our study population self-medicated themselves with allopathic therapeutic management whereas, only 32.2% received those drugs under the prescription of a registered doctor (Fig 3A). The current investigation shows that this pattern of medication use is significantly associated with the gender of the patient (p = 0.012, v = 0.098) as well as with their completed education level (p = 0.004, v = 0. 111) with weak to moderate and moderate to strong effect respectively. Self-medication was most common in male patients (56.6%) as well as in patients with completed secondary education (58.8%) (Table 4).

Current study also displays that most of the patients (80.1%) take medicines only when they face GERD associated problems (Figure 3B) rather than taking regular medications according to the regimen and this kind of inappropriate drug use has been found to be significantly associated with the self-

medication practice of the patients ($p < 0.0005$, $v = 0.215$) (Table 4).

In addition, the present study also shows that maximum of our study participants has been on medication to manage GERD for about 6 months (24.5%). 19.1% and 18.3% of our patients have been taking medications for about 1 year and more than 1 year respectively (Figure 3C). This duration of treatment has also been found to be significantly associated with patients' self-medication behavior ($p < 0.0005$, $v = 0.158$) (Table 4).

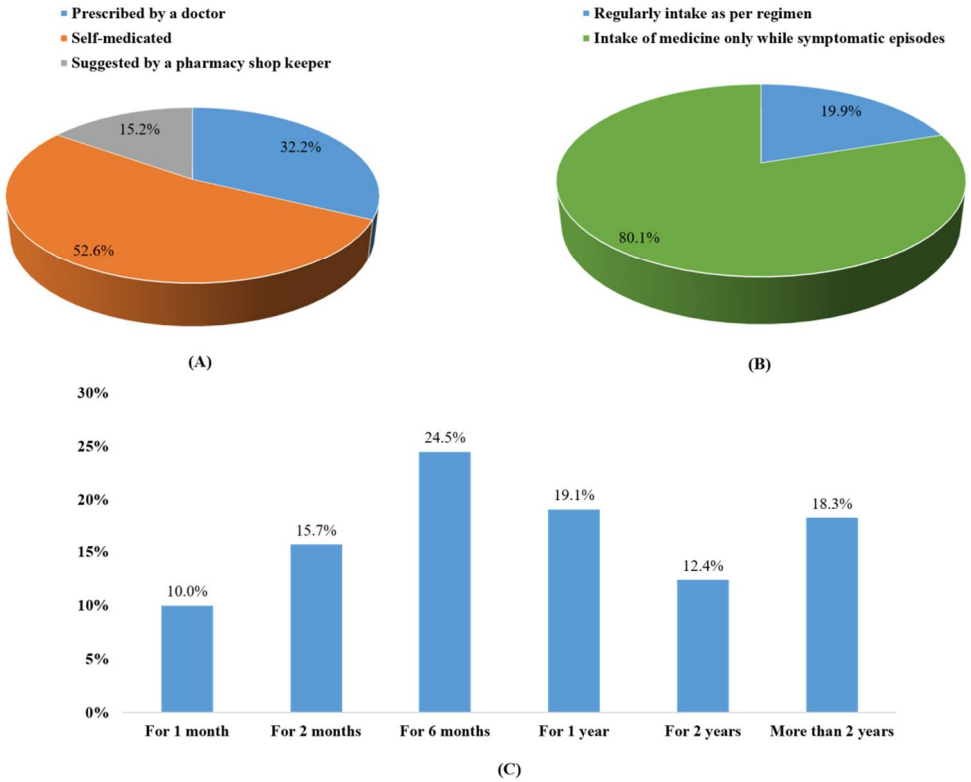

Figure 3. Scenario of therapeutic management of GERD (A) Pattern of prescribed or self-medication against GERD. (B) Frequency of taking medicines against GERD. (C) Duration of taking medicines by the participants to treat GERD.

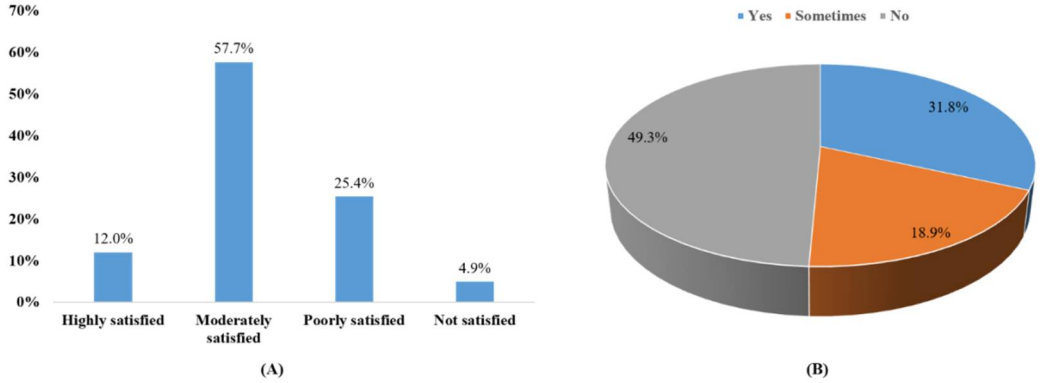

Figure 4. Perceived benefits or adverse events from therapeutic management of GERD management (A) Satisfaction level of the participants with their medicine for GERD. (B) Presence of withdrawal effects of allopathic medicines used in GERD.

Current study demonstrates that a maximum of 57.7% of the patients were moderately satisfied with their therapeutic management of GERD. However, 12.0%, 25.4% and 4.9% of the patients were highly, poorly and very poorly satisfied with their management respectively (Figure 4A). Again, although 49.3% of the patients faced no drug withdrawal affects, 31.8% of the patients experienced different sorts of discontinuation effects every time they stopped taking the medications (Figure 4B). Interestingly, satisfaction level of the patient was significantly associated with his/her gender ($\chi 2$ = 8.769, p = 0.033, v = 0.099) as well as with the duration of treatment ($\chi 2$ = 31.521, p = 0.007, v = 0.110) (data not shown). Presence of the withdrawal effects has also been found to be significantly associated with the length of the treatment period ($\chi 2$ = 67.435, p < 0.0005, v = 0.197) as well as with the regularity of taking the medicine ($\chi 2$ = 28.503, p < 0.0005, v = 0.177) (data not shown). In addition to that, both satisfaction level and presence of withdrawal effects have been found to be associated with the self-medication practice of the patients (p = 0.029, v = 0.089 and p < 0.0005, v = 0.144 respectively) (Table 4).

Peoples' beliefs regarding GERD: 771 (83.4%) out of 925 study participants claimed that they are familiar with GERD (Table 1). Among them, 44.1% of the participants believed that GERD is most likely to occur in adults. 33.9% and 3.3% of the participants thought that GERD is mostly a disease of the elderly and children respectively. However, 18.8% of the study subjects believed that GERD is equally likely to occur in all age groups (Fig 5A). Also, a maximum of 53.1% of the study participants believed that GERD patients are likely to suffer more than two acid reflux episodes per week (Fig 5B). People considered chest pain (59.1%) as the most common symptom of GERD followed by regurgitation of food or sour liquid (57.6%), difficulty in swallowing (52.3%), sensation of lump in the throat (50.5%), heartburn (45.5%) and others (7.50%) (Fig 5C).

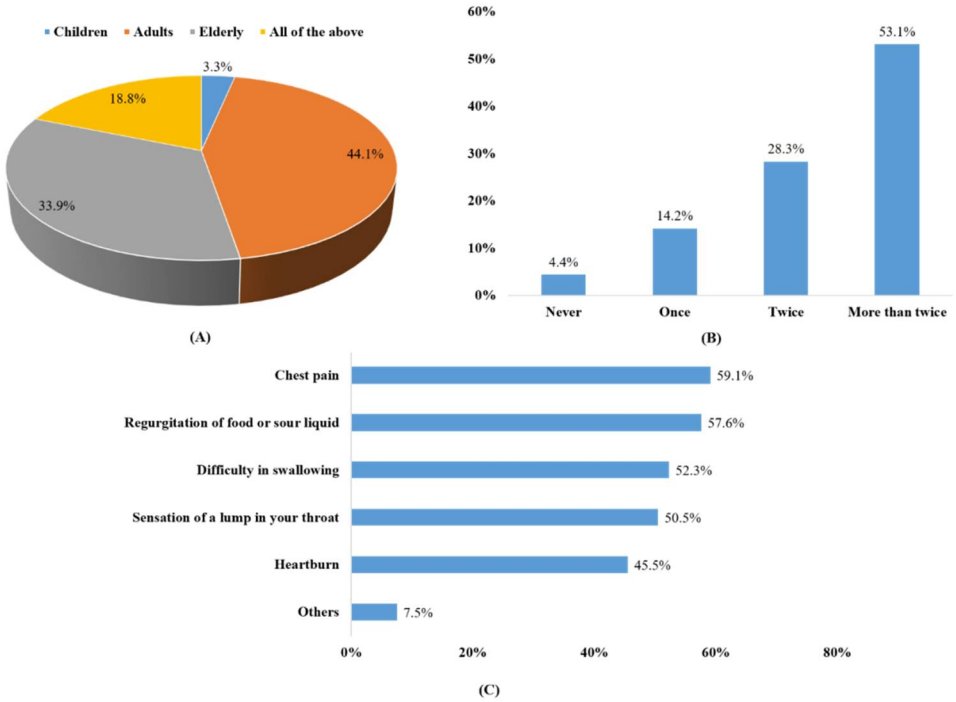

Figure 5. Beliefs associated with GERD among young Bangladeshi population (A) Belief about the most likely age to develop GERD. (B) Belief regarding the number of acid reflux episodes per week in GERD. (C) Belief regarding the common symptoms of GERD.

Table 4. Association of different socio-demographic factors of the patients as well as satisfaction level/ withdrawal effects from anti-GERD drugs with the pattern of medication consumption by the patients.

		Pattern of medication against GERD			χ2, df	P	v
		Prescribed by a doctor	Suggested by a pharmacy shop keeper	Self-medicated			
Age	Young	199 (30.9%)	111 (17.2%)	334 (51.9%)	3.690, 2	0.158	0.158
	Young adult	88 (32.5%)	33 (12.2%)	150 (55.4%)			
Gender	Male	159 (30.1%)	70 (13.3%)	299 (56.6%)	8.792, 2	0.012	0.098
	Female	128 (33.1%)	74 (19.1%)	185 (47.8%)			
Completed education level	Secondary	31 (26.1%)	18 (15.1%)	70 (58.8%)	22.428, 8	0.004	0.111
	Higher Secondary	117 (32.6%)	77 (21.4%)	165 (46.0%)			
	Graduate	90 (31.0%)	30 (10.3%)	170 (58.6%)			
	Post-graduate	39 (33.3%)	13 (11.1%)	65 (55.6%)			
	M. Phil./PhD	10 (33.3%)	6 (20.0%)	14 (46.7%)			
Residence	Urban	219 (31.5%)	101 (14.5%)	376 (54.0%)	3.485, 2	0.175	0.062
	Rural	68 (31.1%)	43 (19.6%)	108 (49.3%)			
Regularity of taking medicines	Regular continuous intake	89 (51.1%)	12 (6.9%)	73 (42.0%)	42.344, 2	<0.0005	0.215
	On demand intake	198 (26.7%)	132 (17.8%)	411 (55.5%)			
Duration of medication	1 month	44 (42.7%)	26 (25.2%)	33 (32.0%)	43.503, 10	<0.0005	0.158
	2 months	40 (30.8%)	18 (13.8%)	72 (55.4%)			
	6 months	73 (36.1%)	16 (7.9%)	113 (55.9%)			
	1 year	37 (22.4%)	23 (13.9%)	105 (63.6%)			
	2 years	30 (29.1%)	24 (23.3%)	49 (47.6%)			
	> 2 years	53 (32.3%)	33 (20.1%)	78 (47.6%)			
Satisfaction level	High	35 (31.8%)	14 (12.7%)	61 (55.5%)	14.084, 6	0.029	0.089
	Moderate	181 (34.9%)	84 (16.2%)	254 (48.9%)			
	Poor	56 (24.9%)	31 (13.8%)	138 (61.3%)			
	Very poor	14 (31.8%)	11 (25.0%)	19 (43.2%)			
Withdrawal effects	Yes	104 (37.7%)	40 (14.5%)	132 (47.8%)	37.457, 4	<0.005	0.144
	No	109 (24.3%)	63 (14.1%)	276 (61.6%)			
	Sometimes	70 (39.5%)	41 (23.2%)	66 (37.3%)			

χ2= Pearson Chi-Square, df= Degree of freedom, p= P value, v= Cramer's V (effect size).

According to our investigation, 44.9% of the study participants believed that a modified lifestyle might be effective to solve or manage GERD (Figure S3). Current study also demonstrates that escaping outside foods (52.0%) was the most widely considered lifestyle modification that is effective against GERD followed by other good practices like maintaining a healthy weight (48.5%), avoiding carbonated beverages or spicy foods (47.3%), stopping to overeat (46.8%), reduced stress (44.7%), quitting to smoke (42.5%), etc (Figure 6).

Interestingly, perception on the effectiveness of better lifestyle against GERD was found to be significantly associated with age of the participants (p = 0.006, v = .105) as well as with their completed education level (p = 0.024, v = 0.098). A highest of 46.4% of young and 47.9% of the participants with completed higher secondary level of education carried a positive perception regarding the effectiveness of healthy lifestyles against GERD (Table 5).

Table 5. Association between different demographic characteristics and perception regarding the effectiveness of better lifestyles against GERD.

		Perception on the effectiveness of better lifestyle against GERD			χ2, df	P	v
		Positive	Negative	Not sure			
Age	Young	302 (46.4%)	106 (16.3%)	243 (37.3%)	10.112, 2	0.006	0.105
	Young adult	113 (41.2%)	30 (10.9%)	131 (47.8%)			
Gender	Male	241 (45.0%)	81 (15.1%)	213 (39.8%)	0.295, 2	0.863	0.018
	Female	174 (44.6%)	55 (14.1%)	161 (41.3%)			
Completed education level	Secondary	51 (42.5%)	29 (24.2%)	40 (33.3%)	17.671, 8	0.024	0.098
	Higher Secondary	174 (47.9%)	50 (13.8%)	139 (38.3%)			
	Graduate	133 (45.1%)	40 (13.6%)	122 (41.4%)			
	Post-graduate	48 (41.0%)	14 (12.0%)	55 (47.0%)			
	M. Phil./PhD	9 (30.0%)	3 (10.0%)	18 (60.0%)			
Residence	Urban	314 (44.7%)	106 (15.1%)	283 (40.3%)	0.329, 2	0.848	0.019
	Rural	101 (45.5%)	30 (13.5%)	91 (41.0%)			

χ2= Pearson Chi-Square, df= Degree of freedom, p= P value, v= Cramer's V (effect size).

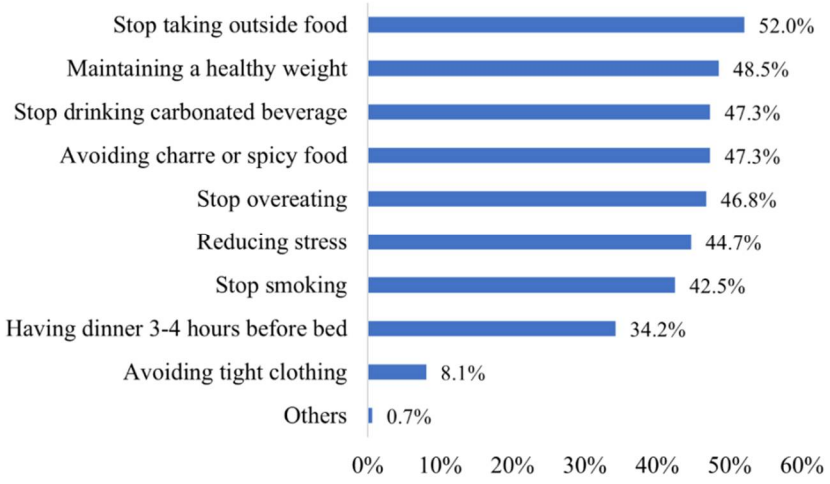

Figure 6. Perception on effective lifestyles to resolve GERD.

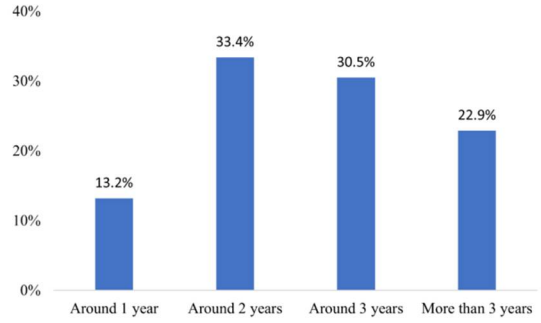

Figure S1. Length of suffering from GERD.

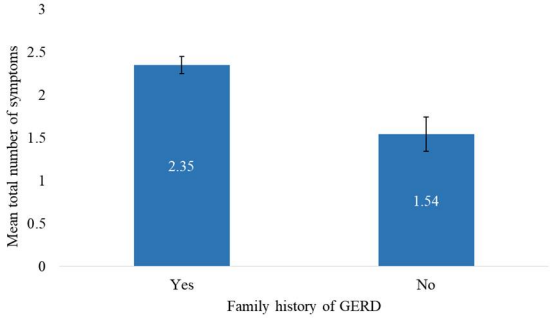

Figure S2. Association of GERD with the mean number of symptoms displayed by the patients (Error bars: 95% CI).

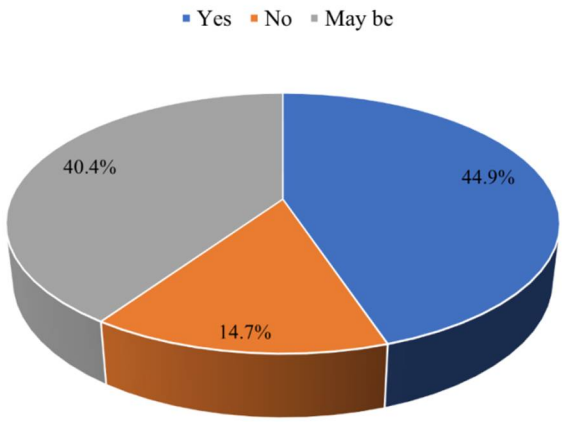

Figure S3. Belief about the effectiveness of modified lifestyle to solve GERD.

Discussion

In this descriptive cross-sectional study, the prevalence of GERD was found to be 55.7% which is higher than the previously conducted studies in Bangladesh or in neighboring countries (Shahed, 2007; Kumar and Shivalli, 2014; Aftab *et al.*, 2008; Suresh *et al.*, 2006; Dk, *et al.*, 2018) but is quite similar to the findings of some studies conducted in Saudi Arabia (Mohammed and Almutairi, 2017; Kuddus *et al.*, 2021) . A big difference with the reported GERD prevalence might be attributed to the differences in the methods used by each investigator as well as to the absence of a generally adopted definition of GERD (DK, *et al.*, 2018). However, a higher prevalence despite using the same GERD definition might indicate an actual increase in the prevalence of GERD among mass population. Our study failed to show any association between age and the prevalence of GERD which was consistent with the findings of other relevant studies (Buraykan and Ahmad, 2018; Nasseri-Moghaddam *et al*., 2008). However, significant association was demonstrated by certain studies as well (Shaha *et al.*, 2012; Çela *et al.*, 2013). Similar sorts of inconsistent findings have been observed regarding the association of gender and GERD prevalence as many of the studies showcased gender as a risk factor for GERD (Dk *et al.*, 2018; Shaha *et al.*, 2012; Kuddus *et al.*, 2021) while most others complies with our findings demonstrating no such association (Goh *et al.*, 2000; Kuddus *et al.*, 2021; Çela *et al.*, 2013). Again, no significant association was found between GERD and educational level supporting the finding of Buraykan & Ahmad (2018) although most other relevant studies demonstrated a significantly higher chance of GERD in less educated people probably owing to their lifestyle and dietary habits (Saberi-firoozi *et al.*, 2007; Çela *et al.*, 2013; Shaha *et al.*, 2012). Current study also could not find any significant relationship between residential area and GERD which is consistent to another study conducted in Saudi Arabia (Buraykan and Ahmad, 2018). However, most other studies showed positive association of GERD with either urban (Sharma *et al*., 2011; Chowdhury *et al.*, 2019) or, rural habitation (Saberi-firoozi *et al.*, 2007; Diaz-Rubio *et al.*, 2004). This lack of significant association of GERD with different socio-demographic factors might be explained by the high familiarity of this disease among population from all socio-demographic categories as found in the current study.

Both univariate and binary linear regression analysis in our study found family history, irregular meal and consumption of spicy and junk foods as significant risk factor of GERD. Although a recent study in Saudi Arabia did not (Kuddus *et al.*, 2021), several relevant studies showed significant association between GERD and relevant family history (Saberi-firoozi *et al.*, 2007; Atta *et al.*, 2019; Diaz-Rubio *et al.*, 2004; Dent *et al.*, 2005). Additive

genetic factors or, gene-encoding collagen-ш alpha-1 might play a role to develop GERD in patients (Mesfer and Ahmad, 2017). In consistence to our findings, majority of other studies have also demonstrated a significantly positive relationship between irregular consumption of meals and GERD (Esmaillzadeh *et al.*, 2013; Yamamichi *et al.*, 2012; Song *et al.*, 2011) with an exception in Saudi Arabia (Alrashed *et al*., 2019). Irregular meal consumption is often positively associated with obesity which eventually predisposes GERD (Esmaillzadeh *et al.*, 2013). It has been demonstrated by several studies alongside ours that GERD significantly associates with the consumption of spicy and junk foods (Taraszewska, 2021; Kuddus *et al.*, 2021; Choe *et al.*, 2017; Alsulobi *et al.*, 2017) although a few studies failed to demonstrate any such association as well (Alrashed *et al*., 2019; Dore *et al.*, 2008). Spicy food can stimulate the nerve endings of esophageal mucosa, thereby triggering heart burn (Taraszewska, 2021) whereas junk foods are often fried or contain high quantity of fat which promotes GERD either through inducing obesity or, delaying gastric emptying (Esmaillzadeh *et al.*, 2013; Moayyedi & Talley, 2006). Factors like eating just before bed (Esmaillzadeh *et al.*, 2013), drinking carbonated beverages (Mesfer and Ahmad, 2017), smoking (Kumar and Shivalli, 2014; Mesfer and Ahmad, 2017), obesity (Chowdhury *et al.*, 2019; Çela *et al.*, 2013), stress (Kuddus et al., 2021), and/or physical exercise (Saberi-firoozi *et al.*, 2007; Mesfer and Ahmad, 2017) have been demonstrated as significant predisposing factor by multiple studies. However, our findings did not perceive any significant association of these factors with GERD predisposition which is consistent with certain findings of multiple relevant studies as well (Kuddus *et al.*, 2021; Shaha *et al.*, 2012; Kumar et al., 2011; Nam et al., 2010). Such opposite findings from different research studies have led to a controversial scenario regarding the risk factors of GERD and hence further optimized studies are required.

Current study demonstrates heart burn and regurgitation as the most and second most prevalent symptoms manifested in most of the GERD patients which is consistent to the findings of multiple other studies (Kumar and Shivalli, 2014; Shaha *et al.*, 2012). However, in 2003, a study in China found regurgitation as the most frequent symptom with heart burn in the second position (Wong *et al.*, 2003), Although, heartburn and regurgitation are the most common GERD symptoms found in different relevant studies, often their frequency were lower than the current study's finding (Kuddus *et al.*, 2021; Dk *et al*., 2018; Rahman *et al.*, 2020) which might be due to the difference in case definitions. In addition, epigastric pain, nausea, globus were also found to be frequent symptoms of GERD which complied with the findings of several other research works (Kuddus *et al*., 2021; Shaha *et al.*, 2012; Rahman *et al*., 2020; Josefsson e*t al.*, 2018).

Current study showed that allopathic medicines were consumed by maximum GERD patients and omeprazole was the most used allopathic medicine followed by antacid and other PPIs. H_2RAs like ranitidine was also consumed by a moderate number of patients. Such finding mimics the outcome of several other studies regarding the therapeutic management of GERD (Rahman *et al.*, 2020; Butt & Hashemy, 2014; Aftab *et al.*, 2009). Greater use of PPIs compared to H_2RAs indicates a good therapeutic practice since it is well-reported that PPIs are better than H_2RAs in relieving GERD related symptoms (Fock *et al.*, 2008; Dekel *et al.*, 2004; Hershcovici & Fass, 2011). However, immediate relieve from GERD symptoms, unlike in PPIs, might contribute to the common intake of antacid and H_2RAs (Fock *et al.*, 2008). Again, herbal medicines were used by 13.5% of GERD patients which is lower that observed in a study conducted in Iran in 2007 (Saberi-firoozi *et al.*, 2007). Current study also found that more than half of the study participants self-medicated themselves to treat GERD symptoms while a fewer number of patients consulted with a physician and such findings are supported by certain other research works (Aftab *et al.*, 2009; Saberi-firoozi *et al.*, 2007; Wong *et al.*, 2003). Significant prevalence of self-medication in male might be due to higher self-deciding tendency of males in a male-dominated society of Bangladesh as they often regard consulting with a physician or

pharmacist unimportant. Interestingly, our study found a significantly positive association between self-medication and duration of treatment. These might be explained by another of our findings that showed that self-medication often involves on demand intake of medication rather than a full regimen treatment which is essential for efficient management and greater satisfaction (Bytzer, 2009; Veldhuyzen *et al.*, 2012). Majority of our study participants were highly or moderately satisfied with the therapeutic management of GERD which is similar to the findings of several other studies that evidenced a high satisfaction rate (70% - 94%) among GERD patients with different medications (Revicki, 2004; Jones *et al*., 2006). Patient satisfaction is often a positive indicator of symptom relieve and improved quality of life (Veldhuyzen *et al.*, 2012) and is mediated by multiple factors like appropriate treatment management, quality of physician-patient communication, etc (Bytzer, 2009).

While investigating people's perception regarding GERD management, current study showed that lifestyle modification is believed as an effective strategy to prevent or manage GERD by about half the study participants; similar acceptance rate of such non-pharmaceutical approach was also highlighted among physicians and patients in a study conducted in 2007 (Reimer and Bytzer, 2007). However, lifestyle modifications are currently utilized as the first line treatment of GERD by many physicians (Festi *et al.*, 2009). Therefore, initiatives should be taken to create more awareness among mass population to adhere them to a better lifestyle to prevent or manage GERD in an efficient and economical way.

Strengths and limitations of the study

The study's strength is vast number of study participants that greatly reduces the overall bias. Again, to our knowledge, this is the first study that is exclusively focused on displaying the GERD scenario among young and young adults. Study, however, has a few limitations. It may not be generalizable to an elder population due to the age restricted sampling. In addition, although the statistical analysis adjusted for various GERD risk variables while doing the binary linear regression analysis, remaining confounders such as medication intake and previous drug therapy were not considered. Convenient non-probability sampling method introduced a certain degree of biasness to the study although it increased the response rate in the study. Along with that, self-administer approach for data collection induced the possibility of information bias and lack of verification of data.

Conclusion

This descriptive cross-sectional study has demonstrated a high prevalence of GERD among the general young population of Bangladesh. Familiarity with GERD is also very high among the study participants. Both univariate and multivariate analysis demonstrated family history and certain behavioral factors (irregular meal, spicy/junk food consumption) as significant risk factors of GERD. Heart burn and regurgitation were the most prevalent manifestations found in GERD patients along with other symptoms. PPIs and H_2RA were used for the therapeutic management of GERD where the first one was way more frequently used than the second one. Self-medication was found as a common practice against GERD that significantly affected the duration of treatment as well as the satisfaction level of patients from the therapy. Analysis of participants' belief showed that about half of them believed in the efficacy of modified lifestyle to manage or prevent GERD. However, further prospective cohort study is advised to solidify the findings of this study.

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