

A cross-sectional study on the association between smoking behavior and GERD
prevalence among the Bangladeshi university students

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A Thesis submitted to the School of Pharmacy in Partial Fulfillment of the Requirements
for the Degree of Bachelor of Pharmacy

School of Pharmacy
BRAC University
November 2025

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Declaration

It is hereby declared that

1. The thesis submitted is my own original work while completing a degree at BRAC University.
2. The thesis does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The thesis does not contain material which has been accepted, or submitted, for any other degree or diploma at a University or other institution.
4. I have acknowledged all main sources of help.

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Approval

The Project titled “A cross-sectional study on the association between smoking behavior and GERD prevalence among the Bangladeshi university students” submitted by Mubasshara Korim (21146013), of Summer 2025, has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Bachelor of Pharmacy.

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Ethics Statement

If review or non-human or animal studies: This project does not involve any kind of animal or human trial.

Abstract

Objective: To know the association between smoking behavior and GERD prevalence, this study was conducted among the public and private university students in Bangladesh. The main purpose of the study was to determine if GERD and smoking are related after analyzing the impact of factors like age, gender, university type, and smoking habit.

Subject and Method: The study included 405 participants and conducted in the period of December 2024 to June 2025. The students who participated were aged above 26 from different public and private universities in Bangladesh. For data collection, a self-administered questionnaire was used. IBM SPSS was used, and Microsoft Excel was used for data analysis.

Analysis and Result: Collected data was analyzed by descriptive statistics and Pearson chi-square test. The majority students were found to have as low to moderate GERD risk while only a few were classified as high risk of GERD. Here, the assessment included smoking status, cigarette consumption, and vaping habit. According to the analyzed result, there was no significant association between smoking behavior and GERD. There were some motivational factors that led the students to smoking behavior. Among these stress, peer pressure, academic pressure, curiosity, family problem and others were common but stress was shown as the prime factor of smoking behavior.

Conclusion: This cross-sectional study found that there was no significant relationship between smoking behavior and GERD prevalence among the university students of Bangladesh. There were some limitations that influenced the result of this study. Firstly, it was a cross-sectional study that might limit the ability to establish causality as well as the data were self-reported which effected the result. Moreover, some other factors like restricted sample collection, narrow age group mostly influenced the result of this study. Future research might be more effective to find relationship between smoking behavior and GERD prevalence if their opportunity to collect data widely, a wider age range, examination of other lifestyle, habits and stress that could affect the result directly.

Keywords: Smoking behavior, GERD, University students, Cross-sectional study, Bangladesh.

Dedication

This one is for the pillar of my life. To my mother, the passive strength behind every success I have ever known. Her resilience, sacrifices, and unwavering love have made me who I am today. Dedicated to my father, whose blessings still illuminate my way. His love serves as a north star, reminding me to keep steady and hopeful to my family, and to my mama in particular, whose guidance, support, and belief in me have informed my path in countless ways that words cannot contain. They have been my anchor and my purpose. My gratitude becomes boundless as I express my deepest feelings to my honorable supervisor, Faria Nasrin Ma'am, for her caring guidance, patience, and perseverance, which transformed an ordinary idea into this present final work. To my closest friends, whose support, understanding, and belief in me changed the unbearable into bearable. And finally, to myself for having the resilience to get through this, the courage to keep going, and the determination to finish this work.

Acknowledgment

It is to the almighty Allah that I owe my first thanks for his kind such and grace, goodness, and mercy. His guidance and blessings inspired me to accomplish this project. I feel so blessed to have been given strength and mental clarity throughout this experience.

I would like to express my sincere gratitude to my supervisor, Faria Nasrin, Lecturer, School of Pharmacy, BRAC University, for her constant supervision and guidance during the work. Her valuable comments, helpful advice, and waiting attitude have greatly contributed to both the direction and quality of this research. I am really thankful to her for her support and guidance.

I would like to extend my thanks to Professor AFM Yusuf Haider, Acting Dean, School of Pharmacy, BRAC University, for his leadership and nurturing an academic center of excellence. His focus on helping us to succeed and learn in all of our classes has made a great impact on my experience.

I am also especially grateful to all the faculty of the School of Pharmacy for their hard work, guidance, and concern during my entire period of study. Their commitment to teaching and mentoring has been crucial to my development and to the completion of my undergraduate career.

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List of Acronyms

GERD Gastroesophageal Reflux Disease

SPSS Statistical Package for the Social Sciences

Chapter 01

Introduction

Gastroesophageal reflux disease (GERD) is a kind of long-standing gastrointestinal disease that occurs when stomach acid repeatedly flows back into the esophagus leading to specific symptoms like heartburn, regurgitation, chest discomfort etc. Moreover, there may be even extra-esophageal symptoms such as heavy cough or laryngitis (Vakil et al., 2006). GERD has been rising drastically worldwide as well as it is now regarded as one of the major public health concerns which can impact people's lifestyle, daily work, productivity, and health-related costs. (EL-serag, 2007). The etiology of GERD is multifactorial. It has some risk factors that are widely recognized. The risk factors include obesity, dietary habits, and stress, where smoking is particularly responsible. (Wienbeck M and Barnert j., 1989).

Besides, according to different studies, smoking might have close connections with GERD symptoms and related complications like erosive esophagus and Barrett's esophagus (Nilsson et al., 2004; Kang et al., 2016). However, there may be a relationship between smoking and GERD depending on genetic, dietary and lifestyle factors.

In Bangladesh, the prevalence of smoking remains very high, especially among young adults and university students in both public and private universities. Generally, university life is the time of forming lifelong habits, and this time is very critical as during this time, health behaviors can significantly influence their long-term well-being. A recent survey from neighboring countries shows GERD among University students with lifestyle factors, smoking, eating patterns, and stress playing contributory roles (Kumar et. al, 2017; Shrestha et al., 2020).

This survey's main purpose is to assess the relationship between smoking behavior and GERD prevalence among Bangladeshi students by conducting a cross-sectional analysis so that it can be used to determine the prevalence of GERD among Bangladeshi University students and the connection with smoking behavior. This survey may be helpful to find the evidence to curb smoking and its gastrointestinal health implications among university students in Bangladesh.

Chapter 02

Study Objective

This cross-sectional study has been conducted to explore the connection between smoking behavior and GERD prevalence among the Bangladeshi University students. Commonly GERD causes symptoms like heartburn, chest discomfort, acid regurgitation that affect a person's daily well-being. In the similar way smoking is considered as a risk factor for many issues like digestive problems, heart disease and many more. This study aims to evaluate the relation between smoking behavior and GERD prevalence. It is hoped that this study will help to understand clearly if smoking is linked to a higher number of GERD cases.

Chapter 03

Methodology

3.1 Study design

The study is designed as a cross-sectional study and it has been administered to examine the relationship between smoking behavior and the prevalence of GERD among the public and private universities in Bangladesh. At first, the data on demographic factors, GERD symptoms and smoking behavior were collected from both public and private university students using a self-administered questionnaire. The study was conducted in the span of December 2024 to June 2025.

3.2 Data collection

For data collection, a questionnaire was designed. The questionnaire consists of three sections and comprises of 18 questions to know about demographic factors, GERD risks and smoking behaviors. The students were informed about the purpose of this survey. An online Google form was made, and data was collected via social media and direct contacts.

3.3 Measure

Section 1 (Demographic Information): In Section-One, the questions were related to age, gender, year of study, and university type.

Section 2 (GERD Assessment): In Section Two, the questions were related to symptoms like stomach contents, nausea, upper stomach pain, heartburn, regurgitation, etc.

Section 3 (Assessment of smoking behavior): In Section-Three, the questions were related to smoking behavior. For example- Smoking status, frequency, duration, use of Nicotine, smoking factors etc.

3.4 Data Analysis

Data analysis was conducted by using IBM Statistical Package for Social Science (SPSS) version 25 and Microsoft Excel. For summarizing categorical variables, descriptive statistics as well as frequencies and percentages, were applied. To examine the relationship between Smoking and GERD the Pearson chi-square test was performed.

3.5 Survey Form

A cross-sectional study on the association between smoking behavior and GERD prevalence among the Bangladeshi university students.
Section 1: Demographic Information 1. Age: • 18-20 years • 21-23 years • 24-26 years • Above 26 years 2. Gender: • Male • Female • Prefer not to say 3. Year of Study: • Undergrad • Postgrad 4. University Type: • Public • Private

Section 2: GERD Assessment

1. How often did you have a burning feeling behind your breastbone (heartburn) over the past week?

- 0 Day
- 1 Day
- 2-3 Days
- 4-7 Days

2. How often did you have stomach contents (liquid or food) moving upwards to your throat or mouth (regurgitation) over the past week?

- 0 Day
- 1 Day
- 2-3 Days
- 4-7 Days

3. How often did you have a pain in the centre of the upper stomach over the past week?

- 0 Day
- 1 Day
- 2-3 Days
- 4-7 Days

4. How often did you have nausea over the past week?

- 0 Day
- 1 Day
- 2-3 Days
- 4-7 Days

5. How often did you have difficulty getting a good night's sleep because of your heartburn and/or regurgitation over the past week?

- 0 Day
- 1 Day
- 2-3 Days
- 4-7 Days

6. How often did you take additional medication for your heartburn and/or regurgitation over the past week?

- 0 Day
- 1 Day
- 2-3 Days
- 4-7 Days

Section 3: Assessment of Smoking Behavior

1. Do you ever smoke tobacco cigarettes?
 - Never
 - Current Smoker
 - Quit
2. If you are a smoker, how many cigarettes a day did you smoke in the past week on average?
 - Less than 5
 - 5-10
 - 10-15
 - More than 15
3. For how long have you smoked?
 - Less than 2 years
 - 2-5 years
 - More than 5 years
4. Do you use electronic cigarettes (vape)?
 - Never
 - Current Smoker
 - Quit
5. For how long have you been using electronic cigarettes (vape)?
 - Less than 6 months
 - 6 months-1 year
 - 1-2 years
 - More than 2 years
6. How frequently do you use e-cigarettes?
 - Daily
 - Weekly
 - Monthly
 - Occasionally
7. Nicotine concentration used in e-cigarettes:
 - 0 mg
 - 3 mg
 - 6 mg
 - 12 mg or higher
8. Which factor motivated your smoking behavior (Tobacco/E-cigarette)?
 - Stress
 - Peer pressure
 - Academic pressure
 - Curiosity
 - Family problems
 - Addiction
 - Others (please specify): _____

Result

4.1 Socio-demographic characteristics of the participants

This study was conducted on 405 students from private and public universities in Bangladesh.. The age range of the participants was above 18. The majority belong to the 24-26 years group (49.9%). For this reason, the result leant to that age because the maximum student's age range was 24 to 26. There was only a small proportion that is found in this study, above 26 years old, and belongs 4.7%. In terms of gender, 350 (86.4%) were male students, whereas 55 (13.6%) had been found as female students. Among the participants, it was seen that male students were more than that of female students. So, the result of this research will go to the male students. Besides, we had collected data from both undergraduate and postgraduate. According to the academic level, 341 participants (84.2%.) were undergraduate. On the other hand, 64 participants (15.8%) were postgraduate students. The number of undergraduate students was high, so the risk of GERD had appeared relatively high compared to the postgraduate student. As well as the terms of university type 96 (23.7%) were public, and 309 (76.3%) were from private universities. Here, the private university students responded more. So, the result leant towards the private university students, and the results might be more applicable for private university students. This demographic result showed that the majority of the students who respond here were from young male undergraduate private universities and had a slightly higher score from public universities.

Table 01: Socio-demographic characteristics of the respondents

Demographic Characteristics	n	%
1. Age		
18-20 years	25	6.2%
21-23 years	159	39.3%
24-26 years	202	49.9%
>26 years	19	4.7%
2. Gender		
Male	350	86.4%
Female	55	13.6%
3. Year of study		
Undergrad	341	84.2%
Postgrad	64	15.8%
4. University type		
Public	96	23.7%
Private	309	76.3%

4.2 Prevalence and risk assessment of GERD

For measuring the prevalence and severity of GERD among the 405 participants, there was a standard questionnaire that consisted of six questions which were related to the core symptom. The points included heartburn, regurgitation, upper stomach pain, nausea, sleep disturbance due to reflux symptoms, and use of additional medication for heartburn. The total participants were 405 students from different public and private universities. They completed a questionnaire where they were asked how frequently they experienced each symptom over the past week. In this questionnaire, they had four response options: 0-day, 1 day, 2-3 days, 4-7 days. To measure the severity of the symptoms, there was a score based on each response category. 0 day - 0-point, 1 day-1 point, 2-3 days -2 points, 4-7 days- 3 points. The responses that were collected from those six questions were summed, resulting in a total score ranging from 0 to 18, and by following this, the participants were categorized into three GERD risk levels. A score range of 0-6 was low risk, a score range of 7-12 was moderate risk, and a score

range of 13-18 was high risk. SPSS was used to analyse all response data, and the scoring system was coded and applied to the dataset. GERD risk categories were generated by SPSS. By this scoring and categorization, the prevalence and severity of GERD can be associated with the study population.

The first question was How often did you have a burning feeling behind your breastbone over the past week? . Among the participants, 201 answered 0 days, and their percentage was 49.6% and 25 participants answered 4-7 days. Those who score range 0-6 were 201 participants having a low risk of GERD prevalence, and score 13-18 were 25 members having a high risk of GERD prevalence.

Secondly, the question was: How often did you have stomach contents (liquid or food) moving upwards to your throat or mouth (regurgitation) over the past week? For this question, similarly, 405 participants answered. According to the chart, the score range was 0-6, low risk, and 187 students responded 0 days. Their percentage was 46.17%. So, it could be said that those who answered 0 days had a low risk of GERD prevalence. On the other hand, a score range of 13-18 was high risk, and among the participants, 26 answered 4-7 days, and their percentage was 6.42%. These participants had a high risk of GERD prevalence.

The third question: How often did you have pain in the centre of the upper stomach over the past week? Among 405 participants, 209 answered 0 day and their percentage was 51.60%. According to the score range 0-6 was low risk. So, it could be said that 209 participants had a low risk of GERD prevalence. In the same way, 77 participants answered 2-3 days and their percentage was 19.01%. The score range showed that 7-12 was in moderate risk. As they answered 2-3 days, they were in a moderate risk zone and they had moderate risk of GERD prevalence. Besides, 22 participants answered 4-7 days, here the score range had showed they were in 13-18, and had a high risk of GERD prevalence.

In the same way, it is asked, how often did you have nausea over the past week? As per the above question, 405 participants answered this question according to their health conditions. Here, 0 days answered 238 persons, whose percentage was 58.77%, 1 day answered 74 persons and their percentage was 18.27%, 2-3 days answered 66 persons, and their percentage was 16.30% and 4-7 days answered 27 persons, and their percentage was 6.67%. For measuring the GERD prevalence and severity score range 0-6 was low risk, score range 7-12 was moderate and 13-18 was high risk. So, those who answered 0 days were in low risk of GERD prevalence and it was found that 238 participants were at low risk, 66 participants were in moderate risk as they answered 2-3 days, and 27 participants were at high risk of GERD prevalence as they answered 4-7 days.

In the same way, the fifth question was: How often did you have difficulty getting a good night's sleep because of your heartburn and/or regurgitation over the past week? After analyzing the data, research had shown that among 405 participants, 212 participants answered 0 days and they accounted for 52.35%, 74 participants answered 1 day and their percentage 18.27%, similarly, 87 participants answered 2-3 days, and their percentage was 21.48% and 32 participants answered 4-7 days, also they account for 7.90%. The scoring system that was followed here, showed (0-6) low risk, (7-12) moderate risk, and (13-18) high risk. As 212 participants answered 0 days. So, they were in a low risk level of GERD prevalence, and 87 participants answered 2-3 days they were in moderate risk. 32 participants answered 4-7 days, and they were at high risk of GERD prevalence.

At last, the question was: How often did you take additional medication for your heartburn and /or regurgitation over the past week? Among 405 participants, 231 or (57.04%) answered 0 days, 75 or (18.52%) answered 1 day, 75 or (18.52%) answered 2-3 days, and 24 or (5.93%) answered 4-7 days. According to the scoring range those who were in 0-6 belong to low risk. So, it had been said that 231 members had low risk of GERD prevalence, and 75 members 2-3 days they had moderate risk 7-12, and 24 members answered 4-7 days, so their score was

13-18, and that's why they had a high risk of GERD prevalence.

Table 02: Questionnaire for the assessment of GERD Risk

Question		Number	Percentage
How often did you have a burning feeling behind your breastbone (heartburn) over the past week?	0 Day	201	49.6
	1 Day	92	22.7
	2-3 Days	87	21.5
	4-7 Days	25	6.2
How often did you have stomach contents (liquid or food) moving upwards to your throat or mouth (regurgitation) over the past week?	0 Day	187	46.17
	1 Day	103	25.43
	2-3 Days	89	21.98
	4-7 Days	26	6.42
How often did you have a pain in the centre of the upper stomach over the past week?	0 Day	209	51.60
	1 Day	97	23.95
	2-3 Days	77	19.01
	4-7 Days	22	5.43
How often did you have nausea over the past week?	0 Day	238	58.77
	1 Day	74	18.27
	2-3 Days	66	16.30
	4-7 Days	27	6.67
How often did you have difficulty getting a good night's sleep because of your heartburn and/or regurgitation over the past week?	0 Day	212	52.35
	1 Day	74	18.27
	2-3 Days	87	21.48
	4-7 Days	32	7.90
How often did you take additional medication for your heartburn and/or regurgitation over the past week?	0 Day	231	57.04
	1 Day	75	18.52
	2-3 Days	75	18.52
	4-7 Days	24	5.93

4.3 Association between smoking behavior and GERD risk

To find out the relation between smoking behavior and GERD prevalence, seven variables were set that were related to smoking. Some variables were set in a way so that the smoking status might be judged. The questions were daily status of taking cigarettes, how many times they took it, about the status of vaping, short or long-term vaping, and the information about the nicotine they had used. On the other hand, to know GERD prevalence, some categories were set like: low, moderate, and high risk. Here, a scoring range for those questionnaires had been set to determine GERD. Every smoking variable had been set into a cross-tabulated system where there were three GERD risk categories. For evaluating statistical significance, a chi-square test had been performed. No smoking variable showed any significant association with GERD in this study (all $p > 0.05$).

To know the association between smoking behavior and GERD prevalence, the first question was: Do you ever smoke tobacco cigarettes? For the answer they had options: never, current smoking and quit. Here, never option answered 87 persons that showed the low level for the GERD risk. As well as 5 persons were in the high level of GERD risk. For this question 159 were current smokers but here they were in the low risk of GERD and 15 persons were shown in high risk of GERD. and among quit, there were 30 persons who were in low risk and 3 were in the high risk. According to research analysis their significance value was 0.368. So, the p value is 0.368 greater than the 0.05. Here, the study failed to reject null hypothesis which indicated the possibility of no association between smoking behavior and risk of GERD.

For the same, to understand the association between smoking behavior and GERD, the second question was: if you are a smoker how many cigarettes a day did you smoke in the past week on average? Here, 95 participants answered 0 and according to the score range they had low risk of GERD and 6 participants were found to had high risk of GERD. Similarly, 80 participants answered (1-5) were in low risk of GERD and 7 participants were found in high risk of GERD. On the other hand, among the (5-10) answering participants 57 were found in low risk and 7 were found as the high risk of GERD. Fourthly, who answered (10-15) having 26 Low risk of GERD and 2 were in the high risk of GERD. Finally, those who smoke >15 had 18 participants with a low risk of GERD and only 1 participant in the high risk of GERD. According to research the significance value was 0.969. So, the p value was $0.969 > 0.05$. Here, the study failed to reject the null hypothesis. It was actually that the study accepted the

null hypothesis. So, it was said that there was no association between smoking behavior and GERD prevalence and smoking behavior did not influence GERD and that was the result.

Again, for the same purpose to know the association between smoking behavior and GERD risk, the third question was: For how long have you smoked?. In response it was seen that 83 participants answered 0 day having low risk of GERD as per the scoring range and 5 participants among the respondents having high risk of GERD. In the same way, 65 respondents among the participants who answered less than 2 years had low risk of GERD and for the same 5 participants were shown as high risk of GERD. After the third point was 2-5 years, here 60 participants were shown as low risk and 7 participants were shown as high risk of GERD. Lastly, 68 participants who answered less than 5 years had a low risk of GERD and 6 were found to had a high risk of GERD. Now, in the term of result it was identified that P value was 0.614 greater than 0.005. So, the study failed to reject the null hypothesis which indicated the possibility of no association between two.

The fourth question was: Do you use electronic cigarettes (vape) ? Among the participants who answered never show 151 having low risk of GERD and among them 14 were in high risk of GERD. Here, current smokers answered by 72 persons having low risk of GERD and 3 persons had been found as the high risk of GERD. Besides, the persons who quit also had 53 persons as low risk of GERD and 6 persons were found as the high risk of GERD. In comparison, it was found that low risk of GERD and high risk of GERD varies from the pattern of questions and the person's reply. In this question, there were 14 people who answered never having a high risk of GERD but those who answered quit having high risk on 6 persons and current smokers 3 persons having high risk. In the similar way, who never answered 151 persons having low risk but who quit having 53 low risk persons again current smokers 72 persons were low risk that was less than who answered never. In terms of result, the p value was 0.572 and the value was greater than the 0.05. As the $p > 0.05$, The study failed to reject null hypothesis, which indicated the possibility of no association between smoking behavior and risk of GERD.

To find the association the fifth question was: For how long have you been using electronic cigarettes (vape)?. Among those who gave 0-day answers to the response, 150 participants were at low risk of GERD and 15 participants were having high risk of GERD. Similarly, of the respondents who answered less than 6 months, 61 participants were at low risk of GERD and also 6 participants had been found as the high risk of GERD. Among 6 months to 1 year 28 participants were in low risk of GERD and 1 participant was found as the high risk. Those

who answered 1-2 years having 18 persons were low risk and 1 person was found as high risk of GERD. Lastly who responded more than 2 years, here 19 persons were in low risk and 0 persons in the high risk. By comparison, it was seen that those who had smoked for less than 6 months also had high risk while those who had smoked for more than two years also had a high risk of GERD. In the same way those who answered 0 day had low risk 150 participants and high risk 15 participants. Furthermore, those who smoked less than 6 months also had low risk 61 participants and high risk 6 participants. Now, the term of p value, here the significance value was 0.767. So, the p value 0.767 was greater than the 0.05. As the $p > 0.05$ the study failed to reject the null hypothesis. It indicated null hypothesis was accepted. which indicated the possibility of no association between smoking behavior and risk of GERD.

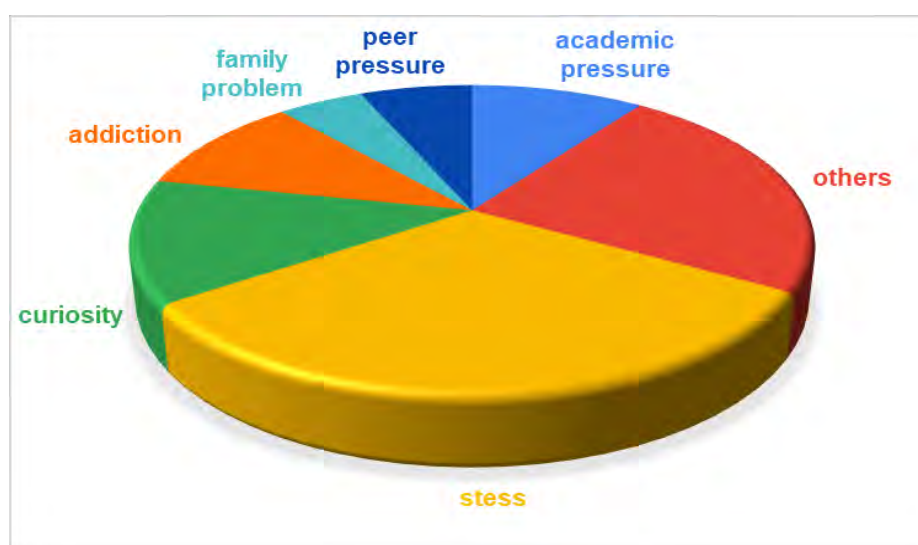
In the same sequence, the number six question was: How frequently do you use e-cigarettes?. Among the participants who answered never having 148 low risk and for the same 16 participants being scored as high risk of GERD. Some were responded as daily among them 47 participants were found as low risk of GERD. Similarly, 4 was found as high risk of GERD. In this section, among weekly respondents 14 participants were found as low risk and 0 participants were found as high risk of GERD. Fourthly, those who answered monthly had 8 members who had low risk of GERD and 0 members who had high risk of GERD. Lastly, those who answered occasionally had 59 persons in low risk and 3 participants were in the high risk of GERD. In comparison, the answer varies from person to person. So, smoking behavior and GERD prevalence also varies. Those who answered never 148 participants having low risk and 16 participants having high risk but who answered occasionally having 59 participants low risk and 3 high risks. Among never answered high risk 16 participants but monthly answered high risk 0 people. Here, the significance value was 0.648. It is found that 0.648 was greater than the 0.05. So, the study failed to reject the null hypothesis. Similarly, it was said that the null hypothesis was accepted. which indicated the possibility of no association between smoking behavior and risk of GERD.

Finally, the question was about nicotine concentration used in e-cigarettes. In analysis, it was seen that of those who answered 0 mg, among them 175 persons were found as low risk and 16 were found as the high risk of GERD. Secondly, those who answered 3mg had 38 persons at low risk of GERD and 4 persons were at high risk of GERD among the respondent participants. Thirdly, those who took 6mg of nicotine had 33 persons at low risk of GERD and 1 person was seen as the high risk of GERD. Finally, the participants who answered 12mg or higher had 30 participants who had a low risk of GERD and 2 participants with a high risk of

GERD. By comparison, it was seen that those who use 12 mg or higher nicotine had 2 people at high risk of GERD but those who 0mg had 16 high risk participants. Similarly, When the result of low risk was shown that 0 mg here 175 persons at low risk but 6 mg here 33 persons at low risk. In the same way, 12mg or higher here 30 participants at low risk. Nicotine concentration varies upon nicotine took more or less. In result, after completing analysis, it was found that the significance value of that question was 0.894. The significance value 0.894 was greater than 0.05. So, the study failed to reject the null hypothesis which indicated the possibility of no association between smoking behavior and risk of GERD.

The pie chart (Figure 01) had been made to know the major motivational factors by which they were getting motivated to the smoking behavior. In this chart stress had been shown as the most prominent factor and it was seen as the largest segment of the pie chart. There some other factors were also included like peer pressure, academic pressure, curiosity, family pressure, addiction and others. All these factors were considered as the motivational factors that led smoking behavior. Here, some smaller properties like addiction, family pressure, and academic pressure had been shown as the influential factor but stress was shown as a big reason of smoking behavior. Finally, it was clearly indicated that larger number of students had been involved into smoking behavior where stress was the prime factor and other factors were also played supporting role.

Figure 01: Motivational factors behind smoking among university students



As in the chi-square test (Table 03), all the values are greater than 0.05, the study failed to reject the null hypothesis, so no association is found between smoking behavior and GERD risk among the university students in this study.

Table 03: Determination of association between smoking behavior and GERD risk by Chi-square test

Smoking Behavior		Risk of GERD			Chi-square value	Significance
		Low	Moderate	High		
Do you ever smoke tobacco cigarettes?	Never	87	30	5	4.289	0.368
	Current Smoker	159	70	15		
	Quit	30	6	3		
If you are a smoker, how many cigarettes a day did you smoke in the past week on average?	0	95	32	6	2.331	0.969
	1-5	80	32	7		
	5-10	57	24	7		
	10-15	26	12	2		
	>15	18	6	1		
For how long have you smoked?	0	83	27	5	4.467	0.614
	<2 years	65	23	5		
	2-5 years	60	33	7		
	>5 years	68	23	6		
Do you use electronic cigarettes (vape)?	Never	151	53	14	2.919	0.572
	Current Smoker	72	29	3		
	Quit	53	24	6		
For how long have you been using electronic cigarettes (vape)?	0	150	52	15	4.961	0.767
	Less than 6 months	61	28	6		
	6 months-1 year	28	9	1		
	1-2 years	18	9	1		
	More than 2 years	19	8	0		
How frequently do you use e-cigarettes?	Never	148	53	16	5.991	0.648
	Daily	47	24	4		
	Weekly	14	7	0		

	Monthly	8	3	0		
	Occasionally	59	19	3		
Nicotine concentration used in e-cigarettes:	0 mg	175	63	16	2.265	0.894
	3 mg	38	16	4		
	6 mg	33	15	1		
	12 mg or higher	30	12	2		

Chapter 5

Discussion

5.1 Overview of key findings

This cross-sectional study has been conducted. Students from the public and private Bangladesh. There are some findings about the overall things that have been done from the beginning to the end of this study. By analyzing demographic data, it is seen that among the participants the majority were found aged between 21 to 23 (39.3%) and by 24 to 26 (49.9%) years. This type of age division indicates that the students were in the mid to late university age range. This study also shows that of those who participated here, the majority were male students (86.4%) and the female participants were less than the number of male participants. Female were only 13.6%. The result is misbalancing and it has typical causes or male participants tend to smoke higher than the female one. According to the assessment of GERD risk, it is observed that most of the students have low to moderate risk of GERD risk category. and among the participants only a small number of students are shown as high risk of GERD prevalence. To know the association between smoking behavior and GERD risk a chi- square test has been performed. The smoking variables included, smoking status, number of cigarettes smoked, duration, vaping status, e-cigarette, frequency and nicotine concentration. There were no associations that were statistically significant ($P>0.05$). This result shows that there is no significant relationship between smoking behavior to GERD risk.

5.2 Comparison with previous studies

To know the association between smoking behavior, there were many previous research worldwide. Some of them show smoking increases the chance of GERD and for smoking there may be weakness in lower esophageal sphincter (LES) and for this stomach acid to move upward. For example, a large population-based study by Nilsson et al. (2004) firmly established. current smoking as a significant risk factor for reflux symptoms. On the other hand, among the worldwide researches some show that among the university students there is no significant association between smoking behavior and GERD risk. For example, a study among European university students found no significant link between smoking status and GERD prevalence (Schroeder et al., 2019) and it is said that this result is very similar to this study.

5.3 Possible explanation for the findings

There are several factors that can be explained as the cause for why no significant association has been found. At first, the number of chain smokers were less than that of light or occasional smokers. As the majority of the participants were light or occasionally smoker these may not be enough physiological changes that can produce GERD symptoms. Secondly, most of the participants were the age range of 21 to 26. Normally this time they have strong digestive and esophageal functions to perform. In this time, they are stronger and more resilient and have the ability to reduce the immediate effect of smoking. Thirdly, in this study it is found that a large number of students use e-cigarettes. Generally, the effects of e-cigarettes are less than traditional smoking. Moreover, there may happen that the participants were not reported properly or they don't give enough response or there may happen that they don't evaluate this study. If they do so the result may be contributing to a non-significant result. Besides, this study only shows smoking behavior. Here other lifestyles like diet, stress levels, sleep patterns, physical activity were not measured properly. But these all are related with the GERD risk. As a result, the result of no association is possibly shown.

5.4 Strength of the study

This study is strong enough as it was conducted on a modest sample size ($n=405$) and provided adequate statistical power. There were few studies in Bangladesh to examine the smoking behavior and their relationship with the GERD, among them this study is one of the few. The pattern of question and the collection of data were done very carefully. Besides, analyzing multiple aspects of smoking, especially the score range, duration of smoking shows the depth of study.

5.5 Limitations

There are some limitations in this study. At first, cross sectional study is not able to show a proper relationship between smoking behavior and GERD. Secondly, All the information that was self-reported may have the possibility of partiality of giving less information that may impact on this study. Again, light or occasionally smoking may not be sufficient to produce a relationship between behavior and GERD. Finally, the samples were collected within a narrow age range and only university students, that limits the result of this study.

Chapter 6

Conclusion

The study was conducted to find the association between smoking behavior and GERD prevalence among Bangladeshi public and private university students. In broader research, though, there might have an association, but this study found no significant association between smoking behavior and GERD risk. This study showed that most of the students experienced low to moderate GERD symptoms, and only a very small number were at high risk of GERD. Some factors, like smoking status, frequency, and duration, were analyzed, but there was no statistical correlation between smoking behavior and GERD prevalence. However, there were some limitations that affected this result. If it is researched widely, especially lifestyle, diet, and stress, they may play a substantial role in GERD prevalence.

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