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**Original Article**

# Association between Stress and Gastroesophageal Reflux Disease (GERD) Among Undergraduate Students in Peshawar: A Cross-Sectional Study

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## ABSTRACT

Gastroesophageal reflux disease (GERD) and stress are growing health concerns among undergraduate students, especially in high-pressure academic settings. However, limited data exist regarding their prevalence and associated factors among students in Peshawar. **Objective:** To determine the association between Stress and GERD and identify its associated risk factors among undergraduate students in Peshawar. **Methods:** A cross-sectional study was conducted among 384 undergraduate students in Peshawar using convenience sampling. Data were collected through a structured questionnaire incorporating the validated GERD-Q and Cohen's Perceived Stress Scale (PSS-10). **Results:** Of the 384 students, 88% were medical, and 12% were non-medical.PSS-10 scores showed 15.4% low stress, 71.1% moderate stress, and 13.5% high stress. Perceived stress was significantly associated with gender (p= 0.021) and academic performance (p= 0.011). Smoking was associated with GERD (p=0.030), with smokers showing a higher moderate-to-severe GERD. Frequent fast-food consumption was also significantly associated with GERD (p=0.014), and weekly or daily consumers had 79%-89% likelihood of GERD. Spearman's correlation showed a weak but statistically significant association between perceived stress levels and GERD severity (p=0.014). **Conclusions:** This study revealed a high burden of moderate to high stress and significant GERD prevalence among undergraduate students in Peshawar. Stress was strongly associated with greater GERD severity and was more common in females and lower academic performers. GERD was significantly associated with smoking, frequent fast-food intake, early academic years, limited physical activity, and NSAID use. College-based interventions focusing on stress management, smoking cessation, healthy eating, and physical activity are recommended.

## INTRODUCTION

Gastroesophageal reflux disease (GERD) and stress are raising health problems among undergraduate students, mainly in high-pressure academic environments and competitions. Symptoms such as heartburn and regurgitation are typical indicators of GERD that can significantly impair daily activities, social interactions, academic performance, and general well-being. According to recent studies conducted at various locations, including Pakistan, the prevalence of GERD among young adults and students ranges from 10% to over 30%, with modifiable risk factors like stress, smoking, unhealthy diets, and frequent fast-food consumption consistently identified as major contributors [1, 2]. In Pakistan, a study from Multan reported a 27.91% GERD prevalence among medical students [3]. These problems not only damage physical health but also worsen quality of life, underscoring the critical need for focused interventions in student populations. Stress is highly prevalent among college students globally, particularly in medical and non-medical academic environments. Key contribution factor included rigorous coursework, frequent exams, financial strain, and difficulties with adjustment [4]. Stress aggravates GERD


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through physiological mechanisms such as altered motility, increased esophageal sensitivity, and increased stomach acid secretion, resulting in a vicious loop that exacerbates both disorders [5, 6]. Most evidence on the association between perceived stress and gastroesophageal reflux disease (GERD) originates from high-income countries or major cities in Pakistan, while worldwide interest in this connection is rising. Tools such as the GERD-Q questionnaire and Cohen's Perceived Stress Scale (PSS-10), which are validated globally, have played a key role in assessing these conditions by providing reliable measures for diagnosis and stress evaluation [7]. Although interest in the connection between stress and GERD is still expanding globally, most of the available information originates from high-income countries or big Pakistani cities like Karachi, Rawalpindi, and Multan. Among Pakistani medical students, moderate to severe stress is highly prevalent, with one recent study reporting 82.9%, and it frequently co-occurs with significant GERD symptoms (13.6%), highlighting the relationship between the two problems in regional academic environments [8]. A recent cross-sectional study on functional gastrointestinal disorders (FGIDs) among medical students in KPK found that GERD accounted for 12.3% of FGID cases [9].

However, there remains a substantial information gap regarding the prevalence, correlations, and modifiable risk factors of GERD in Peshawar's broader undergraduate community, which includes both medical and non-medical students. This study aimed to determine the prevalence of perceived stress and gastro-esophageal reflux disease (GERD) among undergraduate students in Peshawar, and to identify key modifiable risk factors, using the validated GERD-Q questionnaire for GERD and Cohen's Perceived Stress Scale (PSS-10) for Stress.

## METHODS

A cross-sectional study was conducted to assess the prevalence of gastroesophageal reflux disease (GERD) and perceived stress, and to determine the relationship between stress and GERD, in undergraduate students. This study was conducted at various undergraduate institutions in Peshawar, Khyber Pakhtunkhwa, Pakistan, over a period of four months, from September 2025 to December 2025. The sample size was determined using the Open Epi online calculator. Considering a 95% confidence level, 5% margin of error, and an anticipated prevalence of 50%, the required sample size was calculated as 384 participants. The ethical approval was obtained from the Institutional Review Board/Ethical Review Committee of Northwest School of Medicine (NWSM), Peshawar, with reference number 233/RC/NWSM/2025, dated 28th August 2025. A total of 384 undergraduate students were included through non-probability convenience sampling due to time and resource constraints. Undergraduate students aged 18–25 years who were currently enrolled in medical or non-medical undergraduate programs at institutions in Peshawar and were willing to participate were included in the study. Postgraduate or enrolled in non-degree programs, any previously diagnosed gastrointestinal disorders other than GERD... were excluded based on self-report during screening. Participant selection was based on availability and willingness to participate at the time of data collection using non-probability convenience sampling. Data were collected using a structured, self-administered questionnaire that comprised of three sections: (1) demographic and lifestyle information, (2) assessment of perceived stress using the Cohen's Perceived Stress Scale (PSS-10), a validated ten-item instrument, was used to measure perceived stress, with scores ranging from 0 to 40 (0–13 = low stress, 14–26 = moderate stress, 27–40 = high stress) and (3) assessment of gastroesophageal reflux disease (GERD) using the GERD-Q tool, a six-item validated questionnaire was used to assess GERD, where a total score of ≥8 indicated the presence of GERD. Endoscopy or pH studies were not performed due to resource constraints. Both paper-based and online formats (Google Form) were used for data collection. Informed consent was obtained prior to participation from all participants before data collection, and confidentiality of participant information was strictly maintained throughout the study. Mode-effects between paper and online formats were not assessed. The study included gastroesophageal reflux disease (GERD) as the main outcome, while perceived stress was the main exposure. Assessment of GERD was carried out using the Gerd-Q questionnaire, while stress levels were measured using Cohen's Perceived Stress Scale (PSS-10). Sociodemographic variables included age, gender, university, enrolled program, and year of study. Lifestyle-related factors such as smoking status, tea and coffee consumption, fast-food and spicy-food intake, physical activity, sleep duration, and use of non-steroidal anti-inflammatory drugs (NSAIDs) were also recorded. These variables were assessed to explore their association with GERD and to identify potential risk factors among undergraduate students.

Data were analyzed using IBM SPSS Statistics version 27.0. Descriptive statistics were presented as mean ± standard deviation (SD) for continuous variables and frequency with percentages for categorical variables. The association between categorical variables was assessed using the Chi-square test. Spearman's rank correlation coefficient ( ) was used to evaluate the relationship between stress score (PSS-10) and GERD-Q score. GERD-Q scores were


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categorized into likelihood groups (0%, 50%, 79%, 89%) and treated as ordinal in bivariate analyses. However, the proportional odds assumption was not tested. Multivariable logistic regression analysis was performed to identify independent predictors of higher GERD likelihood (GERD-Q score ≥ 8), with adjustment for potential confounders. Prevalence estimates were reported with 95% confidence intervals (CI). A p-value < 0.05 was considered statistically significant. Bonferroni correction was applied to adjust for multiple comparisons (adjusted $\alpha$ = 0.008). All tests were two-tailed.

## RESULTS

A total of 384 students participated in the study, with a mean age of 20.86 ±1.430 years. Out of these, 193 (50.3%) were females, and 191 (49.7%) were males. A total of 338 (88%) medical and 46 (12%) non-medical students were included, reflecting greater accessibility of medical institutions. Perceived stress levels were assessed using the Perceived Stress Scale (PSS-10); 59 (15.4%, 95% CI) students had low levels, 273 (71.1%,95% CI) had moderate levels, and 52 (13.5%,95% CI) had high levels. Thus, 84.6% experienced moderate-to-high stress. GERD likelihood, evaluated with GERD-Q questionnaire, showed that only 31 (8.1%, 95% CI) students had 0% likelihood (score 0-2),237 (61.7%, 95% CI) had 50% likelihood (score 3-7), 97 (25.3%, 95% CI) had 79% likelihood (score 8-10), 19 (4.9%, 95% CI) had 89% likelihood (score 11-18). Overall, 91.9% (95% CI) of students had some likelihood of GERD(Table 1).

**Table 1:** Socio-demographic and Lifestyle Characteristics of Participants

| Variables | Categories | n (%) |
|---|---|---|
| Age | Mean ± SD | 20.86 ± 1.43 |
| Gender | Male | 191 (49.7%) |
| | Female | 193 (50.3%) |
| Institute / Enrolled program | Medical-related | 338 (88.0%) |
| | Non-medical-related | 46 (12.0%) |
| Year of study | 1st | 109 (28.4%) |
| | 2nd | 179 (46.6%) |
| | 3rd | 62 (16.1%) |
| | 4th | 7 (1.8%) |
| | 5th | 7 (1.8%) |
| Lifestyle | Active smoking | 21 (5.5%) |
| | Tea/Coffee intake | 325 (84.6%) |
| | NSAID use | 109 (28.4%) |
| Perceived Stress Level (PSS-10) | Low Stress Level (0 – 10) | 59 (15.4%) |
| | Moderate Stress Level (11 – 20) | 273 (71.1%) |
| | High Stress Level (21 – 30) | 52 (13.5%) |
| GERD Likelihood (GERD-Q Score) | 0% Likelihood (0–2) | 31 (8.1%) |
| | 50% Likelihood (3–7) | 237 (61.7%) |
| | 79% Likelihood (8–10) | 97 (25.3%) |
| | 89% Likelihood (11–18) | 19 (4.9%) |

Medium and high stress levels experienced a relatively high frequency of GERD likelihood (79% and 89% likelihood groups, 95% CI) than those who recorded low stress levels. More precisely, an increase in participants with 79% and more GERD likelihood was observed from 11.9% to 34.1% for medium and 30.8% for high stress levels. Spearman's correlation test showed a weak association between stress and GERD score ($\rho$ = 0.125, p=0.014). While statistically significant, this correlation is clinically weak, indicating that stress explains only a small fraction ($\rho^2 \approx 1.6\%$) of the variability in GERD scores (Table 2).

**Table 2:** Cross-tabulation of Stress Levels and GERD Likelihood

| Stress Score | 0% likelihood of GERD, n (%) | 50% likelihood of GERD, n (%) | 79% likelihood of GERD, n (%) | 89% likelihood of GERD, n (%) | Total, (n) | p-value | Spearman's Rank Correlation ρ (p-value) |
|---|---|---|---|---|---|---|---|
| Low Stress | 9 (15.3%) | 43 (72.9%) | 6 (10.2%) | 1 (1.7%) | 59 | 0.025 | 0.125 (0.014) |
| Moderate Stress | 17 (6.2%) | 163 (59.7%) | 78 (28.6%) | 15 (5.5%) | 273 | | |
| High Stress | 5 (9.6%) | 31 (59.6%) | 13 (25.0%) | 3 (5.8%) | 52 | | |
| Total | 31 (8.1%) | 237 (61.7%) | 97 (25.3%) | 19 (4.9%) | 384 | | |

Perceived Stress was significantly associated with gender (p=0.021), with female students exhibiting a higher proportion of high stress than Male students. Significant associations were also observed with poor sleep duration (p=0.007), limited physical activity, regular intake of spicy food, and regular NSAIDS use, which were linked to higher proportions of high perceived stress. In addition, perceived stress showed a significant association with academic performance (p=0.011). Students with higher stress levels were more likely to have average academic performance, whereas those with lower stress had better academic performance. Bivariate association between perceived stress levels and other factors was determined using Chi-square tests, and their effect sizes were described by Cramer's V values. There were significant relationships between the perceived stress level and the following variables: gender (Cramér's V=0.142, p=0.021), consumption of spicy foods (Cramér's V=0.164, p=0.008), NSAIDs (Cramér's V=0.151, p=0.013), physical exercise frequency (Cramér's V=0.147, p=0.011), sleep duration (Cramér's V=0.152, p=0.007), and academic success (Cramér's V=0.153, p=0.011). All these relationships were of low strength (Cramér's V < 0.30). There were no significant relationships between the perceived stress level and the following variables: type of institute, year of study, smoking, tea or coffee consumption, and fast-food consumption (Table 3).


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**Table 3:** Bivariate Association of Perceived Stress Levels

| Variables | Categories | Low Stress, n (%) | Moderate Stress, n (%) | High Stress, n (%) | Total, (n) | Chi-Square ($\chi^2$) | Cramér's V | p-value |
|---|---|---|---|---|---|---|---|---|
| Gender | Male | 34 (17.8%) | 140 (73.3%) | 17 (8.9%) | 191 | 7.773 | 0.142 | 0.021 |
| | Female | 25 (13.0%) | 133 (68.9%) | 35 (18.1%) | 193 | | | |
| Institute | Medical | 48 (14.2%) | 243 (71.9%) | 47 (13.9%) | 338 | 3.015 | 0.089 | 0.221 |
| | Non-medical | 11 (23.9%) | 30 (65.2%) | 5 (10.9%) | 46 | | | |
| Year of Study/Semester | 1st year | 20 (18.3%) | 73 (67.0%) | 16 (14.7%) | 109 | 8.118 | 0.103 | 0.422 |
| | 2nd year | 26 (14.5%) | 124 (69.3%) | 29 (16.2%) | 179 | | | |
| | 3rd year | 8 (12.9%) | 48 (77.4%) | 6 (9.7%) | 62 | | | |
| | 4th year | 3 (11.1%) | 23 (85.2%) | 1 (3.7%) | 27 | | | |
| | 5th year | 2 (28.6%) | 5 (71.4%) | 0 (0.0%) | 7 | | | |
| Smoking | Yes | 2 (9.5%) | 16 (76.2%) | 3 (14.3%) | 21 | 0.583 | 0.039 | 0.747 |
| | No | 57 (15.7%) | 257 (70.8%) | 49 (13.5%) | 363 | | | |
| Tea/coffee Consumption | Yes | 54 (16.6%) | 230 (70.8%) | 41 (12.6%) | 325 | 3.525 | 0.096 | 0.172 |
| | No | 5 (8.5%) | 43 (72.9%) | 11 (18.6%) | 59 | | | |
| Fast Food Consumption | Never | 9 (37.5%) | 15 (62.5%) | 0 (0.0%) | 24 | 12.213 | 0.126 | 0.057 |
| | Rarely | 21 (13.5%) | 114 (73.1%) | 21 (13.5%) | 156 | | | |
| | Weekly | 25 (14.1%) | 125 (70.6%) | 27 (15.3%) | 177 | | | |
| | Daily | 4 (14.8%) | 19 (70.4%) | 4 (14.8%) | 27 | | | |
| Spicy Food Consumption | 0 | 5 (55.6%) | 3 (33.3%) | 1 (11.1%) | 9 | 20.759 | 0.164 | 0.008 |
| | Never | 3 (16.7%) | 13 (72.2%) | 2 (11.1%) | 18 | | | |
| | Rarely | 25 (15.9%) | 114 (72.6%) | 18 (11.5%) | 157 | | | |
| | Weekly | 18 (14.4%) | 94 (75.2%) | 13 (10.4%) | 125 | | | |
| | Daily | 8 (10.7%) | 49 (65.3%) | 18 (24.0%) | 75 | | | |
| | Yes | 9 (8.3%) | 79 (72.5%) | 21 (19.3%) | 109 | | | |
| NSAID use | No | 50 (18.2%) | 194 (70.5%) | 31 (11.3%) | 275 | 8.729 | 0.151 | 0.013 |
| | Never | 19 (13.3%) | 94 (65.7%) | 30 (21.0%) | 143 | | | |
| Exercise Frequency | 1-2 times/week | 18 (13.0%) | 107 (77.5%) | 13 (9.4%) | 138 | 16.666 | 0.147 | 0.011 |
| | 3-5 times/week | 8 (16.0%) | 36 (72.0%) | 6 (12.0%) | 50 | | | |
| | Daily | 14 (26.4%) | 36 (67.9%) | 3 (5.7%) | 53 | | | |
| Sleep Duration | <5 hours | 8 (9.5%) | 54 (64.3%) | 22 (26.2%) | 84 | 17.689 | 0.152 | 0.007 |
| | 5-7 hours | 38 (16.4%) | 171 (73.7%) | 23 (9.9%) | 232 | | | |
| | >7 hours | 12 (18.2%) | 47 (71.2%) | 7 (10.6%) | 66 | | | |
| | 4 hours | 1 (50.0%) | 1 (50.0%) | 0 (0.0%) | 2 | | | |
| Academic Performance | High achiever | 28 (22.0%) | 88 (69.3%) | 11 (8.7%) | 127 | 8.940 | 0.153 | 0.011 |
| | Average achiever | 31 (12.1%) | 185 (72.0%) | 41 (16.0%) | 257 | | | |

GERD severity also showed a significant association with year of study (p=0.048), with GERD being more prevalent among first- and second-year students as compared to the senior students. Active smoking showed a significant association with GERD (p=0.030), with smokers having a greater proportion of moderate to severe GERD as compared to non-smokers. The association between GERD and fast-food consumption was also statistically significant (p=0.014). Students who consumed fast food weekly or daily had a higher frequency of 79% to 89% likelihood of GERD as compared to those who rarely or never consumed fast food. NSAID use was also significantly associated with GERD (p=0.041), with GERD severity being much higher in those students who used NSAIDs as compared to those who did not use NSAIDs. The GERD likelihood had a significant relationship with the following variables: year of study (Cramér's V = 0.136, p=0.048), active smoking (Cramér's V = 0.153, p=0.030), fast-food consumption (Cramér's V=0.134, p=0.014), and NSAID use (Cramér's V=0.147, p=0.041). All significant associations were weak in strength (Table 4).

**Table 4:** GERD Likelihood with Socio-demographic and Lifestyle Factors

| Variables | Categories | 0% likelihood, n (%) | 50% likelihood, n (%) | 79% likelihood, n (%) | 89% likelihood, n (%) | Total, (n) | Chi-Square ($\chi^2$) | Cramér's V | p-value |
|---|---|---|---|---|---|---|---|---|---|
| Gender | Male | 15 (7.9%) | 116 (60.7%) | 52 (27.2%) | 8 (4.2%) | 191 | 1.106 | 0.054 | 0.776 |
| | Female | 16 (8.3%) | 121 (62.7%) | 45 (23.3%) | 11 (5.7%) | 193 | | | |


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| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Institute | Medical | 29 (8.6%) | 209 (61.8%) | 83 (24.6%) | 17 (5.0%) | 338 | 1.496 | 0.062 | 0.683 |
| | Non-medical | 2 (4.3%) | 28 (60.9%) | 14 (30.4%) | 2 (4.3%) | 46 | | | |
| Year of Study/Semester | 1st year | 6 (5.5%) | 72 (66.1%) | 23 (21.1%) | 8 (7.3%) | 109 | 21.162 | 0.136 | 0.048 |
| | 2nd year | 15 (8.4%) | 109 (60.9%) | 50 (27.9%) | 5 (2.8%) | 179 | | | |
| | 3rd year | 6 (9.7%) | 35 (56.5%) | 18 (29.0%) | 3 (4.8%) | 62 | | | |
| | 4th year | 1 (3.7%) | 18 (66.7%) | 5 (18.5%) | 3 (11.1%) | 27 | | | |
| | 5th year | 3 (42.9%) | 3 (42.9%) | 1 (14.3%) | 0 (0.0%) | 7 | | | |
| Smoking | Yes | 1 (4.8%) | 8 (38.1%) | 9 (42.9%) | 3 (14.3%) | 21 | 8.948 | 0.153 | 0.030 |
| | No | 30 (8.3%) | 229 (63.1%) | 88 (24.2%) | 16 (4.4%) | 363 | | | |
| Tea/coffee Consumption | Yes | 24 (7.4%) | 204 (62.8%) | 82 (25.2%) | 15 (4.6%) | 325 | 2.093 | 0.074 | 0.553 |
| | No | 7 (11.9%) | 33 (55.9%) | 15 (25.4%) | 4 (6.8%) | 59 | | | |
| Fast Food Consumption | Never | 0 (0.0%) | 16 (66.7%) | 5 (20.8%) | 3 (12.5%) | 24 | 20.710 | 0.134 | 0.014 |
| | Rarely | 14 (9.0%) | 96 (61.5%) | 42 (26.9%) | 4 (2.6%) | 156 | | | |
| | Weekly | 17 (9.6%) | 108 (61.0%) | 45 (25.4%) | 7 (4.0%) | 177 | | | |
| | Daily | 0 (0.0%) | 17 (63.0%) | 5 (18.5%) | 5 (18.5%) | 27 | | | |
| Spicy Food Consumption | 0 | 0 (0.0%) | 8 (88.9%) | 1 (11.1%) | 0 (0.0%) | 9 | 14.928 | 0.114 | 0.245 |
| | Never | 2 (11.1%) | 11 (61.1%) | 2 (11.1%) | 3 (16.7%) | 18 | | | |
| | Rarely | 14 (8.9%) | 96 (61.1%) | 37 (23.6%) | 10 (6.4%) | 157 | | | |
| | Weekly | 10 (8.0%) | 79 (63.2%) | 34 (27.2%) | 2 (1.6%) | 125 | | | |
| | Daily | 5 (6.7%) | 43 (57.3%) | 23 (30.7%) | 4 (5.3%) | 75 | | | |
| | Yes | 4 (3.7%) | 64 (58.7%) | 32 (29.4%) | 9 (8.3%) | 109 | | | |
| NSAID use | No | 27 (9.8%) | 173 (62.9%) | 65 (23.6%) | 10 (3.6%) | 275 | 8.257 | 0.147 | 0.041 |
| | Never | 11 (7.7%) | 91 (63.6%) | 33 (23.1%) | 8 (5.6%) | 143 | | | |
| Exercise Frequency | 1-2 times/week | 15 (10.9%) | 77 (55.8%) | 38 (27.5%) | 8 (5.8%) | 138 | 7.785 | 0.082 | 0.556 |
| | 3-5 times/week | 3 (6.0%) | 30 (60.0%) | 15 (30.0%) | 2 (4.0%) | 50 | | | |
| | Daily | 2 (3.8%) | 39 (73.6%) | 11 (20.8%) | 1 (1.9%) | 53 | | | |
| Sleep Duration | <5 hours | 7 (8.3%) | 50 (59.5%) | 19 (22.6%) | 8 (9.5%) | 84 | 13.975 | 0.110 | 0.123 |
| | 5-7 hours | 19 (8.2%) | 137 (59.1%) | 69 (29.7%) | 7 (3.0%) | 232 | | | |
| | >7 hours | 5 (7.6%) | 48 (72.7%) | 9 (13.6%) | 4 (6.1%) | 66 | | | |
| | 4 hours | 0 (0.0%) | 2 (100.0%) | 0 (0.0%) | 0 (0.0%) | 2 | | | |
| Academic Performance | High achiever | 11 (8.7%) | 84 (66.1%) | 25 (19.7%) | 7 (5.5%) | 127 | 3.140 | 0.090 | 0.371 |
| | Average achiever | 20 (7.8%) | 153 (59.5%) | 72 (28.0%) | 12 (4.7%) | 257 | | | |

P-values were obtained using the Chi-square test. Cramér's V was calculated as a measure of effect size (values < 0.30 indicate a weak association). Significant associations ($p < 0.05$) are highlighted in bold

Multivariable logistic regression analysis was performed to identify independent predictors of the outcome. In the multivariable logistic regression analysis, none of the included variables reached statistical significance as independent predictors of GERD (Table 4). Stress score was not significantly associated with the outcome (OR=1.40, p=0.349). NSAIDs use demonstrated a trend towards increased odds (OR=2.73, p=0.071), although this did not reach statistical significance. Spicy food (OR=0.90, p=0.779), fast food (OR=1.18, p=0.668), achiever status (OR=1.02, p=0.969), and sleep (OR=0.86, p=0.741) were also not significantly associated with the outcome. After applying Bonferroni correction for multiple comparisons (adjusted significance level p<0.008), none of the variables showed a statistically significant association with the outcome (Table 5). This contrasts with the bivariate findings where multiple factors appeared significantly associated.

**Table 5:** Multivariable Logistic Regression Analysis of Factors Associated with GERD among Study Participants

| Variables | B (β) | SE | Adjusted OR (Exp B) | p-value | Bonferroni Value |
|---|---|---|---|---|---|
| Stress Score | 0.337 | 0.360 | 1.40 | 0.349 | 0.349 |
| NSAIDs Use | 1.004 | 0.556 | 2.73 | 0.071 | 0.071 |
| Spicy Food | -0.109 | 0.387 | 0.90 | 0.779 | 0.779 |
| Fast Food | 0.167 | 0.388 | 1.18 | 0.668 | 0.668 |
| Academic Performance | 0.016 | 0.404 | 1.02 | 0.969 | 0.969 |
| Sleep | -0.153 | 0.463 | 0.86 | 0.741 | 0.741 |

## DISCUSSION

To our knowledge, the present study evaluates the prevalence of Gastroesophageal Reflux Disease (GERD) among undergraduate students in Peshawar. This study reveals a high prevalence of GERD, with 91.9% of participants showing some likelihood of GERD according to the GERD-Q questionnaire (61.7% with 50% likelihood, 25.3% with 79% likelihood, and 4.9% with 89% likelihood).


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This high prevalence is due to the high-pressure academic environment and competition, which contribute to increased stress and lifestyle factors. Various Studies have reported similar GERD prevalence among undergraduate students, with rates ranging from 16% to 33% among young adults and students [1]. The present study observed a notable prevalence of GERD symptoms, which is consistent with previous research among the student population. A study conducted in Saudi Arabia found a prevalence of 33.18% among college students, with a higher rate linked to perceived stress. Similarly, research conducted in Multan, Pakistan, reported a GERD prevalence of 27.91% among medical students associated with inadequate sleep, frequent consumption of soft drinks, and fried/spicy foods. In Nigeria, the prevalence was 32.8% among undergraduate students, while in Sri Lanka it reached 52% among advanced-level and private tuition students [10-13]. The markedly higher prevalence in this study (91.9% any likelihood) compared to international estimates reflects methodological differences. Our GERD-Q categories included 50% likelihood (score 3-7), whereas most international studies report only definite GERD (score ≥8). When applying the definite GERD threshold (score ≥8, representing 79-89% likelihood), our prevalence was 30.2%, which closely aligns with the 26-33% reported internationally. Additionally, the predominance of medical students and convenience sampling may have contributed to higher observed rates. Stress is a common issue among university students, often caused by demanding coursework, examinations, and lifestyle changes. It is especially prevalent in medical students' academic settings. In addition, medical students often experience additional stress from psycho-social factors such as expectations from parents, frequent examinations, sleep problems, heavy academic workload, social isolation, and concerns regarding their academic future [14, 15]. Increased psychological stress can lead to unhealthy lifestyle habits such as smoking, poor dietary choices, lack of physical activity, and disturbed sleep, which may aggravate GERD symptoms [7]. The higher prevalence of depression among participants with GERD in this study supports the well-established bidirectional relation between gastrointestinal function and psychological factors [16]. The results also showed that female students had significantly higher stress levels as compared to male students (p=0.021). The gender difference in stress may be attributed to greater academic and psychological pressure on female students, including societal expectations, multiple role demands, and possible hormonal influences that can affect lower esophageal sphincter tone and symptom perception. Our study also found a higher prevalence of depression among participants with GERD compared to those without GERD. This observation was supported by a weak association between perceived stress and GERD score (p = 0.014), where students with higher stress levels (moderate: 71.1%, high: 13.5%) showed greater GERD likelihood (25.3% with 79% likelihood and 4.9% with 89% likelihood). This association aligns with a well-established bidirectional relationship between GERD, stress, and depression [17]. In addition, several factors were associated with markedly increased likelihood of high stress levels, including poor sleep quality, limited physical activity, frequent consumption of spicy food, and frequent use of NSAIDs. This study also observed that GERD was associated with impaired quality of life and disruptions to daily activities. Students experiencing higher stress tended to report average academic performance, whereas those with lower stress had better academic performance. Previous research has similarly linked poor sleep to higher stress but found no direct statistical association with academic achievements [18]. Controversy persists regarding sex differences in GERD prevalence across population-based studies. While many studies report no significant difference, some indicate male predominance, and others indicate female predominance [19]. Smoking showed a significant association with GERD in this study, with smokers exhibiting a greater proportion of moderate-to-severe symptoms compared to non-smokers. Moreover, it is evident from previous studies that quitting smoking is beneficial in reducing and improving the control of GERD symptoms [10]. In the current study, GERD severity was also associated with year of study, with higher severity among 1st- and 2nd-year students compared with senior students. To our knowledge, GERD is also associated with fast-food consumption. A higher prevalence of GERD was observed among participants who consumed fried/fast foods infrequently and had low fruit and vegetable intake [20]. However, dietary patterns warrant further exploration as risk factors can vary. In contrast, no significant association was found between GERD severity and factors such as age, Institute, enrolled program, tea or coffee consumption, exercise frequency, sleep duration, or academic performance, findings that align with several previous studies. In the current study, the Spearman's correlation test didn't show a significant relationship between stress and GERD score, but the statistical association was strong, which proves that participants with higher levels of stress were more prone to greater severity of GERD, which indicates that stress, despite being significantly associated with GERD, doesn't contribute much to the severity of GERD. This is consistent with previous studies indicating that high stress increases GERD risk and is positively associated with the condition [10]. Evident from previous studies, chest pain is the most common symptom of GERD associated with stress. Patients with GERD having chest pain are found to have


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more anxiety attacks and high levels of stress than patients with GERD without chest pain. Moreover, stressful situations can exacerbate GERD symptoms [21].

There are several limitations. Firstly, convenience sampling limits generalizability, with the sample skewed toward medical students (88%). Secondly, GERD was assessed via questionnaire without endoscopic/pH confirmation, risking misclassification. Thirdly, exclusion criteria relied on self-report without verification. Fourthly, paper and online mode-effects were not assessed. Fifthly, sample size assumed 50% prevalence due to lack of Peshawar-specific data. Sixthly, GERD-Q categories were treated ordinally without testing proportional odds assumption. Seventhly, the weak correlation (ρ=0.125), though statistically significant, is clinically insignificant. Eighthly, while bivariate associations were significant, multivariable analysis with Bonferroni correction found no independent predictors, suggesting possible confounding. Lastly, the cross-sectional design prevents causal inference. Nevertheless, this study provides valuable preliminary data. College-based health promotion may be considered, but intervention studies are needed to determine which specific approaches are effective.

## CONCLUSIONS

The current study showed high prevalence of perceived stress and GERD symptoms among participating students, with a weak but statistically significant association (ρ=0.125). Although multiple factors showed bivariate associations, multivariable analysis with Bonferroni correction found no independent predictors. Given the weak effect size and cross-sectional design, stress management and lifestyle interventions should be recommended cautiously.

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## Authors' Contribution

Conceptualization: MH, S, ZK
Methodology: MH, S, ZK, A, DA, OA, DA
Formal analysis: MH, S, ZK, A, DA, OA, DA
Writing and Drafting: MH, S, ZK, A, DA, OA, DA
Review and Editing: MH, S, ZK, A, DA, OA, DA

All authors approved the final manuscript and take responsibility for the integrity of the work

## Conflict of Interest

All the authors declare no conflict of interest.

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