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Lifestyle, Dietary Factors, and Salivary pH in Young Adults with Gastro-Esophageal Reflux Disease: A Cross-Sectional Study

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ABSTRACT

Background: Gastro-esophageal reflux disease (GERD) is a common chronic gastrointestinal disorder that is increasingly observed among young adults. Repeated exposure of the oral cavity to gastric acid may influence salivary properties and contribute to oral health complications.

Objective: To evaluate the association between gastro-esophageal reflux disease and salivary pH levels among individuals aged 18–35 years in Tamil Nadu, India.

Methods:A case control study was carried out with 100 participants aged between 18-35 years with 50 GERD patients and 50 non-GERD controls. A six-item GERD questionnaire that was validated was used to determine the GERD status. The structured questionnaire was used to record the sociodemographic characteristics, lifestyle habits, dietary patterns, and body mass index (BMI). Measurement of unstimulated salivary pH with standardized pH indicator strips was done at least two hours after eating. Descriptive statistics, Chi-square test and analysis of variance (ANOVA) were used to analyze data.

Results: The salivary PH values were also significantly reduced in participants with GERD than in those without GERD ($P < 0.05$). The GERD group had more unhealthy lifestyle choices, consumption of spicy and acidic foods, meals taken late in the day, and the lack of sufficient sleep time. Though it was found that higher values of BMI were observed among the GERD participants, they were not found to be statistically significant.

Conclusion: Among young adults, there is a strong relationship between low salivary pH and gastro-esophageal reflux disease, potentially exposing individuals to the risk of oral conditions associated with acid. Early GERD diagnosis and proper lifestyle and dietary changes can be beneficial in reducing the possible oral complications.

KEYWORDS: Salivary pH, Gastro-esophageal reflux disease, oral health, systemic diseases, BMI, Socio-economic status

INTRODUCTION:

Gastroesophageal reflux disease (GERD) is the most common chronic illness globally, and it imposes a huge burden on health care systems. Historically, GERD has been viewed as a disease that is mainly prevalent among adults who are middle-aged and elderly. Nevertheless, the increasing influence of risk factors on the adult population on GERD prompts more fears that young people might become the victims of the same [1]. Gastroesophageal reflux disease (GERD) had been perceived as more common in western nations than in Asian nations. Nonetheless, recent research has suggested that GERD is currently more prevalent in India compared to the western countries, possibly because of lifestyle and dietary modification. This change indicates that the factors are elevated intake of processed foods, sedentary lifestyles, and rising obesity rates in India which are contributing to the rising incidence of GERD. Consequently, healthcare systems in India might have to adjust to this new health issue to deal with it effectively. [2].

GERD is likely to increase the intensity of vomiting and nausea in pregnancy, which significantly deteriorates the quality of life of most pregnant women. This condition is most observed during the first trimester and usually subsides soon after childbirth [3,4,5]. Gastroesophageal reflux disease (GERD) is a condition where stomach contents flow back into the esophagus, affecting millions of people globally and severely impacting their quality of life. Hearthburn and acid regurgitation are common symptoms of GERD, where less common symptoms can include noncardiac chest pain, cough, and laryngitis [5].

Moreover, GERD may also develop in the oro-facial areas, causing many dental and mucosal issues, sour taste, burning mouth, bruxism, hyperesthesia, temporomandibular disorder (TMD) and aphthous-like ulcerations [6,7,8]. Dental caries is related to certain systemic diseases. Gastroesophageal reflux disease (GERD) is one such condition that may contribute to tooth decay due to alterations in the oral cavity. These changes involve a drop in oral pH, a decrease in salivation, a loss of buffering ability of the saliva, which all result in an environment that favors dental erosion and caries development [9]. The tooth surface minerals are in a dynamic equilibrium with the oral fluids and enamel experiences demineralization and remineralization throughout the day [9,10]. Saliva is a key element in the neutralization of bacterial acids and facilitating remineralization [10,11].
The oral cavity is a region with specific features, as it has significant variability of pH, bacterium, and temperature. These temperature and pH are important factors that can affect the electrochemical characteristics of restorative dental materials used in a successful dental treatment plan [12,13]. With this controversy, the present study seeks to evaluate the relationship between GERD and salivary pH in young adults in Tamil Nadu, India.

MATERIALS AND METHOD:

Study Design and Setting

A case-control study aimed to evaluate the relationship between gastro-esophageal reflux disease (GERD) and dental caries in people aged 18-35 years in Tamil Nadu, India. The experiment was conducted in three months (July 2025 to September 2024). The study was initiated with the assistance of the Ethical clearance given by the Institutional Review Board of the Sree Balaji Dental College & Hospital, Chennai. Sample, and Study participants.

Sample size calculation was done on the results of a prior study by Bechir et al. [9] which gave a minimum required sample of 67 participants. A total of 100 participants were recruited to take care of non-responses.Participants were equally divided into two groups:

- Case group: 50 individuals diagnosed with GERD
- Control group: 50 individuals without GERD

Case and Control Definition

GERD status was determined using the validated six-item Gastro-Esophageal Reflux Disease Questionnaire (GERD-Q), which has a maximum score of 18. Participants with a GERD-Q score ≥8 were categorized as GERD-positive (cases), while those with a score <8 were categorized as GERD-negative (controls).

Inclusion criteria:

- Individuals aged 18–35 years
- Participants diagnosed with GERD and those without GERD
- Willingness to participate and provision of written informed consent

Exclusion criteria:

- Individuals aged above 35 years
- Participants unwilling to provide consent
- Individuals with systemic diseases affecting salivary secretion (e.g., Sjögren's syndrome, diabetes mellitus)
- Pregnant or lactating women
- Individuals on medications influencing salivary flow or pH (anticholinergics, antidepressants)
- History of head and neck radiation therapy

Sampling Technique:

Cases were enrolled in different gastroenterology clinics/hospitals in Chennai and controls were enrolled among patients visiting the outpatient department of Sree Balaji Dental College and Hospital to have their teeth cleaned. Stratified random sampling was carried out through table of random numbers whereby one in five eligible patients visiting the respective hospitals or clinics was sampled to reduce selection bias.

A structured interviewer-administered questionnaire was used to gather sociodemographic information such as age, gender, place of residence, educational status, occupation, and socioeconomic status. The Modified Kuppusamy scale 2025 was used to assess the socioeconomic status. A structured questionnaire that had been pre-tested was used to capture the lifestyle habits and dietary patterns using face-to-face interviews. Data on tobacco smoking, alcohol intake, physical exercise, sleep time and the timing of meals were gathered. A food frequency questionnaire (FFQ) was used to evaluate eating habits which included spicy, fried and fatty, carbonated, tea, coffee, and snacking at night. The pilot test of the questionnaire was conducted to make the questionnaires clear and culturally appropriate before the actual study.

Standardized procedures were used to measure anthropometric measurements. A calibrated digital weighing scale was used to measure body weight and stadiometer was used to measure height. Body mass index (BMI) has been determined using the formula: weight (kg)/height (m^2) and classified as per WHO. All the participants in both groups were

evaluated in standardized conditions in terms of salivary pH. The samples of saliva were taken at least two hours post-breakfast to reduce the impact of the diet. The participants were advised to avoid eating, drinking, brushing their teeth or applying mouth rinses at this time. Each participant had a pH indicator strip (Merck, Germany) in the buccal sulcus, which was left to dry after 10 seconds to allow the color to develop. The color change obtained was matched with the color chart provided by the manufacturer and the salivary pH was noted. All measurements were done by the same examiner using a standard protocol to provide uniformity.

Data Collection and Statistical Analysis

Data were entered and analyzed using SPSS software version 26. Descriptive statistics were used to summarize sociodemographic, lifestyle, dietary, anthropometric, and clinical variables. Chi-square test was used to assess associations between categorical variables. Independent t-test / One-way ANOVA was used to compare mean values between groups. A p-value <0.05 was considered statistically significant.

RESULTS

FIG 1: Distribution of gastro-esophageal reflux disease (GERD) and non-GERD participants among the study population

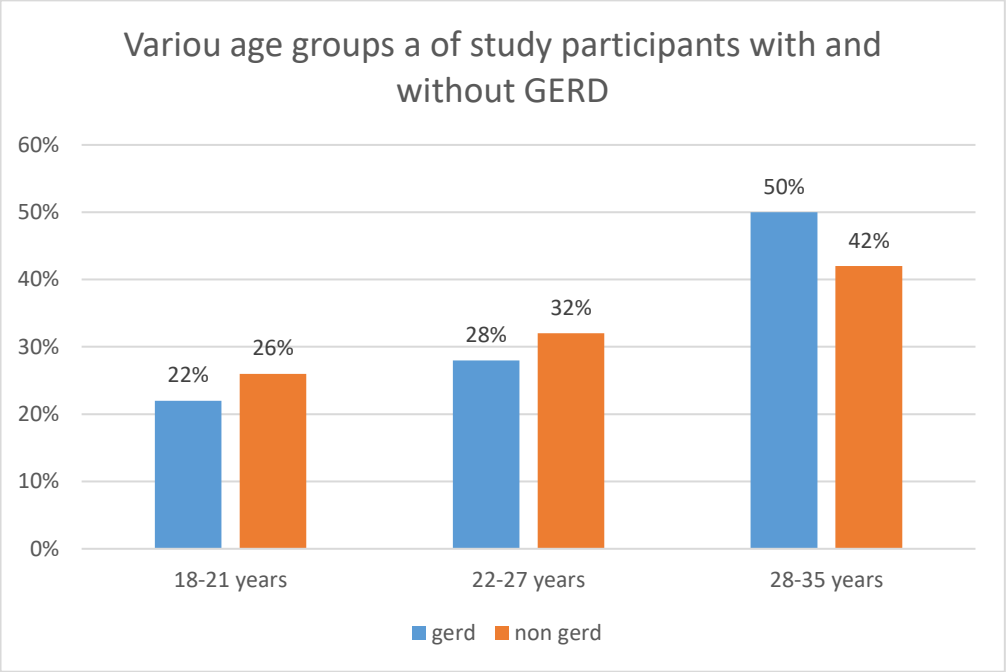

Fig 1 depicts GERD status was determined using the GERD-Q questionnaire. Participants with a score ≥8 were categorized as GERD, while those with scores <8 were classified as non-GERD.

FIG 2: Comparison of salivary pH levels between GERD and non-GERD participants.

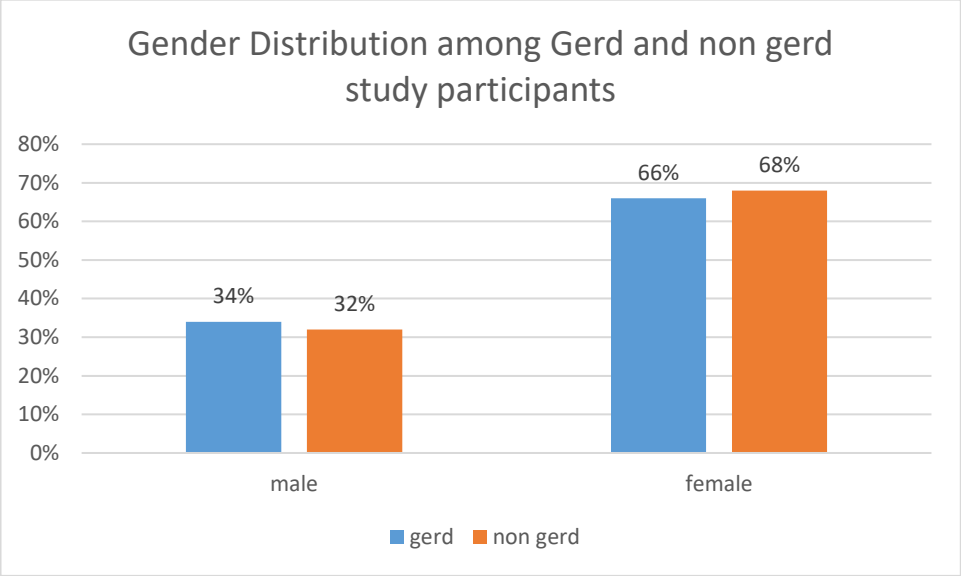

TABLE 1: Distribution of sociodemographic characteristics, lifestyle habits, dietary patterns, body mass index, and salivary pH among GERD and non-GERD participants.

Variables			Frequency n (%)	Total n (%)
Age	GERD PATIENTS	18-21 years	11(22%)	50 (100%)
		22-27 years	14 (28%)	
		28-35 years	25 (50%)	
	NON-GERD PATIENTS	18-21 years	13 (26%)	50 (100%)
		22-27 years	16(32%)	
		28-35 years	21(42%)	
Gender	GERD PATIENTS	Female	33(66.0%)	50 (100%)
		Male	17 (34.0%)	
	NON-GERD PATIENTS	Female	34 (68%)	50 (100%)
		Male	16 (32%)	
Place of Residence	GERD PATIENTS	urban	21(42%)	50 (100%)
		semi urban	19(38%)	
		rural	10(20%)	
	NON-GERD PATIENTS	urban	16(32%)	50 (100%)
		semi urban	23(46%)	
		rural	11(22%)	
Socioeconomic status	GERD PATIENTS	upper	8(16%)	50 (100%)
		upper middle	15(30%)	
		lower middle	17(34%)	
		lower	10(20%)	
	NON-GERD PATIENTS	upper	5(10%)	50 (100%)
		upper middle	18(36%)	
		lower middle	18(36%)	
		lower	9(18%)	
		Yes	21(42%)	50 (100%)

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	GERD PATIENTS	No	29(58%)	
Usage of tobacco in any form	NON-GERD PATIENTS	Yes	17(34%)	50 (100%)
		No	33(66%)	
Consumption of alcohol	GERD PATIENTS	Yes	31(62%)	50 (100%)
		No	19(38%)	
	NON-GERD PATIENTS	Yes	27(54%)	50 (100%)
		No	23(46%)	
Engage in physical activity tleast 30 minutes per day	GERD PATIENTS	Yes	11(22%)	50 (100%)
		No	39(78%)	
	NON-GERD PATIENTS	Yes	19(38%)	50 (100%)
		No	31(62%)	
Average sleep duration per night	GERD PATIENTS	<6	21(42%)	50 (100%)
		6-8	21(42%)	
		>8	8(16%)	
	NON-GERD PATIENTS	<6	16(32%)	
		6-8	21(42%)	
		>8	13(26%)	50 (100%)
Do you consume meals within 2 hours before bedtime?	GERD PATIENTS	Yes	29(58%)	
		No	21(42%)	50 (100%)
	NON-GERD PATIENTS	Yes	22(44%)	
		No	28(56%)	50 (100%)
Frequency of spicy food consumption:	GERD PATIENTS	never	8(16%)	
		1-2 times / week	26(52%)	
		>3 times / week	16(32%)	50 (100%)
	NON-GERD PATIENTS	never	11(22%)	
		1-2 times / week	26(52%)	
		>3 times / week	13(26%)	50 (100%)
Frequency of fried or fatty food intake:	GERD PATIENTS	never	8(16%)	
		1-2 times / week	26(52%)	
		>3 times / week	16(32%)	50 (100%)
	NON-GERD PATIENTS	never	21(42%)	50 (100%)
		1-2 times / week	22(44%)	
		>3 times / week	7(14%)	
Frequency of carbonated/soft drink consumption:	GERD PATIENTS	never	8(16%)	50 (100%)
		1-2 times / week	26(52%)	
		>3 times / week	16(32%)	
	NON-GERD PATIENTS	never	22(44%)	50 (100%)
		1-2 times / week	24(48%)	
		>3 times / week	4(8%)	
		never	8(16%)	50 (100%)

Tea or coffee consumption per day:	GERD PATIENTS	1- 2 cups	30(60%)	50 (100%)
		>3 cups	12(24%)	
	NON-GERD PATIENTS	never	25(50%)	
		1- 2 cups	19(38%)	
		>3 cups	6(12%)	
Do you consume snacks after dinner?	GERD PATIENTS	Yes	29(58%)	50 (100%)
		No	21(42%)	
	NON-GERD PATIENTS	Yes	19(38%)	50 (100%)
		No	31(62%)	
Have you noticed tooth sensitivity or enamel erosion?	GERD PATIENTS	Yes	42(84%)	50 (100%)
		No	8(16%)	
	NON-GERD PATIENTS	Yes	22(44%)	50 (100%)
		No	28(56%)	
BMI	GERD PATIENTS	normal	11(22%)	50 (100%)
		overweight	21(42%)	
		obese	18(36%)	
	NON-GERD PATIENTS	normal	15(30%)	50 (100%)
		overweight	19(38%)	
		obese	16(32%)	
Salivary pH	GERD PATIENTS	5.6-6.1	23(46%)	50 (100%)
		<5.5	27(54%)	
	NON-GERD PATIENTS	6.2-7.6	25(50%)	50 (100%)
		5.6-6.1	18(36%)	
		<5.5	7(14%)	

Table 1 presents the distribution of sociodemographic characteristics, lifestyle habits, dietary patterns, body mass index, and salivary pH among GERD and non-GERD participants. A higher prevalence of unhealthy lifestyle behaviors, lower salivary pH levels, and oral symptoms was observed among GERD participants compared to the non-GERD group.

TABLE 2: Association between socioeconomic status, body mass index, and salivary pH levels among GERD and non-GERD participants.

VARIABLES		GERD	NON-GERD	P VALUE
Socio-economic status	Upper class	8	5	0.7
	Upper middle class	15	18	
	Lower middle class	17	18	
	Lower class	10	9	
BMI	Normal	11	15	0.6
	Overweight	21	19	
	Obese	18	16	

Salivary pH	6.2-7.6	0	25	<0.001*
	5.6-6.1	23	18	
	<5.5	27	7	

Table 2 reveals the relationship between the socioeconomic status, body mass index, and salivary pH of GERD and non-GERD participants. The level of salivary pH and GERD status were found to be significantly associated with the socioeconomic status and BMI.

DISCUSSION

The current case-control study assessed the relationships between gastro-esophageal reflux disease (GERD), salivary pH, and the corresponding lifestyle and dietary variables in people aged 18–35 years in Tamil Nadu. The results suggest that the gastro-intestinal disorders and oral health are closely related, especially in young adults, whose prolonged exposure to acid can impact the oral environment and predispose them to dental complications. Compared to the older group (28-35 years), a greater number of GERD respondents were in the older bracket in the current study, indicating that GERD is cumulatively affecting the young adults. This pattern can be explained by contemporary lifestyle changes, changes in diet, as well as high levels of psychosocial stress, which have been proven to impact gastro-esophageal physiology and symptoms expression [11,12]. Both GERD and non-GERD groups showed a prevalence of female respondents, which can be associated with the variation in healthcare-seeking behaviour and hormonal effects on gastrointestinal motility and reflux behaviour [13].

Unhealthy lifestyle practices, including tobacco use, alcohol consumption, reduced physical activity, inadequate sleep duration, and late-night meals, were more prevalent among GERD participants. These behaviors are known to impair lower esophageal sphincter function, delay gastric emptying, and increase esophageal acid exposure [11,14]. Sleep deprivation and late-night eating further aggravate nocturnal reflux episodes, thereby worsening symptom severity and prolonging acid contact with the upper aero-digestive tract [12,15].

Dietary habits demonstrated a strong association with GERD status in the present study. Frequent intake of spicy foods, fried and fatty foods, carbonated beverages, and caffeinated drinks was significantly higher among individuals with GERD. These dietary components have been reported to stimulate gastric acid secretion, reduce esophageal clearance, and exacerbate reflux symptoms [19,20]. Additionally, post-dinner snacking and irregular meal timing may further contribute to reflux episodes by increasing gastric volume and intra-abdominal pressure, thereby promoting acid regurgitation [15]. Although overweight and obesity were more common among GERD participants, body mass index did not show a statistically significant association. While increased body weight is recognized as an important risk factor for GERD due to elevated intra-abdominal pressure and altered gastro-esophageal dynamics, the lack of statistical significance in the present study may be related to the limited sample size and the relatively young study population [11,12].

The major conclusion of this study was that the salivary pH was significantly lower in GERD subjects than non-GERD subjects. Over half of GERD group had salivary pH values below the critical level of 5.5 which is a level that supports enamel demineralization. Similar research has also shown that the repeated exposure of the oral cavity to gastric acid leads to an acidic oral cavity, thus undermining the buffering ability of saliva [19,20]. Saliva

serves as a key factor in oral homeostasis as it dilutes acids, enamel is remineralized, and antimicrobial effects; therefore, chronic decline in salivary pH predisposes the body to dental erosion and caries formation [14-16].

The higher prevalence of tooth sensitivity and enamel erosion among GERD participants further supports the biological mechanism linking gastric acid reflux to oral manifestations. Acid-induced enamel dissolution, coupled with reduced salivary buffering action, accelerates structural tooth damage and hypersensitivity. Similar associations between GERD, dental erosion, and oral discomfort have been documented in earlier investigations [17–20]. These findings emphasize the need for early oral assessment in patients with GERD to prevent progressive dental damage.

The findings of the current research highlight the need to engage gastroenterologists and dental professionals in an interdisciplinary cooperation. Oral screening of patients with GERD can be done routinely to detect possible acid-related dentin alterations, and proper dietary recommendations and lifestyle change measures can alleviate gastrointestinal symptoms and oral complications [18,21]. Although it has strong points, such as using a validated GERD questionnaire and a standardized salivary pH level, some limitations are to be considered. The case-control design restricts causal inference, and the sample size is quite small, which could limit generalizability. It is also suggested to include objective diagnostic instruments and larger samples in future longitudinal research to better understand how GERD and oral health changes relate over time.

CONCLUSION:

Conclusively, the current research shows that there is a significant correlation between GERD and low pH of saliva, and poor oral health among the young adults. The importance of lifestyle and eating habits in the regulation of GERD and its oral manifestation seems to be significant, with the necessity of global prevention and management approaches.

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