



Dietary Component as a Risk Predictor for Dental Erosion among GERD Patients: Analytical Cross-Sectional Study

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Abstract

Aim and Objectives: To evaluate the role of dietary components in prevention or causation of dental erosion among GERD patients in Haryana, India.

Methodology: A cross-sectional study was conducted in the department of gastroenterology of a tertiary care hospital, Rohtak. Study participants comprised of aged 18 years and above diagnosed with GERD. Evaluation of dental erosion was done using BEWE index. The statistical analysis was done using SPSS (Statistical Package for Social Sciences) Version 17.0 statistical Analysis Software.

Results: Among the study population, 84.8% had dental erosion. In the present study consumption of soft drink (OR=0.5), spicy food (OR=0.5), sour food (OR=0.5) was found significantly negatively associated with presence of dental erosion. No significant correlation was reported between the frequency of consumption of acidic food and drinks and risk of dental erosion. Significant negative correlation was found between frequency of consumption of milk and risk of dental erosion ($r = -0.1, p = 0.001$).

Conclusion: Dental erosion was prevalent among GERD patients but still severity of dental erosion was found less so GERD can be considered as a risk factor for dental erosion. Severity of dental erosion found to be decreased with increase in milk consumption frequency. The frequent consumption of milk could be considered as a substitute way in dietary behavior to prevent dental erosion. Also raising public knowledge about dental erosion and its correlation to GERD and dietary habits is essential.

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Keywords: GERD; Dental erosion; Food habits; Public Health

Introduction

GERD, or gastroesophageal reflux disease, is a common clinical condition that affects millions of people throughout the world. According to the Montreal definition, GERD is a condition of troublesome symptoms and complications that result from the reflux of stomach contents into the esophagus [1].

Gastroesophageal reflux is essentially a dysfunction of the Lower Esophageal Sphincter (LES); however it can be caused by a variety of factors. Physiologic as well as pathologic factors influence GERD. The most prevalent cause is Transient Relaxations of the Lower Esophageal Sphincter (TLESRs). TLESRs are independent of swallowing moments of lower esophageal sphincter tone inhibition [2].

Older age, a high Body Mass Index (BMI), smoking, anxiety/depression, and a lack of physical activity at work are all risk factors for GERD [3,4]. Eating habits, such as the acidity of food, as well as the amount and timing of meals, can all contribute to GERD, particularly with respect to sleep [5].

In the Western world, a prevalence of 10% to 20% was found for GERD, characterized as at least weekly heartburn and/or acid regurgitation, whereas in Asia, the prevalence was less than 5%. In the Western world, the incidence was nearly 5 per 1,000 person years [5,6]. The prevalence of GERD in Asia ranges from 2.5% to 6.7% [7]. In India, the prevalence of GERD ranges from 7.6% to 30% [7]. Among them 7.6% of the respondents reported symptoms of heartburn and/or regurgitation at least once a week [5]. As gastric contents are regurgitated up to the larynx and oral cavity, GERD patients frequently exhibit oral symptoms such as pruritus and oral mucosal irritation, tooth decay sensitivity, aphthae, sour taste, and dental erosion [8]. Regurgitated intrinsic acids have a pH less than 2.0, which is less than the critical pH threshold of 5.5 and have the ability to dissolve hydroxyapatite crystals in enamel [9]. A previous study has found GERD significantly

associated with dental erosion [9]. In another study dental erosion was found more prevalent in GERD patients, and they were at higher risk of developing dental erosion [10]. Evidence has shown that those who have regular oral exposure to gastric secretions are at a high risk of developing dental erosion [10-13].

Dental erosion, also known as periodontium, is the physical outcome of a pathologic, chronic, localized, painless loss of dental hard tissue chemically eroded away from the tooth surface by acid and/or chelation in the absence of bacterial involvement. The acids that cause erosion are not produced by the intraoral flora; rather, they are derived from dietary, occupational, or intrinsic sources [14].

When it comes to the development of dental erosion, there is a complicated interplay of causal and protective factors. Frequent contact between the tooth surface and acids produced by a variety of extrinsic and intrinsic factors causes demineralization of the tooth. Extrinsic factors include regular consumption of acidic foods, carbonated beverages, sports drinks, red and white wines, citrus fruits, and to a lesser extent, workplace exposure to acidic substances. Chronic gastrointestinal disorders like gastroesophageal disease, as well as health concerns like anorexia and bulimia, where regurgitation and frequent vomiting are frequent, are intrinsic causes. The main dietary acids associated with erosion that are present in beverages are citric, phosphoric, malic, and tartaric acids [15-18].

Diet is the most important extrinsic source of acid exposure, and it can comprise a wide range of ingredients and products with a complex composition and the potential for erosive damage [19]. A food's or beverage's acid content can be measured using pH or actual acidity readings; anything less than 7 indicates an acid [20]. There is evidence that acidic diets and beverages contribute to dental erosion development. The pH of a dietary item, on the other hand, is not a reliable indicator of its ability to cause erosion since other factors also influence the erosive process. Food titratable acidity, buffering capacity, oral clearance rate, calcium, phosphate, and fluoride contents are among these factors [21]. The term "titratable acidity" is sometimes interchanged with "neutralizable acidity." The amount of titratable acid in a solution is more important than the pH level, which is the amount of base required to get a solution to a neutral pH. Higher buffering capacity is associated with higher titratable acidity [22]. The higher this quantity, the more potentially erosive a product is considered to be. The degree of saturation with respect to the tooth mineral is determined by the pH value, calcium, phosphate, and fluoride content of a drink or food, and thus determines the driving force for dissolution [21].

As in GERD patients the presence of acidic gastric contents in the oral cavity on a regular basis can cause a chronically acidic environment and increases the risk of development of dental erosion, there are not many studies conducted to evaluate the role of dietary components in prevention or causation of dental erosion among GERD patients in Haryana, India. Thus, this study aimed to study the dietary components as a risk predictor for dental erosion among GERD patients in Haryana, India.

Materials and Methods

A Cross-sectional study was conducted in the Department of Gastroenterology of a Tertiary Care Hospital, Rohtak. Patient recruitment was done for 4 months from January 2020 - April 2020, twice in a week till the required sample size of 330 was obtained. Subjects with age 18 years and above were included after they were

diagnosed with Gastro-oesophageal reflux disease for more than 6 months and above, clinically and confirmed by endoscopy and present on the day of data collection with the ICF (informed consent form) signed by them.

Patients with orthodontic interventions history, pregnant women or lactating mothers, uncooperative patients, intellectually disabled patients and patients with any other conditions like hiatus hernia, bulimia nervosa were excluded from the study [22-36].

Sample size was calculated to assess severe erosion. Pilot study revealed severe dental erosion among 30% of cases. A sample size of 30 was calculated to estimate this prevalence with an absolute margin of error of 5%. Final sample size calculated was 330.

Ethical clearance was obtained from the Institution Ethics committee of "Post Graduate Institute of Dental Sciences, Rohtak" explaining the aims & importance of the study and was obtained vide letter no. PGIDS/IEC/2019/39 dated 30/11/2019.

Subjects were examined by one examiner previously trained and calibrated. Data were collected through questionnaire followed by clinical oral examinations. A structured questionnaire in Hindi language was developed for the study. Dental Examination was done according to ADA Type 3 classification. Dental erosion was evaluated according to location, severity, and area affected by the condition using Basic Erosive Wear Examination Index [37].

The data collected was coded and tabulated and subjected to appropriate statistical analysis using SPSS version 20.0. Data analysis involved descriptive statistics (frequency distribution) and analytic statistics. Chi-squared test was used to evaluate the association of independent variables and dental erosion. Pearson and spearman's correlation was used to correlate severity of dental erosion with independent variables. To test the association between the occurrence of dental erosion and diet, a process of binary logistic regression was conducted, using the exact versions of the nonparametric Pearson's chi-squared test. The level of statistical significance was set at 5% with a confidence interval of 95%.

Results

The present study comprised of 330 study participants with GERD, where 184 (55.8%) were females, and 146 (44.2%) were males. Majority of the study participants i.e., 149 (45.2%) belonged to 18 to 28 years age group followed by 133 (40.3%) who belonged to the 29 to 58 years age group and 48 (14.5%) to the 59 to 78 years age group. Majority of the study participants i.e., 280 (84.8%) reported to have dental erosion, 50 (15.2%) did not have dental erosion (Table 1).

Table 2 shows the distribution of the participants according to severity of dental erosion among GERD patients. Majority of the study participants i.e., 122 (37.0%) had no risk of erosion followed by 109 (33.0%) who had low risk of erosion, 84 (25.5%) had medium risk of erosion and 15 (4.5%) had high risk of erosion.

Table 3, 4 shows occurrence of dental erosion according to the socio-demographic characteristics and GERD condition and dietary habits. The results show that the presence of erosive lesions was significantly associated with female gender (OR=1.4). Result of the study showed that odds of presence of dental erosion was reported significantly lower in stage 1 GERD (OR=0.1, p=0.001) and stage 2 GERD (OR=0.3, p=0.01) as compared to stage 3 GERD. In the present study consumption of soft drink (OR=0.5), spicy food (OR=0.5), sour food (OR=0.5) was found significantly negatively associated with

Table 1: Distribution of the participants according to dental erosion among GERD patients.

Dental Erosion	Frequency	Percentage
Present	280	84.80%
Absent	50	15.20%
Total	330	100.00%

Table 2: Distribution of the participants according to severity of dental erosion among GERD patients.

Severity Of Dental Erosion	Frequency	Percentage
No	122	37.00%
Low	109	33.00%
Medium	84	25.50%
High	15	4.50%
Total	330	100.00%

presence of dental erosion.

Table 5 shows correlation of different independent variables with severity of dental erosion. Significant correlation of different independent variables like age ($r=0.4$, $p < 0.001$), and consumption of milk ($r= -0.2$, $p < 0.001$) was found with severity of dental erosion.

Discussion

In the present study dental erosion was found among 84.8% of participants with GERD. In GERD patients the presence of acidic gastric contents in the oral cavity on a regular basis can cause a chronically acidic environment and increases the risk of development of dental erosion, there are not many studies conducted to evaluate the role of dietary components in prevention or causation of dental erosion among GERD patients in Haryana, India. Thus, this study aimed to study the dietary components as a risk predictor for dental erosion among GERD patients in Haryana, India.

Similar to this study high prevalence i.e., 97.5% of dental erosion in GERD patients was found in a study done by Reddy VK et al. [23], they concluded that the acidic stomach content refluxed into the oral cavity can dissolve tooth structures and ultimately cause erosive

tooth wear. In contrast to this study, low prevalence i.e., 60.8% of dental erosion among GERD patient was found in study done by Li W et al. [24], in their study the diagnosis of GERD was based on the participant's history of heartburn or reflux and/or endoscopy.

In this study majority i.e., (37.0%) study participants had no risk of erosion, followed by (33.0%) had low risk of erosion, (25.5%) had medium risk of erosion and (4.5%) had high risk of erosion. In a study done by Jacob et al. [25], in adults of 18 years and above, study participants with GERD conditions mainly showed low-level dental erosion and they concluded GERD to be the risk factors for dental erosion. This corroborated the findings of the present study, where majority of study participants showed no risk and low risk of erosion and GERD can be considered as a risk factor for dental erosion.

In the present study a significant association between severity of GERD and presence of dental erosion. Odds of presence of dental erosion was reported significantly lower in stage 1 GERD ($OR=0.1$, $p=0.001$) and stage 2 GERD ($OR=0.3$, $p=0.01$) as compared to stage 3 GERD. No significant correlation was reported between severity of dental erosion and stages of GERD. Our study agrees with results of previous researches by VK Reddy et al. [23], Holbrook et al. [26], Oginni et al. [27], they discovered a significant association between GERD diagnosis and presence of dental erosion. They concluded that the acidic stomach content refluxed into the oral cavity can dissolve tooth structures and ultimately cause erosive tooth wear. The findings of the present study supported that development of erosive tooth wear in patients with GERD not merely determined by the presence or absence of GERD, the duration and intensity of disease also plays an important role.

In the present study dental erosion was present more in those didn't have habit of consuming fruit juice, soft drinks, acidic food then those had habit of consuming these. In the present study consumption of soft drink ($OR=0.5$), spicy food ($OR=0.5$), sour food ($OR=0.5$) was found significantly negatively associated with presence of dental erosion. This study disagrees with the study done by Reddy VK et al. [23], in their study positive association was found between dietary habits such as consumption of carbonated drinks, fruits, and tea/coffee with dental erosion. They concluded that soft

Table 3: Occurrence of dental erosion according to the socio-demographic characteristics and GERD condition.

Characteristics	Dental Erosion		p value for (Chi-Square)	Odds (95% CI)
	Absent (n=50)	Present (n=280)		
Age (Years)				
18-28 Years	33 (66.0%)	116 (41.4%)	<0.001	1
29-58 Years	16 (32.0%)	117 (41.8%)		0.7 (0.3-1.5)
59-78 Years	1 (2.0%)	47 (16.8%)		0.18 (0.08-4.2)
Gender*				
Male	29 (58.8%)	117 (41.8%)	0.03	1
Female	21 (42.0%)	163 (58.2%)		1.4* (0.8-2.4)
Location				
City	18 (36.0%)	106 (37.9%)	0.18	1
Village	32 (64.0%)	174 (62.1%)		0.8 (0.8-2.7)
Stages Of GERD*				
Stage 1	7 (14.0%)	14 (5.0%)	<0.001	0.1* (0.04-0.4)
Stage 2	35 (70.0%)	156 (55.7%)		0.3* (0.1-0.7)
Stage 3	8 (16.0%)	110 (39.3%)		1

Table 4: Occurrence of dental erosion according to the frequency of acidic and non-acidic drink consumption.

Parameters	Dental Erosion		p -value for (Chi-Square)	Odds (95% CI)
	Absent (n=50)	Present (n=280)		
Food Habits: Fruit Juice (Yes)	24 (48.0%)	133 (47.5%)	0.835	0.9 (0.5-1.7)
No	26 (52.0%)	147 (52.5%)		1
Food Habits: Soft Drink (Yes)	28 (56.0%)	86 (30.7%)	<0.001	0.5* (0.3-0.9)
No	22 (44.0%)	194 (69.3%)		1
Food Habits: Acidic Food (Yes)	40 (80.0%)	134 (47.9%)	<0.001	0.5* (0.2-0.9)
No	10 (20.0%)	146 (52.1%)		1
Food Habits: Milk (Yes)	41 (82.0%)	251 (89.6%)	0.119	1.9 (0.8-4.3)
No	9 (18.0%)	29 (10.4%)		1
Food Habits: Yoghurt (Yes)	42 (84.0%)	246 (87.9%)	0.451	1.3 (0.3-3.1)
No	8 (16.0%)	34 (12.1%)		1
Frequency: Fruit Juice			0.335	
Many Times A Day	1 (2.0%)	2 (0.7%)		0.4 (0.04-6.4)
Once A Day	3 (6.0%)	16 (5.7%)		0.9 (0.3-3.1)
3-5 Times A Week	0 (0.0%)	1 (0.4%)		1.8 (0.04-3.2)
1-2 Times A Week	13 (26.0%)	97 (34.6%)		1.1 (0.6-2.1)
Less Than Once A Week	7 (14.0%)	17 (6.1%)		0.5 (0.2-1.4)
Never	26 (52.0%)	147 (52.0%)		1
Frequency: Soft Drink			<0.001	
Many Times A Day	0 (0.0%)	0 (0.0%)		
Once A Day	6 (12.0%)	6 (2.1%)		0.2 (0.4-1.0)
3-5 Times A Week	1 (2.0%)	0 (0.0%)		0.02 (0.0-11.8)
1-2 Times A Week	14 (28.0%)	51 (18.2%)		0.6 (0.3-1.2)
Less Than Once A Week	9 (18.0%)	27 (9.6%)		0.5 (0.2-1.2)
Never	22 (40.2%)	194 (69.3%)	1	
Frequency: Acidic Food			<0.001	
Many Times A Day	0 (0.0%)	7 (2.5%)		1.2 (0.1-13.2)
Once A Day	6 (12.0%)	4 (1.4%)		0.1 (0.03-0.5)
3-5 Times A Week	3 (6.0%)	4 (1.4%)		0.2 (0.03-0.4)
1-2 Times A Week	24 (48.0%)	76 (27.1%)		0.4 (0.2-0.9)
Less Than Once A Week	7 (14.0%)	43 (15.4%)		0.7 (0.3-1.6)
Never	10 (20.0%)	146 (52.1%)		
Frequency: Milk			0.854	
Many Times A Day	5 (10.0%)	26 (9.3%)		0.6 (0.14-2.5)
Once A Day	35 (70.0%)	191 (68.2%)		0.6 (0.21-1.9)
3-5 Times A Week	0 (0.0%)	0 (0.0%)		
1-2 Times A Week	6 (12.0%)	29 (10.4%)		0.5 (0.1-2.2)
Less Than Once A Week	0 (0.0%)	0 (0.0%)		
Never	4 (8.0%)	34 (12.1%)	1	
Frequency: Yoghurt			0.891	
Many Times A Day	1 (2.0%)	14 (5.0%)		0.3 (0.3-25.7)
Once A Day	34 (68.0%)	180 (64.3%)		0.8 (0.4-2.5)
3-5 Times A Week	0 (0.0%)	0 (0.0%)		
1-2 Times A Week	0 (0.0%)	9 (3.2%)		0.6 (0.4-3.9)
Less Than Once A Week	0 (0.0%)	0(0.0%)		
Never	8 (16.0%)	34 (11.9%)	1	

p values were based on chi-square test. *p<0.05 considered significant

Table 5: Correlation of different independent variables with severity of dental erosion among GERD patients.

	r-	p-value
Gender	-0.017	0.544
Age (Years)	.488*	<0.001
Education	-0.259	0.2
Location	-0.014	0.8
Severity Of GERD	0.002	0.097
Dietary Habits		
Fruit Juice	0.139	0.07
Soft Drinks	0.125	0.08
Spicy Food	0.452	0.07
Sour Food	0.465	0.06
Alcohol	-0.085	1.22
Milk	-.202*	<0.001
Yoghurt	0.069	0.208
Frequency of Diet		
Fruit Juice	0.195	0.09
Soft Drinks	0.279	0.07
Spicy Food	0.446	0.08
Sour Food	0.458	0.09
Alcohol	0.028	0.614
Milk	-0.113	0.4
Yoghurt	0.106	0.06

drinks, including carbonated beverages and fruit juices, are almost exclusively acidic (pH<4.0) and these beverages, when in contact with the tooth, will reduce the pH at the tooth surface to a level below the critical value of 5.5 for enamel demineralization. Erosion starts with enamel surface softening in the early stage, and enamel tissue loss develops progressively with continued erosive challenges. Softened enamel is susceptible to abrasive wear. In the present study presence of dental erosion was found negatively associated with the frequency of consumption of fruit juice, soft drinks, acidic food and no significant correlation was reported between the frequency of consumption of acidic food and drink and severity of dental erosion.

In a previous study dental erosion was more frequently reported to be associated with acidic drinks among adults when the consumption was high [28]. In study done by Manaf ZA et al. [29], no association was found between dental erosion and the frequency and amount of acidic foods and drinks consumed because the majority of participants reported low fruit juice and acidic food intake.

Pure fruit juice is often recommended as a healthy beverage; however it includes a lot of acid and has a low pH. Furthermore, because of its strong buffering capacities, it may cause a prolonged drop in oral pH, which can lead to dental erosion [30]. All carbonated drinks, including soda (even diet options), contain acids such as citric, phosphoric, and carbonic acids, which can rapidly dissolve tooth enamel. Energy drinks have pH levels of around 2.9 and included a significant amount of fermentable carbohydrates [30]. Because of their high buffering capacity, Owens determined that these energy drinks had a high erosive potential on teeth [31]. In addition, the high titratable acidity or the high buffering capacity of the soft drinks can resist pH changes induced by the salivary actions and precipitate a

prolonged period of oral acidity [32]. In study done by Lussi A et al. [33], dental erosion was found associated with four or more servings of acidic products per day. Enamel, despite its high mineral content, can be eroded if it is exposed to acid for an extended period of time or on a frequent basis [30,35,36]. In the present study majority of study participants had reported to consume acidic food and drinks less frequently than four times per day, also carbohydrates in liquid form do not normally stay in the mouth for long, only when teeth are exposed to sugary drinks constantly, bacteria developed by acids that stay in the oral cavity for prolonged periods of time, producing dental caries and erosion [37], this could explain the consumption of soft drinks and acidic food being not a risk factor for directly causing dental erosion and also not increasing the severity of dental erosion in this study.

In the present study majority of the participants reported to have habit of frequent consumption of milk and yoghurt, dental erosion was present more in those had habit of consuming milk and yoghurt than those hadn't habit of consuming these. In this study no significant association found between frequency of consumption of milk and yoghurt and presence of dental erosion. Our study agrees with study done by Aguiar YPC et al. [34], in which no significant difference found between frequency of consumption of milk and yoghurt and presence of dental erosion. They concluded that individual modifying factors such as saliva's protective contribution *via* flow rate and buffering ability, as well as the extrinsic and intrinsic multifactorial characteristics of acids involved in the etiology of dental erosion, may explain the lack of association between diet and the occurrence of dental erosion observed in their study. In the present study majority of study participants with habit of drinking milk many times a day had had no risk of erosion i.e., 38.7% followed by 35.5% had low risk of erosion and 0.0% had high risk of erosion. Risk of dental erosion was found decreased significantly with increase in frequency of consumption of milk (p=0.01). Significant negative correlation was found between frequency of consumption of milk and risk of dental erosion (r= -0.1, p=0.001), which disagrees with study done by Manaf ZA et al. [29], they found out the association between the risk of having dental erosion and milk consumption was not significant when other confounding factors were taken into account. This may be because milk consumption was low among their participants. In the present study we found that frequency of consumption of milk is a protective factor and prevent dental erosion from getting severe. Milk, due to its high calcium content, has been shown in laboratory studies to protect teeth from erosion. Foods' high in calcium and phosphate may help to prevent dental enamel from erosion. Calcium is important for dental health since it aids in the mineral composition of teeth during the demineralization and remineralization processes, which are dependent on dietary factors, pH, and the oral environment [22,35,36]. The frequent consumption of milk could be considered as a substitute way in diet behavior to prevent dental erosion [36].

The present study found no significant correlation between consumption of yogurt and risk of dental erosion, this could be explained according to findings of previous studies, when an acidic liquid comes into contact with a tooth's surface, the pH drops rapidly, but gradually rises over the next 20 min to 30 min (recovery phase) due to neutralization and clearance of the acidic solution by normal salivary flow. If enough saliva (containing calcium and phosphate) is available at this period, the mineral content that has been dissolved is restored. During this time, further exposure to the acidic solution induces a rapid drop in pH, extending the overall period of tooth

surface demineralization. The presence of calcium, phosphate, and fluoride has a protective effect; for example, yoghurt has a low pH of 3.8 but no erosive potential due to its high calcium and phosphate content [36,38].

Conclusion

Dental erosion presence was found negatively associated with fruit juice, soft drink, and sour and spicy food consumption. Dental erosion presence was not found associated with frequency of acidic food and drinks. However significant negative correlation had been observed between the severity of dental erosion and frequency of milk consumption. Severity of dental erosion found to be decreased with increase in milk consumption frequency. Which shown that milk was playing protective role in preventing teeth by decreasing dental erosion severity. The frequent consumption of milk could be considered as a substitute way in dietary behavior to prevent dental erosion. Also raising public knowledge about dental erosion and its correlation to GERD and dietary habits is essential.

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