ORIGINAL ARTICLE

Associated Risk Factors with Tooth Wear in Patients Attending Private Dental Hospital in Karachi: A Cross-Sectional Study

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Abstract

Background: Tooth wear is non-carious enamel and dentinal destruction with multi-factorial etiology affecting oral health-related quality of life. Identification of risk factors and their prevention are crucial in the management of such cases.

Objective: To determine risk factors associated with tooth wear in patients attending private dental hospital.

Methods: A cross-sectional study was conducted from February to July 2023. Non-probability consecutive sampling was done. Patients with tooth wear were identified according to Smith and Knight Criteria of tooth wear. Patients with tooth wear were interviewed on a modified questionnaire to identify further associated risk factors. Data was entered and analyzed in SPSS version 22. Descriptive statistics were used for categorical variables. Univariate and multivariate logistic regression were used to determine predictive factors associated with tooth wear. Crude and adjusted Odds ratios with 95% confidence intervals were used to measure association. P-values < 0.05 were considered statistically significant.

Results: Overall, 755 patients were examined and participated in the study accounting for a 98% response rate. 62.6% were males and 37.4% were females with an age range of 18-65 years. Tooth Wear was present in 75.6% of participants with 58.8% erosion, 31.5% attrition, and 6.1% abrasion cases. 3.5% of patients demonstrated more than one type of TW. Carbonated drinks showed a higher risk of tooth wear, followed by bruxism, gastric problems, and aggressive tooth brushing.

Conclusion: Associated risk factors of tooth wear should be given due consideration to implementing patient education and preventive strategies to preserve dental health.

Keywords: *Tooth wear, tooth surface loss, risk factors, bruxism.*

INTRODUCTION

Tooth wear (TW) or tooth surface loss (TSL) is a subtle, multifactorial condition that involves non-carious enamel and dentinal destruction which can threaten tooth survival and also affect oral health-related quality of life [1]. TW seems to impact different age groups and both genders [2, 3]. It is often intricate to find out if TW is pathological or age-dependent *i.e*., physiological. The cause of pathological TW involves physical and thermo-physical processes which are attrition, erosion, abrasion, and abfraction. Some evidence suggests that tooth wear is age-dependent [4]. However, in literature TW seems to be increasingly common amongst younger age groups and, as these people will retain their teeth into old age, it is imperative that wear is identified quickly and managed appropriately [1-6].

TW may yield various patterns that commonly occur simultaneously, complicating analysis and management even further. Severe TW may lead to hypersensitivity, reversible and irreversible pulpitis, gingivitis, and periodontitis which can negatively impact esthetics and function [5]. Continued TW may generate or propagate cracks or fractures of the tooth which can lead to subsequent tooth loss [6]. Esthetically, the loss of enamel due to TW may also increase the visibility of the underlying dentine, producing discoloration [7]. In extreme cases, pulpal exposure can occur, further complicating management [8]. Conservation of loss of tooth tissue is often substantial and the need to restore remaining tooth structure is vital [8].

TW prevalence is increasing globally as a result of changes in diet, modified lifestyles, and lack of awareness [9, 10]. In literature, the prevalence of tooth wear in the United Kingdom is reported as 29% [11], Germany as 23.4% [12], Brazil as 38.2% [13], Indonesia as 23% [14], and Jordan as 51% [15].

TW is reported to have a multifactorial etiology where identification of risk factors and implementation of related preventive strategies are keystones in management [1-6]. Although studies have been conducted on the Pakistani population highlighting the prevalence of TW the causative factors associated with TW have not been explored much specifically in the population of Karachi [16-18]. Diversity in demographics, lifestyle, dietary habits, parafunctional habits, and oral health behaviors in the local context as compared to the global population

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warrants the need for further investigation. Thus this study is aimed to determine the associated risk factors with TW in our population. Regular assessment of risk factors can help in designing accurate dental health programs which will raise public awareness related to prevention according to the needs of specific populations thus promoting oral health. This can also help dental clinicians identify patients early and design an accurate management plan for TW.

MATERIAL AND METHODS

A cross-sectional study design was adopted to achieve the study objective. The duration of the study was six months conducted from 1st February to 31st July 2023. The study was carried out in a private institute Hamdard Dental Hospital, Karachi. The study proposal was reviewed by the Scientific Review Committee of Hamdard University Dental Hospital, under Hamdard University which provided institutional approvals. (IRB Approval letter number: 1025-01-23).

A sample size of 770 was selected using a non-probability consecutive sampling technique. The online "calculator.net" for sample size calculation was used to compute a minimal number of participants to meet the desired statistical constraints. To calculate sample size the frequency of carbonated drink consumption identified as an associated factor with TW in a previous study reported as 78% was considered [19]. Confidence level of 95% was taken and with absolute precision of ±3%, the sample size calculated was 732. To account for non-respondents and potential missing data, we have increased the sample size by 5%. Therefore, the estimated sample size for the study was set at n=770.

The study team included the principal investigator and four house officers in the Operative and Endodontic Department at Hamdard University Dental Hospital. Data collectors received thorough training from the principal investigator. To maintain data quality and reliability, the principal investigator performed both field editing and office editing daily, carefully reviewing the collected information for any missing or incorrect entries.

In the initial step before the data collection procedure, examiners explained to the patients the aims and details of the study and assured them that their relevant information would be kept confidential. Patients between the ages of 18 and 65 years who presented with complaints of dental pain and sensitivity were included in the study (assessed on the Visual Analogue Scale with a score of 3 or greater) [7] whereas patients with dental developmental defects, history of trauma or grossly carious dentition were excluded from the study. Patients' written consent was obtained before being recruited into the study.

History and clinical presentation were used to determine TW. The methodology described by Smith and Knight [20, 21] was followed for clinical assessment to identify patients with TW (**Table 1**). Clinical examination was carried out using intra-oral examination instruments under the dental operating light. Patients identified with TW were then interviewed a modified comprehensive questionnaire adopted from previous studies [21, 22]. The questionnaire was designed to target the evaluation of risk factors of all types of tooth wear. It included questions related to demographic data such as (Name, Gender, Age, and Education) and dental history (Past dental history, Brushing, frequency of brushing, nighttime grinding *i.e*., bruxism, nail biting, pen biting). It also included the patient's relevant medical history such as gastrointestinal problems and smoking.

Data was entered and analyzed using SPSS version 22 software. To maintain the confidentiality of the data, a hard copy was securely stored in a locked location, while the SPSS files were saved on a password-protected personal computer that only the principal investigator could access. Unique identifiers were given to each patient's form to maintain privacy. As dependent and independent variables were categorical, descriptive statistics *i.e*., frequency and percentage were used for describing the study variables like gender, educational status, presenting complaint, past dental history, tooth wear, tooth wear type, and factors responsible for TW. Further, univariate and multivariate logistic regression were used to determine the predictive factors associated with tooth wear. In the first step, an association of each independent variable with the dependent variable was assessed. In the second step, variables significant at a p-value of less than or equal to 0.20 in the univariate analysis were included in multivariable logistic regression. Crude and adjusted Odds ratios with 95% confidence intervals were used to measure association. P-values of less than 0.05 were considered statistically significant. The final model was constructed using backward elimination; variables were retained if the p-value was less than 0.05. The calculated final model represented statistically significant risk factors that are associated with the dependent variable.

Table 1. Smith and Knight Tooth Wear Index.

Surface	Criteria	Score
Buccal/Lingual/Occlusal/Incisal	No loss of enamel surface characteristics	**0**
Contour	No loss of contour.	
Buccal/Lingual/Occlusal/Incisal	Loss of enamel surface characteristics.	**1**
Contour	Minimal loss of contour.	
Buccal/Lingual/Occlusal	Loss of enamel exposing dentine for less than one-third of the surface.	**2**
Incisal	Loss of enamel just exposing dentine. Defect less than 1 mm deep.	
Contour	Defects less than 1 mm deep	
Buccal/Lingual/Occlusal	Loss of enamel exposing dentine for more than one-third of the surface.	**3**
Incisal	Loss of enamel and substantial loss of dentine.	
Contour	Defects less than 1-2 mm deep	
Buccal/Lingual/Occlusal	Complete enamel loss - pulp exposure - secondary dentin exposure.	4
Incisal	Pulp exposure or exposure to secondary dentine.	
Contour	Defect more than 2mm deep - pulp exposure - secondary dentine exposure	

RESULTS

A total of 755 patients were examined and participated in the study accounting for a 98% response rate. The variables categorized as the demographics (gender, age, and education), dental characteristics (presenting complaint, duration of presenting complaint, past dental history, and the study outcome variable tooth wear and type of tooth wear), oral health behavior (brushing, frequency of tooth brushing, pan/gutka, carbonated drink, smoking), parafunctional habits (bruxism, nail biting, pen biting) and systemic condition (gastric problem).

Demographic Characteristics of Study Participants

The male and female distribution of our study is presented in Table **2**. The age range of participants in our study was 18 to 65 years. Further categorization of different age groups is also presented in Table **2**. Most participants had more than 10 years of education 613 (81.1%).

Dental Characteristics of Study Participants

Among the participants, 474 (62.8%) were presented with complaints of pain and 281 (37.2%) with sensitivity, and the maximum duration of their presenting complaint was 1 or more than one month 539 (71.4 %). The majority had a past dental history of previous dental treatment 488 (64.7%) (**Table 2**).

Table 2: Independent Variables – Demographic and Dental characteristics.

Demographic Characteristics	**n**	**%**
Gender		
Male	473	62.6
Female	282	37.4
Age (years)		
18-25	61	8.1
26-35	195	25.8
>36	499	66.1
Education		
1-10	142	18.5
>10 years	613	81.5
Dental Characteristics		
Presenting Complain		
Pain Complain	474	62.8
Sensitivity Complain	281	37.2
Duration of Complain		
2 weeks	34	4.5
4 weeks	182	24.1
>1 month	539	71.4
Past Dental History		
Yes	490	64.9
No	265	35.1

Dependent Variable- Tooth Wear

The outcome variable *i.e.*, TW was present in 571 (75.6%) participants. Among them, 336 (58.8%) showed erosive type of TW, 180 (31.5%) patients demonstrated attrition, and 35 (6.1%) showed abrasive type. However, 20 (3.5%) patients demonstrated more than one type of TW. Table **3** presents the frequency and percentages of dependent variables for tooth wear. **Fig. (1)** presents a case of tooth wear (primary attrition and secondary erosion) recorded in our study.

Table 3: Dependent Variable – Tooth Wear.

Variable	n	%
Tooth Wear		
No	184	24.4
Yes	571	75.6
Type of Tooth Wear		
Erosion	336	58.8
Attrition	180	31.5
Abrasion	35	6.1
More than one type	20	3.6

Fig. (1): Case of tooth wear.

Oral Health Behavior and Dental Habits

Table **4** shows the independent variables of our study *i.e.*, oral health behavior and dental habits. The most common parafunctional habit was bruxism (38%) followed by biting objects (nail; 11.9%, pen: 4.5%).

Univariate Logistics Regression

Table **5** shows the unadjusted odd ratio (UOR), 95% CI, and p-values of univariate analysis of each independent variable associated with tooth wear. Age group 26-35 had an odds ratio indicating lower odds of tooth wear compared to 18–25-year category. Similarly, individuals above the age of 36 had an odds ratio suggesting reduced odds of tooth wear compared to the 18-25 years reference category. There was no statistically significant association observed between education levels and tooth wear. The odds suggest that there was no meaningful difference in the odds of tooth wear between individuals with 1-10 years of education compared to participants having more than 10 years of education. The odds of tooth wear were not associated with pain and sensitivity complaints. There was a statistically significant association observed between the duration of complaint of more than 1 month and the tooth wear. Participants who had past dental treatment history were two times more likely to have tooth wear compared to those who didn't visit any dentist. The results of the frequency of brushing, pan, and smoking were not significant. The odds ratios and their corresponding confidence intervals suggest that there is no meaningful difference in the odds of tooth wear in these categories.

Participants who had parafunctional habits showed higher odds of tooth wear than those who did not have these habits. Carbonated drinks showed an 8 times higher risk of tooth wear followed by bruxism, gastric problems, and aggressive tooth brushing.

Table 4: Independent Variables - Oral Health Behavior and Habits.

Variable	n	%
Frequency of Brushing		
No brushing	222	29.5
Less than once daily	50	6.6
Once or Twice daily	390	51.7
Thrice or more daily	93	12.2
Aggressive Brushing		
No	222	29.4
Yes	533	70.6
ByPan Eating		
Yes	256	33.9
No	499	66.1
Carbonated Drink		
Yes	562	74.4
No	193	25.6
Smoking		
Yes	137	18.2
No	618	81.8
Bruxism		
Yes	355	47.1
No	400	52.9
Nail Biting		
Yes	90	11.9
No	665	88.1
Pen Biting		
Yes	34	4.5
No	721	95.5
Systemic Condition- Gastric Problem		
Yes	453	60
No	302	40

Table 5: Univariate and Multiple Logistic Regression risk factors associated with tooth wear.

Variable	Univariate Logistics Regression[¥]			Multiple Logistics Regression[€]		
	95%C.I	OR	*P-Value*	95%C.I	aOR[a]	*P-Value*
Aggressive Brushing						
No	-	Ref	-	-	Ref	-
Yes	(5.896-14.237)	8.207	<0.001*	(17.44-52.32)	35.46	<0.001*
Carbonated Drinks						
No	-	Ref	-	-	Ref	-
Yes	(4.237-15.896)	8.207	<0.001*	(16.34-40.12)	35.46	<0.001*
Bruxism						
No	-	Ref	-	-	Ref	-
Yes	(8.489-31.66)	16.394	<0.001*	(27.37-61.21)	55.15	<0.001*
Gastric Problem						
No	-	Ref	-	-	Ref	-
Yes	(1.311-21.68)	4.602	0.021*	(11.50-62.84)	21.10	<0.001*

*[¥]p value ≤ 0.20 statistically significant in the univariate analysis, [€]p value <0.05 statistically significant in the multivariate OR=Odds ratio, Ref=Reference category, [a]Adjusted for gender and age, *statistically significant.*

Multivariate Logistics Regression

When adjusted in the multivariate model at p values less than 0.05, variables such as carbonated drink, bruxism, gastric problems, and aggressive tooth brushing were found to have a statistically significant association with tooth wear. However, variables such as past dental history and duration of presenting complaint were not statistically significant with tooth wear.

DISCUSSION

The present study aimed to identify the risk factors associated with TW in patients attending a private dental hospital in Karachi, Pakistan. Overall, the occurrence of TW was high in the study setting. The univariate logistic regression analysis provided initial insights into the relationship between various independent variables and tooth wear. The subsequent multivariate logistic regression analysis adjusted for confounding factors and identified the significant predictors of TW. In our investigated sample, the use of carbonated drinks, bruxism, gastric diseases, and aggressive tooth brushing were found to have a significant association with TW.

The frequency of presentation of TW in our study was found to be 75.6%. Sahab [16] investigated a sample of 250 participants and reported a high prevalence rate of TW at 92.4% among patients attending a dental hospital in Karachi. Contrary to this, Toufique et al. [22] reported 10% of cases presenting with TW in their study conducted in Karachi in a sample of 400 participants.

In literature, the most reported risk factors that contribute to TW are parafunctional activities, gastrointestinal problems, oral health behavior, dietary habits, medicaments, and acid regurgitation [1, 18-20, 23]. Carbonated drinks, a dietary factor, were found to be significantly associated with TW in our study. Participants who consumed carbonated drinks had a substantially higher risk of TW compared to those who did not. A study found that acidic drinks were the most common factor associated with TW [19]. In our study also patients The erosive properties of carbonated drinks, attributed to their high acidity and sugar content, can contribute to enamel erosion and tooth wear over time [24]. Dental practitioners should educate patients about the potential harm of excessive carbonated drink consumption and encourage moderation to preserve dental health.

In our study, parafunctional habits, including bruxism were found to be strongly associated with increased odds of TW. Bruxism, characterized by grinding or clenching of teeth, was found to increase the odds of TW by a substantial magnitude. Patients with a history of bruxism were associated with increased pathological wear [24]. These findings highlight the detrimental effects of parafunctional habits on tooth structure and emphasize the need for interventions to manage and mitigate these behaviors.

Gastric problems were also statistically significant in our study. It is worth noting that they are a potential risk factor for tooth wear. Gastric issues, such as acid reflux or gastroesophageal reflux disease (GERD), can result in acid regurgitation into the oral cavity, leading to enamel erosion and tooth wear. Patients with GERD show an increase in tooth wear scores due to the regurgitation of gastric acidic contents into the oral cavity [17, 25]. In our study, 60% of patients gave a history of gastric problems including GERD. Yanushevich [26] in their

meta-analysis reported that dental erosion in patients having GERD is observed commonly and is often seen in about half of the cases of GERD. In the literature the reported prevalence of patients with GERD having dental erosion wear ranges between 24%-51.52% [26, 27]. In Pakistan prevalence of dental erosion in GERD patients is reported as 35.3% by Warsi [28] and 44.16% by Iqbal [29]. Further research with a larger sample size is needed to ascertain the association between different gastric problems and tooth wear more accurately.

Our finding also highlights the importance of oral hygiene practices such as aggressive tooth brushing in influencing tooth wear. 70.2% of patients in our study reported practicing aggressive tooth brushing which was then confirmed with the presence of clinical signs of non-carious cervical lesions on examination. Penoni reported that 39.5% of patients in their study were practicing harmful aggressive toothbrushing [30]. Alam [31] in their study conducted at a tertiary care hospital setting in Pakistan noted hard bristles and variable tooth brushing movements to be significantly associated with non-carious cervical lesions [27]. Also in our study, past dental treatment of restorative work emerged as a significant predictor, with participants who had a history of dental visits being more likely to have tooth wear. This finding indicates that individuals who sought dental care in the past may have pre-existing dental conditions or behaviors that contribute to tooth wear. Dentists often use 'aesthetic' indirect restorations such as porcelain or ceramics irrespective of whether the restoration is visible. These materials have the potential to accelerate tooth surface loss, particularly if used on occluding surfaces in parafunctional patients [32, 33]. The specific factors within dental history that may contribute to tooth wear, such as previous dental treatments or oral habits, were not examined in this study and warrant further exploration.

Exploration of risk factors related to tooth wear in our study provides evidence to propose recommendations for future experimental and large-scale research. Dentists in their practice also should emphasize counseling patients presenting with the associated factors of tooth wear. Appropriate prevention, early detection, and targeted treatment approaches can lead to successful management of tooth wear cases. Public awareness programs that will raise awareness regarding tooth wear and its' causative factors can also help in declining the incidence.

LIMITATION OF STUDY

The factors that were not included in this study were the amount of pressure applied for brushing, the pH of the oral environment, any developmental disturbances of teeth, medication, and biological factors such as saliva, tooth composition, and structure. Further investigations and continuous follow-up may allow the mapping of the relationship of biological factors with the occurrence of tooth wear. It was a cross-sectional study design which limits the establishment of causal relationships between the identified risk factors and tooth wear. Longitudinal or case-control studies should be done in the future for better elucidation of the risk factors of tooth wear.

CONCLUSION

Risk factors associated with tooth wear should be considered during clinical assessments, patient education, and implementation of preventive strategies to preserve dental health. Carbonated drink consumption, bruxism, aggressive brushing, and gastric diseases are found to be associated with the development of tooth wear.

ETHICAL APPROVAL

Ethical approval was obtained from the Scientific Review Committee of Hamdard University Dental Hospital, under Hamdard University, Karachi (REF letter No. 1025-01-23). All procedures performed in studies involving human participants were by the ethical standards of the institutional and/ or national research committee and with the Helsinki Declaration.

CONSENT FOR PUBLICATION

Written informed consent was taken from the participants.

AVAILABILITY OF DATA

The data set may be acquired from the corresponding author upon a reasonable request.

FUNDING

Declared none.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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Declared none.

AUTHOR'S CONTRIBUTION

Dr. Hina Nafees: Conceptualization of study design and Write-up, Dr. Wardah Ahmed: Write-up, Data Analysis& interpretation, Dr. Fariha Irfan: Write-up, Data Analysis & interpretation, Dr. Hina Hammad Khan: Write up, Data Collection & interpretation, Dr. Zohaib Younus: Data Collection, Dr. Sheikh Haroon Shah: Proofreading, Dr. Syed Abrar Ali: Critical review of Manuscript

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