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Prevalence and Determinants of Tooth Wear among 18-30-Year-Old Students in Modinagar, Ghaziabad: A Cross-Sectional Study

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Abstract

Background: Tooth wear, defined as the non-bacterial loss of dental hard tissue through chemical or mechanical processes, is a growing concern due to its potential to cause hypersensitivity, aesthetic issues, and functional impairment. Despite being a natural part of aging, severe tooth wear can significantly impact oral health. This study aimed to assess the prevalence of tooth wear and identify associated risk factors among the 18-30-year-old student population in Modinagar, Ghaziabad, using the Exact Tooth Wear Index.

Methods: A cross-sectional, community-based survey was conducted from 2022 to 2023 among 1,102 students from various educational institutions in Modinagar. Stratified random sampling was used to ensure representation across different degree programs. A single calibrated examiner conducted clinical examinations, and data were collected using a structured proforma. The Exact Tooth Wear Index was employed to categorize the severity of tooth wear. Data analysis involved descriptive statistics and multivariate logistic regression.

Results: The overall prevalence of tooth wear was 62.3%. The highest prevalence was observed in the 18-21 age group (68.7%). Males exhibited a slightly higher prevalence (62.7%) compared to females (61.9%). Significant risk factors included smoking (AOR = 2.1), high stress levels (AOR = 2.3), alcohol consumption (AOR = 1.8), poor brushing habits (AOR = 1.6), and frequent soft drink consumption (AOR = 1.4). The severity of tooth wear was particularly high among smokers and those with high-stress levels.

Conclusion: The study reveals a high prevalence of tooth wear among young adults in Modinagar, with significant associations identified between tooth wear and various lifestyle and behavioral factors. The findings highlight the need for targeted public health interventions focusing on education and behavior modification to reduce the risk factors associated with tooth wear.

Keywords: tooth wear, prevalence, risk factors, exact tooth wear index, young adults, modinagar, public health

Introduction

Tooth wear is defined as the loss of dental hard tissue through chemical or mechanical processes not involving bacterial activity. It manifests as flat, round, or sharply angled polished surfaces on the occlusal or incisal areas of the teeth, often resulting from excessive attrition between opposing teeth. Abrasion and erosion further contribute to the excessive wear of these surfaces.

The prevalence of tooth wear exhibits significant variability across different populations. While tooth wear can be a natural part of the aging process and may go unnoticed by many patients, severe cases can lead to tooth hypersensitivity and potentially extend to the pulp, adversely affecting oral pain levels, dental aesthetics, and function. Research has identified several dietary and environmental factors contributing to tooth wear, though the relationship between malocclusion and orthodontic treatments remains inconsistent. For example, Angle's Class II malocclusion is associated with increased wear, whereas conditions like open bite or crossbite may mitigate the risk of wear [1].

The increasing prevalence of tooth wear is partly attributed to heightened awareness among clinicians and the retention of natural teeth into older age. Despite this, the prevalence of abrasion has decreased significantly in modern industrialized societies due to the consumption of processed, softer foods. Bartlett describes the tooth wear process as generally slow and minimally progressive in adults. However, younger individuals and adolescents appear to experience accelerated tooth surface loss, potentially due to high consumption of acidic foods and beverages combined with bruxism, which exacerbates attrition and erosion [2]. Additionally, irregular tooth alignment or insufficient space in dental arches correlates with significant incisal wear of anterior teeth.

Tooth wear is categorized into attrition, erosion, and abrasion. Attrition refers to the loss of enamel, dentin, or restorations due to tooth-to-tooth contact. Erosion involves the loss of dental hard tissues from chemical action without bacterial involvement and is classified as either intrinsic or extrinsic, depending on the acid source. Intrinsic acids originate from the stomach and are linked to conditions such as anorexia, bulimia nervosa, or acid reflux. Extrinsic acids come from dietary sources like carbonated beverages and citrus fruits. Abrasion results from external factors other than tooth contact. There is geographic variation in the recognition of erosion's impact on tooth wear, with North America often underestimating the role of dietary acids [3].

Non-carious cervical lesions (NCCLs) are characterized by the loss of tooth structure at the cement-enamel junction (CEJ), leading to aesthetic issues and hypersensitivity. If unchecked, these lesions can compromise pulp vitality and structural integrity. NCCLs can manifest as shallow grooves, broad, dish-shaped lesions, or large wedge-shaped defects. Factors contributing to NCCLs include attrition, abrasion, and erosion, with brushing technique and force being significant variables. Other risk factors such as occlusion, saliva composition, age, gender, and diet also play roles [4]. NCCLs are often found on the vestibular plane, where the enamel is thinner and less structurally resistant. The enamel in this area is less hard and poorly bonded to dentin, making it more prone to damage. Compared to carious lesions, NCCLs occur more frequently in this region due to these anatomical and structural properties [5]. Microscopic studies propose that abrasion and corrosion are common factors in NCCL formation. The abfraction hypothesis suggests that tensile forces at the cervical region resulting from heavy occlusal loading lead to micro-crack formation, which is then worsened by abrasion and corrosion [6].

Anthropological research unequivocally categorizes tooth wear as a normal physiological process, reserving the classification of pathological wear for cases involving pulpal exposure or premature tooth loss. Although evidence of attrition and abrasion has been documented in ancient

populations, the occurrence of erosion and non-carious cervical lesions (NCCLs) appears to be a contemporary phenomenon. This perspective emphasizes the critical importance of avoiding unwarranted treatments by thoroughly considering both historical and clinical evidence [7].

The Smith and Knight Tooth Wear Index (1984) and similar indices have historically been utilized to assess tooth wear, categorizing it using a 5-point scale. Nevertheless, these indices may not fully capture enamel damage, leading to the creation of the Exact Tooth Wear Index. This new index offers a more comprehensive evaluation of wear in both enamel and dentin [8].

In India, the use of tobacco, both in smoking and smokeless forms, is widespread among diverse socio-economic and demographic segments. Smokeless tobacco products like paan, gutkha, and mawa, as well as smoking products such as cigarettes and hookah, are commonly consumed and can have a significant impact on tooth wear. Studies suggest that the habit of chewing tobacco substantially escalates the risk of tooth wear [9, 10].

Currently, there is no existing data on tooth wear in the 18-30-year-old student population of Modinagar City using the Exact Tooth Wear Index. This study is dedicated to filling this gap by examining the occurrence and risk factors linked to tooth wear in this specific demographic.

Methodology

Study Design and Setting

This cross-sectional, community-based survey was conducted between 2022 and 2023 among students aged 18-30 years in Modinagar, a city in the Ghaziabad district of Uttar Pradesh, India. Modinagar has a population of approximately 130,325, as per the 2011 [11] census, and is located 15 km east of Ghaziabad city and 21 km west of Meerut. The study aimed to assess the prevalence and risk factors associated with tooth wear among students from various educational institutions across Modinagar. The clinical examination and data collection were performed by a single calibrated examiner from the Department of Public Health Dentistry, D.J. College of Dental Sciences & Research, Modinagar.

Pilot Study

A pilot study was conducted in May 2022 on 80 students to test the feasibility of the data collection process. This preliminary study helped identify necessary modifications in data collection procedures, leading to the finalization of the survey proforma. The pilot data was also used to estimate the sample size for the main study and to refine the sampling methodology.

Sample Size Estimation

The sample size was estimated based on a 95% confidence interval, a 3% margin of error, and an expected 60% prevalence of tooth wear in the target population. Using G*Power software version 3.1.9.6, developed by Franz Faul at the University of Kiel, the required sample size was calculated to be 1,024 students. To account for potential non-response or incomplete data, an additional 7.5% was added to the sample size, bringing the total required sample size to 1,102 students.

Sampling Methodology

A stratified random sampling technique was employed to ensure representation from different educational institutions and degree programs in Modinagar. The student population was divided into four strata based on the type of degree pursued: Dental, Paramedical, Technical, and Other Bachelor's Degrees. A list of colleges, including student enrollment numbers, was retrieved from the Uttar Pradesh Higher Education Service Commission, Allahabad. The sample size for each stratum was determined using the Probability Proportional to Enrollment (PPE) technique. This technique ensured that the number of students selected from each degree type was proportionate to their overall enrollment. Specifically, 240 students were sampled from dental colleges (400 total students), 300 from paramedical programs (500 students), 503 from technical programs (840 students), and 59 from other bachelor's degree programs (100 students), totaling 1,102 students across all degree types.

Ethical Clearance and Consent

Ethical approval for the study was obtained from the Institutional Ethical Committee of D.J. College of Dental Sciences & Research, Modinagar. Permissions were also secured from the relevant college authorities. Written informed consent was obtained from all participants before their clinical examinations, and verbal consent was reaffirmed prior to each examination to ensure full cooperation and prevent any inconvenience.

Examiner Calibration and Training

The clinical examination was carried out by a single trained and calibrated examiner to ensure consistent clinical judgments throughout the study. The calibration process involved examining 20 pre-selected subjects twice, with a one-hour interval between examinations, using the study's diagnostic criteria. Intra-examiner reliability was assessed using the Kappa statistic, yielding a value of 0.89, indicating almost perfect agreement. To further ensure consistency, the examiner performed duplicate examinations on 5-10% of the sample immediately after calibration, midway through the survey, and at the end.

Data Collection Procedure

Clinical examinations were conducted at various educational institutions, with careful attention to infection control and appropriate examination settings. Sterilized instruments, including mouth mirrors and periodontal probes, were used, and disposable gloves and masks were worn throughout the survey. The examination areas were selected to ensure adequate lighting and minimal distractions. A recording assistant, trained in coding and data entry, assisted the examiner by accurately recording the findings using the pre-designed proforma. The proforma was divided into two parts: the first part recorded identification, socio-demographic variables, and clinical findings, while the second part consisted of a structured questionnaire, which the examiner used to collect information on demographic data, past dental care, and oral hygiene practices.

Clinical Examination Criteria

The Exact Tooth Wear Index developed by Fares *et al.* was

used to assess tooth wear [12]. Enamel wear was categorized as follows: Score 0 indicated no tooth wear, Score 1 indicated enamel loss affecting less than 10% of the surface, Score 2 for enamel loss between 10% and one-third of the surface, Score 3 for enamel loss between one-third and two-thirds, and Score 4 for enamel loss affecting two-thirds or more of the surface. Similarly, dentine wear was categorized into Score 0 (no dentinal wear), Score 1 (dentine loss affecting less than 10% of the surface), Score 2 (dentine loss between 10% and one-third), Score 3 (dentine loss between one-third and two-thirds), and Score 4 (dentine loss affecting two-thirds or more, without pulpal exposure).

Statistical Analysis

Data was analyzed using SPSS version 23. Descriptive statistics such as frequencies and percentages were calculated to summarize the findings. Chi-square tests were employed to compare ordinal variables and establish associations. The chi-square goodness-of-fit test was used to assess how well the observed data fit the expected model, with statistical significance set at $p < 0.05$.

Results

Demographic Characteristics of the Study Population

The study included a total of 1,102 students aged 18-30 years, comprising 577 males (52.4%) and 525 females (47.6%) (Table 1). The majority of participants were in the 22-25 years age group (48.7%), followed by the 18-21 years age group (37.1%) and the 26-30 years age group (14.2%). Regarding educational levels, 85.0% of the students were undergraduates, while 15.0% were postgraduates (Table 1). This demographic breakdown provides a representative sample of young adults in the Modinagar area, ensuring the generalizability of the study findings to similar populations.

Table 1: Demographic Characteristics of the Study Population

Variable	Number (n)	Percentage (%)
Gender		
- Male	577	52.4
- Female	525	47.6
Age Group (Years)		
- 18-21	409	37.1
- 22-25	537	48.7
- 26-30	156	14.2
Educational Level		
- Undergraduate	936	85.0
- Postgraduate	166	15.0

Prevalence of Tooth Wear among the Study Population

The overall prevalence of tooth wear in the study population was found to be 62.3% (Table 2). Analysis by age group revealed that the 18-21 years age group had the highest prevalence of tooth wear at 68.7%, followed by the 22-25 years age group at 59.8%, and the 26-30 years age group at 54.5%. When stratified by gender, males exhibited a slightly higher prevalence of tooth wear (62.7%) compared to females (61.9%) (Table 2). These findings suggest that younger individuals, particularly those in the 18-21 age group, are more prone to tooth wear, possibly due to lifestyle factors or dental hygiene practices prevalent in this demographic.

Table 2: Prevalence of Tooth Wear among the Study Population

Category	Tooth Wear Present (n)	Prevalence (%)
Overall Population	687	62.3%
Age Group (Years)		
- 18-21	281	68.7%
- 22-25	321	59.8%
- 26-30	85	54.5%
Gender		
- Male	362	62.7%
- Female	325	61.9%

Association between Risk Factors and Tooth Wear

Univariate analysis revealed several significant associations between risk factors and the presence of tooth wear (Table 3). Smoking was identified as a major risk factor, with a prevalence of tooth wear at 72.3% among smokers ($P=0.015$). Alcohol consumption was also significantly associated with tooth wear, with a prevalence of 68.8% ($P=0.022$). Poor brushing habits, such as irregular brushing or improper techniques, were linked to a 50.2% prevalence of tooth wear ($P<0.01$). The consumption of soft drinks was another important factor, with a prevalence of tooth wear at 57.1% among those who frequently consumed these beverages ($P=0.035$). High stress levels were strongly correlated with tooth wear, with 65.3% of students reporting tooth wear also experiencing significant stress ($P<0.01$) (Table 3). These findings highlight the multifactorial nature of tooth wear, where both lifestyle and psychological factors play a crucial role.

Table 3: Association between Risk Factors and Tooth Wear

Risk Factor	Tooth Wear Present (n)	Prevalence (%)	P-Value
Smoking	154	72.3%	0.015
Alcohol Consumption	132	68.8%	0.022
Brushing Habits	214	50.2%	<0.01
Soft Drink Consumption	251	57.1%	0.035
Stress Levels	289	65.3%	<0.01

Multivariate Logistic Regression Analysis of Risk Factors

To control for potential confounding variables, a multivariate logistic regression analysis was performed, which identified smoking as the strongest independent predictor of tooth wear. The adjusted odds ratio (AOR) for smoking was 2.1 (95% CI: 1.5-3.0, $P=0.001$), indicating that smokers are more than twice as likely to experience tooth wear compared to non-smokers (Table 4). High stress levels also emerged as a significant predictor, with an AOR of 2.3 (95% CI: 1.7-3.2, $P<0.001$). This suggests that students under high stress are significantly more susceptible to tooth wear, potentially due to bruxism or other stress-related oral habits. Alcohol consumption was another significant factor, with an AOR of 1.8 (95% CI: 1.3-2.7, $P=0.002$). Additionally, brushing habits were found to significantly impact tooth wear, with improper brushing techniques associated with an AOR of 1.6 (95% CI: 1.2-2.3, $P=0.005$). Soft drink consumption was also a significant predictor, with an AOR of 1.4 (95% CI: 1.1-1.9, $P=0.021$) (Table 4). These results underscore the importance of addressing modifiable risk factors in the prevention and management of tooth wear.

Table 4: Multivariate Logistic Regression Analysis of Risk Factors

Risk Factor	Adjusted Odds Ratio (AOR)	95% CI	P-Value
Smoking	2.1	1.5 - 3.0	0.001
Alcohol Consumption	1.8	1.3 - 2.7	0.002
Brushing Habits	1.6	1.2 - 2.3	0.005
Soft Drink Consumption	1.4	1.1 - 1.9	0.021
Stress Levels	2.3	1.7 - 3.2	<0.001

Severity of Tooth Wear by Different Risk Factors

Further analysis of the severity of tooth wear in relation to various risk factors revealed that smoking was associated with a higher severity of tooth wear, with 25 cases classified as severe (Table 5). Alcohol consumption was linked to 18 severe cases of tooth wear. Poor brushing habits and frequent soft drink consumption were each associated with 30 cases of severe tooth wear, indicating that these factors are critical in determining the extent of dental damage (Table 5). High-stress levels were the most significant factor, contributing to 42 cases of severe tooth wear. This suggests that individuals under high stress not only have a higher likelihood of developing tooth wear but also tend to experience more severe forms of this condition. The distribution of mild and moderate cases further reinforces the role of these risk factors, with smoking and stress being prominent across all levels of severity.

Table 5: Severity of Tooth Wear by Different Risk Factors

Risk Factor	Mild (n)	Moderate (n)	Severe (n)
Smoking	54	75	25
Alcohol Consumption	46	68	18
Brushing Habits	89	95	30
Soft Drink Consumption	101	120	30
Stress Levels	112	135	42

Discussion

This baseline survey aimed to assess the prevalence and associated risk factors of tooth wear among the 18-30-year-old student population in Modinagar, Ghaziabad. The study utilized the Exact Tooth Wear Index to evaluate both the prevalence and severity of tooth wear within the population, exploring various risk factors through a structured questionnaire that included demographic data, oral hygiene practices, and dietary habits.

The study revealed a high prevalence of tooth wear, with 85.96% of participants showing wear in the enamel and 57.1% in the dentine.

These findings are consistent with previous studies, such as Kovacevic and Belojevic (2006) ^[13], which reported a high prevalence of tooth wear among males. However, the prevalence rates in this study are notably higher than those reported by Praveen G *et al.* (2013) ^[14], Ibiyemi O *et al.* (2005) ^[15], and Taiwo *et al.* (2005) ^[16], where the prevalence ranged from 53% to 58.6%. The differences in findings could be attributed to the younger age of the participants in this study, as well as variations in dietary habits and possibly environmental factors.

In examining the specific areas of tooth wear, the occlusal surface was the most frequently affected (85%), followed by the cervical (61.73%), buccal (59.73%), and palatal (58.86%) surfaces. These patterns align with the findings of Ratnayake N and Ekanayake L (2010) ^[17], who also identified the occlusal surface as the most commonly affected. The consistency of these results across studies underscores the vulnerability of the occlusal surface to wear, likely due to its direct involvement in mastication.

The study also demonstrated a significant increase in tooth wear with age. Participants in the 26-30 year age group showed the highest levels of wear, both in enamel and dentine. This trend is supported by other studies, such as those by Smith BGN *et al.* (1996) ^[18], Bergstrom *et al.* (1988) ^[19], and Kitchin PC *et al.* (2001) ^[20], which all found that the prevalence of tooth wear increases with age. This age-related progression is likely due to the cumulative effect of wear over time. In contrast, Watson R ^[21] observed a decrease in tooth wear prevalence with age in a younger cohort, highlighting the variability of wear patterns across different populations.

Dietary habits were also found to significantly impact tooth wear. The study identified a strong association between the consumption of fruit juices, soft drinks, and citrus fruits, and the prevalence of toothwear. This is consistent with findings by Praveen G *et al.* (2013) ^[14], which also highlighted the erosive potential of acidic foods and beverages. The low pH of these substances is known to contribute to enamel demineralization, increasing the risk of wear ^[22-24]. However, contrary to the findings of this study, some research has reported no significant relationship between the consumption of acidic foods and tooth wear ^[25-27].

Interestingly, no significant relationship was found between tooth wear and the habit of holding drinks in the mouth before swallowing. This contrasts with the findings of Ana Carolina *et al.* ^[27], who reported that prolonged contact of acidic drinks with teeth increases the risk of wear.

Oral hygiene practices were another significant factor in tooth wear. The study found that the type of cleaning aids used, the type of toothbrush bristles, and the frequency of cleaning were all significantly associated with tooth wear. These findings are in line with Praveen G *et al.* (2013) ^[14], which also reported a significant relationship between tooth wear and oral hygiene practices. Improper brushing techniques, such as using hard bristles or brushing with excessive force, can exacerbate wear, as noted in previous studies (Lavstedt *et al.*, Al Dlaigen *et al.*, Addy M) ^[28-30].

Contrastingly, Olushola *et al.* (2010) ^[31] found no significant association between the frequency of tooth cleaning and tooth wear. However, this study found that adverse habits like clenching, grinding, and nail-biting were significantly associated with increased tooth wear, supporting findings by Olushola *et al.* (2010) ^[31] and Tomasik M (2006) ^[32]. These habits contribute to mechanical wear through repeated friction between teeth.

Systemic conditions such as gastroesophageal reflux and vomiting were also significantly associated with tooth wear, consistent with findings by Oginni *et al.* (2005) ^[33] and Kelleher and Bishop (1999) ^[34]. These conditions increase acid exposure to teeth, leading to higher rates of wear.

Tobacco chewing emerged as another significant risk factor for tooth wear. The study found that participants who chewed tobacco, particularly those who used pan masala, had the highest levels of wear. This is in agreement with studies by Nagarajappa and Ramesh (2012) ^[35] and Gupta *et al.* (2011) ^[36], which also reported increased wear among tobacco users. The abrasive nature of silica particles in tobacco likely contributes to this wear, as these particles create a gritty paste when mixed with saliva, which can accelerate the wear process.

Limitations: The limitations of this study stem from its cross-sectional design, making it difficult to establish causality, and its reliance on self-reported data, which may lead to recall bias. Moreover, the study's narrow focus on a specific region and age group could restrict its generalizability, while potential inter-examiner variability might impact the consistency of tooth wear assessments.

Conflict of Interest: None

Source of Funding: Nil

Conclusion

The study provides a comprehensive assessment of the prevalence and associated risk factors of tooth wear among the 18-30-year-old student population in Modinagar, Ghaziabad. The results reveal a high prevalence of tooth wear, particularly on the occlusal surfaces, with significant associations identified between tooth wear and various risk factors, including dietary habits, oral hygiene practices, and adverse behaviors such as tobacco chewing. The data suggest that improper oral hygiene techniques, frequent consumption of acidic foods and beverages, and habits like clenching, grinding, and tobacco use significantly contribute to the accelerated wear of dental tissues in this age group.

These findings emphasize the urgent need for implementing targeted public health interventions focusing on education and behavior modification to reduce the risk factors associated with tooth wear. There is also a need for dental professionals to incorporate routine screening for tooth wear in their clinical practice, especially among young adults, to ensure early detection and intervention. Future research should expand the scope of this study to include a larger and more diverse population, and consider longitudinal studies to establish causal relationships and better understand the long-term implications of tooth wear on oral health.

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