

Is Dental Fluorosis More Prone/Susceptible to Tooth Erosion?

FAREED AHMAD¹, ALI ANWAAR², BILAL ABDUL QAYUM MIRZA³, MUSTAFA QADEER⁴, MUHAMMAD AFZAL⁵, ANWAAR ALAM⁶

¹Assistant Professor & Head of Department of Oral Medicine Institute of Dentistry, CMH Lahore Medical College National University of Medical Sciences, Rawalpindi, Pakistan

²Assistant Professor Community & Preventive Dentistry Institute of Dentistry, CMH Lahore Medical College National University of Medical Sciences, Rawalpindi, Pakistan

³Professor and Head of Department, Community & Preventive Dentistry Institute of Dentistry, CMH Lahore Medical College, National University of Medical Sciences, Rawalpindi, Pakistan

⁴Associate Professor, Department of Oral Biology, Institute of Dentistry, CMH Lahore Medical College, National University of Medical Sciences, Rawalpindi, Pakistan

⁵Associate Professor, Department of Prosthodontics, Institute of Dentistry, CMH Lahore Medical College, National University of Medical Sciences, Rawalpindi, Pakistan

⁶Associate Professor, Department of Oral Biology, Azra Naheed Dental College, University of Health Sciences, Lahore Pakistan

Correspondence to Dr. Fareed Ahmad drfareedahmad@yahoo.com; +923214292521

ABSTRACT

Background: The fluoride drug is mentioned as a double-edged weapon due to its positive and negative outcomes. Reducing dental caries in large population, cost effective and excess fluoride in teeth or body may lead to systemic diseases and even death. Dental erosion affects the hard tissues of the teeth rendering them vulnerable to decay.

Methods & Materials: A school based descriptive cross-sectional survey. Purposive sampling was performed. All examiners were calibrated and trained for the criteria to identify dental fluorosis and dental erosion. The World Health Organisation Oral Health Assessment form 2013 was used to fill and measure dental fluorosis and erosive tooth wear. For Univariate analysis, mean, frequencies of both genders (dental erosion and Fluorosis) while Chi square was calculated and for bivariate analysis.

Results: 22.7 % students were found to have fluorosis (ranging from questionable level to severe). Male students (primarily teenagers) had more enamel erosion as compared to the female's ones.

Conclusion: The higher levels of fluoride in water may make children and adults more susceptible to erosive tooth wear. Consuming excess fluoridated water may turn the mild fluorosis cases into moderate or severe ones.

Keywords: Fluorosis, Erosive Tooth Wear, Gender, Fluoride

INTRODUCTION

The use of fluoride for water fluoridation has been widely accepted due to its proven effect of dental caries reduction¹. The term Dental Fluorosis is enamel hypoplasia which occurs due to excess exposure of ingested fluoride than the optimum level of fluoride in either water or other sources^{2,3}. Dental fluorosis especially enamel fluorosis is a practical biological marker in identifying and indicating the level of fluorosis in a tooth or teeth³. The sources which lead to fluorosis are excess fluoride in water either naturally or acquired, supplements, gels and toothpastes and mouth rinses. Different forms and shape of fluorosis are observed based on dose and exposure time in amelogenesis. Differentiation in extrinsic staining and fluorotic intrinsic staining is very important. Because of this there may be some misleading results whilst recording the stain level³.

Tooth wear is the irreversible loss of dental hard tissue due to the chemical influence of extrinsic acid (e.g., acid from diet etc.) and intrinsic acid (including acid from gastroesophageal reflux, vomiting etc.) without bacterial involvement^{5,6}. This in turn leads to the loss of the chemically softened oral tissue or structure by abrasive forces⁵. It is a multifactorial condition involving an interplay of various chemical, biological, and behavioural factors. The potential for tooth wear depends on chemical factors including pH, titratable acidity, mineral content, and the

calcium-chelating properties of the dental tissue. Biological factors, such as saliva, acquired pellicle, tooth structure, and tooth position in relation to the soft tissues and the tongue, are correlated with the pathogenesis of tooth wear. Furthermore, behavioural factors, including eating and drinking habits, and excessive oral hygiene are predisposing factors for tooth wear^{5,6}. The prevalence of tooth wear varies widely worldwide, suggesting the effect of the diverse diet habit among different countries or regions on tooth wear.

Keeping in view the downside of improper fluoride intake in children between age 3 and 6 years which can cause dental fluorosis during the developmental phase, there are some doubts about uses of fluoridation⁹. The increased universality of dental fluorosis in children tends to create aesthetic discontent which may cause psychological and behavioural distress⁹.

Little is known about the level and severity of fluorosis in children and adolescents suffering from erosive tooth wear or dental erosion in other terms. The aim of the study is to find severity of fluorosis in children and adolescent with Erosive Tooth Wear (ETW) or commonly known as dental erosion.

METHODS AND MATERIALS

A school based descriptive cross-sectional study incorporating purposive sampling from 18130 individuals (total students in all 12 schools). Ethical approval was obtained from Ethics Review Board, CMH Lahore Medical

Received on 24-03-2021

Accepted on 19-07-2021

College (Case# 513/ERC/CMH/LMC). The Principals of each of the 12 schools sent consent forms to the students' parents to request their consent for their children to participate in School Dental Health Program, by explaining the aim behind the study, its possible outcome, and importance of the study. A few students were excluded from study due to negative consent without any prejudice. All dental examinations were carried by six examiners who were given prior training and were calibrated for the criteria to identify dental fluorosis and erosive tooth wear. The students were examined under natural light on a chair using Gauze pieces and sets of plane mouth mirrors. The periodontal probes used were pre-sterilized in sufficient quantities for each day. Modified version of the World Health Organisation Oral Health Assessment form 2013 was filled for measuring dental erosion and dental fluorosis.

Data analysis was performed on SPSS version 23 (IBM). For Univariate analysis, mean, frequencies of both genders (dental erosion and fluorosis) were calculated and for bivariate analysis Pearson Chi-square test was performed keeping standard error $P < 0.05$. Charan *et al*⁴ mentioned a formula for cross sectional study determination of sample size.

$$\text{Sample Size} = \frac{Z_{1-\alpha/2}^2 p(1-p)}{d^2}$$

Here

$Z_{1-\alpha/2}$ = standard normal variate

(At 1% type 1 error ($P < 0.01$) it is 2.58 and at 5% type 1 error ($P < 0.05$) it is 1.96)

p = Expected proportion in population based on previous studies or pilot studies.

d = Absolute error or precision – this value is decided by researcher.

To calculate the sample size for our study, we used the given values:

$Z_{1-\alpha/2} = 1.96$ (In majority of studies, P values are considered significant below 0.05, therefore 1.96 is used here)

$p = 11.44\% = 0.1144$

$d = 0.05$

Hence the minimum sample size for the study should be 156.

RESULTS

The study sample (18130) comprised of male and female category with fluorosis and erosive tooth wear in private schools of Lahore. Table 1 depicts the values of both genders in each category. Univariate analysis yields frequency distribution and mean for both genders in fluorosis and dental erosion categories. The questionable category in both genders yields 11.6% and 10.5% percentages out of total sample. Comparable results were observed in very mild and mild category however moderate and severe categories depicted a clear demarcation between the gender with 2.6% and 0.6% and 1% to 0.3% percentages, respectively. The mean for fluorosis is 0.32 ± 0.73 .

Table 2 shows the values for Erosive tooth wear. A well-documented difference was observed between male and female category for lesions in Enamel surface/lesion which turned out to be 7.8% and 5.3%. Comparable differences were observed for remainder two categories of Lesions in dentin and pulp with 1.7% and 1.5% and 0.4% and 0.3 % respectively. Mean for Erosive tooth wear was 0.1 ± 0.39 .

Table 3 gives the intersection of students affected by fluorosis and dental erosion simultaneously. Among the individuals with low level of fluorosis (questionable, very mild and mild), 16.5% had enamel erosion alongside minor fluorosis. Similarly, 19.9% had intersection of low-level fluorosis with dentinal erosion and 30.4% had convergence of pulp involvement and questionable, very mild, or mild fluorosis.

The bivariate analysis (Chi-square) depicted a strong association between gender and dental fluorosis i.e., $P < 0.00$. Moreover, strong association between gender and erosive tooth wear was also observed i.e., $P < 0.00$.

Table 1: Gender based distribution in affected individuals of Dental Fluorosis

Fluorosis	Frequency (in Males)	%age (in Males)	Frequency (in Females)	%age (in Females)	Frequency (Total)	%age (Total)
Normal	6924	74.6	7087	80.1	14011	77.3
Questionable	1075	11.6	929	10.5	2004	11.0
Very mild	798	8.6	678	7.7	1476	8.2
Mild	152	1.6	71	0.8	223	1.2
Moderate	241	2.6	56	0.6	297	1.6
Severe	93	1.0	26	0.3	119	0.7
Total	9283	100.0	8847	100.0	18130	100

Table 2: Gender based distribution in affected individuals of Dental Erosion.

Dental Erosion	Frequency (in Males)	%age (in Males)	Frequency (in Females)	%age (in Females)	Frequency (Total)	%age (Total)
Normal	8392	90.4	8192	92.6	16584	91.5
Enamel erosion	696	7.5	496	5.6	1192	6.6
Dentinal erosion	158	1.7	133	1.5	291	1.6
Pulp involvement	37	0.4	26	0.3	63	0.3
Total	9283	100.0	8847	100.0	18130	100.0

Table 3: Intersection of students with Fluorosis Type and Dental Erosion

Dental Erosion Type →	Enamel Erosion		Dentinal Erosion		Pulp involvement	
Fluorosis Type ↓	Frequency	%age	Frequency	%age	Frequency	%age
Normal	971	81.4	218	74.9	38	60.3
Questionable	127	10.7	23	7.9	6	9.5
Very mild	61	5.1	29	10.0	8	12.7
Mild	10	0.8	6	2.1	6	9.5
Moderate	14	1.2	5	1.7	3	4.8
Severe	9	0.8	10	3.4	2	3.2
Total	1192	100.0	291	100.0	63	100.0

DISCUSSION

There is a study which emphasize on the use of water fluoridation in prevention of dental erosion¹². However, little is known about the relationship between fluorosis and dental erosion. In this study, we are trying to investigate the intersection of fluorosis and dental erosion in school going children.

Our results for the dental fluorosis were comparable with the findings of a study done by Ashraf et al¹ in Gojra, Pakistan except the fact that our study sample comprised of all age groups and gender whilst their study only targeted 12-15 years' age group. As shown in Table 1, overall, 22.7% students were found to have fluorosis (ranging from questionable level to severe). This high percentage is possibly due to the amount of fluoride in the city's water supplies. Per a nationwide study¹⁰, out of various water samples collected in Lahore city, about 28% had fluoride levels exceeding the 1.5 ppm. However, the permissible range of fluoride in water is 0.7 ppm to 1.2 ppm.

Table 2 represents the gender-based distribution in affected individuals of dental erosion. The data shows that more male students (primarily teenagers) had more enamel erosion as compared to the female ones. One possible explanation of this increased rate in boys was observed to be smoking and chewing of betel nuts. Another study in Pakistan stated that most people who consume betel quid were reported with tooth wear however the specific age group was male adults¹⁰.

Moreover, the trend of fizzy drink consumption was prominent in both genders which accounts for a major reason of various levels of erosion in students. Some other reasons of erosive tooth wear in students were noted by the examiners. To begin with, many students reported clenching of teeth thus making them prone to erosion. Secondly, several subjects were observed to have parafunctional habit (wrong tooth brushing technique). Additionally, a small fraction of individuals (0.6%) reported with Gastro-oesophageal reflux disease (GERD). These factors which add up to higher erosion risk were also discussed in a study done in Karachi¹¹.

As represented in Table 3, it is noted that 18.6% of the individuals suffering from dental erosion have some level of fluorosis. Moreover, 25.1% subjects with dentinal erosion are also affected by fluorosis in which about 5% have either moderate or severe fluorosis. Similar relationship is seen in students with pulp involvement where about 40% of them had fluorosis as well. Amongst them, 8% had moderate or severe fluorosis along with pulp involvement. Based on a study recently done in New York City, it can be safely assumed that moderate and severe classes of fluorosis weaken the teeth making them more vulnerable to dental erosion¹³.

CONCLUSION

As observed from this study, the higher levels of fluoride in water of the city made the children and growing adults more susceptible to erosive tooth wear. Continued consumption of water with high levels of fluoridation can turn the mild fluorosis cases into moderate or severe ones

causing aesthetic issues as well as increasing their tendency to be affected by erosion.

Conflict of Interest: The authors had no conflict of interest. The authors whose names are mentioned in the manuscript certify they have NO affiliations with or involvement in any organization or affiliation with any financial interest (educational grant, participation as speaker, consultancies, organization membership). The authors also certify that the manuscript in question has not been published in any local or international journal or newspaper and the matter or material discussed in the manuscript is not in collaboration with any individual or organization.

Ethical Approval: Ethical Review Board, CMH Lahore Medical College & Institute of Dentistry granted the approval. (Case#. 513/ERC/CMH/LMC) The Principal of 12 schools sent forms to the students' parents to request their consent for their children to participate in School Dental Health Program, by explaining the aim behind the study, its possible outcome, and importance of the study. A few students were excluded from study due to negative consent without any prejudice.

Funding of the Study: The author bears all the expenses conducting the research. No funding was provided from the any institute or any organisation.

REFERENCES

1. Ashraf S, Khalid MU, Jamil H. Dental fluorosis; Incidence in schoolchildren age 12-15 years in Gojra, Pakistan. *Professional Med J* 2018; 25(2):242- 245. DOI:10.29309/TPMJ/18.4434
2. Tahir M.A, Rasheed H. Fluoride in the drinking water of Pakistan and the possible risks of crippling fluorosis. *Drink water Eng. Sci.* 2013; 6, 17-23.
3. Buzalaf MAR. Review of Fluoride Intake and Appropriateness of Current Guidelines. *Adv Dent Res.* 2018;29(2):157-166. doi:10.1177/0022034517750850
4. Maharani, D.A., Pratiwi, A.N., Setiawati, F. et al. Tooth wear among five-year-old children in Jakarta, Indonesia. *BMC Oral Health* 19, 192 (2019). <https://doi.org/10.1186/s12903-019-0883-5>
5. Linnett V, Seow WK. Dental erosion in children: a literature review. *Pediatr Dent.* 2001; 23:37-43.
6. Taji S, Seow WK. A literature review of dental erosion in children. *Aust Dent J.* 2010; 55:358-67.
7. Carvalho TS, Lussi A, Jaeggi T, et al. Erosive tooth wear in children. *Monogr Oral Sci.* 2014; 25:262-78.
8. Bartlett D, Ganss C, Lussi A. Basic Erosive Wear Examination (BEWE): a new scoring system for scientific and clinical needs. *Clin Oral Investig.* 2008;12 Suppl 1(Suppl 1):S65-S68. doi:10.1007/s00784-007-0181-5
9. Moimaz SA, Saliba O, Marques LB, Garbin CA, Saliba NA. Dental fluorosis and its influence on children's life. *Braz Oral Res.* 2015;29:S1806-83242015000100214. doi:10.1590/1807-3107BOR-2015.vol29.0014
10. Ali KFM, Khalid A, Memon MA, Kadir WB. Anterior Verses Posterior Tooth Wear and Associated Risk Factors Among Patients Attending Oral Medicine OPD of Karachi. *J Pak Dent Assoc* 2017;26(4):164-70. DOI: <https://doi.org/10.25301/JPDA.264.164>
11. Baber, H., Abbas, Z., & Maqsood, S. (2016). Knowledge and Association of Dental Erosion with Age and Gender in Local OPD of Pakistan. *J Pak Dent Assoc* Vol. 25 No. 01 Jan-Mar 2016.
12. Bardsley PF, Taylor S, Milosevic A. Epidemiological studies of tooth wear and dental erosion in 14-year-old children in North West England. Part 1: The relationship with water fluoridation and social deprivation. *Br Dent J.* 2004;197(7):413-399. doi: 10.1038/sj.bdj.4811722
13. New York University. (2020, February 18). How too much fluoride causes defects in tooth enamel: Changes within enamel cells point to mechanism by which excessive fluoride leads to fluorosis. ScienceDaily. Retrieved August 9, 2020 from www.sciencedaily.com/releases/2020/02/20200218143719.htm
14. Charan J, Biswas T. How to calculate sample size for different study designs in medical research? *Indian J Psychol Med.* 2013 Apr;35(2):121-6. doi: 10.4103/0253-7176.116232. PMID: 24049221; PMCID: PMC3775042.