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Dental fluorosis and associated risk factors among secondary school students in Zing community, North-Eastern Nigeria

Ewere Patience Ofiri,[1] Hope Inegbenosun[2]

[1]Department of Family Dentistry, University of Benin Teaching Hospital, Benin City, Nigeria; [2]Dental Department, Taraba State Health Services Management Board, Jalingo, Nigeria

Abstract

Fluorosis affects both children's oral health and quality of life because even the mildest form of tooth discoloration is considered cosmetically unacceptable and is a cause of psychological concern for those affected. This study aims to assess the prevalence of dental fluorosis and determine its associated risk factors among adolescents in the Zing community. This study is a quantitative cross-sectional survey. The study participants were 300 children residing in Zing community and studying in one of the secondary schools selected for this study using a systematic random sampling technique. A questionnaire was designed and pretested to record information about demographic characteristics and risk factors for dental fluorosis. The children were also asked about their source of water consumption and their main source of drinking water recorded. The Dean Fluorosis Index (1934) was used to determine the grade of the severity of dental fluorosis. A Chi-square analysis test was used to test for possible associations. The prevalence of dental fluorosis was calculated as 52.0% and it varied significantly with age. A severe form of dental fluorosis (21.7%) was the most common grade of severity of dental fluorosis. Mild dental fluorosis had the lowest prevalence of 6.0%. The correlation between the occurrence of dental fluorosis and the duration of residence was found to be highly statistically significant ($p \leq 0.001$). The prevalence of dental caries in this study was 12.7%. No correlation was found between dental fluorosis and caries status. The prevalence of dental fluorosis was significantly high among the secondary school students of the Zing community in Taraba State. There is thus a need for health education and community awareness for preventing fluorosis and for early intervention to reduce the consequences on dental and periodontal health status.

Correspondence: Hope Inegbenosun, Dental Department, Taraba State Health Services Management Board, Jalingo, Nigeria.
E-mail: inegbenosun190@gmail.com

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Introduction

Fluoride has always been known as a double-edged sword. When taken in recommended quantity, it can protect against dental caries but when an excess of fluoride is ingested during the years of tooth calcification, essentially during the first 7 years of life, it results in dental fluorosis.[1,2] Excessive levels of fluoride in the drinking water can lead to even more serious health problems than dental fluorosis, as it may progress to skeletal fluorosis in some persons.[3] In its severe form, skeletal fluorosis can be a very serious and debilitating disease.[4]

Although there are several sources of fluoride intake, it is estimated that 60% is through drinking water.[5,6] Other sources of fluoride intake can be through consumption of fluoride-containing supplements, unintentional swallowing of fluoridated toothpaste, breathing in fluoride-polluted ambient air, and fluoride-rich foods and beverages.[7] Thus the consumption of these products along with drinking water high in fluoride, can contribute to the development of dental fluorosis.

Although breast milk has very low fluoride levels, preparing infant formula with fluoride-rich drinking water can also cause dental fluorosis in the child.[7,8]

Zing community located in Zing local government area is a rural settlement in northern Nigeria.

This area belongs to the Mumuye tribe of Taraba State, in north-east Nigeria, whose population is commonly associated with discolored teeth (locally called "Zingbo teeth") right from childhood.[9] The tribe lives on fairly hilly terrain with a warm climate and a few naturally flowing streams running through different sections of the community.[9]

Fluorosis affects both children's oral health and quality of life because even the mildest form of tooth discoloration is considered cosmetically unacceptable and is a cause of psychological concern

for those affected.[10] Reported studies[11-15] on prevalence and severity of dental fluorosis in Nigeria are very limited especially in the North-eastern part of the country. Also, the data on the prevalence of dental fluorosis and associated risk factors in adolescents is scanty.

Hence, this study aims to assess the prevalence of dental fluorosis and determine its associated risk factors in adolescents in the Zing community. The study findings will help to draft effective policies for the improvement of the quality of life of adolescents.

Material and Methods

This study is a quantitative cross-sectional survey. The study participants were 300 children residing in the Zing community and studying in one of the secondary schools selected for this study. The study participants were selected by a systematic random selection of every third student from each of the six grades in the selected schools. The schools selected were Mountain Top Academy, a private secondary school located in Didonko ward, and Government Technical Training School, A public school located in Angwa Baba.

A questionnaire was designed and pretested to record information about demographic characteristics and risk factors for dental fluorosis. The children were also asked about their source of water consumption and their main source of drinking water recorded. The Dean Fluorosis Index was used to determine the grade of the severity of dental fluorosis.[16] The instrument used for clinical examination was a mouth mirror (Osung, USA) and Community Periodontal Indexes (CPI) probe (Zahnsply, India). The instruments were sterilized before every use.

The data analysis was done using the Statistical Package for Social Sciences (SPSS) version 20 (IBM, Armonk, NY, USA) for collating and coding the data points generated from the survey questionnaire. The resulting data were analyzed for demographic profiles using frequency tables while a Chi-square analysis test was used to test for possible associations. $p<0.05$ was considered statistically significant.

Results

A total of 300 school children were examined, and it was found that 156 were affected by varying severity of dental fluorosis. The prevalence was calculated as 52.0%. A total of 163 (54.3%) were females while 137 (45.7%) were males. Although the prevalence

Table 1. Correlation between gender and the occurrence of dental fluorosis.

Gender	Dental Fluorosis Status n (%) Present	Absent	χ^2	p-value
Male	72 (24.0)	65 (21.7)	0.031	0.908
Female	84 (28.0)	79 (26.3)		
Total	156 (52.0)	144 (48.0)		

Table 2. Correlation between age and the occurrence of dental fluorosis.

Age (in year)	Dental Fluorosis Status n (%) Present	Absent	p-value
9	3 (1.0)	1 (0.3)	0.006*
10	7 (2.3)	6 (2.0)	
11	17 (5.7)	5 (1.7)	
12	33 (11.0)	12 (4.0)	
13	20 (6.7)	22 (7.3)	
14	34 (11.3)	32 (10.7)	
15	23 (7.7)	31 (10.3)	
16	7 (2.3)	11 (3.7)	
17	5 (1.7)	10 (3.3)	
18	3 (1.0)	7 (2.3)	
19	3 (1.0)	4 (1.3)	
20 and above	1 (0.3)	3 (0.7)	
Total	156 (52.0)	144 (48.0)	

*Fischer exact test by Monte Carlo method

Table 3. Association between dental fluorosis and the source of drinking water.

Group	Source of drinking water n (%) Well	Hand-Pump	Tap	Stream	Total, n (%)
With dental fluorosis	49 (16.3)	9 (3.0)	89 (29.7)	9 (3.0)	156 (52.0)
Without dental fluorosis	41 (13.7)	7 (2.3)	81 (27.0)	15 (5.0)	144 (48.0)
Total	90 (30.0)	16 (5.3)	170 (56.7)	24 (8.0)	300 (100.0)

$\chi^2 = 2.36$; $p = 0.501$

Table 4. Association of Dean's fluorosis score with the source of drinking water.

Sources	Dean's Fluorosis Score n (%) Unaffected	Questionable	Very Mild	Mild	Moderate	Severe	Total, n (%)
Well	38 (12.7)	0 (0.0)	10 (3.3)	5 (1.7)	12 (4.0)	25 (8.3)	90 (30.0)
Hand-Pump	8 (2.7)	0 (0.0)	1 (0.3)	1 (0.3)	3 (1.0)	3 (1.0)	16 (5.3)
Tap	70 (23.3)	6 (2.0)	20 (6.7)	12 (4.0)	27 (9.0)	35 (11.7)	170 (56.7)
Stream	15 (5.0)	1 (0.3)	5 (1.7)	0 (0.0)	1 (0.3)	2 (0.7)	24 (8.0)
Total	131 (43.7)	7 (2.3)	36 (12.0)	18 (6.0)	43 (14.3)	65 (21.7)	300 (100.0)

$\chi^2 = 16.07$; $p = 0.377$

of dental fluorosis was marginally higher in females (28.0%), the variation was not statistically significant (p =0.908). The correlation between age and the occurrence of dental fluorosis showed that the age with the highest prevalence was 14 followed by 12 and 15. It was also observed that the prevalence of dental fluorosis varied significantly with age (p =0.006; Table 1 and 2).

Dental fluorosis was found mostly among children who consumed borehole/tap water 89 (29.7%) followed by well water (16.3%) and least by hand-pump and stream water; 9 (3.0%) and 9(3.0%) respectively (Table 3). A Dean's fluorosis score of 0.5 (questionable), 1 (very mild), and 2 (mild) was found in 7 (2.3%), 36 (12.0%) and 18 (6.0%) children respectively, while 43 (14.3%) and 65 (21.7%) children presented with scores of 3 (moderate) and 4 (severe). A severe form of dental fluorosis (21.7%) was the most common grade of severity of dental fluorosis. Mild dental fluorosis had the lowest prevalence of 6.0% (Table 4). The source of drinking water was found to be insignificantly associated with dental fluorosis (p=0.501, Table 3) and also with its severity (p=0.377, Table 4).

Out of the 300 students examined, 119 (39.7) were from a Government school while the rest, 181 (60.3%) were from a private school. Although the prevalence of students with dental fluorosis was higher in the private school 101 (33.7%) when compared to that of the government school 55 (18.3%), no significant association was observed (p =0.125; Table 5).

The study showed that those that have stayed 11 to 15 years in the Zing community had more dental fluorosis cases 93 (31.0%) than those that have stayed for fewer years. The correlation between the occurrence of dental fluorosis and the duration of residence was found to be highly statistically significant (p<0.001; Table 6). The prevalence of dental caries in this study was 12.7%. No correlation was found between dental fluorosis and caries status (p=0.166; Table 7).

Discussion

In our study, the prevalence of dental fluorosis in the Zing community was recorded as 52.0%. The obtained prevalence of dental fluorosis was lower than 58% recorded in Bauchi State among school children in Tilden Fulani[12] but higher than 43% recorded among school children in Kanadap, Plateau State,[12] 32% among 15 year olds Lagos children,[11] 20.6% in Langtang town in Plateau State[13] and 12.9% among 12-15 year old lifelong residents in Central Plateau State.[14]

Severe forms of dental fluorosis were more common among the study participants than its milder forms in this study. This was in contrast with the findings of Srivastava *et al*.,[17] Zhang and Si,[18] Ajayi *et al.*,[19] and Naidu *et al.*[20] Two studies conducted in two different communities in Bayelsa State (Oloibiri and Ogbia) reported a prevalence of 3% and 7% respectively for severe dental fluorosis cases as against 21.7% recorded in this study.[21,22] Out of the children affected, dental fluorosis was found to be more in females as compared with males. This is in agreement with two other previous studies[3,23] but differs from the study done by Kotecha *et al.*[24] where dental fluorosis was more prevalent among the male participants. No significant difference was observed in the prevalence of dental fluorosis among both genders. This finding was the same as the ones observed in other studies.[25-28]

The prevalence of dental fluorosis varied significantly with age. This was found to be similar to the study of Arif *et al.*[25] but in contrast with the findings of Sukhabogi et al.[28] and Choubisa *et al*.,[27] who both found no correlation between age and the occurrence of dental fluorosis. This may be due to differences in the frequency of fluoride intake at different ages that would have corresponded with the development of certain teeth. It may also be due to variations in the water fluoride level where the children resided during the development of their permanent teeth. The prevalence of dental fluorosis was highest in children who consumed water from bore-hole/tap.

This variation of dental fluorosis with the source of drinking water was found to be statistically insignificant. This is in agreement with the study by Gopalakrishnan *et al.*[3] who also found no association between the source of drinking water and the occurrence of dental fluorosis. This finding was in contrast with two previously conducted studies.[20,26]

In this study, the prevalence of dental caries was low at 8% but no correlation was found between the occurrences of dental caries and dental fluorosis. It has been reported that the risk of dental caries was less when the fluoride content in drinking water was more.[26]

Conclusions

The prevalence of dental fluorosis was significantly high among the secondary school students of the Zing community in Taraba State. Presence or absence of dental fluorosis was found to vary significantly with age and duration of residence. The importance of physical appearance to a young person's self-esteem cannot be overemphasized as the disfiguring stains of severe fluorosis can have profound psychological and behavioral consequences to

Table 5. Association between dental fluorosis and type of school.

Group	School n (%)		Total
	Government	Private	
With dental fluorosis	55 (18.3)	101 (33.7)	156 (52.0)
Without dental fluorosis	64 (21.3)	80 (26.7)	144 (48.0)
Total	119 (39.7)	181 (60.3)	300 (100.0)

$\chi^2 = 2.64$; p = 0.125

Table 6. Correlation between duration of residence and the occurrence of dental fluorosis.

Duration	Dental Fluorosis Status n (%)		χ^2	p-value
	Present	Absent		
1 – 5 years	28 (9.3)	42 (14.0)	17.96	<0.001
6 – 10 years	29 (9.7)	22 (7.3)		
11 – 15 years	93 (31.0)	60 (20.0)		
16 years and above	6 (2.0)	20 (6.7)		
Total	156 (52.0)	144 (48.0)		

Table 7. Correlation between the occurrences of dental caries and dental fluorosis.

Caries status	Dental Fluorosis Status n (%)		χ^2	p-value
	Present	Absent		
Caries present	24 (8.0)	14 (4.7)	2.170	0.166
Caries absent	132 (44.0)	130 (43.3)		
Total	156 (52.0)	144 (48.0)		

which the adolescent age group is a highly vulnerable and also financial burden for the parents/caregiver. Thus there is a need for health education and community awareness for preventing fluorosis and for early intervention to reduce the consequences on dental and periodontal health status.

References

1. Peter S. Essentials of Community Dentistry. 4th ed. New Delhi: Arya Publishers; 2013.
2. Fejerskov O, Manji F, Baelum V. Dental fluorosis: a handbook for health workers. Copenhagen: Munksgaard;1988. p. 123.
3. Gopalakrishnan P, Vasan RS, Sarma PS, Nair KS, Thankappan KR. Prevalence of dental fluorosis and associated risk factors in Alappuzhadistrict, Kerala. Natl Med J India 1999;12:99–103.
4. Kurdi MS. Chronic fluorosis: The disease and its anaesthetic implications. Indian J Anaesth 2016; 60: 157–162.
5. Rao KV, Mahajan CL. Fluoride content of some common South Indian foods and their contribution to fluorosis. J Scifood Agric 1990;51:275-279.
6. Fawell J, Bailey K, Chilton J, Dahi E, Fewtrell L, Magara Y. Fluoride in drinking-water. World Health Organization. Geneva 2006.
7. Lipiak A, Giernaś B, Wierzejska E. Dental fluorosis as a public health problem. Polski Przegląd Nauk o Zdrowiu 2019;4:72.
8. Sikorska-Jaroszyńska MHJ, Czelej G. Fluoride in dentistry and medicine. 1st ed. Czelej Publishing House. Lublin 2000.
9. Ambinkanme, AH, Sale SS, Ahmed A, et al. A brief history of Taraba State within the Nigeria centenary (1914-2014). Jalingo, Taraba State Government. 2014;1:60-3.
10. Kumar A, Kumar V, Singh J, Hoods A, Dutta S. Drug-induced discoloration of teeth: An updated review. Clinical Pediatrics 2012;51:181-5.
11. Akpata ES, Jackson D. Mottled permanent incisorsin 15-year-old Lagos children. Community Dent. Oral Epidemiol 1978;6:36-9.
12. El Nadeef M, Honkala E. Fluorosis in relation to fluoride level in water in central Nigeria. Community Dent. Oral Epidemiol 1998;26:26-30.
13. Wongdem JG, Aderinokun GA, Ubom GA, et al. Prevalence and distribution pattern of enamel fluorosis in Langtang town, Nigeria. Afr J Med Med Sci 2000;29:243-6.
14. Akosu TJ, Zoakah AL, Chirdan OA. The prevalence and severity of dental fluorosis in the high and low altitudes parts of central Plateau, Nigeria. Community Dent Health 2009;26:138-42
15. Sheiham A. The prevalence of dental caries in Nigerian population. Br Dent J 1967;123:144-8.
16. Dean HT. Classification of mottled enamel diagnosis. J Am Dent Assoc (1922) 1934;21:1421-6.
17. Srivastava AK, Singh A, Yadav AS, Mathur A. Endemic dental andskeletal fluorosis: Effects of high ground water fluoride in some North Indian Villages. Int J Oral Maxillofac Pathol 2011;2:7-12.
18. Zhang B, Si Y. Epidemiological study of dental fluorosis in China. 4th International Workshop on Fluorosis Prevention and Defluoridation of Water. Ed.: Dahi E. & Rajchagool S. National Committee for Oral Health; 2009.
19. Ajayi DM, Arigbede AO, Dosumu OO, Ufomata D. The prevalence and severity of dental fluorosis among secondary schoolchildren in Ibadan, Nigeria. Niger Postgrad Med J 2012;19:102-6.
20. Naidu GM, Rahamthullah SA, Kopuri RK, et al. Prevalence and self-perception of dental fluorosis among 15 yearold school children in Prakasham district of south India. J Int Oral Health 2013;5:67-71.
21. Ephraim-Emmanuel BC, Asara AA, Ronami O, Francis E. Prevalence of dental fluorosis among secondary school children in Oloibiri community. Int J Trop Dis Health 2016;11:1-7.
22. Ephraim-Emmanuel BC, Dotimi DA, Kei BO, Joshua RI. Prevalence of dental fluorosis: a case study of the government secondary school, Ogbia, Bayelsa State, Nigeria. Cont J Med Res 2013a;7:1-8.
23. Murugan A, Subramanian A. Studies on dental fluorosis in low fluoride areas in the Southern Most Parts of India. Aust J Basic Appl Sci 2011;5:329-33.
24. Kotecha PV, Patel SV, Bhalani KD, et al. Prevalence of dental fluorosis and dental caries in association with high levels of drinking water fluoride content in a district of Gujarat, India. Indian J Med Res 2012;135:873-7.
25. Arif M, Husain I, Hussain J, Kumar S. Assessment of fluoride level in groundwater and prevalence of dental fluorosis in Didwana block of Nagaur district, Central Rajasthan, India. Int J Occup Environ Med 2013;4:178-84.
26. Sarvaiya BU, Bhayya D, Arora R, Mehta DN. Prevalence of dental fluorosis in relation with different fluoride levels in drinking water among school going children in Sarada tehsil of Udaipur district, Rajasthan. J Indian Soc Pedod Prev Dent 2012;4:317-22.
27. Choubisa SL, Choubisa L, Choubisa D. Osteo-dental fluorosis in relation to age and sex in tribal districts of Rajasthan, India. J Environ Sci Eng 2010;52:199-204.
28. Sukhabogi Jr, Parthasarathi P, Anjum S, et al. Dental fluorosis and dental caries prevalence among 12 and 15-yearold school children in Nalgonda district, Andhra Pradesh, India. Ann Med Health Sci Res 2014;4:245-52.