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DENTAL FLUOROSIS, CARIES EXPERIENCE AND SNACK INTAKE OF 13-15 YEAR OLDS IN KENYA

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ABSTRACT

Objectives: To determine the dental caries experience in relation to the severity of dental fluorosis and; to evaluate the dietary snacking habits of adolescents.

Design: A descriptive cross-sectional study.

Setting: A peri-urban primary school in Nairobi, Kenya.

Subjects: Two hundred and seventy five adolescents aged 13-15 years among whom 128 were males and 149 were females.

Results: Two hundred and seventy five adolescents were examined for varying degrees of dental fluorosis according to the Thylystrup Fejerskov Index (TFI) scores and the dental caries was determined in the four first permanent molars. One hundred and five individuals were found to have had a TFI score of zero with a corresponding decayed missing and filled teeth (DMFT) for dental caries of 1.30 ± 1.03 and 88(52%) individuals had mild to moderate severity of dental fluorosis (TF scores 1-4) and had a corresponding mean DMFT of 1.53 ± 1.005 for dental caries. Furthermore, 82(48.2%) adolescents had severe degrees of dental fluorosis of TFI scores 5-9 and had a corresponding DMFT value of 1.85 ± 1.24 for dental caries. When the prevalence of dental caries was compared among individuals with TFI scores zero (non-fluorosed teeth) with those who had fluorosed first permanent molars the Chi square test showed that there was a high statistical significance with a p-value of 0.001 (P=0.005). Amongst the 175 adolescents with varying degrees of severity of dental fluorosis it was noted that 44(26%) did not like taking snacks and had a DMFT of 1.54 ± 1.17 while 126(74%) adolescents who enjoyed taking snacks had a DMFT of 1.64 ± 1.08 . However, there was no statistical significance.

Conclusion: While there was a statistically significant association between the severity of dental fluorosis and caries experience among the participants in the present study, there was no co-relation between the caries experience and snacking habits among those who had varying degrees of dental fluorosis..

INTRODUCTION

Dental fluorosis has been reported to be caused by the intake of high doses of fluoride during the early childhood years when both the deciduous and the permanent dentition are developing. Smith and Smith (1) stated that there was ample evidence that mottled teeth, though somewhat more resistant to onset of decay, were structurally weak and when the

decay set in the result was disastrous. The intake of excessive doses of fluoride above the recommended WHO (2) dose of 1.5ppm has been reported to damage the tooth-forming cells in both the deciduous and the permanent dentitions. This damage leads to defects in both the dentine and the forming enamel matrix resulting in a change in the dentine / enamel composition and structure (3,4). Teeth with fluorosis also have an increased porosity of enamel hence the

affected teeth tend to pick up extrinsic stains which is visible as discoloration, ranging from white spots to brown and black stains. In the milder forms, the porosity is limited to the external surface of the enamel, whereas in the severe forms, the porosity impacts the surface enamel as well as the inner enamel resulting in extensive pitting, chipping, fracturing, and decay of the teeth (3,5). Cunha-Cruz and Nadanovsky (6) conducted a study suggesting an increasing risk of caries among children with fluorosis. The severity of dental fluorosis was found to have been associated with a high DMFT in the affected teeth and it was also observed that there was a non-linear dose-response relationship. The lowest TFI score at which dental fluorosis was associated with increased DMFT was TFI score 3. Excess levels of fluoride have been found to occur in most parts in underground water in Kenya especially in Nairobi, Rift Valley, Eastern and Central provinces which constitute approximately 59.5% of the Kenyan population (7). There are no studies which have reported on the severity of dental fluorosis, caries experience and snack intake in adolescents. The purpose of this study was to investigate severity of dental fluorosis caries experience reported as decayed, missing and filled teeth (DMFT). In addition the dietary habits of snack intake by the adolescents were looked into so as to relate the snack intake to caries experience in the fluorosed first permanent molars.

MATERIALS AND METHODS

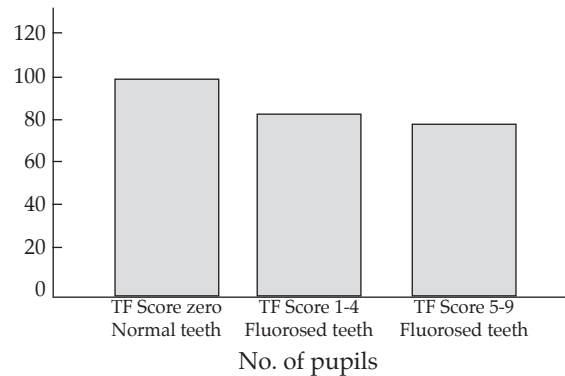
This was a cross-sectional descriptive study involving 275 adolescents aged 13 to 15 years who had all four first permanent molars erupted. These teeth were chosen as enamel formation starts intra-uterine and complete mineralisation post-natally and it is also the largest of the tooth series to erupt in the mouth. This makes the first permanent molar vulnerable to environmental chemical changes (3). Dental fluorosis was assessed using the TFI score proposed by Thylstrup and Fejerskov (3,4). This index was chosen because it has been shown to be more sensitive for individual tooth surface, as each tooth in the oral cavity develops at different times, when compared with the Dean’s index which uses the most affected tooth. Dental caries was determined based on the WHO (2). After the examination for dental fluorosis, the 275 adolescents were divided into two groups: those with normal or non-fluorosed teeth and those who had fluorosed teeth. Decayed, missing, filled teeth (DMFT) was then determined for both groups based on the: first permanent molars (8-11) which is the first molar to start enamel matrix lay down maturation and mineralisation (12). The 170 adolescents who had varying degrees of severity of dental fluorosis were subjected to a dietary intake questionnaire designed to evaluate their accessibility to snacking. Data were then analysed using the SPSS computer software version 11.

That this study was approved by the Ethics Research and Standards Committee of the Kenyatta National Hospital and the University of Nairobi.

RESULTS

Among the 275 pupils, 125 (45.3%) were 13-year-olds, 92(33.3%) were 14 year olds and 59 (21.4%) 15-year-olds respectively. Male pupils were 126 (45.7%) and females 150 (54.3%). The mean age of the subjects was 13.76 years, (mode= 14 years and median =13 years). Majority of the pupils were born in Ongata Rongai, Kajiado 167 (60.5 %) followed by Nairobi 52 (18.8%) then Murang’a 13 (5.1 %). Out of the 275 adolescents who were examined for dental fluorosis, 170 (62%) were found to have had varying degrees of severity of dental fluorosis according to the TFI which ranged from TFI scores 1-9. When the individual TF scores for severity of dental fluorosis were considered 105 (38%) of the adolescents TF score zero (normal teeth) while 88 (52%) individuals had TF scores 1-4 (mild to moderate severity) and 82(48%) had TFI scores 5-9. (Figure 1)

Figure 1
Severity of dental fluorosis



The general DMFT among the 275 adolescents was 1.54±1.071. When the DMFT was calculated by gender caries experience was found to be higher DMFT 1.71 ±1.074 for boys when compared to the DMFT of the girls which was 1.40±1.052 (Table 1). There was a slight statistical significant difference with a Chi square value of 5.489 and a p- value 0.019 (≤0.05).

Table 1
Mean DMFT of the study group by gender

Gender	No.	Mean DMFT
Male	126	1.71 ±1.074
Female	149	1.40 ±1.052
Both gender	275	1.54± 1.071

The DMFT was considered for the various degrees of dental fluorosis, there were 105 adolescents whose

first permanent molars had a TF score zero and a corresponding DMFT of 1.30 ± 1.030 . The mean DMFT for the 170 children experiencing varying degrees of severity of dental fluorosis, thus TF scores 1-9, was found to be slightly higher 1.60 ± 1.11 . Those individuals 88 (52%) with TF scores 1-4 in the first permanent molars had a mean DMFT of 1.53 ± 1.01 while 82 (48%) adolescents who had severe degrees of dental fluorosis TF scores ≥ 5 , had a DMFT of 1.85 ± 1.12 (Table 2).

Table 2

Corresponding mean DMFT for the varying degrees of dental fluorosis

State of teeth	Adolescents No.	% affected	Mean DMFT
TF scores 0	105	38	1.30 ± 1.030
TF Scores 1-9	170	100	1.60 ± 1.11
TF scores ≤ 4	88	32	1.53 ± 1.005
TF scores ≥ 5	82	30	1.85 ± 1.124

When the prevalence of dental caries was compared between the non-fluorosed and the fluorosed first permanent molars the Chi $X^2 = 11.996$ test showed that there was a high statistical significance with a P-value 0.001 (0.05). Out of the 170 children there were 126 (74%) participants who were found to have enjoyed taking snacks who had a DMFT of 1.64 ± 1.08 while the 44 (26%) of those who did not like taking snacks had a DMFT of 1.54 ± 1.17 . Considering snack intake in association with the prevalence of dental caries it was noted that the higher the snack intake the higher the prevalence of dental caries among the affected individuals (Table 3).

Table 3

Snack intake by 13-16 year-olds with varying degrees of dental fluorosis in the first permanent molars

Response to snacks intake	TF scores 1-9	Mean DMFT
No	44	1.54 ± 1.17
Yes	126	1.64 ± 1.08
Total	170	1.60 ± 1.11

However, the Chi square value of 1.594 and p-value at 0.207 ($p < 0.05$) which was not statistically significant.

DISCUSSION

In the present study we have reported a prevalence of 62% of dental fluorosis. The severity of dental fluorosis was observed on the buccal and lingual surfaces of the first permanent molars. Gitonga *et al* (7) established that high levels of fluoride in ground

waters are widely distributed throughout the Rift valley province where the study area Ongata Rongai is geographically located. The area also does get its water supply from bore holes.

In the questionnaire 169 children reported having used borehole water. Notably, there were 105 individuals who had normal (TF scores zero) or non-fluorosed teeth who may have migrated into the study area after the first permanent molars had fully developed. On the other hand, the children who had TF scores 1-4 (mild to moderate severity) may have moved into the study area during the stages of late maturation and mineralisation of the dentine and enamel. However, the children who had TF scores 5-9 may have been exposed to chronic high doses during the period of enamel development, maturation and mineralisation of the first permanent molars, thus affecting both the enamel matrix resulting in the poor enamel structure. This then culminated in the increased enamel porosity with subsequent enamel/dentine staining and fracture (3).

The severity of fluorosis increased depending on the stage of tooth development in the individual when they were exposed to chronically high toxic doses of fluoride during tooth tissue formation when the child may have moved into the study area. According to Gitonga *et al* (7) high fluoride areas tend to coincide with the geographic location of volcanic rocks in and around the Rift Valley. Water samples obtained from 21 springs, wells and boreholes in Kenya were analysed in particular for fluoride concentration. Fifteen spring water samples had a fluoride concentration range of 0.2- 1.2 ppm, well water ranged from 0.2-0.3 ppm while borehole water ranged from 1.0-9.3 ppm. Opinya *et al* (9) reported on a high caries experience as the severity of dental fluorosis increases but she did not report on any association between the severity of dental fluorosis and caries experience. Recently, Waweru (10) reported on dental fluorosis and caries in 12-15 year-olds. She noted that all the posterior teeth were affected, however the first permanent molar was most affected but she did not report any association between the severity of dental caries and dental fluorosis. However, Chipole (11) in his study compared the caries experience for the non-fluorosed teeth to the fluorosed teeth in children with mixed dentition in Kenya and found there was a significant difference in caries experience; the fluorosis group had higher DMFT and DFT with increased severity of dental fluorosis when compared to the group with non-fluorosed teeth. Other studies (12,13) in Ethiopia, reported on the dental fluorosis and dental caries but did not report on association with severity of dental fluorosis. Waweru (10) in her study also reported the first permanent molar to erupt at age 4-5 years-old in African children has to function until death of an individual. Hence it has to withstand the forces of mastication and changes in the oral environment.

Waweru's study was the first to report on severity of dental fluorosis in 12- 13 -year-olds dental caries as DMFT in permanent dentition.

Individuals with severe degrees of dental fluorosis at TFI scores 5-9 also experience pain on eating and discomfort on brushing teeth resulting in difficulties in maintaining good oral hygiene. The fracturing of the malformed and weakened enamel exposes young dentine to the oral cavity temperature fluctuations. The temperature changes in the oral cavity results in complains of pain and sensitivity due to this exposure. Also the children who have fluorosed teeth are prone to the development of dental caries probably due to the rough tooth surfaces that may accumulate and retain plaque. The inability to maintain a good oral hygiene makes the teeth susceptible to demineralisation and the development of high incidences of dental caries. Wondwossen *et al* (13) reported that the fluoride concentration in drinking water, caries prevalence increased consistently with increasing severity of dental fluorosis in the second molars and first molars, followed by premolars and canines. Ekanayake and Van Der Hoek (14) reported that both caries prevalence and the mean caries experience were significantly higher in children with dental fluorosis than those without. Other studies (15,16) have shown that the prevalence of caries increased as the degree of severity of fluorosis increased. The mean DMFT was 0.43 in children showing no fluorosis but increased up to 1.65 in children showing a fluorosis score 3. When comparing the DMFT between boys and girls it was noted that both genders scored a high DMFT 1.71 \pm 1.07 for boys and the girls had a mean DMFT 1.40 \pm 1.052.

There was found to be an association between the severity of dental fluorosis and caries experience in 13- 15 year olds. However, there was no association found between caries experience in children who had varying degrees of severity of dental fluorosis and snack intake, the children with a frequency of intake of snacks had a high DMFT 1.64 \pm 1.08 when compared to those who did not take snacks but had a lower DMFT 1.54 \pm 1.17. Generally increase in snack intake has been associated with the maintenance of a low pH which is held close to the tooth surface by the sticky dextrans. These polysaccharides hold the bacteria and acid closely to the tooth surface resulting in the demineralisation of the enamel. This situation is made worse in the case of fluorosed enamel which has fractured and rough surface acts as receptacle for plaque deposits for the buildup of bacterial colonies. The affected individual is unable to clean adequately the crater surfaces of the fluorosis defects (17). Also as the enamel chips off as is observed in the severe TF scores \geq 5 there is exposure of the dentine resulting in sensitivity and pain thus making it difficult for one to

brush adequately removing all the dental plaque. This may explain why the individuals with TF scores \leq 4 may have had a lower DMFT 1.54 \pm 1.17 while those with the TF scores \geq 5 had a slightly higher DMFT of 1.64 \pm 1.08 (18,19).

In this study the boys showed a high DMFT of 1.71 \pm 1.074 when compared to the girls who had a DMFT of 1.40 \pm 1.05. This may imply a gender predisposition to dental caries, ostensibly influenced by gender biased dietary habits, whence the boys according to our culture may have easy access to money to buy snacks and confectionaries when compared to the girls. Remarkably, in the age group of 13-year olds and above boys tend to be more outdoors and may have the freedom of indulging in the purchase and consumption of snacks while girls who, when adolescence commences, will tend to be in the home most of the time. Girls are also meticulous about their oral hygiene when compared to boys which may explain the differences in DMFT between genders in this study. The weakened enamel when it fractures the individuals experienced varying degrees of pain when there are varying temperature changes.

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