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The fluoride content of drinking water and caries experience in 15 – 19 year old school children in Ibadan, Nigeria

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Summary
Fluoride, a trace element with anticariogenic benefit may either occur naturally or be added to drinking water sources. This study aimed at determining the fluoride level of the different drinking water sources in Ibadan, Oyo State, Nigeria and to relate this with the caries experience of secondary school children in the city. Sixteen samples of the drinking water sources from various locations in the five local government areas of the city were analysed for fluoride concentration. The locations were selected around the vicinities of the secondary schools used for caries study. Nine hundred and fifty five students aged 15-19 years randomly selected from eleven secondary schools in Ibadan metropolis were examined for dental caries over a period of 4-5 months. Only teeth with obvious cavitations were recorded as being carious using the WHO standard method. Teeth grossly covered with calculus and third molars were excluded. No radiograph was taken. The fluoride level of the different water sources was between 0.02 and 0.03ppm. Forty-four (4.6%) of the children had dental caries. There was no statistically significant difference between either DMFT and gender (t = 0.67, p = 0.91) or DMFT and age (F=1.488, p=0.224). However, females had a slightly higher mean DMFT than males and the highest mean DMFT (2.67 ± 1.15) was found among the 19- year- old children. Twenty-three (52.3%) of the students with caries had only one carious tooth while only two had four carious teeth each. In conclusion, both the fluoride level and caries prevalence were low.

Keywords: *Fluoride, anticariogenic, dental caries, school children.*

Résumé
Fluoride est un élément de trace avec un bénéfice anti cariogenèse peut apparaître naturellement ou être additionné a l'eau buvable de sources. Cette étude avait pour but de déterminer le taux de fluoride dans différente eau potable buvable aux sources à Ibadan, Oyo State, Nigeria et de lier à l'expérience de la carie dentaire chez les collégiens dans la ville. Saxointe échantillons des eaux de sources buvables de endroits varies dans cinq district de la cite d Ibadan étaient collectés et la concentration en fluoride analysée. Les locations sélectionnées étaient proches des établissements secondaires utilisés pour étudier la carie dentaire. Neuf cent cinquante cinq collégiens âgés de 15-19 ans étaient choisis au hasard parmi onze établissements secondaire dans la ville métropolitaine d'Ibadan, examinés par la carie dentaire durant une période de 4-5 mois. Seulement les dents ayant les cavitations sure étaient enregistrées comme ayant la carie utilisant le méthode standard de l'OMS. Les dents complément couvert avec le calculus et les troisièmes molaires étaient exclues. Aucune radiographie n'était prise. Le taux de fluoride dans différente eau de sources était entre 0.02 - 0.03ppm. Quarante quatre (4.6%) des enfants avaient la carie dentaire. Il n'y avait pas de différence statistiquement significative entre soit DMFT et le gendre (t = 0.67, p = 0.91) ou le DMFT et l'age (F=1.488, p=0.224). Cependant, les femelles avaient une légèrement plus grande moyenne du DMFT que les males, et la plus élevée moyenne du DMFT (2.67 ± 1.15) étaient trouvé parmi les collégiens de 19 ans. Vingt trois (52.3%) des étudiants avec la carie dentaire avait seulement une dent a carie alors que seulement deux collégiens avaient quatre dents chacun avec la crie dentaire. En conclusion, le taux de fluoride et de la carie dentaire était faible.

Introduction

The knowledge of the fluoride content of drinking water sources in any environment should be considered very important as this relates greatly to prevention of dental caries and enamel fluorosis. Drinking water is a major source of fluoride ingestion, thus the individual water sources should be tested for fluoride contents. High fluoride levels in drinking water, especially during infancy, have been linked with development of enamel fluorosis [1,2]. Though such teeth were found to be resistant to decay [3], severe fluorosis especially in the anterior teeth could also be aesthetically unacceptable. On the other hand, if the fluoride concentration is too low caries risk may increase.

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The caries preventive benefit of fluoride was thought to be through its presence and concentration in the water supply. It was assumed that this beneficial effect was related to its systemic effect in strengthening tooth enamel during development [4], therefore the optimal level was put at 0.7 – 1.2ppm depending on the climatic condition of the area [5] However, current evidence suggests that the predominant effects of fluoride occur at the tooth surface and that systemic (pre-eruptive) effects are of much less importance [6].

The main drinking water sources in Ibadan (a city in the South Western part of Nigeria) include wells, boreholes, springs, pipe borne water; while packaged water as well as bottled water are either from boreholes or springs. The fluoride concentration of these water sources has not been previously analysed separately in the recent past.

In 1967 however, Sheiham [7] in his paper reported the fluoride level in Ibadan to be 0.1ppm without further details. Fluoride concentration of water sources of some other parts of Nigeria has been reported [8-10]. These studies [8-10] reported different ranges with lower concentrations in the western parts of the country and much higher levels in Plateau State situated in the middle belt of the country.

The prevalence of dental caries among Nigerian children has been previously reported [11-13]. Sheiham [3] found about 98% of the children aged 10-14 years in Ibadan to be caries free while 6.7% of the 15-19 year olds had dental caries. However, in a recent study, 11.2% of the school children aged 12-14 years were found to have caries [13].

Therefore, WHO Expert Committee on Oral Health status and fluoride use recommended that survey of dental caries and dental fluorosis be conducted periodically [14]. It was pointed out that flunctuation of the fluoride concentrations in drinking water sources may occur over the years [15]. The aim of this study was therefore to determine the contribution of the fluoride in the drinking water to caries prevention by determining the current level of fluoride in the main drinking water sources in Ibadan, Oyo State, Nigeria and then relate this with the present caries status of the 15-19 year old school children.

Materials and methods

Sixteen samples of the drinking water sources from various locations in the five local government areas of Ibadan were collected into clean uncontaminated bottles by one of the investigators (DMA).The locations were selected around the vicinities of the secondary schools used for caries study. The fluoride concentration in each sample was analysed in the Department of Chemistry, University of Ibadan. The fluoride levels were determined using a colorimetric method [16]. Sources of analysed samples included water from borehole, well, tap and spring.

The subjects for the caries study were taken from public secondary schools in the five local government areas of Ibadan metropolis. The list of all the secondary schools was obtained from the State Ministry of Education and eleven schools were chosen using a proportionate sampling method .The sample consisted of nine hundred and fifty five school children aged 15-19 years randomly selected from the participating schools.

Intra-oral examination

The children were examined either in their classrooms facing the natural light or outdoors, with the aid of sterile mouth mirrors, blunt caries probes and wooden tongue depressors. The examination was carried out by only one of the investigators (OODe). The caries status in each child was determined using WHO standard method [17]. Caries experience was expressed as the number of decayed, missing (due to caries) and filled teeth (DMFT). The third molars or teeth grossly covered with calculus were excluded and only teeth with obvious cavitations were examined and recorded. No radiograph was taken.

Means, standard deviation, student t-test and analysis of variance were used as appropriate in analyzing the data with the SPSS version 11.0. Differences were statistically considered significant at the level of $p < 0.05$.

Results

Table 1 shows the fluoride levels of the main drinking water sources in the five local government areas (LGAs) of Ibadan Metropolis. There was little or no difference in the fluoride levels of the different sources and at the different LGAs. The range was 0.02 – 0.03ppm.

Caries distribution by age and gender is presented in table 2. The study population consisted of 955 children, (506 males, 449 females) aged 15-19 years. The mean age was 17.06 ±S.D. 1.27 years. Over 90% of the children in each age group were caries-free. The overall caries prevalence was 4.6%. Out of the 44 children that had caries, 22 were males while the remaining 22 were females giving a caries prevalence of 4.4% in males and 4.9% in females.

Table 1: Fluoride level of different drinking water sources at LGAs.

Local Government Areas (LGAs)	Fluoride level in ppm Well	Tap	Borehole	Spring
Ibadan South East	0.02	-	0.02	-
Ibadan North	0.03	0.02	0.02	-
Ibadan South West	0.03	0.02	0.02	-
Ibadan North East	0.02	0.02	0.03	0.02
Ibadan North West	0.02	0.02	0.02	-

Range = 0.02 – 0.03 ppm

Table 2: Caries prevalence by age and gender

Age	Children with caries M	F	Total	Caries Free M	F	Total
15	8	5	13	116	105	221
16	8	10	18	88	134	222
17	3	4	7	138	80	218
18	3	0	3	99	71	170
19	0	3	3	43	37	80
	22	22	44	484	427	911

Table 3: Gender distribution of DMFT values

	n	D	M	F	DMFT	Mean
Male	22	37	1	-	38	1.73±0.88
Female	22	39	1	-	40	1.82±0.92

t – test = 0.67, P = 0.91

Table 4: Mean DMFT at the different ages studied

Age	n	D	M	F	DMFT	Mean DMFT
15	13	23	2	-	25	1.92±0.95
6	18	30	-	-	30	1.67±0.84
17	7	10	-	-	10	1.43±0.79
18	3	5	-	-	5	1.67±0.58
19	3	8	-	-	8	2.67±1.15
Total	44	76	2	-	78	1.82±0.90

F value = 1.49; P = 0.22

The gender distribution of DMFT values is shown in table 3. There was no statistically significant difference in the mean DMFT values between males and females (t = 0.67, p = 0.91). None of the children had restoration of the carious lesions done. Table 4 also shows the mean DMFT at the different ages studied, with the highest mean DMFT seen in the 19-year-olds, (2.67 ± 1.15) and the lowest (1.43 ± 0.79) seen in 17-year-olds.

Among participants with caries, over 50% had only one carious cavity, 27.3% had two carious cavities; approximately 16% with three cavities and only 4.5% had four cavities. (Table 5)

Table 5: No. of carious teeth per subject.

No of Carious teeth	n	%
0	911	95.39
1	23	2.41
2	12	1.26
3	7	0.73
4	2	0.21
Total	955	100.0

The distribution of caries in different tooth types is shown in Table 6. There is almost an equal distribution of carious lesions in the first and the second molars both in the upper and the lower jaws. The incisors were unaffected.

Table 6: Distribution of carious lesions in different tooth types

Tooth type	No Carious	%
Lower 1st molars	24	31.6
Lower 2nd molars	25	32.8
Upper 1st molars	11	14.5
Upper 2nd molars	10	13.2
Lower 2nd Premolars	1	1.3
Upper 2nd Premolars	3	4.0
Lower Canine	1	1.3
Upper Canine	1	1.3
Total	76	100.0

Discussion

The prevalence of caries (4.6%) among the age group studied was quite low compared with the caries prevalence in younger age group reported in a recent study [13]. The earlier study reported a prevalence of 11.2% among children aged 12-14 years in the same environment. The selection of study samples in the two studies which were conducted independently and the different age groups involved could account for this observation.

The mean DMFT value was found to be slightly higher in females than in males. This is in agreement with most of the previous studies [13,18,19]. This may be due to a more frequent snacking habit generally observed in females than

males. The highest caries prevalence was seen in the 16-year-olds. However, the mean DMFT was highest in the 19-year-olds followed by the 15 years olds. The value of DMFT has been reported to increase with increasing age [20], but this pattern was not observed generally in this study except among the 17-19year olds. The filled (restorative) component of the DMFT was as nil for all ages. This may be a reflection of low level of oral and dental awareness, low socio-economic status of the children (thus the inability to afford restorative treatments) and the attitude of many people to restorative treatment in this environment.

Caries distribution pattern of the first and second permanent molars among Africans had been reported to be quite different from the pattern observed in the Europeans [21-23]. These Africans studies [21-23] reported that caries prevalence in second permanent molar was higher than in the first permanent molars. However, in the present study, an almost equal distribution of caries was observed on the first and second molars .At the age group studied, the second permanent molars may also have been exposed to the oral condition long enough to be equally affected by cariogenic diets thus resulting in an almost equal distribution of caries in the two tooth types.

The fluoride level of the drinking water sources in Ibadan metropolis was found to be very low (0.02 – 0.03ppm). This is much lower than 0.1ppm reported by Sheiham [7] .The method used for the analysis was however not mentioned. The fluoride levels in the Western parts of Nigeria and in some other West African countries had been consistently found to be low [9,25,26]. For instance, in Senegal, the fluoride levels ranged from 0.009 – 0.8mg/L while in Cameroon, the level was 0.25mg/L. These levels are well below the recommended 0.7ppm [27] which is the fluoride level ideally required in the drinking water of the people living in the tropical regions, for optimal reduction of dental caries [27].

The findings from over 800 clinical trials showed that fluoride either in water or toothpaste is the most important prophylactic agent against caries [28]. However, despite the low level of fluoride in the drinking water sources, caries prevalence in this age group was still very low. This study therefore agrees with the current general belief that systemic fluoride plays a limited role in caries prevention [6]. The low caries prevalence, therefore, could not be totally attributed to preventive benefit of fluoride in drinking water. It may be due to low consumption of cariogenic diets by these adolescents or availability and usage of fluoride from other sources especially fluoridated toothpaste as observed in the developed countries [29].

Conclusion

Caries prevalence is low despite the low level of fluoride in our drinking water. In view of the finding of this study, the availability of fluoride from other sources needs to be known in order to determine the most appropriate water fluoride level that would be beneficial to this environment.

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