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Tooth Erosion: Evaluation of the Use of Soft Drinks, Fresh Fruit, Fruit Juices and Medication among University Students

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Abstract: Objective: To evaluate the use of common extrinsic dental erosive agents among Obafemi Awolowo University residential students. Self administered questionnaire was completed by 789 residential students who consented to participate in the survey. They were asked to rate the level of use of common acidic drinks and medications and their knowledge about adverse dental effects of these erosive agents. 789 responses were adequate for analysis; there were 486 (61.6%) males and 303 (38.4%) females. Fresh oranges has the highest mean of 3.23. Coke, Fanta, Seven-up and Mountain dew consumption exceeded the mean (2.43) for soft drinks. The use of 5-Alive, Tampico and Chi vita was found to exceed the mean (2.36) for fruit juices. Use of Chewable Vitamin C and antiseptic mouthwash surpasses the mean (1.68) for erosive medications (1.68) 66.3% of the participants believed the agents could cause wear of teeth while 67.5% indicated sensitivity of teeth. The agreement of their responses was statistically significant with a low Kappa value (0.42). Fresh oranges, Coke and Fanta, 5 Alive and Chewable Vitamine C were the most heavily used extrinsic erosive agents by the volunteers and did not demonstrate perfect knowledge about their adverse dental effects.

Key words: Tooth erosion · Dietary factors · Toothwear · Sensitivity

INTRODUCTION

Dental erosion is defined as loss of tooth substance by chemical processes not involving bacteria caused by a variety of extrinsic and intrinsic factors [1]. It is a relatively new risk factor for dental health, introduced by today's lifestyle. Dental erosion is termed either idiopathic, extrinsic or intrinsic, implying that according to the case history, the acids producing tooth destruction may be of unknown, exogenous or endogenous origin. Idiopathic erosion is the result of contact with acids of unknown origin, that is, an erosion-like pathology where neither tests nor case history taking is capable of providing an etiologic explanation [2].

Dental erosion due to intrinsic factors is caused by gastric acid reaching the oral cavity and the teeth as a result of vomiting or gastroesophageal reflux. Therefore, dental erosion is a common manifestation in patients suffering from organic or psychosomatic disorders such as anorexia or bulimia nervosa or alcohol abuse [3].

The most common extrinsic acids that can lead to erosion are dietary acids, such as fruit, fruit juices, carbonated drinks and sports drinks [4]. In 1943, McClure [5] described erosion of enamel of rat molar teeth caused by drinking acid beverage in place of water. Since then, his results have been confirmed by many other workers.

Other extrinsic causes that have been suggested to contribute to erosion include oral hygiene products with a low pH, such as toothpastes and fluoride rinses [5]. Oral misuse of medications such as hydrochloric acid tablets, [7,8] aspirin (acetylsalicylic acid) [8-10] and vitamin C [7,9] can lead to loss of dental hard structures. Inappropriate use of some mouthwashes [11] and salivary substitutes [12] also can cause erosion.

Environmental acids are also potential risk factors. People who work in battery factories are exposed to acid fumes and professional wine tasters sip low pH beverages for long periods of time; thus, these professions have been suggested to be high risk [13]. Dental erosion has been reported in swimmers who work out regularly in pools with excessive acidity [14].

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Non-carious tooth loss has become a major clinical challenge for dentist treating young patients today. In modern societies the extrinsic factor of dental erosion is becoming more important due to the increased consumption of acid drinks as soft drinks, sport drinks, fruit juices and fruit teas [15] Robb [16] reported that the prevalence of pathological loss of tooth tissue in patients less than 26 years of age was greater than in many older age groups. Age related phenomenon has been ruled out in explaining the pattern of erosion observed in them which could probably be as a result of changing lifestyles and social pressures. Marketing of soft drinks and beverages is heavily directed toward the younger age groups which surreptiously can explain why the intake is higher among them [17].

It is the aim of the present study is to evaluate the use of common extrinsic dental erosive agents among Obafemi Awolowo University (OAU) students. OAU is located in ILe-Ife, Osun State, south-western part of Nigeria.

MATERIALS AND METHODS

The present study was a descriptive one using paper questionnaire administered randomly to residential students in all the hostels located in the University campus.

Eight hundred and four students consented to participate in the study within thirty days of recruitment.

The questionnaire was developed from items generated from the review of the relevant literature [17-22]

The questionnaire was divided into four sections: Section A solicited information on demographic data of the respondents and in Section B, C and D contain lists of common erosive agents grouped as soft drinks, fruit juices and medications respectively.

The respondents were asked to rate the level of use of each of the erosive agents using a Likert's [23] scale of "Often", "Occasionally"; "Rarely" and Never". Section E sought to assess the knowledge of the participants about two common effects of the erosive agents on the teeth investigated. (1) Whether the agents could cause wear of teeth. (2) Whether they could also cause sensitivity of teeth. Here, a Likert's [23] scale of "Strongly agree", "Agree", "Don't know", "Disagree" and "Strongly disagree" were employed.

Verbal consent was sought and obtained from all the participants before administration of the questionnaire. The study participants self-completed the questionnaire. Four trained students were available to assist in the administration of the questionnaires.

For the data analysis, the ratings for the level of use of the agents were assigned weight values of 4, 3, 2 and 1 respectively while their knowledge were assigned weight values of 5, 4, 3, 2 and 1.

Determination of the Level of Use of the Erosive Agent: The total weight value (TWV) for each erosive agent in the questionnaire was obtained through the summation of the product of the number of responses for each rating to an erosive agent and the respective weight value. This is also expressed mathematically below:

$TWV = \sum_{i=1}^{4} PiVi$ (where TWV is the total weight value, Pi the number of respondents rating an erosive agent i; and Vi the weight assigned to the erosive agent i.

The levels of use for each erosive agent were arrived at by dividing the TWV for each item by the total number of respondents (789). The values obtained ranged from 1 to 4; the closer the value to 4 the higher the use of such erosive agent.

$$\text{Use of Erosive Agents (UE)} = \frac{TWV}{N}$$

where N=number of study population (789).

The mean value of use for each group (Soft Drink Use; $\overline{SDU}$ Fruit Juice Use; $\overline{FJU}$ and Medication Use; $\overline{MU}$) was calculated by the addition of the values generated for each erosive agent in the group divided by the number of items/erosive agents in each group (i.e. Soft drinks by 10, Fruit juices by 6 and Medication by 5 each). Only fresh oranges were investigated in Fruit juices group.

Average value for each group (SDU/FJU/MU) $\overline{UE} = \sum_{i=1}^{4} \frac{UE}{n}$ (UE = use of a particular erosive agent, n= number of items/erosive agents in a group).

Assessment of the Knowledge of the Participants about the Adverse Effects of the Agents: The total weight value (TWV) for each of the two questions asked was obtained through the summation of the product of the number of responses for each rating to question and the respective weight value. This is expressed mathematically below:-

$TWV = \sum_{i=1}^{5} PiVi$ (where TWV is the total weight value of a question, Pi the number of respondents for a rating i; and Vi the weight assigned to the rating i.

The levels of knowledge for each question were arrived at by dividing the TWV for each question by the total number of respondents. The values obtained ranged from 1 to 5; the closer the value to 5 the higher the level of knowledge about whether the agent could cause wear of teeth or tooth sensitivity.

$$\text{Level of knowledge (LK)} = \frac{TWV}{N}$$

where N=number of study population.

The level of knowledge was expressed in percentage by dividing the values obtained by the number of ratings in the scale, ie 5 ratings were used.

$$\text{LK}(\%) = \frac{LK}{5}$$

The data was entered anonymously for the purpose of confidentiality using SPSS (Version 11.0) software package. Generally frequencies were calculated, cross tabulation and kappa value of agreement was found.

RESULTS

Seven hundred and eighty nine responses retrieved immediately were adequate for interpretation. There were 486 (61.6%) males and 303 (38.4%) females. The ages of the participants ranged from 14 to 38 years, with the mean age of 21.35 ± 3.07 years. Stratification according to the number of years in school: participants in year I were 277; Year II, 240; Year III, 181; Year IV, 48; Year V, 25 and Year VI, 18.

The use of fresh oranges has a mean of 3.28 which was the highest. From Tables 1, 2 and 3; soft drinks were the next most commonly used dental erosive agents with a mean use of 2.43; fruit juice use, 2.36 and medication use mean of 1.68.

The use of Coke, Fanta, Seven-up, Mountain dew was above the mean value for soft drinks and has a positive deviation about the mean. Coke and Fanta were the most used (2.83) while Sanz was the least used (1.84).

Table 1: Soft drink Use (SDU)

		4	3	2	1		SDU	(SDU- $\overline{SDU}$)
1	Coke	160	367	231	31	2234	2.83	0.33
2	Fanta	154	382	221	32	2236	2.83	0.33
3	Sprite	74	273	365	77	1922	2.44	-0.06
4	Schweppes	86	279	324	100	1929	2.44	-0.06
5	Tonic Fanta	18	151	324	296	1469	1.86	-0.64
6	Seven-Up	88	297	340	64	1987	2.52	0.02
7	Pepsi-cola	89	270	328	102	1924	2.44	-0.06
8	Mountain dew	128	295	273	93	2036	2.58	0.08
9	Sanz	28	146	284	331	1449	1.84	-0.66
10	La casera	68	309	336	76	1947	2.47	-0.03

Mean = 24.25/10=2.43

Table 2: Fresh Fruits and Fruit Juices Use

		4	3	2	1		FJU	(FJU- $\overline{FJU}$)
Fruit Juices (FJU)								
1	Fuman	48	251	320	170	1755	2.22	-0.14
2	Chi vita	65	315	302	107	1916	2.43	0.07
3	Chi exotic	27	207	317	238	1601	2.01	-0.35
4	5 Alive	147	417	193	32	2257	2.86	0.5
5	Tampico	126	325	252	86	2069	2.62	0.26
6	Fruita	38	195	291	265	1575	2.00	-0.36
Fresh Fruits (FFU)								
	Fresh oranges	375	285	104	25	2588	3.28	0.0

Mean for fruit juices:14.47/6=2.36

Table 3: Medication Use (MU)

		4	3	2	1		MU	(MU - $\overline{MU}$)
1	Chewable Vitamin C	208	337	180	64	2267	2.87	1.19
2	Soluble Aspirin	18	79	289	403	1290	1.63	-0.05
3	Alabukun (Acetylsalicylic acid)	18	76	287	408	1282	1.62	-0.06
4	Antiseptic mouthwash	50	98	218	423	1353	1.71	0.03
5	Artificial saliva	5	21	115	648	961	1.22	-0.46
6	Vinegar (Preservative)	9	43	156	581	1058	1.34	-0.34
7	Swimming in chlorinated water	16	57	148	568	1099	1.39	-0.29

Mean for medication use; 11.78/7=1.68

Table 4: Determination of the level of agreement about whether the erosive agents investigated could cause wear or sensitivity of teeth

		Whether the agents could cause wear of teeth		Whether the agents could cause tooth sensitivity	
Ratings	Weight of the ratings (Vi)	Number of responses (Pi)	Pi.Vi	Number of responses (Pi)	Pi.Vi
Strongly agree	5	85	425	96	480
Agree	4	385	1140	285	1140
Don't know	3	264	792	286	858
Disagree	2	102	204	64	128
Strongly disagree	1	53	53	58	58
Total		789	2614	789	2664
Level of Agreement (LA)			3.31		3.38
LA (%)			66.3		67.5

$TWV = \sum_{i=1}^{5} PiVi$, $LA = \frac{TWV}{N}$, $LA\ (\%) = \frac{LA}{5}$

Table 5: Cross tabulation of the responses about whether the agents could cause wearing away of teeth or sensitivity of teeth

		The agents can cause sensitivity of teeth					
		Strongly agree	Agree	Don't know	Disagree	Strongly disagree	Total
The agents can cause	Strongly agree	64	20	11	1	0	96
wearing away of teeth	Agree	34	199	90	12	3	338
	Don't know	7	72	182	5	1	267
	Disagree	5	25	11	24	4	69
	Strongly disagree	2	4	2	3	8	19
Total		112	320	296	45	16	789

Kappa 0.42, $p<0.00$

Table 2 reports the fruit juice use of the respondents with a mean ($\overline{FJU}$) of 2.36. The use of 5-Alive, Tampico and Chi vita was found to be above the mean use and has a positive deviation about the mean. The most used fruit juice was 5-Alive (2.86) while Fruita (2.00) was least used.

Table 3 shows the use of erosive medications with a mean of 1.68. Chewable Vitamin C and antiseptic mouthwash were the commonly used erosive medications; the values have positive deviation from the mean value for medication use. Chewable vitamin C represents the most used (2.87) while artificial saliva was the least used (1.22)

Concerning the knowledge of the participants on the erosive effects of the agents, (Table 4) 66.3% indicated that they can cause wear of teeth while 67.5% of the volunteers noted that the agents could cause sensitivity of teeth. Their responses were further presented in cross tabular form in (Table 5) with a slightly low Kappa value of 0.42. A statistically significant ($p<0.05$) agreement of responses was found for participants who believed the agents could cause wear of teeth ditto tooth sensitivity.

DISCUSSION

Tooth wear is becoming more commonly recognized in both adults and children, with studies suggesting a prevalence of 98% in adults. [24] At the outset, it is the aim of this study to look at the use of dental erosive agents among residential university students.

Findings from the study revealed that fresh oranges were the most used dental erosive agents. In Nigeria, growers of oranges are present in the six regions which make fresh oranges available, although with undulating quantities throughout the year. Larger productions in recent years with improvement in transportation especially from rural areas had correspondingly increased the availability of the product. These have indeed caused a reduced cost of oranges and enabled higher levels of consumption. In the university campus, they are usually sold by hawkers who target the students in the hostels, reading rooms and classrooms especially after the lecture hours. Unfortunately, Janvien el al [25] suggested that eating citrus fruit twice daily would increase an individual's susceptibility to dental erosion.

Soft drinks were another predominantly used extrinsic erosive agent after fresh oranges by the volunteers. This result is not quite surprising as Wagner [26] noted that it is disturbing to discover that bottled water in Nigeria is actually more expensive than Coca-Cola. Many Nigerians consume 2-8 bottles of soft drinks a day.

This assertion was lend credence to by a study that assessed the magnitude of soft drink consumption in a cross section of Nigerian adolescents, 1000 high school students were recruited, nearly all (97.2%) subjects consumed at least one bottle (350 ml) of soft drink a day.

No significant difference in the average daily consumption was found between male and female subjects [27].

Coke and Fanta manufactured by Coca-Cola were the most heavily used carbonated soft drinks; this is followed by Mountain dew and Seven-up manufactured by Seven-up. Coca-Cola Nigeria Ltd is the largest player in soft drinks in Nigeria; its dominance stems from its efficient nationwide distribution network, the popularity of its brands and the company's marketing and advertising activities. The Coca-Cola brand is everywhere; on billboards and kiosks and is one of the best known brands in Nigeria. 7-Up Bottling Co Nigeria is the second largest player in soft drinks after Coca-Cola. It manufactured under license from Pepsi Co Inc. These two groups of carbonated drinks are available in all the hostel butteries, restaurants and snack bars in the university and they are presumably cheaper than bottled water.

5 Alive, Tampico and Chi vita were the most used fruit juices with 5 Alive manufactured by Coca-Cola having a slight edge. This might still not be unconnected with the popularity of Coca-Cola brands in Nigeria. In 2002, the government of Nigeria placed an import ban on a wide range of agricultural products to protect local industries. The fruit juice industry, producing far below capacity before the ban, increased production from just 12 percent in 2002 to over 75 percent by 2004. Nigeria's demand for imported fruit juice concentrates and pre-mixes also grew from 1,500 metric tons in 2002 to 17,000 metric tons by 2004 which was attributed partly to lowering of tariff on concentrates and pre-mixes from 40 to 10 percent in 2002. [28] These factors has tremendously increased the local production of various brands of fruit juices with lower retail prices and increased consumption. Chewable Vitamin C tablet was found to be heavily used by the participants. Owing to the widespread belief that it may provide a wide range of health benefits and virtually non-toxic, it is often taken in large quantities. [29] Chewable vitamin C tablets are "delicious and fruit-flavored. Its use has been shown to cause the pH of saliva to drop to a level at which tooth enamel can lose calcium by the formation of calcium citrate complexes [9]. Mouthwashes is another erosive medication with consumption that was above average. They are the most commonly used OTC dental products next to toothbrushes and dentifrices. Promotional gimmicks likely account for the tremendous popularity of these products. Advertisements have convinced the public that mouthwashes are effective for use in the never-ending battle against germs that cause bad breath. Antiseptic mouthwashes reduce the number of plaque bacteria and help prevent gum disease. Some of them have a pH well below 5.5 and some researchers believe that this can lead to tooth erosion [30]. The respondents in this study did not demonstrate a perfect knowledge about the adverse effects of the erosive agents investigated, in that; barely more than 60% of the participants (male and female) agreed the agents could cause wearing away of teeth or tooth sensitivity. This also was revealed in the low kappa value of the cross tabulation with significant percentage (on observation) of don't know, disagree and strongly disagree. It should be noted, that the responses of the participants to whether the agents could cause wear or sensitivity of teeth were equal i.e. statistically significant level of agreement of the cross tabulation. There exists overwhelming evidence from several studies that the frequency of consumption of acidic agents was significantly higher in patients with erosion than without [31,32]. This is of concern, particularly, the compelling dubious messages to consume them that are heavily directed towards adolescents and youths and the resultant negative financial, social, or personal consequences in terms of wear of teeth and its associated esthetic problem, tooth sensitivity and dental pain. The first step to every health choice is information. This requires full and continuing access to dental health information which is best given by the dental personnel. Dentists must be alert for signs of dental erosion and be aware of the consumption of common dietary products that contribute to it. Individuals who are at high risk of dental erosion, regular dental check-ups are recommended for the detection of early lesions and planning of preventive strategies comprising behaviour as well as dietary advice, optimization of fluoride regimes, stimulation of salivary flow rate, use of buffering medicaments and encouraging non-destructive toothbrushing habits [33]. Erosion is clearly a 'multi-factorial' disease, therefore further investigation of the relative importance in terms of erosive potentials of these factors is required.

CONCLUSION

Fresh oranges, Coke and Fanta, 5 Alive and Chewable Vitamine C were the most heavily used extrinsic erosive agents by the volunteers and did not demonstrate perfect knowledge about their adverse erosive effects. Because youths are the target of pockets of adverts and

information about the consumption of these agents, dental practitioners should be aware of the level of use of this agents and include them when giving dietary advice in case of erosion compromised dentition.

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