

Original Research Article

Awareness of dental fluorosis among undergraduate dental students in Riyadh region: a survey based study

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ABSTRACT

Background: Fluoride protects the teeth from dental caries using the needed amount of fluoride products.

Methods: A Modified structured questionnaire has been validated through a pilot trial (20 responses) prior to administration that contains 16 questions was distributed. Other than the demographics, the data were collected from 500 participants including undergraduate male and female dental students.

Results: The majority described the mild fluorosis appearance in the teeth according to Dean's index appropriately as white opacity of the enamel (64%, n=320). On the other hand, only 31.1% (n=155) and 46% (n=229) described the moderate and severe fluorosis appearance in the teeth according to Dean's index appropriately.

Conclusions: The dissemination and education about dental fluorosis is urgently needed and should be tailored to reach this population. The knowledge about causes of fluoride and the effect on dental fluorosis should be presented in the education.

Keywords: Dental fluorosis, Dental students' knowledge, Topical fluoride

INTRODUCTION

Dental fluorosis can be divided into three distinct historical periods. First period was from (1901-1933), which was concerned with the cause of developmental enamel defect described in 1916 by Dr. Fredrick McKay of Colorado USA North America. He discovered permanent stains on teeth of his patients which were referred as "Colorado stains"; later on, this defect was identified as mottled enamel or in more specific term chronic endemic enamel, that lead to discover the action of fluoride caries prevention.^{1,2}

Dental fluorosis is stated as hypoplasia or hypomineralization and disturbance in the tooth formation

caused by the excessive and prolonged ingestion (eating or drinking) of fluoride during the formative and developing stage of the dentition. In most situations, it is non-carious disease characterized clinically by discoloration ranging from minute white flecks, yellow, or brown to black scattered irregular spots over the teeth surface, crippling, mottled enamel.³ To rely on the index that has been used it should be sensitive, easy to understand and consistent.^{4,5}

Continued long time of exposure will harden and brittle the enamel by replacing the hydroxyapatite by fluoroapatite. During primary stages, the color of the enamel will be yellow, brown to black depending on the

severity. The coloration on the teeth appears as spots or streaks.⁶⁻⁸

Direct cytotoxicity will cause cell death due to fluorosis. The postponed development of narrow junctions, the apical and baso-lateral surfaces is essential to form a sealed barrier between them, and the effect of fluoride on factorial calcium and/or bicarbonate transport is directly inhibitory.⁹

The duration, timing and the dose of fluoride exposure affects the degree of dental fluorosis.¹⁰ The most frequently contributor to fluoride is drinking water, and according to the WHO1993, the superior limit of fluoride in drinking water has been set as 1.5mg/11l. Furthermore, improper use of fluoride supplement, milk bottle formula in long-term use, when the young children start to brush their teeth in an early age using fluoride dentifrices, high consumptions of dietary practices like fish, drinking tea before age of 7 and higher socioeconomic status increase the chances of toxicity.¹²⁻¹⁴



Figure 1: Very mild/mild fluorosis.



Figure 2: Mild fluorosis.

The relationship between dental fluorosis and dental caries depend on the exposure of fluoride which can lead to mottled enamel and dental caries. Mann et al, have reported statistically significant positive association between caries prevalence and fluorosis, the more severe the fluorosis level, more is the caries rate.^{15,16} Dean's fluorosis index was first published in 1934 by H. Trendley, Dean developed an index (Figures 1,2,3) for

assessing the presence and severity of mottled enamel. The index undertook two changes, appearing in its final form in 1942, an individual's fluorosis score is based on the most severe form of fluorosis found on two or more teeth.^{17,18}



Figure 3: Mild fluorosis.

The classification method should rely on clinical examination (gold standard)

Asking about the living area (fluoridated or none - fluoridated area) followed by using of Visual observation (Observe the enamel surface appearance), dental mirror, blunt probe (to discover the changes on enamel surface) and portable lightening may be helpful.¹⁹

In dentistry prevention is better than the cure so we can prevent fluorosis with little simple ways like reducing amount of fluoride intake by using toothpaste with less amount of fluoride, drinking water with optimal fluoride level recommended by WHO which is 1ppm.^{20,21}

METHODS

The presented study is a survey study carried out in Riyadh region, Saudi Arabia. A Modified structured questionnaire has been validated through a pilot trial (20 responses) prior to administration that contains 16 questions was distributed. Other than the demographics, the data were collected from 500 participants including undergraduate male and female dental students from 3rd year to internship by submitting their attempts via online survey (Survey Monkey).

The study registration was done in the research center of Riyadh Elm University (REU) colleges of dentistry and pharmacy and the number of the registration FUGRP/2018/59 that has been reviewed by IRB of REU.

The research was approved by the ethics committee No: RC/IRB/2016/721 and the study was concluded in two study semesters. The questionnaire consists of sixteen questions in two parts.

The first part consists of general information such as age and academic year (from 3rd year to internships); the

second part of the questionnaire included the questions regarding the awareness and knowledge of undergraduate dental students. It consisted of fourteen questions, three of them described the appearance of fluorosis (mild, moderate and severe) in the teeth according to dean index consist of these following options (a. white opacity of the enamel, b. all teeth surface affected marked with brown stain maybe, c. smooth, glossy creamy white translucent, d. pitting and wide spread brown stain, e. I don't know) and one question was about the main cause of dental fluorosis options (a. public water, b. fluoride application in dental clinic, c. toothpaste, d. hereditary and e. genetic) and one of the questions was asked about the suitable treatment for moderate to severe dental fluorosis and the following options (a. dental enamel micro abrasion, b. vital bleaching c. composite build up , d. ceramic crown or ceramic veneer) the rest of the six questions general information about dental fluorosis to assess the awareness with options of (a. yes and b. no).

The data analysis was performed using SPSS version 22 windows. Descriptive analysis was performed and difference between the groups was examined using Chi square and Fisher exact test. A p value of <0.05 was considered as statistically significant.

RESULTS

Descriptive analysis

The sample was (n=500) with the gender frequency of males: 131 and female: 369. Academic year (n=496) with frequency of the third and fourth years was 129, fifth and sixth years was 223 and the dental interns were 144. The majority of the respondents were females (73.8%, n=369) (Figure 4). The distribution of subjects by subjects by academic year is shown in Figure 5. There is a statistically significant association between gender and academic year (p=0.002). Males are more likely to be in internship and females are more likely to be in 3rd and 4th year.

Table 1 shows the responses of participants related to their knowledge about moderate dental fluorosis and its clinical presentation. It can be noted that 17.8% of the participants believed it is related to white opacities. However, moderate dental fluorosis is presented as brown discoloration without pitting. Therefore, 31% of the subjects were knowledgeable about the correct diagnosis.

Table 2 shows the answers provided by the study participants regarding the clinical presentation of severe dental fluorosis. As it is mentioned in the literature review that severe dental fluorosis is associated with pitted surface and roughness, 45.8% of the subjects revealed the correct response. On the other hand, 5.6% did not know the right answer.

Table 3 shows the participants knowledge about the main cause behind dental fluorosis. It can be noted from the

findings that 74.6% of the participants blamed the public water supply, which may be true as long-term water consumption with high fluoride content causes dental fluorosis. However, only 5.6% believed that dental fluorosis can be caused by ingestion of toothpaste.

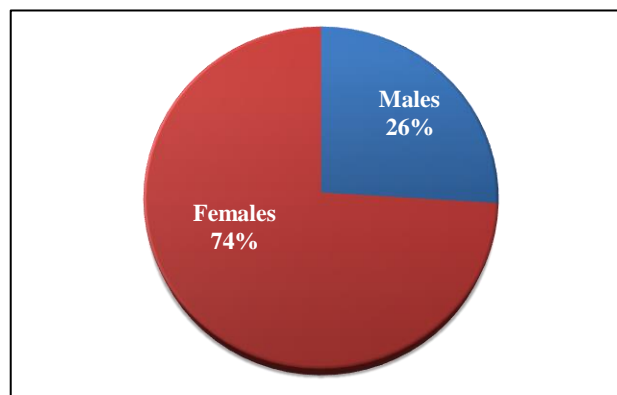


Figure 4: Male to female ratio among the study participants.

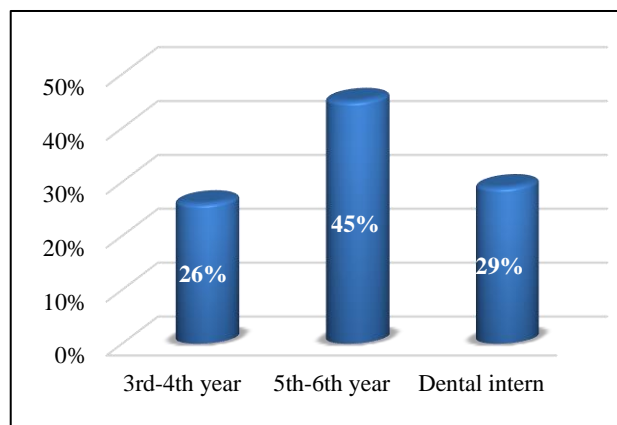


Figure 5: Level of dental students participating in this study.

Table 1: Responses of participants when inquired about the clinical presentation of moderate dental fluorosis.

Responses of participants	Frequency	Percent
	1	0.2%
White opacity of the enamel	89	17.8%
All teeth surfaces affected marked with brown stain maybe	155	31.0%
Smooth, glossy creamy white translucent	93	18.6%
Pitting and wide spread Brown stains	125	25.0%
I don't know	37	7.4%
Total	500	100.0%

Table 4 represents the attitude of participants towards the use of topical fluoride since it is associated with toxicity.

It can be noted from the table that 82.4% of the study subjects believed that using fluoride would not lead to dental fluorosis as it is associated with the amount of care.

Table 2: Responses of participants when inquired about the clinical presentation of severe dental fluorosis.

Responses of participants	Frequency	Percent
	2	0.4%
White opacity of the enamel	15	3.0%
All teeth surfaces affected marked with brown stain maybe	213	42.6%
Smooth, glossy creamy white translucent	13	2.6%
Pitting and wide spread Brown stains	229	45.8%
I don't know	28	5.6%
Total	500	100.0%

Table 3: Knowledge of participants about the main cause of dental fluorosis.

	Frequency	%	Valid %	Cumulative %
Public water	373	74.6%	74.6%	75.0%
Fluoride application in dental clinic	27	5.4%	5.4%	80.4%
Toothpaste	28	5.6%	5.6%	86.0%
Hereditary / genetics	70	14.0%	14.0%	100.0%
Total	500	100.0%	100.0%	

Table 5 explains if there is any reported association of dental fluorosis with socioeconomic status.

It can be seen that a majority of study subjects support this association, as there is a possibility of unawareness among the patients due to their lack of reach towards social media or other sources of information.

Table 4: Attitude of participants about the use of topical fluoride.

	Frequency	%	Valid %	Cumulative %
Yes	88	17.6%	17.6%	17.6%
No	412	82.4%	82.4%	100.0%
Total	500	100.0%	100.0%	

Table 6 represents the possible linkage of dental fluorosis with caries and it can be noted from the findings that a large majority of participants did not link these two together.

Although there is a small percentage supporting this theory, which may be a result of the fact that dental fluorosis makes the teeth weaker as compared to the natural tooth.

Table 5: Perception of participants on the relation between fluorosis with socioeconomic status.

	Frequency	%	Valid %	Cumulative %
	2	0.4	0.4	0.4%
Yes	277	55.4	55.4	55.8%
No	56	11.2	11.2	67.0%
Maybe	139	27.8	27.8	94.8%
I don't know	26	5.2	5.2	100.0%
Total	500	100.0	100.0	

Table 6: Perception of participants regarding fluorosis causing dental caries.

	Frequency	%	Valid %	Cumulative %
	2	0.4%	0.4%	0.4%
Yes	104	20.8%	20.8%	21.2%
No	301	60.2%	60.2%	81.4%
I don't know	39	7.8%	7.8%	89.2%
Maybe	54	10.8%	10.8%	100.0%
Total	500	100.0%	100.0%	

Table 7: Knowledge of fluorosis according to Dean's index.

		Frequency (percent) n (%)	
		Appropriate	Inappropriate
Describe the mild fluorosis appearance in the teeth according to Dean's index (n=500)	White opacity of the enamel	320 (64.0)	180 (36.0)
Describe the moderate fluorosis appearance in the teeth according to Dean's index (n=499)	All teeth surfaces affected marked with brown stain	155 (31.1)	344 (68.9)
Describe the severe fluorosis appearance in the teeth according to Dean's index (n=498)	Pitting and wide spread brown stains	229 (46.0)	269 (54.0)

Table 8: Knowledge of fluorosis.

		Frequency (percent) n (%)	
		Appropriate	Inappropriate
What do you think is the main cause of dental fluorosis? (n=498)	Public water	373 (74.9)	125 (25.1)
Did you stop using topical fluoride on your own teeth because it may cause dental fluorosis? (n=500)	Yes	88 (17.6)	412 (82.4)
Do you think there is a relation between dental fluorosis and socioeconomic status? (n=498)	Yes	277 (55.4)	221 (45.6)
Do you think that dental fluorosis can lead to dental caries? (n=498)	No	301 (60.2)	197 (39.8)
Do you think the dental fluorosis can affect both enamel and dentin? (n=498)	Yes	221 (44.2)	277 (55.8)
Can fluoride application be effective in prevention of tooth decay?	Yes	384 (76.8)	116 (23.2)
Do you think the rural area have more prevalence in developing dental fluorosis? (n=498)	Yes	258 (51.6)	240 (48.4)
What is the best treatment for moderate to severe dental fluorosis in your opinion? (n=499)	Ceramic crown or veneer	276 (55.2)	223 (44.8)
If a pregnant woman ingested high dose of fluoridated water, does it affect the teeth development of the fetus? (n=497)	Yes	266 (53.2)	231 (46.8)
If children swallow fluoridated toothpaste are they susceptible to develop dental fluorosis?	Yes	174 (34.8)	326 (65.2)

Table 9: Knowledge of fluorosis according to Dean's index by gender.

	Gender	Frequency (percent) n (%)		p-value	
		Appropriate	Inappropriate		
Describe the mild fluorosis appearance in the teeth according to Dean's index	White opacity of the enamel	Male (n=131)	68 (58.9)	63 (41.1)	0.010*
		Female (n=369)	262 (68.3)	107 (31.7)	
Describe the moderate fluorosis appearance in the teeth according to Dean's index	All teeth surfaces affected marked with brown stain	Male (n=131)	29 (22.1)	102 (77.9)	0.038*
		Female (n=368)	126 (34.2)	242 (65.8)	
Describe the severe fluorosis appearance in the teeth according to Dean's index	Pitting and wide spread brown stains	Male (n=130)	46 (35.4)	84 (64.6)	0.073
		Female (n=368)	183 (49.7)	185 (50.3)	

* indicates statistical significance

The majority described the mild fluorosis appearance in the teeth according to Dean's index appropriately as white opacity of the enamel (64%, n=320). On the other hand, only 31.1% (n=155) and 46% (n=229) described the moderate and severe fluorosis appearance in the teeth according to Dean's index appropriately (Table 1, 2). Approximately three quarter responded appropriately that public water is the main cause of dental fluorosis (74.9%, n=373) and that fluoride application will be effective in prevention of tooth decay (76.8%, n=384) (Tables 3, 4, 5, 6).

On the other hand, approximately half responded that there is a relation between dental fluorosis and socioeconomic status (55.4%, n=277), that the rural area have more prevalence in developing dental fluorosis (51.6%, n=258), ceramic crown or veneer is the best

treatment for moderate to severe dental fluorosis (55.2%, n=276), and if a pregnant woman ingested high dose of fluoridated water it affect the teeth development of the fetus (53.2%, n=266). One hundred and forty (28.1%) subjects reported family members have dental fluorosis (Table 8).

Females are more likely to have the knowledge of mild and moderate fluorosis appearance in the teeth according to Dean's index. Moreover, this association was found to be statistically significant ($p < 0.05$) (Table 9). Females were more likely to respond appropriately that the dental fluorosis can affect both enamel and dentin. This association was also found to be statistically significant ($p < 0.05$) (Table 10). Family members of females are more likely to have fluorosis than males ($p=0.244$).

Table 10: Knowledge of fluorosis according to Dean's index by gender.

	Gender	Frequency (percent) n (%)		P value	
		Appropriate	Inappropriate		
What do you think is the main cause of dental fluorosis?	Public water	Male (n=129)	95 (73.6)	34 (26.4)	0.208
		Female (n=369)	278 (75.3)	91 (24.7)	
Did you stop using topical fluoride on your own teeth because it may cause dental fluorosis?	Yes	Male (n=131)	23 (17.6)	108 (82.4)	0.988
		Female (n=369)	65 (17.6)	304 (82.4)	
Do you think there is a relation between dental fluorosis and socioeconomic status?	Yes	Male (n=131)	63 (48.1)	68 (51.9)	0.166
		Female (n=367)	214 (58.3)	153 (41.7)	
Do you think that dental fluorosis can lead to dental caries?	No	Male (n=130)	80 (61.5)	51 (38.5)	0.548
		Female (n=368)	221 (60.1)	148 (39.9)	
Do you think the dental fluorosis can affect both enamel and dentin?	Yes	Male (n=131)	73 (55.7)	58 (44.3)	0.029*
		Female (n=367)	148 (40.3)	219 (59.7)	
Can fluoride application be effective in prevention of tooth decay?	Yes	Male (n=131)	103 (78.6)	28 (21.4)	0.812
		Female (n=369)	281 (76.2)	88 (23.8)	
Do you think the rural area have more prevalence in developing dental fluorosis?	Yes	Male (n=131)	76 (58.0)	55 (42.0)	0.063
		Female (n=367)	182 (49.6)	185 (50.4)	
What is the best treatment for moderate to severe dental fluorosis in your opinion?	Ceramic crown or veneer	Male (n=131)	73 (55.7)	58 (44.3)	0.529
		Female (n=368)	203 (55.2)	165 (44.8)	
If a pregnant woman ingested high dose of fluoridated water, does it affect the teeth development of the fetus?	Yes	Male (n=131)	66 (50.4)	65 (49.6)	0.352
		Female (n=366)	200 (56.4)	166 (43.6)	
If children swallow fluoridated toothpaste are they susceptible to develop dental fluorosis?	Yes	Male (n=131)	43 (32.8)	88 (67.2)	0.949
		Female (n=369)	131 (35.5)	238 (64.5)	

* indicates statistical significance

DISCUSSION

In present study, authors found the response rate from the female participants were more than the male participants, which is predictable as the female students have more compliance with the surveys. Regarding the description of mild fluorosis, the majority choose the white opacity of the enamel followed by smooth, glossy creamy white translucent, while the rest of the options came at the distribution.

Regarding the description of the severe fluorosis, the mainstream of the responses was allocated between all teeth surfaces affected marked with brown stain maybe and pitting and wide spread brown stains, and little responses were scattered among the rest of the options. A study finding suggested that perceptions of unattractiveness, dissatisfaction and treatment need increase with increasing severity of dental fluorosis.²² As a result in line with previous findings and indicating that

greater severities of fluorosis have an adverse effect on aesthetics.²³

More than half of the sample size agreed that the main cause of dental fluorosis is the public water. The main sources which could be responsible for increased fluoride consumption are fluoride containing drinking water and the rest 125 responses were distributed between the other options.²⁴ Another investigation mentioned that the fluorosis is the most prevalent problem in 24 countries of the world. The majority of the participants was aware of the fact that water contains fluoride and had some knowledge about fluorosis.²⁵

The respondents agree about stopping the use of topical fluoride will not affect the dental fluorosis. Since the topical fluoride can cause dental fluorosis for the teeth which give us a hint that most of the students do not have adequate information regarding fluorosis. This is the reason of abusing topical fluoride among their patents

causing fluoride toxicity. Another study found that the prevalence of fluorosis was very high and recommended further research on topical use of fluoride, as well as consumption of diet enriched with fluoride.²⁶

Regarding the relationship between dental fluorosis and socioeconomic status, 277 responded with 'yes, although 139 were not sure about it while 56 decided to ignore the relationship between them. According to few authors, the family income had inverse relation to children's dental fluorosis status; however, it could not predict fluorosis status as shown in the multivariate analysis.^{27,28} Other studies also found the mix results that higher socioeconomic status correlated with higher dental fluorosis or vice versa, which may due to the influence of local factors in various circumstances.

In the treatment of the severe cases of fluorosis the best option was the ceramic crowns or veneers which have been chosen by 276 of the responses. In another study, it is also seen that majority of participants believe that fluorosis can be treated by tooth bleaching which is an effective option for the mild cases followed by composite veneers and crowns for the moderate and severe cases.²⁹

Depending on the public water the rural area will have more prevalence than other areas; the answer for this question was yes it will be more in rural areas which approved in the literature. Almas et al, found that the fluorosis was prevalent in rural subjects and there is a need of de-fluoridation of water supplies in the areas with high fluoride level.³⁰

CONCLUSION

Within the limitation of this study it was concluded that although students were aware of the levels of fluorosis and had good didactic knowledge, they experienced practical difficulty in differentiating between stages of fluorosis. This difficulty was significant between moderate and severe dental fluorosis. The dissemination and education about dental fluorosis is urgently needed and should be tailored to reach this population. The knowledge about causes of fluoride and the effect on dental fluorosis should be presented in the education because of the consequence of the problem. However, the major issue regarding fluorosis prevention would be to optimize fluoride level in drinking water, or the other sources of drinking water need to be available and accessible. To prevent dental fluorosis in the community a policy should be formulated to strictly adhere to a safety level of fluoride in drinking water.

Recommendations

Based on this study it can be recommended that easy and short messages in oral health educational media should be encouraged and tested with an awareness of low learning levels. Increases the lectures and workshops related to

fluorosis with discussion of different severity clinical cases.

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