

## THE PREVALENCE OF DENTAL FLUOROSIS IN SAUDI ARABIA †

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كجزء من مشروع المسح الطبي لأمراض الفم والأسنان فقد تم اختيار عينة مجزئة لا على التعيين تشمل (٧٣٧٧) فرداً من عشرة مناطق بالمملكة تتراوح أعمارهم ما بين ٦ - ٧ سنوات و ١٢ - ١٣ سنة و ١٥ - ١٤ سنة. جرى فحص أفراد العينة تحت الضوء الطبيعي لتحديد نسبة انتشار تلون الأسنان بالفلورايد اعتمدت طريقة الفحص على الدراسة لمنظمة الصحة العالمية رقم (٢) المعروفة بـ (١١ - ICS) أظهرت النتائج أن نسبة إصابة الأسنان بتلون الفلورايد تتراوح ما بين (٧,٧٧٪) بين الأطفال الذين تتراوح أعمارهم ما بين ٦ - ٧ سنوات وتترفع هذه النسبة إلى ٣٧,٥٤٪ عند الكبار ممن تتراوح أعمارهم ما بين ٢٠ - ٢٩ سنة. وكان هناك فارق إحصائي ذو دلالة ما بين مستوى انتشار تلون الأسنان بالفلورايد بين المناطق الحضرية والريفية التي شملتها عينة البحث بفارق ( $p < 0.01$ ) ويستنتج من هذه الدراسة بأن نسبة انتشار تلون الأسنان بالفلورايد يصل إلى ٢٤,٦٪ ما بين السعوديين ومع ذلك فإن هذه النسبة لا تمثل مشكلة صحية كبيرة على مستوى المملكة.

As a part of the Oral Health Survey of Saudi Arabia, a stratified random cluster sample of 7,377 subjects, aged 6 to 7, 12 to 13, and 15 to 74 years, were examined under natural lighting conditions for fluorosis in ten regions of the country. The methodology was based on the WHO International Collaborative Study II (ICS-II). Results indicated that fluorosis varied from a low of 7.77% among the 6- to 7-year-olds to a high of 37.54% among those 20-29 years of age. There was a significant difference in the level of fluorosis between rural and urban residents ( $p < 0.01$ ). It is concluded that fluorosis is present in Saudi Arabia among 24.6% of the population. However, the prevalence of severe fluorosis is not a great countrywide problem.

### Introduction

The effect of fluoride supplements on caries experience and dental fluorosis was studied in Canadian children, aged 7 to 9 and 11 to 14 years.<sup>1</sup> Although caries experience was lower in the regular users than irregular users of fluoride supplements, the difference was not statistically significant. The prevalence of mild dental fluorosis was considerably high (38% to 63%) in both irregular and regular users of fluoride supplements given in juice, water and/or milk. The prevalence of dental fluorosis was much higher in maxillary incisors and molars than in mandibular incisors in both age-groups.

In a recent Illinois study, it was concluded that the prevalence of dental fluorosis observed between 1980 and 1985 did not continue to increase for 1985-1990, and the fluoride levels above the optimal level in water supplies remained stable.<sup>2</sup> In another study where fluorosis was measured in areas with negligible fluoride levels, optimal levels and four times the optimal, it was found that fluorosis occurred in all the areas although it was not a

problem esthetically. It was concluded that the benefit in preventing caries was more important.

In a study in fluoridated and non-fluoridated communities in British Columbia, over 60% of the children had fluorosis.<sup>4</sup> In a Mexican community with fluoride levels at 2.8ppm, 57% had moderate fluorosis, and 19% had severe fluorosis.<sup>5</sup>

There have been numerous other studies across the globe on the fluorosis question that demonstrate the growing importance of this issue in dental health.<sup>6,12</sup>

The objective of the present study was to determine the level of oral diseases in the Saudi Arabian population. This study focused on determining the level of fluorosis in the Saudi population, aged 6 to 74 years.

### Materials and Method

The overall methods of this study adhered to the WHO International Collaborative Study II (ICS-II) protocol.<sup>13</sup> The sampling strategy was designed to cover multiple sites with random stratified cluster sampling. Housing conditions and population density were the basis for stratification. Data collection was confined to six age-groups: 6 to 7 years, 12 to 13 years, 15 to 19 years, 20 to 29 years, 35 to 44 and 65 to 74 years.

Saudi Arabia regions randomly selected for Phase II of the survey to cover the entire country were ten: Eastern Province, Al Qassim, Hail, Tabouk, Najran, Al Baha, Gizan, Makkah-Al-Mukarramah, Al Madinah-Al-Munawarah and Asir. The 1972 Census figures with a 3% growth rate were used to determine the current population of the country. A list of

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municipalities was prepared for each of the ten regions subject to the condition of having a population of at least 100,000.

Random selection was used to include up to one municipality in each region. The following were selected: Onaizah, Dammam, Hail, Tabouk, Najran, Al Baha, Samitah, Taif, Madinah, and Khamis Mushayt.

Due to the dynamic social progress in the Kingdom during the last two decades, urbanization has rapidly occurred. It is estimated that 75% of the population are now living in the urban centers. Consequently, we divided the municipalities' sample sizes into a ratio of 3:1 for urban and rural areas, respectively.

Two types of stratification for the sampling strategies were used. They were: a) housing density; divided into low, medium and high density; and b) quality of houses, divided into good, fair, and poor. The combination of these categories produced a maximum of nine strata for each urban area.

Data collection for the age-groups 6 to 7 and 12 to 13-years were carried out in the primary and intermediate schools of the selected municipalities. From a list of primary and intermediate schools we randomly selected two of each (one priority, one alternative): primary boys, primary girls, intermediate boys and intermediate girls.

The clinical form included measures for caries, fluorosis, malocclusion, denture status, prosthodontic status, and periodontal status. The form was developed in conjunction with the World Health Organization's International Collaborative Study II (ICS-II) of Oral Health Outcomes. Examiners were calibrated for inter-examiner and inter-examiner reliability using the kappa statistic. Kappa averaged .907 for inter-examiner reliability. Informed consent was obtained by providing information to respondents of the survey and its objectives and requesting their agreement to have a clinical exam and be interviewed with a questionnaire. There were no schools that refused to participate and the response rate among other respondents was 96%. The refusals were negligible and were mostly due to lack of time to

answer the questionnaire. There was no difference between the respondents and non-respondents in age, sex and geographic distribution. Clinical exams were undertaken under natural light conditions with sharp explorers. Portable reclining chairs were used for the examinations.

Statistical analysis was performed with the IBM mainframe version of SAS (Statistical Analysis System) utilizing the Chi-square distribution.

## Results

The proportion of subjects affected by any degree of dental fluorosis (including questionable category) varied from a low of 7.77% among the 6 to 7-year-olds, which increased consistently by age, to a peak of 37.54% among the 20-29 age-group. The prevalence of fluorosis then gradually decreased in the older age-groups to reach 24.03% among the 65 to 74-year-olds. The overall proportion affected by fluorosis for the total sample was 24.60% (Table 1).

Table 1. Number and percentage of subjects affected by fluorosis (including observations in the questionable category) (n = 1815).

Age-Group	Frequency	Percentage
6- 7(n = 2149)	167	7.77
12- 13 (n= 1867)	512	27.42
15- 19 (n= 1822)	614	33.70
20-29(n= 919)	345	37.54
35-44(n= 423)	140	32.63
65-74(n= 188)	37	24.03
<b>Total (n = 7377)</b>	<b>1815</b>	<b>24.60</b>

The distribution of subjects by severity of fluorosis also varied between different age groups (Table 2). In children aged 6 to 7 years, 92.23% were free from fluorosis, 3.3% had questionable

Table 2. Number and percentage of subjects with fluorosis by severity of fluorosis (n = 7377).

Diagnosis	Age - Group						Total
	6-7	12-13	15-19	20-29	35-44	65-74	
Normal	1982 (92.23)	1355 (72.58)	1208 (66.30)	574 (62.46)	292 (67.59)	151 (80.32)	5562 (75.40)
Questionable	71 (3.30)	180 (9.64)	229 (12.57)	121 (13.17)	38 (8.80)	10 (5.32)	649 (8.80)
Very mild	37 (1.72)	113 (6.05)	175 (9.60)	92 (10.01)	48 (11.11)	8 (4.26)	473 (6.41)
Mild	40 (1.86)	132 (7.07)	115 (6.31)	69 (7.51)	37 (8.56)	10 (5.32)	403 (5.46)
Moderate	13 (0.60)	69 (3.70)	71 (3.90)	45 (4.90)	11 (2.55)	5 (2.66)	214 (2.90)
Severe	6 (0.28)	18 (0.96)	24 (1.32)	18 (1.96)	6 (1.39)	4 (2.13)	76 (1.03)
<b>Total</b>	<b>2149</b> (29.13)	<b>1867</b> (25.31)	<b>1822</b> (24.70)	<b>919</b> (12.46)	<b>432</b> (5.86)	<b>188</b> (2.55)	<b>7377</b> (100.0)

fluorosis, 1.72% had very mild, 1.86% had mild, and less than 1% had either moderate, or severe fluorosis. In the 12 to 13-year age group, 72.58% had no fluorosis, 9.64% had questionable, 6.05% had very mild, 6.31% had mild, 3.90% had moderate, and 1.32% had severe fluorosis.

Among adolescents who were 15 to 19 years of age, a lower percentage of 66.3% were free from fluorosis, 12.57% had questionable, 9.60% had very mild, 6.31% had mild, 3.90% had moderate, and 1.32% had severe fluorosis.

Young adults aged 20 to 29 years had the lowest proportion of 62.46% with no fluorosis, and the highest proportion of 13.17% in the questionable category compared to other age-groups. About 10% had very mild, 7.51% had mild, 4.90% had moderate and 1.96% had severe fluorosis.

In the 35 to 44 years age-group, 67.59% were free from

fluorosis, 8.8% had questionable, 11.11% had very mild, 8.56% had mild, 2.55% had moderate, and 1.39% had severe fluorosis.

Among those 65 to 74 years of age, 80.32% had no fluorosis, 5.32% had questionable, 4.26% had very mild, 5.32% had mild, 2.66% had moderate, and 2.13% had severe fluorosis.

Objectionable levels of fluorosis, i.e., the moderate and severe categories combined, affected a relatively small proportion of 3.93% of the total sample of 7,377 subjects. The most affected were the 15 to 19- and the 20 to 29-year age-groups at 5.22% and 6.86%, respectively. The least affected were the 6 to 7-year-olds (0.88%), followed by the 35 to 44-year age-group (3.94%).

When the rural respondents were compared with the urban respondents (Table 3) there were significant differences in fluorosis between those in age-groups 6 to 7, 12 to 13, 20 to 29, and the 35 to 44 years.

**Table 3.** Distribution of subjects according to level of dental fluorosis and location of residence for each age group.

Diagnosis		Age Group											
		^_7***		12-13***		15-19		20-29***		35-44**		65-74	
		Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Normal	No. %	1507 (94.78)	467 (84.75)	1085 (78.57)	2667 (55.39)	953 (70.18)	253 (54.76)	462 (66.47)	112 (50.00)	235 (69.53)	56 (60.22)	110 (82.09)	41 (75.93)
Questionable	No. %	36 (2.26)	35 (6.35)	128 (9.27)	54 (10.58)	178 (13.11)	51 (11.04)	90 (12.95)	31 (13.84)	28 (8.28)	10 (10.75)	8 (5.97)	2 (3.70)
Very mild	No. %	16 (1.01)	21 (3.81)	64 (4.63)	49 (10.17)	119 (8.76)	59 (12.15)	71 (10.22)	21 (9.38)	38 (11.24)	10 (10.75)	3 (2.24)	5 (9.26)
Mild	No. %	22 (1.38)	18 (3.27)	67 (4.85)	65 (13.49)	68 (5.01)	77 (10.17)	40 (5.76)	29 (12.95)	29 (8.58)	8 (8.60)	8 (5.97)	2 (3.70)
Moderate	No. %	6 (0.38)	7 (1.27)	26 (1.88)	43 (8.92)	27 (1.99)	44 (9.52)	20 (2.88)	25 (11.16)	7 (2.07)	4 (4.30)	3 (2.24)	2 (3.70)
Severe	No. %	3 (0.19)	3 (0.54)	11 (0.8)	7 (1.45)	13 (0.96)	11 (2.38)	12 (1.73)	6 (2.68)	1 (0.30)	5 (5.38)	2 (1.49)	2 (3.70)
<b>Total</b>	<b>No.</b>	<b>1590</b>	<b>551</b>	<b>1381</b>	<b>482</b>	<b>1358</b>	<b>462</b>	<b>695</b>	<b>224</b>	<b>338</b>	<b>93</b>	<b>134</b>	<b>54</b>

\*\* P < .01

\*\*\* P < .001

## Discussion

Dental fluorosis can be a problem in areas where children and adults are exposed to more fluoride than needed. This is true for over 25% of the population in Saudi Arabia even though our samples of drinking water supplies in the areas studied revealed that most were deficient in fluoride. This prevalence rate corresponds to the range of 20% to 45% found in non-fluoridated areas of North America. The prevalence level in Saudi Arabia suggests that other sources of fluoride is available to the population. It has been shown that the proportion of fluorosis due to water fluoridation is now less than that attributed to other fluoride sources." The presence of fluorosis in a country with low-fluoride levels in drinking water supplies reflects exposure to fluoride from other sources, such as toothpaste and diet. In Saudi Arabia, there has been an enormous increase in the use of fluoride toothpaste and supplements, concurrent with the rapid development of the dental sector of the health care system. The majority of fluorosis was found in the

questionable and very mild categories. These levels of fluorosis could be considered clinically insignificant. There are localized regions of the country that were not sampled where severe fluorosis is much higher. They are generally small communities dependent on local wells for drinking water.

The differences found between rural and urban populations are primarily due to differences in the source of water supplies. Many urban areas of the country have access to centralized desalinated water, whereas many rural areas are dependent on isolated well water.

## Conclusion

It is concluded that fluorosis has a relatively high prevalence in a country with no policy of fluoridation of drinking water supplies. The most common categories of fluorosis are mainly of the very-mild or questionable type. There is a significant difference between urban and rural residents in most age-groups.

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