

## Prevalence of dental caries (DMFT) in Iraqi children and adolescent living in areas with low and high level of natural fluoride

Tarik Y KHAMRICO\*  
May Gh AL - AJRAB\*\*

### ABSTRACT

The purpose of the study was to determine the prevalence of dental caries in a group of school children lived in area with high and low natural fluoride contained drinking water in Ninevah governorate.

The study is conducted among (1724) school's students aged 11-16 years from randomly selected schools (primary and intermediate) in two provinces in Ninevah governorate.

Eight hundred and thirteen students who had lived since birth in high natural fluoride level area (Sinjar province) (2.05-2.22 ppm) and (911) students lived continuously from birth in low natural fluoride level area in their drinking water (Talkaif province) (0.11-0.19 ppm).

WHO methodology (1997) has been used to assess the dental caries status and using DMFT index for permanent teeth.

The results show that in Sinjar province the mean DMFT for total samples were (1.67) and (36.2%) are caries free with no sex difference, while there is a significant age differences. On the other hand, in Talkaif province the results reveal higher DMFT (3.7) and lower percent of caries free (19.1%). The mean DMFT reported twice in Talkaif province than Sinjar province with highly significant differences between them.

The percentage of reduction of dental caries has been found to be (54.3%) in Sinjar province compare to Talkaif province.

**Key Words:** Fluoride, water fluoridation, dental caries free, school children, student, dental caries, DMFT.

---

\* Tarik Yousif KHAMRICO; BDS, DDPH(RCS), MSc : Prof.

\*\*May Ghanim AL - AJRAB; BDS, MSc: Assistant Lecturer.

Department of Pedodontics, Orthodontics, & Preventive Dentistry, College of Dentistry, University of Mosul, Mosul, IRAQ.

## الخلاصة

إن الهدف من هذه الدراسة هو لمعرفة مدى انتشار تسوس الاسنان عند طلاب المدارس يعيشون في منطقتين: الأولى تحتوي على نسبة عالية من الفلورايد والثانية تحتوي على نسبة ضئيلة من الفلورايد في ماء الشرب في محافظة نينوى.

تم إجراء الدراسة على عينة مكونة من (١٧٢٤) طالب في مدارس مختارة بصورة عشوائية (ابتدائية وثانوية) وبأعمار تتراوح بين (١١-١٦) سنة في قضاءين تابعين لمحافظة نينوى هما قضاء سنجار بعينة مكونة من (٨١٣) طالب ولدوا وعاشوا في هذا القضاء الذي يستخدم ماء شرب من عين سنجار يحوي على نسبة عالية من عنصر الفلور (٢,٢٢-٢,٠٥ جزء من المليون) والعينة الأخرى مكونة من (٩١١) طالب ولدوا وعاشوا في قضاء تكليف الذي يستخدم ماء شرب من نهر دجلة ويحوي على نسبة منخفضة من عنصر الفلور (٠,١١ - ٠,١٩ جزء من المليون).

لقد استخدمت طريقة منظمة الصحة العالمية لسنة ١٩٩٧ لتشخيص تسوس الاسنان واستخدمت الدلالة تسوس ، قلع حشوة سن للأسنان الدائمة (DMFT) .

أظهرت النتائج بان معدل تسوس الاسنان (DMFT) في قضاء سنجار هو (١,٦٧) وان (٣٦,٢%) من الطلاب لا يوجد أي تسوس في أسنانهم (Caries free) ، وبدون اختلاف بين الذكور والإناث ولكن هناك فرق إحصائي بزيادة في معدل تسوس مع زيادة العمر؛ أما بالنسبة لقضاء تكليف فقد كان معدل تسوس الاسنان أعلى (٣,٧) وان نسبة الطلاب الذين ليس لديهم أي تسوس في أسنانهم كانت اقل ( ١٩,١% ) . كما سجلت النتائج بان معدل تسوس الاسنان في قضاء تكليف ضعف معدل في قضاء سنجار وبفرق إحصائي عالي ومعنوي . إن نسبة تسوس الأسنان كانت (٥٤,٣%) أقل في قضاء سنجار من قضاء تكليف.

## INTRODUCTION

Dental caries is one of the common oral diseases. The prevalence of dental caries in Iraq is high in children and adolescents <sup>(1-3)</sup>.

An epidemiological study has indicated the possibility of a practical and efficient method of markedly reducing the incidence of dental caries in large population group by the addition of a minute amount of fluoride to public water supplies <sup>(4- 6)</sup>. The recommended level of fluoride in water supplies is (1) ppm <sup>(7)</sup>, and the excess of fluoride in caused mottled enamel <sup>(8,9)</sup>.

Optimum concentration of fluoride in public water supplies has been proposed in various countries depending more on climatic information than on local epidemiological data<sup>(10)</sup>.

Studies showed that in all age groups the mean number of a decay missing and filled teeth (DMFT) was lower in those children who had been life time resident of a fluoride community when compared with those who have resided all their lives in a non – fluoridated community, has also shown a strong correlation between the prevalence of caries free young men and the availability of fluoride in public water supplies<sup>(11,12)</sup>.

The aim of the study was to evaluate the caries experience (DMFT) in a group of school children and adolescent aged (11-16) years old lived in areas with high and low natural fluoride contained drinking water in Ninevah governorate.

## MATERIALS AND METHODS

The study was conducted in two district areas in Ninevah governorate, one with drinking water containing high natural fluoride and the second area with drinking water containing naturally low level of fluoride.

The first area is Sinjar province with drinking water used containing (2.05 – 2.22 ppm) fluoride and the source of water is tap water from borehole. The second area, on the other hand is Talkaif province with its drinking water containing (0.11 – 0.19 ppm) fluoride and the source of water is public water supply from Tigris river. The two areas are nearly of the same socio-economic and educational status. The population of the study is students (girls and boys) aged from (11-16) years. They have been examined for estimation of prevalence of dental caries. The students have been examined either at primary or secondary schools, and the selection of schools has been done randomly. Four primary schools and two secondary schools for boys and two secondary school for girls have been selected for each province and the classes selected are from fifth primary up to fourth intermediate classes.

All the students examined have lived continuously from birth on the district area from which they have been examined.

The students have been examined in a suitable room, and before examination any student that doesnot meet the age qualification or subject not born and lived in that areas has been excluded from the examination and also information regarding name, age and sex of the student has been



registered prior to examination on a special form which contained the assessment of dental caries status.

This form contains also some questionnaires that the students have to be answer them before examination these questionnaires are about the students' born area, also the students asked about using any form of fluoride supplements and if the answer is yes, the students excluded from the study.

Then the examination is done during the light hours in good natural light, using plane mirrors and sharp sickle probe with the students, setting in a chair in front of the examination. Clinical examination of the teeth for detection of dental caries has been performed according to the WHO guidelines <sup>(13)</sup> using DMFT index for permanent teeth. On this study only permanent teeth has been included. Radiograph for detection of approximal caries would not recommended because it is impracticability of using the equipment in all situations.

All the permanent teeth present in the mouth have been examined in a systematic approach starting from the last upper right molar and proceeding to the last lower right molar.

The statistical analysis of the data, which was conducted using SPSS (for windows version 9.0), include the followings:

1. Classification of data and calculation of frequencies.
2. Calculation of statistical parameters: the mean and standard deviation.
3. One way analysis of variance (ANOVA), followed by Duncan's Multiple Range test, was used to determine the significant difference between age groups and sexes of different age groups of DMFT.
4. Chi – square test have been used for comparing the difference between two provinces for caries free students, and also for sex differences for the most affected teeth by dental caries.
5. Z- test has been used for determine the significant difference between the two provinces selected.
6. The differences were considered significant when the probability was less than (5%) level ( $p < 0.05$ ).

## RESULTS

The distribution of the sample by age and sex is shown in table (1). The total sample is divided into two main groups.

The first group consisted of [813 (47.15%)] students lived continuously from birth in high level natural fluoride area (Sinjar province), and the second group consists of [911 (52.85%)] students lived continuously from birth in low level natural fluoride area (Talkaif province).

The total sample consists from (1724) students, [969 (56.2%)] males and [755 (43.80%)] females.

Each group is subdivided into three age groups (11-12,13-14and 15-16) years.

Table (1): Distribution of the sample by age and sex

Age (year)	Area	Males		Females	
		No.	%	No.	%
11-12	Sinjar	190	49.00	198	51.00
	Talkaif	185	45.12	228	54.80
13-14	Sinjar	194	70.50	81	29.50
	Talkaif	195	61.50	122	38.50
15-16	Sinjar	94	62.70	56	37.30
	Talkaif	111	60.00	70	40.00
Total	Sinjar	478	58.79	335	41.21
	Talkaif	491	53.89	420	46.11
Total Sample		969	56.20	755	43.80

Table (2) shows the mean DMFT and its component for Sinjar province students. The mean DMFT for the total sample is (1.67), mean DT= (1.59) mean MT= (0.042) and mean FT= (0.043).

The ratios of the components to the DMFT are found to be D/DMFT = (95.2%), M/DMFT = (2.30%) and F/DMFT = (2.5%).

The mean DMFT appears to increase significantly with age the mean DMFT increase from (1.42) for (11-12) years old group to (2.17) for (15-16) years old group. Also DT component appear to increase significantly with age.

For the total sample, the males reported slightly higher mean DMFT (1.73) than females (1.62).

There was no significant difference between males and females in the mean DMFT and its component except FT component for the total sample.



Table (2): Mean DMFT and it's components  $\pm$  SE by age and sex for Sinjar province

Age (year)	Sex	DMFT		DT		MT		FT	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE
11-12	Male	1.41 <sup>(A)</sup>	0.11	1.38 <sup>(A)</sup>	0.12	0.02 <sup>(A)</sup>	0.06	0.04 <sup>(A)</sup>	0.01
	Female	1.42 <sup>a</sup>	0.11	1.41 <sup>a</sup>	0.11	0.02 <sup>a</sup>	0.04	0.03 <sup>a</sup>	0.01
Total		1.42 <sup>A</sup>	0.08	1.40 <sup>A</sup>	0.08	0.02 <sup>A</sup>	0.01	0.03 <sup>A</sup>	0.009
13-14	Male	1.85 <sup>(B)</sup>	0.13	1.84 <sup>(B)</sup>	0.17	0.05 <sup>(A)</sup>	0.01	0.01 <sup>(A)</sup>	0.009
	Female	1.75 <sup>b</sup>	0.17	1.73 <sup>b</sup>	0.17	0.11 <sup>a</sup>	0.03	0.04 <sup>a</sup>	0.02
Total		1.80 <sup>B</sup>	0.10	1.78 <sup>B</sup>	0.10	0.07 <sup>A</sup>	0.01	0.02 <sup>B</sup>	0.01
15-16	Male	2.18 <sup>(B)</sup>	0.19	2.08 <sup>(B)</sup>	0.19	0.06 <sup>(A)</sup>	0.05	0.02 <sup>(A)</sup>	0.01
	Female	2.16 <sup>b</sup>	0.26	2.06 <sup>b</sup>	0.16	0.05 <sup>a</sup>	0.04	0.02 <sup>a</sup>	0.05
Total		2.17 <sup>C</sup>	0.016	2.07 <sup>c</sup>	0.16	0.05 <sup>A</sup>	0.04	0.02 <sup>B</sup>	0.05
Total Males		1.73	0.08	1.68	0.08	0.04	0.01	0.01 <sup>*</sup>	0.006
Total Females		1.62	0.09	1.51	0.09	0.04	0.01	0.06 <sup>*</sup>	0.01
Total Sample		1.67	0.06	1.59	0.06	0.04	0.01	0.04	0.007

-Means with same letters refers to non-significant difference.

-Capital letters in brackets show Duncan results for males between age groups.

-Small letters show Duncan results for females between age groups.

-Capital letters without brackets show Duncan results for totals between age groups.

-\* Refers to significant difference between males and females using Z test.

Table (3) shows that the mean DMFT and its components for Talkaif students. The mean DMFT for the total sample is (3.65), mean DT= (3.56), mean MT= (0.029) and mean FT= (0.062).

The ratios of the components to DMFT are found to be D/DMFT=(97.5%), M/DMFT = (0.8%) and F/DMFT= (1.7%). The result revealed that the mean DMFT and DT component increase significantly

with age. The mean DMFT increases from (2.91) for (11-12) years old to (5.35) for (15-16) years old.

The total females reported slightly lower mean DMFT (3.55) than that for the total males (3.74). However, this difference is not significant and the only significant sex differences which has been noted in FT component for the total sample.

Table (3): Mean DMFT and it's components = SE by age and sex for Talkaif province

Age (year)	Sex	DMFT		DT		MT		FT	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE
11-12	Male	2.76 <sup>(A)</sup>	0.18	2.70 <sup>(A)</sup>	0.17	0.02 <sup>(A)</sup>	0.01	0.03 <sup>(A)</sup>	0.03
	Female	3.05 <sup>a</sup>	0.16	2.92 <sup>a</sup>	0.16	0.009 <sup>a</sup>	0.006	0.03 <sup>a</sup>	0.01
Total		2.91 <sup>A</sup>	0.12	2.86 <sup>A</sup>	0.12	0.01 <sup>A</sup>	0.006	0.03 <sup>A</sup>	0.009
13-14	Male	3.67 <sup>(B)</sup>	0.22	3.63 <sup>(B)</sup>	0.22	0.03 <sup>(A)</sup>	0.01	0.10 <sup>(A)</sup>	0.007
	Female	3.88 <sup>b</sup>	0.26	3.76 <sup>b</sup>	0.25	0.17 <sup>a</sup>	0.01	0.07 <sup>a</sup>	0.02
Total		3.75 <sup>B</sup>	0.17	3.66 <sup>B</sup>	0.17	0.03 <sup>AB</sup>	0.01	0.08 <sup>B</sup>	0.01
15-16	Male	5.49 <sup>(C)</sup>	0.34	5.37 <sup>(C)</sup>	0.33	0.01 <sup>(A)</sup>	0.01	0.02 <sup>(A)</sup>	0.02
	Female	5.08 <sup>c</sup>	0.41	4.72 <sup>c</sup>	0.38	0.09 <sup>b</sup>	0.03	0.27 <sup>b</sup>	0.05
Total		5.32 <sup>C</sup>	0.26	5.11 <sup>c</sup>	0.25	0.04 <sup>B</sup>	0.01	0.17 <sup>B</sup>	0.02
Total Males		3.74	0.14	3.67	0.14	0.02	0.007	0.03 <sup>*</sup>	0.02
Total Females		3.55	0.014	3.43	0.13	0.03	0.009	0.08 <sup>*</sup>	0.00
Total Sample		3.65	0.10	3.56	0.10	0.02	0.006	0.06	0.008

- Means with same letters refers to non-significant difference.
- Capital letters in brackets show Duncan results for males between age groups.
- Small letters show Duncan results for females between age groups.
- Capital letters without brackets show Duncan results for totals between age groups.
- \* Refers to significant difference between males and females using Z test.



To compare the mean DMFT for Sinjar and Tarkaif provinces and percent reduction are listed in table (4). The results show that Sinjar province students have lower significant DMFT than Tarkaif province students. The percentage of DMFT reduction in high fluoride area compare with low fluoride area appears to increase with age group. The reduction percentage in total females (55.7%) is slightly higher than that for total males (53.6%), but with no significant difference between them. The reduction percentage in DMFT for the total sample reached (54.3%).

Table (4): the percentage of reduction and difference between DMFT scores for Sinjar and Tarkaif province students

Age	Sex	DMFT Sinjar	DMFT Tarkaif	% Reduction	Z	p - value
11-12	M	1.41	2.76	48.9	5.69	< 0.001
	F	1.42	3.03	53.1	6.44	< 0.001
Total		1.42	2.91	51.2	6.96	< 0.001
13-14	M	1.85	3.67	49.6	6.26	< 0.001
	F	1.75	3.88	54.9	5.03	< 0.001
Total		1.80	3.75	52.0	8.06	< 0.001
15-16	M	2.18	5.49	60.3	6.39	< 0.001
	F	2.16	5.08	57.5	4.16	< 0.001
Total		2.17	5.32	59.2	7.30	< 0.001
Total Males		1.73*	3.74*	53.7*	11.32	< 0.001
Total Females		1.62*	3.66*	55.7*	9.06	< 0.001
Total Sample		1.67	3.70	54.3*	15.21	< 0.001

\* No significant difference between males and females at 0.05 confidence level.

Table (5) shows the percentages of caries free students (DMFT =0) for the three age groups. The study indicated that the caries free percentage for the total sample in Sinjar province is higher (36.2%) than Tarkaif province (19.17) with high significant difference is observed in all age groups and the total sample.



Table (5): Caries free for children by age and sex (expressed as no. and % for both studied provinces)

Age	Sex	Sinjar			Tarkaif			X <sup>2</sup>	P
		No.	Caries Free Students		No.	Caries Free Students			
			No.	%		No.	%		
11-12	Male	190	83	43.7	185	38	20.5	23.34	< 0.001
	Female	198	80	40.4	224	38	17.0	28.38	< 0.001
Total		388	165	42.0	409	76	18.6	51.75	< 0.001
13-14	Male	194	64	33.5	195	47	24.1	4.17	< 0.001
	Female	81	25	30.9	122	21	17.5	5.41	< 0.001
Total		275	89	32.17	317	68	21.0	9.37	< 0.001
15-16	Male	94	24	25.5	111	17	15.3	3.32	< 0.001
	Female	56	17	30.4	74	13	17.6	2.8	< 0.015
Total		150	41	27.3	189	30	16.2	6.13	< 0.001
Total Males		476	171	36.0*	491	102	20.8*	27.41	< 0.001
Total Females		335	122	36.4*	420	72	17.1*	36.44	< 0.001
Total Sample		813	293	36.2	911	174	19.1	63.27	< 0.001

\*No significant difference between males and females using  $\chi^2$  test.

Table (6) shows the percent of affect teeth by DMFT for both provinces. From the finding of the study can notice that this percent is higher in Tarkaif province for the following teeth: lower and upper second molars, premolars (16.2%), (14.8%), (11.8%) respectively. While in Sinjar province it is higher for lower and upper first molars (46.8%) and (23.3%) respectively.

Table (6): The percentage of affected teeth by DMF in Sinjar and Talkaif provinces

Area	Upper Teeth				Lower Teeth			
	2 <sup>nd</sup> Molar	1 <sup>st</sup> Molar	Premolars	Anteriors	2 <sup>nd</sup> Molar	1 <sup>st</sup> Molar	Premolars	Anteriors
Sinjar	6.2%	23.3%	3.0%	2.5%	13.4%	46.8%	4.7%	0.1%
Talkaif	14.8%	18.9%	11.1%	3.8%	16.2%	22.9%	11.8%	0.5%

## DISCUSSION

The community water fluoridation is an ideal public measure for prevention of dental caries <sup>(14,15)</sup> in countries with well developed centralized public water supplies. It was in agreement with the view of WHO and the medical and dental profession through the world that community water fluoridation is an effective, safe and inexpensive measure which has the virtue of requiring no active compliance in the part of person benefit.

This was the first study carried out in Iraq to evaluate the prevalence of dental caries in permanent teeth in areas with different natural fluoride level concentration in their drinking water supplies (high and low fluoride areas).

The result indicated that the mean DMFT for each age group in high natural fluoride area (Sinjar province) (1.42, 1.8 and 2.17 respectively) was lower than that the low fluoride area (Talkaif province) (2.91, 3.75 and 5.32 respectively). The percentage of reduction of dental caries in high fluoride area compare with low fluoride area for each groups were (51.2%, 52% and 59.2% respectively), the slight increase of the percentage of reduction of dental caries with the increasing of the age is in agreement with other studies <sup>(16,17)</sup>. The slight increase in percentage of reduction is mainly observed in percentage of the second molar teeth affected by dental caries.



The mean DMFT in high fluoride for (11-12) years old in this study has reported lower than that of James<sup>(18)</sup> and Rock *et al*<sup>(19)</sup>, which higher than Szpunar and Burt<sup>(20)</sup>, Hawew *et al*<sup>(21)</sup>.

In a low fluoride area, the mean DMFT has reported was less than in area with nearly the same level of natural fluoride<sup>(22,23)</sup> and more than the others<sup>(21,24,25)</sup> and it was nearly the same as in study carried out in other low fluoride area in Mosul city<sup>(1)</sup>.

The percentage of reduction in dental caries for age group (11-12) years in high fluoride area has been higher than that reported in many areas (mystic stonighton in USA, Tornoto in Canada and Yamashia in Japan)<sup>(20)</sup>. The same finding for other age groups (13-14) and (15-16) years, so we did not discuss in detail.

The result revealed that the mean DMFT for total sample of high natural fluoride area (Sinjar province) was (1.67) and the mean DMFT for total sample of low fluoride area (Talkaif province) was (3.65). The percentage of reduction of dental caries has been found to be (54.3%). The percentage of DMFT reduction is nearly the same of many studies carried out in areas used optimum fluoride level in naturally or in drinking water supplies<sup>(26-28)</sup>.

It is obvious from the results of this study that Sinjar province has less mean DMFT than Talkaif province, this expressed in a form of percentage of reduction in dental caries, which is due to the difference in fluoride level in both areas of study.

The results of study indicated that (36.2%) and (19.1%) are caries free student in high and low fluoride areas respectively. The percentage in high fluoride area is higher than that observed by Forrest<sup>(29)</sup>, Szpunar and Burt<sup>(20)</sup> and Grobler *et al*. in Tweerivier city with very high fluoride (3.5 ppm)<sup>(30)</sup>, and nearly the same of that of Nourivier city<sup>(30)</sup>.

On the other hand the percentage of caries free students in low fluoride area in this study is higher than that of Saffron Walden and district Essex area<sup>(29)</sup>, Stoneleigh and Malden west in Surrey area<sup>(29)</sup> and in center of Mosul<sup>(2)</sup>, while less than other studies<sup>(24,31,32)</sup>.

These variation in the mean DMFT values and the percentage of caries free students reported in different studies may be attributed to the difference in dietary habits, especially the consumption of refine sugars between different individuals as in studies carried out in developed countries in (1950s) and (1960s), they reported a high prevalence of dental caries. Also, it may be attributed to the use of other preventive measures other than water fluoridation like the use of fluoride supplements and fissure sealant especially in developed countries as in studies carried out in (1980s) and (1990s) that reported a declined in dental caries because of use of

preventive measure <sup>(33,34)</sup>. Although may be to use of different diagnostic criteria in various studies may cause this variation.

The study revealed that the mean DMFT increase with the increasing of the age of students significantly and the percentage of caries free decrease with age. This finding gives agreement with many studies <sup>(18,19,34,35)</sup>. This fact is attributed to the irreversibility an accumulation nature of dental caries.

The result of study shows no significant difference between males and females in mean DMFT. This is accordance with results of other studies <sup>(14,29,33,36,37)</sup>.

The study revealed that the decay components of the DMFT scores had the grates values when compared to missing and filled teeth in both provinces. This means that the presence of a high percentage of caries teeth is untreated. This result is in accordance with other studies carried out in third world countries <sup>(1,2,21,38)</sup>, while it is in contrast with the result in developed countries, when the majority of DMFT index was formed of filled teeth <sup>(39,40)</sup>. This finding reveals the limited restorative approach in most of developing countries, which is due to the limited resources, in addition to lack of dental awareness. Also, it may be attributed to the expensive therapeutic measurements and restriction of resources, which is due to the embargo imposed on Iraq.

The study indicated that the mean missing components of DMFT in low fluoride area is six times more than that of high fluoride area (0.174 and 0.029) respectively. This reflects the benefit of fluoride in drinking water for reducing the evidence of tooth loss due to caries.

The caries experience has found to involve more mandibular posterior teeth especially first molars than the maxillary posterior teeth, this is in agreement with the other studies <sup>(2,41)</sup>. This may be attributed to the fact that most of the caries lesions are sticky pit and fissure lesion and due to the morphology of mandibular molars which makes them more susceptible to caries attack than the maxillary teeth.

This study reveals that the greater caries experience is found among the posterior teeth than the anterior, this finding is in accordance with other studies <sup>(1,2)</sup> and it is clear from the result that the percentage of the affected second molars teeth by dental caries increases with the age of students, it is increased about (20%) in both provinces in lower jaw. This is due to their eruption at age of (12) year, so be more susceptibility to dental caries, while on the other hand the anterior teeth affected by dental caries decrease with age especially lower anterior teeth, because these teeth have greater resistance to dental caries.



According to the questionnaire that the students answer, only five students from the total sample used a preventive measure (fluoride gel), these five students are excluded from the study and this indicates the limited preventive measure used by student because of low educational level about the benefit of preventive measure in dentistry.

So the planning for preventive health programs for the areas of low fluoride level is of high importance especially for school children provided by school dental services. This preventive program including application of fissure sealant prophylaxis to newly erupted teeth especially the mandibular molars and premolars.

## REFERENCES

1. خمركو، طارق يوسف؛ مكاني، ليلى عزيز. حالة صحة الفم والأسنان في قريتي السادة وبعويزة . مجلة طب الاسنان العراقية. ١٩٩٧؛ ٢٠: ٣-٢٣.
2. Khamrco TY, Selman KA. Dental health status among 4<sup>th</sup> – 8<sup>th</sup> school children in the center of Mosul. *Iraqi Dent J.* 1998; 23: 77–88.
3. AL-Azawi LA. Oral health status and treatment needs Iraq five years old kindergarten children and fifteen years old students (A national survey). PhD thesis submitted to the College of Dentistry, University of Baghdad. 2000.
4. Herschel S, Horowitz H. Symposium fluoride for every one. *Clin Prev Dent.* 1982; 4(2): 5-10.
5. Lewis PW, Banting DW. Water fluoridation: Current effectiveness and dental fluoride. *Community Dent Oral Epidemiol.* 1994; 22: 153-158.
6. Seppa L, Karkkainen S, Hausen H. Caries frequency in permanent teeth before and after discontinuation of water fluoridation. *Community Dent Oral Epidemiol.* 1998; 26: 256–262.
7. Temporate–Doherty JM. Use of dietary fluoride. *Wisconsin Medical J.* 1968; 67: 599-602.
8. Murry J. Appropriate use of fluoride, Human Health. World Health Organization, Geneva, Switzerland. 1986.

9. Wahab IK, Shellis RP, Elderton E. Effect of low fluoride concentrations on formation of caries – like lesions in human enamel in a sequential – transfer bacterial system. *Archs Oral Biol.* 1993; 38(11): 985-995.
10. Ismail AL. What is the effective concentration of fluorides? *Community Dent Oral Epidemiol.* 1995; 23: 246-251.
11. Keen HJ, Mellrery JR, Wicholuson GR. History of fluoride: Dental fluorosis concentration of fluoride in surface layer of enamel of caries free navel recruits. *J Public Health Dent.* 1973; 33:142-148.
12. O'Mullance D, Whelton H. Efficacy of fluoride against dental caries; fluoride in water. Oral Health Services Research Center, University Dental School, Wilton, Cork, Ireland. 1997.
13. World Health Organization. Oral Health Surveys: Basic Methods. 4<sup>th</sup> Edn, WHO, Geneva, Switzerland. 1997.
14. Angelillo IF, Romano F, Fortunato L, Montanard D. Prevalence of dental caries and enamel defect in children living in areas with different water fluoride concentrations. *Community Dent Health.* 1990; 7: 229-236.
15. Ellwood RP, O'Mullance D. The association between developmental enamel defects and caries in populations with and without fluoride in their drinking water. *J Public Health Dent.* 1995; 55(4): 1-5.
16. Newburn E. The effectiveness of water fluoridation. *J Public Health Dent.* 1989; 49: 279-289.
17. Heifetz SB, Driscoll WS, Horowitz HS, Kingman A. Prevalence of dental caries and dental fluorosis in areas with optimal and above optimal water fluoride concentration: A five-years follow-up survey. *J Am Dent Assoc.* 1988; 116: 490-495.
18. James PN. Dental caries prevalence in high and low fluoride areas of east Anglia. *Br Int J.* 1961; 110: 156-169.
19. Rock WP, Gordan PH, Bradnock G. Dental caries experience in Brimingham and Wolverhampton school children following the fluoridation of Brimingham water in 1964. *Br Dent J.* 1981; 150: 61-66.
20. Szpunar SM, Burt BA. Caries fluorosis and fluoride exposure in Michigan school children. *J Dent Res.* 1988; 67: 802-806.
21. Hawew RM, Ellwood RP, Blinkhorn AS. Dental caries in children from two Libyan cities with different levels of fluoride in their drinking water. *Community Dent Health.* 1996; 13: 173-177.
22. Murray J, Rugg-Gunn A. Water fluoridation update. In: Stewart RE, Barber TK. Predictive Dentistry. 2<sup>nd</sup> Edn. Mosby Co. St Louis. 1982.
23. Hussein S, Doumit M, Donghan B, EL-Nadeef M. Oral health in Lebanon, a pilot path-finder survey. *Eastern Med Health J.* 1996; 2: 299-303.
24. Hamdan M, Rock W. Dental caries experience of Jordanian and English school children. *Community Dent Health.* 1993; 10: 151-157.



25. Downer M, Blinkhon A, Host R, Attwood D. Dental caries experience and defects of dental enamel among 12- year old children in north. *Community Dent Oral Epidemiol.* 1994; 22: 283-285.
26. Thystrup A, Bill J, Brunn B. Caries experience of Danish children living in area with low and optimum levels of natural water fluoride. *Caries Res.* 1984; 16: 413-420.
27. Stockwell AJ, Medcalf GW, Holman CD, Roberts M. Dental caries experience in school children in fluoridation and non-fluoridated community in Western Australia. *Community Dent Oral Epidemiol.* 1990; 18: 184-189.
28. Moola MH. Fluoridation of South Africa. *Community Dent Health.* 1996; 13(2): 51-55.
29. Forrest JR. Caries evidence and enamel defects in area with different levels of fluoride in the drinking water. *Br Dent J.* 1956; 100(8): 195-200.
30. Grobler SR, Vanwyk CW, Kotze D. Relationship between enamel fluoride levels, degrees of fluorosis and caries experience in communities with nearly optimal and high fluoride level in the drinking water. *Caries Res.* 1986; 20: 284-288.
31. Baghdady VS, Ghose LJ. Dental caries prevalence in school children in Baghdad province, Iraq. *Community Dent Oral Epidemiol.* 1982; 10: 148-151.
32. El-Baibari M, Downer MC. Dental caries experience among 12 years old children in Grazstrip. *Community Dent Oral Epidemiol.* 1993; 21: 321-322.
33. Riordan PJ. Dental fluorosis in 7 years old. *Caries Res.* 1993; 27: 71-77.
34. Dini EL, Holt RD, Bedi R. Prevalence and severity of caries in 3-12 years old children from 3 districts with different fluoridation histories in Araraqnara, SP, Barzil. *Community Dent Health.* 1998; 15: 44-48.
35. Peterson LG, Anderson H, Magnusson K, Truedsson L. Caries frequency in 3 to 30 years old individuals in two comparable contemporary communities, one with natural optimal fluoride concentration (1.2 ppm) and one with fluoride concentration (0.2 ppm) in the drinking water. *Community Dent Health.* 1997; 114: 191-199.
36. Spencer AJ, Slad FD, Davies M. Water fluoridation in Australia. *Community Dent Health.* 1996; 13: 27-37.
37. AL-Naimi RJ, Khamrco TY. Oral health status and treatment need in 13-15 year old students in Mosul city, Iraq. *J Coll Dent.* 1999; 5: 90-100.
38. Medcal FG, O'Crady M. The dental health of children eight and fifteen years of age living in Burbury, Western Australian. *Aust Dent J.* 1993; 28: 162-165.

39. Pitts NB, Palmer JA. The dental caries experience of 5, 12 and 14 years old children in Great Britain –survey coordinated by the British Association for the study of community dentistry in 1991/92, 1992/93 and 1990/91. *Community Dent Health*. 1994; 13: 51-58.
40. Pitts NB, Evans DJ. The dental caries experience of 14 year old children in the United Kingdom. Surveys coordinated by the British Association for the study of community dentistry 1994/95. *Community Dent Health*. 1996; 15: 51-55.
41. Mahmood MS. Oral health status and treatment need among Iraqi school children aged 6-12 years. MSc thesis submitted to the College of Dentistry, University of Baghdad. 1995.