

Evaluation of the Sequelae of Untreated Dental Caries Using PUFA Index

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الخلاصة

الأهداف: تحدد الدراسة إلى تقييم مؤشر (PUFA/pufa) في تقدير انتشار وشدة الأحوال الفموية المتعلقة بتسوس الأسنان غير المعالج في مجموعة من تلاميذ المدارس الابتدائية في مدينة الموصل. **المواد وطرائق العمل:** أجري الفحص لأسنان 756 تلميذ مدرسة ممن تتراوح أعمارهم بين 7-12 سنة، قسّموا إلى ثلاث مجموعات عمرية: 7-8 و 9-10 و 11-12 سنة. وتم تسجيل تسوس الأسنان من حيث "منخور" و "مفقود" و "مخشو" لكل من الأسنان اللبنية (dmft) والأسنان الدائمة (DMFT). وسُجّل أيضا مؤشر (PUFA/pufa) لكل من الأسنان اللبنية والدائمة من حيث وجود نخر الأسنان الشديد المؤدي إلى انكشاف عصب السن (P/p) والتقرح الناجم عن شظايا الأسنان (U/u) والناسور (F/f) والحراج (A/a). **النتائج:** سجل تسوس الأسنان في الأسنان اللبنية القيم التالية للفئات العمرية الثلاث إضافة للعينة الكلية على التوالي: 6,33 و 4,75 و 1,00 و 4,43، في حين كان للأسنان الدائمة 0,59 و 1,18 و 3,67 و 1,58، على التوالي. سجل مؤشر (PUFA/pufa) القيم التالية لكل فئة عمرية وكذلك العينة الكلية للأسنان الدائمة واللبنية على التوالي: 0,03/2,35 و 0/1,66 و 0,42/0,58 و 0,12/1,66. **الاستنتاجات:** كما وُجِدَ أن المكون الرئيسي في هذا المؤشر لجميع الفئات العمرية ولكل من الأسنان اللبنية والدائمة كان انكشاف عصب السن. **الاستنتاجات:** ينبغي النظر إلى مؤشر (PUFA) باعتباره مكمل للمؤشر تقييم تسوس الأسنان الحالي (DMF)، مع الأخذ بنظر الإعتبار المعلومات التي يتضمنها هذا المؤشر للمختصين في علم الباثيات والمخططين للرعاية الصحية.

ABSTRACT

Aim: To evaluate (PUFA/pufa) index in assessing the prevalence and severity of oral conditions related to untreated caries in a group of primary school pupils in Mosul City. **Materials and Methods:** Dental examination was conducted on 756 school pupils aged 7–12 years old, divided into 3 groups according to age; 7–8, 9–10, and 11–12 years old. Caries was recorded in terms of decayed, missing and filled teeth for both primary teeth (dmft) and permanent teeth (DMFT). The PUFA/pufa index was also recorded for both dentitions regarding the presence of severely decayed teeth with visible pulpal involvement (P/p), ulceration caused by dislocated tooth fragments (U/u), fistula (F/f) and abscess (A/a). **Results:** Caries experience in the primary dentition was found to be 6.33, 4.75, 1.00, and 4.43 for the three age groups as well as the total sample, respectively. While for the permanent dentition, it was 0.59, 1.18, 3.67, and 1.58, respectively. The PUFA/pufa index recorded the following values for each age group as well as the total sample for permanent and primary teeth respectively; 0.03/2.35, 0/1.66, 0.42/0.58, and 0.12/1.66. The main component in this index for all age groups, and both dentitions was found to be pulpal involvement. **Conclusion:** The PUFA index should be seen as a complementary to the current caries assessment index (DMF), with relevant information for epidemiologists and health care planners.

Key Words: PUFA/pufa index, Untreated dental caries, Caries assessment.

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INTRODUCTION

During the last decade, international caries epidemiology has focused on the development of more sensitive diagnostic criteria to allow for assessment of the initial stages of caries.^(1,2) This is considered important in the light of the decline of cavitated caries lesions in high-income countries, where nonoperative and preventive

interventions require an index that distinguishes between the different stages of initial caries lesions.⁽³⁾ However, in low- and middle-income countries, as well as deprived communities within high-income countries, where people have little access even to the most basic forms of care, there is a need for a diagnostic index that addresses the advanced stages of untreated

caries lesions.⁽⁴⁾

The Decayed Missing Filled Surfaces/Teeth (DMF) index has been in use and is well established as the leading measure of caries experience in dental epidemiology.^(5,6) This classical index provides information on caries and restorative and surgical treatment, but fails to provide information on the clinical consequences of untreated dental caries, such as pulpal involvement and dental abscess, which may be more serious than the caries lesions themselves.⁽⁵⁾ A deep caries cavity with pulpal involvement is usually considered under the code "caries of dentin"^(7, 8) and pulpal involvement is not mentioned at all in the caries scoring system in the latest edition of Oral Health Surveys—Basic methods WHO.⁽⁹⁾ Some limited information might be obtained on the severity of advanced caries lesions by the scoring of "teeth indicated for extraction" under treatment needs⁽⁹⁾ but this code does not give the precise reason for extraction. For example, the term "indicated for extraction" can be for reasons other than the consequences of untreated dental caries, e.g. as a sequel to trauma, for orthodontic or cosmetic reasons, or in preparation for a prosthesis. Moreover, "treatment needs" for extraction are rarely reported in the literature and the consequences of untreated dental caries are hardly ever mentioned.⁽⁴⁾

PUFA/pufa is an index used to assess the presence of oral conditions and infections resulting from untreated caries in the primary (pufa) and permanent (PUFA) dentitions. The index is recorded separately from the DMFT/dmft and scores the presence of either a visible pulp (P/p), ulceration of the oral mucosa due to root fragments (U/u), a fistula (F/f), or an abscess (A/a). The PUFA/pufa index per child is calculated in the same cumulative way as the DMFT/dmft index and represents the number of teeth meeting the PUFA/pufa diagnostic criteria.⁽¹⁰⁾

The aim of the present study is to evaluate the index (PUFA/pufa) in assessing the prevalence and severity of oral conditions related to untreated caries in a group of primary school pupils in Mosul City aged 7–12 years old.

MATERIALS AND METHODS

The sample was collected from 4 randomly selected primary schools in Mosul City during the academic year 2010–2011. Approval for the study was obtained from the local authorities in the city and from the authorities of the schools.

The parents of each pupil received detailed explanatory letters concerning the aims of the study and including their approval about participation. Each pupil, whom parents refused to participate, was excluded from the study. The total sample consisted of 756 pupils (390 males and 366 females). The sample was divided into three groups according to age as follows; Group 1: 7–8 years old (n= 300); group 2: 9–10 years old (n= 264) and group 3: 11–12 years old (n= 192).

Clinical examination was carried out in the classroom of each school under natural daylight. Each pupil was examined semi-supine by the researcher and data recorded by a trained assistant. Diagnosis was visual with drying of the teeth by cotton rolls, minimal explorer probing by sickle-shaped caries explorer, and careful examination of enamel surface texture by plane mouth mirror and caries explorer. Caries was recorded for both permanent and primary teeth in terms of decayed, missing and filled teeth index (DMFT and dmft), using WHO recommendations for oral health surveys.⁽⁹⁾

Regarding PUFA index recording, lesions in the surrounding tissues that are not related to a tooth with visible pulpal involvement as a result of caries were not recorded. The assessment was made visually without the use of an instrument. Only one score was assigned per tooth. In case of doubt concerning the extent of odontogenic infection, the basic score (P/p for pulp involvement) was given. If the primary tooth and its permanent successor tooth were present, and both present stages of odontogenic infection, both teeth were scored.^(4, 10)

The codes and criteria for PUFA index are as follows (Figure 1).⁽⁴⁾

P/p: Pulpal involvement is recorded when the opening of the pulp chamber is visible or when the coronal tooth structures have been destroyed by the carious process and only roots or root fragments

are left. No probing is performed to diagnose pulpal involvement (Figure 1 a, b).

U/u: Ulceration due to trauma from sharp edges of a dislocated tooth with pulpal involvement or root fragments have caused traumatic ulceration of the surrounding soft tissues; e.g., tongue or buccal mucosa (Figure 1 c, d).

F/f: Fistula is scored when a pus releasing sinus tract related to a tooth with pulpal involvement is present (Figure 1 e, f).

A/a: Abscess is scored when a pus containing swelling related to a tooth with pulpal involvement is present (Figure 1 g, h).

Data were analyzed using Statistical Package for Social Sciences (IBM SPSS) Data Entry software version 19.0, and descriptive statistics were conducted as means and standard deviations, frequencies and percentages. The "Untreated Caries, PUFA Ratio" was calculated as:⁽⁴⁾
 $[(PUFA+pufa)/(D+d)] \times 100$



Figure 1):⁽⁴⁾ (a, b) Pulpal involvement (P/p), (c, d) Ulceration (U/u), (e, f) Fistula (F/f), (g, h) Abscess (A/a).

RESULTS

The sample was distributed according to age and gender as shown in Table (1). The first age group represented 39.7% of

the total sample, while the second and third age groups represented 34.9% and 25.4% of the total sample, respectively.

Also, males represented 51.6% and females comprised 48.4% of the total sample.

Table (1): Distribution of the sample regarding age groups and gender

Age Group (Years)	Gender	No.	Percentage
7-8	Males	164	54.7
	Females	136	45.3
	Total	300	39.7
9-10	Males	114	43.2
	Females	150	56.8
	Total	264	34.9
11-12	Males	112	58.3
	Females	80	41.7
	Total	192	25.4
Total Males		390	51.6
Total Females		366	48.4
Total Sample		756	100.0

For the first age group (7-8 years), caries experience in the primary dentition was 6.33, with 5.33 on the d-component. The permanent dentition presented 0.59 DMFT, with 0.48 were on the D-component. The pufa index for the primary dentition was 2.35, and the PUFA index for the permanent dentition was 0.03. The main component of pufa was pulpal in-

volvement, while for PUFA the components were divided equally between pulpal involvement and abscess (Tables 2-5). The "Untreated Caries, PUFA Ratio" was 40.96%, indicating that approximately 41% of the D + d component for this age group had progressed mainly to pulpal involvement.

Table (2): Descriptive statistics for the dmft index and its components regarding different age groups for both genders

Age Group (Years)	dmft	Males		Females		Total	
		No.*	Mean ± SD	No.*	Mean ± SD	No.*	Mean ± SD
7-8	dt	972	5.93 ± 3.762	628	4.62 ± 3.060	1600	5.33 ± 3.517
	mt	88	0.54 ± 0.968	72	0.53 ± 1.040	160	0.53 ± 0.999
	ft	32	0.20 ± 0.673	108	0.79 ± 1.769	140	0.47 ± 1.322
	st	1688	10.29 ± 5.557	1328	9.76 ± 5.101	3016	10.05 ± 5.353
	dmft	1092	6.66 ± 3.967	808	5.94 ± 3.155	1900	6.33 ± 3.633
9-10	dt	330	2.89 ± 2.255	648	4.32 ± 2.211	978	3.70 ± 2.336
	mt	90	0.79 ± 1.286	150	1.00 ± 1.475	240	0.91 ± 1.398
	ft	24	0.21 ± 0.697	12	0.08 ± 0.272	36	0.14 ± 0.505
	st	840	7.37 ± 3.675	918	6.12 ± 2.222	1758	6.66 ± 2.998
	dmft	444	3.89 ± 2.985	810	5.40 ± 2.270	1254	4.75 ± 2.703
11-12	dt	64	0.57 ± 1.054	80	1.00 ± 0.900	144	0.75 ± 1.013
	mt	0	0.00 ± 0.000	32	0.40 ± 0.805	32	0.17 ± 0.554
	ft	0	0.00 ± 0.000	16	0.20 ± 0.403	16	0.08 ± 0.277
	st	208	1.86 ± 3.010	96	1.20 ± 1.951	304	1.58 ± 2.636
	dmft	64	0.57 ± 1.054	128	1.60 ± 1.866	192	1.00 ± 1.532
Total	dt	1366	3.50 ± 3.576	1356	3.70 ± 2.776	2722	3.60 ± 3.213
	mt	178	0.46 ± 0.984	254	0.69 ± 1.223	432	0.57 ± 1.112
	ft	56	0.14 ± 0.582	136	0.37 ± 1.153	192	0.25 ± 0.911
	st	2736	7.02 ± 5.628	2342	6.40 ± 4.758	5078	6.72 ± 5.231
	dmft	1600	4.10 ± 3.982	1746	4.77 ± 3.068	3346	4.43 ± 3.582

* indicates number of teeth; SD: Standard deviation; S: Sound teeth.

Table (3): Descriptive statistics for the DMFT index and its components regarding different age groups for both genders

Age Group (Years)	DMFT	Males		Females		Total	
		No.*	Mean ± SD	No.*	Mean ± SD	No.*	Mean ± SD
7-8	DT	56	0.34 ± 0.847	88	0.65 ± 1.262	144	0.48 ± 1.065
	MT	0	0.00 ± 0.000	0	0.00 ± 0.000	0	0.00 ± 0.000
	FT	8	0.05 ± 0.216	24	0.18 ± 0.749	32	0.11 ± 0.532
	ST	828	5.05 ± 3.337	856	6.29 ± 3.838	1684	5.61 ± 3.620
	DMFT	64	0.39 ± 0.998	112	0.82 ± 1.387	176	0.59 ± 1.203
9-10	DT	66	0.58 ± 1.047	198	1.32 ± 1.521	264	1.00 ± 1.384
	MT	0	0.00 ± 0.000	12	0.08 ± 0.272	12	0.05 ± 0.209
	FT	18	0.16 ± 0.490	18	0.12 ± 0.432	36	0.14 ± 0.458
	ST	1284	11.26 ± 2.301	1602	10.68 ± 2.080	2886	10.93 ± 2.193
	DMFT	84	0.74 ± 1.168	228	1.52 ± 1.505	312	1.18 ± 1.421
11-12	DT	288	2.57 ± 1.849	208	2.60 ± 1.026	496	2.58 ± 1.556
	MT	16	0.14 ± 0.351	16	0.20 ± 0.403	32	0.17 ± 0.374
	FT	144	1.29 ± 2.060	32	0.40 ± 0.493	176	0.92 ± 1.661
	ST	2192	19.57 ± 4.324	1520	19.00 ± 4.971	3712	19.33 ± 4.601
	DMFT	448	4.00 ± 3.266	256	3.20 ± 0.986	704	3.67 ± 2.600
Total	DT	410	1.05 ± 1.593	494	1.35 ± 1.513	904	1.20 ± 1.561
	MT	16	0.04 ± 0.199	28	0.08 ± 0.266	44	0.06 ± 0.234
	FT	170	0.44 ± 1.262	74	0.20 ± 0.590	244	0.32 ± 1.001
	ST	4304	11.04 ± 6.902	3978	10.87 ± 5.905	8282	10.96 ± 6.435
	DMFT	596	1.53 ± 2.517	596	1.63 ± 1.623	1192	1.58 ± 2.131

* indicates number of teeth; SD: Standard deviation; S: Sound teeth.

Table (4): Descriptive statistics for the pufa index and its components regarding different age groups for both genders

Age Group (Years)	pufa	Males		Females		Total	
		No.*	Mean ± SD	No.*	Mean ± SD	No.*	Mean ± SD
7-8	p	436	2.66 ± 2.287	216	1.59 ± 1.824	652	2.17 ± 2.154
	u	24	0.15 ± 0.567	4	0.03 ± 0.170	28	0.09 ± 0.438
	f	16	0.10 ± 0.298	0	0.00 ± 0.000	16	0.05 ± 0.225
	a	0	0.00 ± 0.000	8	0.06 ± 0.236	8	0.03 ± 0.161
	s	2200	13.41 ± 4.710	1836	13.50 ± 4.772	4036	13.45 ± 4.730
9-10	pufa	476	2.90 ± 2.514	228	1.68 ± 1.865	704	2.35 ± 2.322
	p	96	0.84 ± 0.992	312	2.08 ± 1.881	408	1.55 ± 1.675
	u	0	0.00 ± 0.000	6	0.04 ± 0.197	6	0.02 ± 0.149
	f	18	0.16 ± 0.366	6	0.04 ± 0.197	24	0.09 ± 0.288
	a	0	0.00 ± 0.000	0	0.00 ± 0.000	0	0.00 ± 0.000
11-12	s	1080	9.47 ± 2.829	1248	8.32 ± 2.805	2328	8.82 ± 2.868
	pufa	114	1.00 ± 0.978	324	2.16 ± 1.939	438	1.66 ± 1.695
	p	64	0.57 ± 1.054	48	0.60 ± 0.493	112	0.58 ± 0.864
	u	0	0.00 ± 0.000	0	0.00 ± 0.000	0	0.00 ± 0.000
	f	0	0.00 ± 0.000	0	0.00 ± 0.000	0	0.00 ± 0.000
Total	a	0	0.00 ± 0.000	0	0.00 ± 0.000	0	0.00 ± 0.000
	s	208	1.86 ± 3.010	144	1.80 ± 2.655	352	1.83 ± 2.860
	pufa	64	0.57 ± 1.054	48	0.60 ± 0.493	112	0.58 ± 0.864
	p	596	1.53 ± 1.933	576	1.57 ± 1.743	1172	1.55 ± 1.843
	u	24	0.06 ± 0.374	10	0.03 ± 0.163	34	0.04 ± 0.292
Total	f	34	0.09 ± 0.282	6	0.02 ± 0.127	40	0.05 ± 0.224
	a	0	0.00 ± 0.000	8	0.02 ± 0.146	8	0.01 ± 0.102
	s	3488	8.94 ± 6.097	3228	8.82 ± 5.677	6716	8.88 ± 5.894
	pufa	654	1.68 ± 2.089	600	1.64 ± 1.795	1254	1.66 ± 1.951

* indicates number of teeth; SD: Standard deviation; S: Sound.

Table (5): Descriptive statistics for the PUFA index and its components regarding different age groups for both genders

Age Group (Years)	PUFA	Males		Females		Total	
		No.*	Mean ± SD	No.*	Mean ± SD	No.*	Mean ± SD
7-8	P	0	0.00 ± 0.000	4	0.03 ± 0.170	4	0.01 ± 0.115
	U	0	0.00 ± 0.000	0	0.00 ± 0.000	0	0.00 ± 0.000
	F	0	0.00 ± 0.000	0	0.00 ± 0.000	0	0.00 ± 0.000
	A	0	0.00 ± 0.000	4	0.03 ± 0.170	4	0.01 ± 0.115
	S	892	5.44 ± 3.844	960	7.06 ± 4.448	1852	6.17 ± 4.200
	PUFA	0	0.00 ± 0.000	8	0.06 ± 0.339	8	0.03 ± 0.230
9-10	P	0	0.00 ± 0.000	0	0.00 ± 0.000	0	0.00 ± 0.000
	U	0	0.00 ± 0.000	0	0.00 ± 0.000	0	0.00 ± 0.000
	F	0	0.00 ± 0.000	0	0.00 ± 0.000	0	0.00 ± 0.000
	A	0	0.00 ± 0.000	0	0.00 ± 0.000	0	0.00 ± 0.000
	S	1368	12.00 ± 2.439	1818	12.12 ± 2.072	3186	12.07 ± 2.234
	PUFA	0	0.00 ± 0.000	0	0.00 ± 0.000	0	0.00 ± 0.000
11-12	P	64	0.57 ± 0.732	16	0.20 ± 0.403	80	0.42 ± 0.642
	U	0	0.00 ± 0.000	0	0.00 ± 0.000	0	0.00 ± 0.000
	F	0	0.00 ± 0.000	0	0.00 ± 0.000	0	0.00 ± 0.000
	A	0	0.00 ± 0.000	0	0.00 ± 0.000	0	0.00 ± 0.000
	S	2560	22.86 ± 4.785	1744	21.80 ± 4.737	4304	22.42 ± 4.781
	PUFA	64	0.57 ± 0.732	16	0.20 ± 0.403	80	0.42 ± 0.642
Total	P	64	0.16 ± 0.469	20	0.05 ± 0.228	84	0.11 ± 0.376
	U	0	0.00 ± 0.000	0	0.00 ± 0.000	0	0.00 ± 0.000
	F	0	0.00 ± 0.000	0	0.00 ± 0.000	0	0.00 ± 0.000
	A	0	0.00 ± 0.000	4	0.01 ± 0.104	4	0.01 ± 0.073
	S	4820	12.36 ± 8.149	4522	12.36 ± 6.630	9342	12.36 ± 7.448
	PUFA	64	0.16 ± 0.469	24	0.07 ± 0.289	88	0.12 ± 0.395

* indicates number of teeth; SD: Standard deviation; S: Sound.

The third age group (11-12 years) displayed the following; caries experience for the primary dentition was 1.00 and that for the permanent dentition was 3.67. The vast majority of the components for both dmft and DMFT were of the decayed type (0.75 for primary and 2.58 for permanent dentitions). The index of the untreated dental caries was found to be 0.58 for primary dentition and 0.42 for permanent dentition which were purely concentrated on the pulpal involvement category (Tables 2-5). Again, the "Untreated Caries, PUFA Ratio" was 30.03%, indicating that approximately 30% of the D + d component for this age group had progressed mainly to pulpal involvement.

For the total sample, caries experience

in the primary dentition was 4.43, with 3.60 on the d-component. The permanent dentition presented 1.58 DMFT, with 1.20 were on the D-component. The pufa index for the primary dentition was 1.66, and the PUFA index for the permanent dentition was 0.12. The main components of pufa and PUFA were pulpal involvement (1.55 and 0.11, respectively) (Tables 2-5). The "Untreated Caries, PUFA Ratio" was 37.08%, indicating that approximately 37% of the D + d component for the total sample had progressed mainly to pulpal involvement.

Figures (2) and (3) illustrated the percentage of each component of dmft, DMFT, pufa and PUFA indices regarding each age group as well as the total sample.

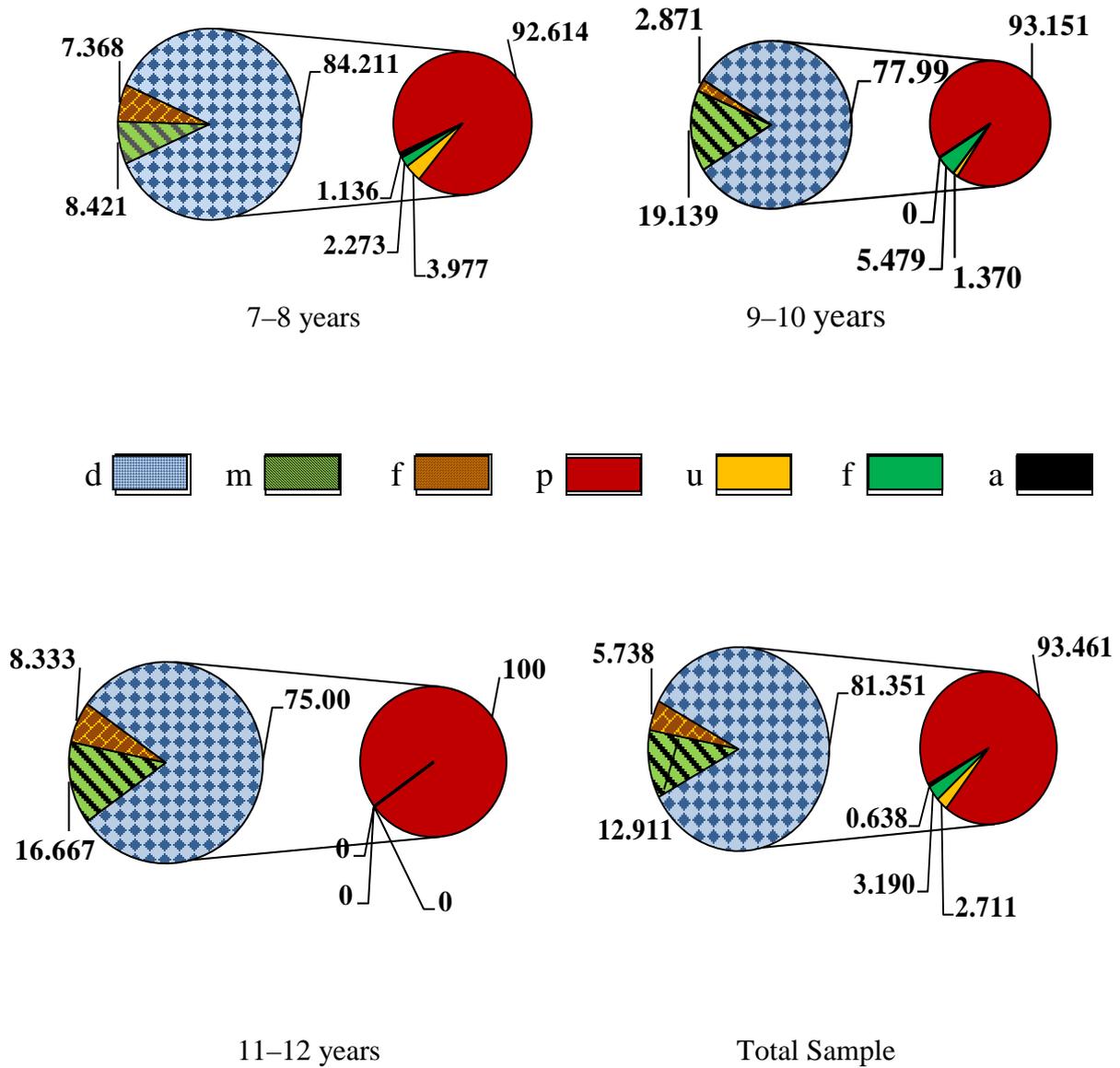
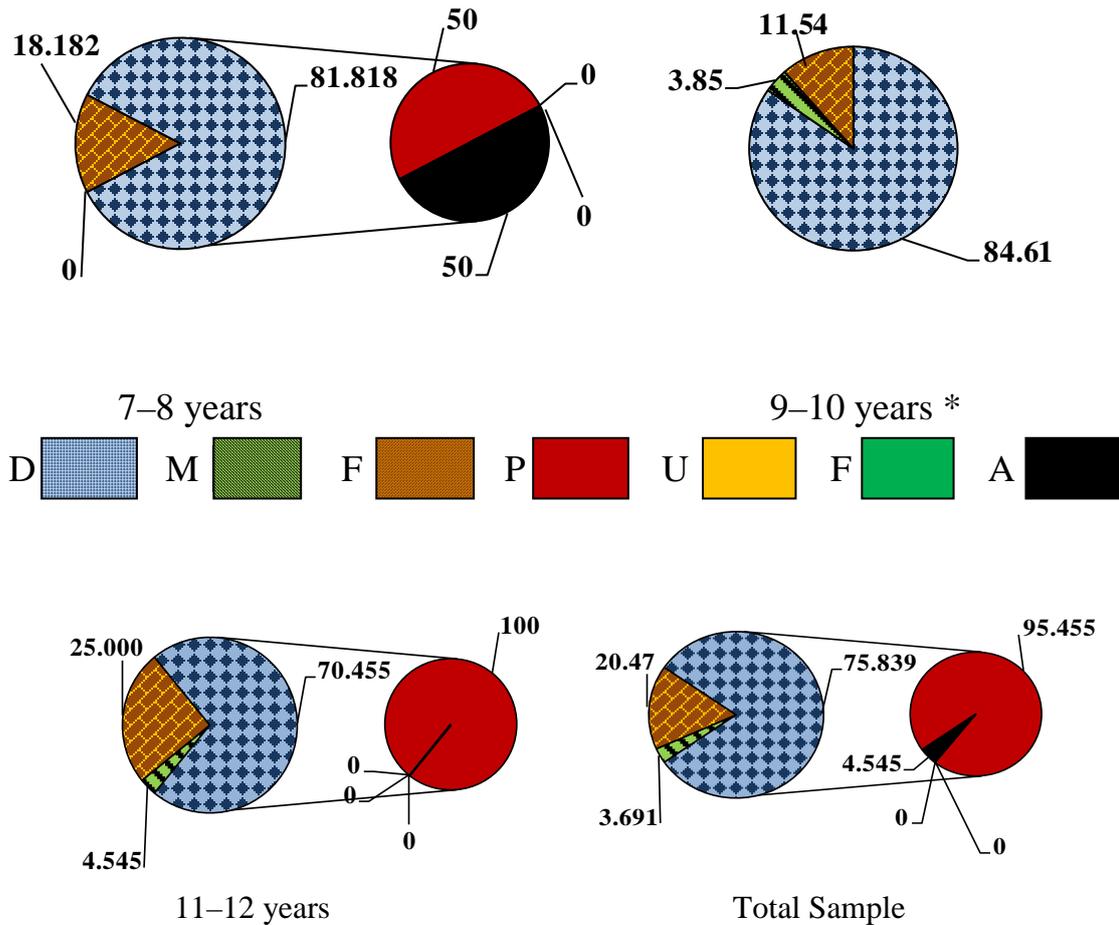


Figure (2): Prevalence (%) of dm and pu fa indices for each age group and the total sample



* Prevalence (%) of P, U, F and A for this age group were 0.

Figure (3): Prevalence (%) of DMF and PUFA indices for each age group and the total sample

DISCUSSION

Usually, children's oral health problems are investigated through the use of clinicalmeasure ments, like the DMFT/dmft index for dental caries assessment. The results obtained with this type of data collection (as demonstrated in the present study) do not provide much insight into the consequences of oral diseases for children's lives.⁽¹¹⁾ Taking into consideration, dental pain in children has been described as a common experience affecting quality of life, sleep, impair nutrition, cause school absences,⁽¹²⁻¹⁴⁾ and dental caries has been considered the main biological cause of dental pain in children,⁽¹⁵⁻¹⁷⁾ this clearly demonstrates the limited and often misleading explanatory power of the DMFT. By exposing decision makers only to DMFT data, leaves them unaware of the high levels of untreated caries lesions, their severity and associated

health and quality of life consequences.⁽⁵⁾

Despite the high prevalence of dental caries lesions in the primary dentition, the prevalence of clinical consequences of untreated carious lesions was considered moderate and the severity was considered low in comparison to the outcomes of Monse *et al.*⁽⁴⁾ However, the prevalence of fistulae and abscesses for 6-7 years old group in the present study were comparable to those results carried out among the same age group for Brazilian children.⁽¹⁸⁾ Likewise, the results of the present study were in line with those carried out in Scotland and reported a prevalence of sepsis (defined as the presence of an abscess or fistula) of about 4.8%.⁽¹⁹⁾

Approximately, 40% of decayed teeth had signs of odontogenic infection. This figure is closely similar to that reported by Monse *et al.*⁽⁴⁾ This information may be useful for treatment planning as it will help to calculate the treatment need (tooth

extractions, restorations, endodontic treatment) depending on the availability of the health care system. Presenting data based on the PUFA index will provide health planners with relevant information, which is complementary to the DMFT.^(4, 20)

Codes "P/p", "F/f" and "A/a" can be considered direct consequences of untreated carious lesions. However, traumatic ulceration of the surrounding soft tissues, which is the definition of code "U/u", is not directly related to the caries process. The almost complete absence of code "U" obtained in the present study regarding permanent dentition is another argument to question the necessity of integrating code "U/u" into an index. This finding is not in line with the results obtained from Monse's *et al.* study,⁽⁴⁾ where code "u" was more prevalent than codes "f" and "a". However, the results of the present study comes in accordance with those of other studies.^(18, 20)

CONCLUSIONS

The PUFA/pufa index is an epidemiological tool complementary to existing caries index (DMF/dmf) aimed to assess dental caries. The relevance of this index to address the neglected problem of untreated caries and its consequences is of considerable importance for epidemiologists and health care planners. However, there appears to be no need to include code "U/u" in the index.

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