Evaluation of the Sequelae of Untreated Dental Caries Using PUFA Index

Karam H Jazrawi
BDS, MSc (lec.)
Dept of Pedod, Orthod, and Prev. Dentistry
College of Dentistry, University of Mosul

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.
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. 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. A deep caries cavity with pulpal involvement is usually considered under the code "caries of dentin" and pulpal involvement is not mentioned at all in the caries scoring system in the latest edition of Oral Health Surveys–Basic methods WHO. Some limited information might be obtained on the severity of advanced caries lesions by the scoring of "teeth indicated for extraction" under treatment needs 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.

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.

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)
- 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.

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.

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

\[
\text{PUFA Ratio} = \frac{(PUFA+pufa)}{(D+d)} \times 100
\]

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       |
|                   | Males  | 114 | 43.2       |
|                   | Females| 150 | 56.8       |
|                   | Total  | 264 | 34.9       |
| 9–10              | 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 involvement, 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 | No.* | Males Mean ± SD | No.* | Females Mean ± SD | No.* | Total 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 ± 5.335   |
|                   | dmft | 1092 | 6.66 ± 3.967    | 808  | 5.94 ± 3.155     | 1900 | 6.33 ± 3.633    |
|                   | 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    |
| 9–10              | 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    |
|                   | 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    |
| 11–12             | 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 |
|                   | 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 |
| 9–10              | 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 |
|                   | 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 |
| 11–12             | 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 |
|                   | 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   | 0.41 ± 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              | 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 |
|                   | s    | 1080  | 9.47 ± 2.829 | 1248 | 8.32 ± 2.805 | 2328 | 8.82 ± 2.868 |
| 11–12             | p    | 114   | 1.00 ± 0.978 | 324 | 2.16 ± 1.939 | 438 | 1.66 ± 1.695 |
|                   | u    | 64    | 0.57 ± 1.054 | 48  | 0.60 ± 0.493 | 112 | 0.58 ± 0.864 |
|                   | 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    | 208   | 1.86 ± 3.010 | 144 | 1.80 ± 2.655 | 352 | 1.83 ± 2.860 |
|                   | 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 |
|                   | 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 |
|                   | p    | 654   | 1.68 ± 2.089 | 600 | 1.64 ± 1.795 | 1254 | 1.66 ± 1.951 |

* indicates number of teeth; SD: Standard deviation; S: Sound teeth.
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 pulp 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 pulp 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 on the d–component. The permanent dentition was 3.60 on the d–component. The permanent dentition was 3.60 on the d–component. The permanent dentition was 3.60 on the d–component. The permanent dentition was 3.60 on the d–component.

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

| Age Group (Years) | PUFA No.* | Males Mean + SD | Females Mean + SD | No.* | Total 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 |
| 9–10              | P 0       | 0.00 ± 0.000    | 8                | 0.06 ± 0.339 | 8 | 0.03 ± 0.230 |
|                   | 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 |
| 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 |
|                   | 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 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.
**Figure (2):** 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 clinical measurements, 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.\(^{(5)}\) 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.\(^{(5)}\) 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. 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, 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.

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.

REFERENCES

1. Nyvad B, Machiulskiene V, Baelum V. Reliability of a new caries diagnostic system differentiating between active and inactive caries lesions. *Caries Res*. 1999; 33: 252-260.
2. Ismail AI, Sohn W, Tellez M, Amaya A, Sen A, Hasson H, Pitts NB. The International Caries Detection and Assessment System (ICDAS): An integrated system for measuring dental caries. *Community Dent Oral Epidemiol*. 2007; 35: 170-178. (Source: The Iraqi Virtual Science Library. www.ivsl.org).
3. Whelton H. Overview of the impact of changing global patterns of dental caries experience on caries clinical trial. *J Dent Res*. 2004; 83 Spec No. C: C29-C34.
4. Monse B, Heinrich–Weltzien R, Benzian H, Holmgren C, van Palenstein Helderman W. PUFA–An index of clinical consequences of untreated dental caries. *Community Dent Oral Epidemiol*. 2010; 38: 77-82. (Source: The Iraqi Virtual Science Library. www.ivsl.org).
5. Broadbent JM, Thomson WM. For debate: Problems with the DMF index pertinent to dental caries data analysis. *Community Dent Oral Epidemiol*. 2005; 33: 400-409.
6. Spencer AJ. Skewed distributions–new outcome measures. *Community Dent Oral Epidemiol*. 1997; 25: 52-59.
7. World Health Organization. A Guide to Oral Health Epidemiological Investigations. Geneva, World Health Organization. 1979.
8. Pitts NB, Fyffe HE. The effect of varying diagnostic thresholds upon clinical caries data for a low prevalence group. *J Dent Res*. 1988; 67: 592-596.
9. World Health Organization. Oral Health Surveys. Basic Methods. 4th edn. Geneva, World Health Organization. 1997.
10. Benzian H, Monse B, Heinrich–Weltzien R, Hobdell M, Mulder J, van Palenstein Helderman W. Untreated severe dental decay: A neglected determinant of low Body Mass Index in 12–year–old Filipino children. *BMC Public Health*. 2011; 11: 558-566. (Source: The Iraqi Virtual Science Library. www.ivsl.org).
11. McGrath C, Broder H, Wilson–Genderson M. Assessing the impact of oral health on the life quality of children: Implications for research and practice. *Community Dent Oral Epidemiol*. 2004; 32: 81-85.
12. Barretto EPR, Ferreira EF, Pordeus IA. Determinant factors of toothache in 8– and 9– year–old schoolchildren, Belo Horizonte, MG, Brazil. *Braz Oral Res*. 2009; 23: 124-130. (Source: The Iraqi Virtual Science Library. www.ivsl.org).
13. Naidoo S, Chikte UM, Sheiham A. Prevalence and impact of dental pain in 8–10–year–olds in the western Cape. *SADJ*. 2001; 56: 521-523.
14. Lancet. Oral health: Prevention is key
Peres MA, Latorre MRDO, Sheiham A, Peres KG, Barros FC, Hernandez PG, Maas AMN, Romano AR, Victoria CG. Social and biological early life influences on severity of dental caries in children aged 6 years. Community Dent Oral Epidemiol. 2005; 33: 53-63.

Tickle M, Blinkhorn AS, Milsom KM. The occurrence of dental pain and extractions over a 3-year period in a cohort of children aged 3–6 years. J Public Health Dent. 2008; 68: 63-69. (Source: The Iraqi Virtual Science Library. www.ivsl.org).

Boeira GF, Correa MB, Peres KG, Peres MA, Santos IS, Matijasevich A, Barros AJD, Demarco FF. Caries is the main cause for dental pain in childhood: Findings from a birth cohort. Caries Res. 2012; 46: 488-495. (Source: The Iraqi Virtual Science Library. www.ivsl.org).

Figueiredo MJ, de Amorim RG, Leal SC, Mulder J, Frencken JE. Prevalence and severity of clinical consequences of untreated dentine cavious lesions in children from a deprived area of Brazil. Caries Res. 2011, 45: 435-442. (Source: The Iraqi Virtual Science Library. www.ivsl.org).

Pine CM, Harris RV, Burnside G, Merritt MCW. An investigation of the relationship between untreated decayed teeth and sepsis in 5-year-old children. Br Dent J. 2006; 200: 45-47.

Leal SC, Bronkhorst EM, Fan M, Frencken JE. Untreated cavitated dentine lesions: Impact on children's quality of life. Caries Res. 2012: 46: 102-106. (Source: The Iraqi Virtual Science Library. www.ivsl.org).