

## INDEX OF REVERSIBILITY OF THE CARIES LESIONS

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### SUMMARY

The DMFT (S) index, created at a time when caries was thought to be an irreversible condition of the tooth structures, proves now to be insufficiently informative under the present situation. The non-operative preventive therapeutic approach is highly regarded now, which is an approach requiring additional information on the reversible carious pathology so that an adequate treatment could be applied.

The epidemiological examination of a 1000 children aged 6 - 15 has been conducted in Sofia and Rousse – two big Bulgarian cities in which no public prophylactic programme has been carried out. On the basis of predetermined diagnostic criteria for the determination of the reversible phases in the development of the dental caries and by accepting an early diagnostic threshold, an IR reversibility index was created. This index is very helpful in supplementing the information obtained by means of the DMFT and DMFS indexes, allowing us to determine the correlation between the reversible and irreversible lesions within the DMF index and making possible adequate therapeutic decision-making. The IR reversibility index is there for the sake of preventive approach in modern cariesology and can successfully be used in epidemiological studies.

Epidemiological studies are conducted in the world all the time, aimed at monitoring the level of development of the caries distribution (1, 3, 4, 5, 6, 20). Hence the possibility for comparison between the different countries, geographic regions, groups and populations. The studies reflect the medical therapy conducted, the need for therapy as well as the volume of the social and group prophylactic measures taken (2, 8, 9, 11, 14, 15). In order that comparisons could be reliable, a unification of the indexes applied as well as a unification of the diagnostic bands and criteria used must be achieved, though (7, 10, 14, 16, 17, 18).

The universally recognised DMF index has been introduced by Klein and Palmer in 1930 (13). At this time the caries was considered to be an irreversible condition of the dental structures and the index totally reflected that understanding of what the suitable therapeutic approach should be. Even though the index is very handy and easy

to apply, it does provide us with information concerning the character of the caries process, about the correlation between the reversible and irreversible lesions as well as about the most adequate therapeutic approach to be employed. Nowadays that we have plenty of evidence that the caries process is reversible with a long period of time and that the therapeutic approach has changed towards embracing the need for non-operative treatment this index is not sufficient (12, 13, 19).

In order that the non-operative approach is applied, it is necessary for us to introduce fine diagnostic thresholds detecting the earliest stages in the development of the caries. Also needed are precise diagnostic criteria and indexes supplementing the information obtained by means of the DMFT and DMFS indexes – criteria and indexes showing the amount of reversible and irreversible lesions (21, 22, 23). Only in this way can within an epidemiological study the type of therapy needed be determined.

**It is the aim of this work** to create an index, showing the amount of reversible and irreversible lesions within the totality of carious lesions detected.

### MATERIAL AND METHODOLOGY

The epidemiological study was conducted among a 1000 children aged 6 - 15, distributed in different age groups each comprising 100 children. The children were randomly chosen from schools in Sofia and Rousse.

The medical checkups were carried out in the corresponding school's dental office, using professional dental chair with directed lighting, water and air supply.

A multi-examiner experiment was conducted with the participation of three examiners and with a preliminary calibration and validation. Before the start of the examination the team was acquainted with the criteria for diagnosing and was trained to diagnose employing different diagnostic thresholds. After the last attempt no valid differences were discovered (the coefficient of agreement between the different examiners reaching 0,96). No valid loss of sensitivity was found out in the diagnosing using different diagnostic threshold. There was no verifiable difference in terms of specificity either.

The diagnostic method used is predominantly visual. The observation was conducted by means of using a mirror. Sound was not used for the studying of any of the lesions observed. Since the research was carried out to serve the purpose of non-operative preventive treatment, we avoided any possibility for additional harming which would clearly impede such an approach.

The cases observed were documented by means of an intraoral camera.

#### **Diagnostic criteria used:**

**Loss of the gloss of the enamel** – the first and most early change detectable by means of visual observation. This criterion was seen by us as being there for a condition that triggers the carious process. The gloss loss is detected under dental plaque after cleaning and continuous drying and airing.

**Loss of transparency** – the enamel loses its transparency. The condition is detected after the dental plaque has been removed and 5-second drying has been applied. The most early type of lesion is discovered here, in which the enamel is opaque and beginning to whiten.

**Whitening of the enamel** – white enamel lesion is observed visible without drying.

**Loss of smoothness** – the enamel surface of the lesion observed loses its smoothness. Becomes rough but without cavitation.

**Borders of the enamel lesion** – the link between healthy enamel and lesion. The borders can be clearly delineated, diffuse or unrestricted.

#### **Diagnostic scale of carious lesions:**

- **D0** – healthy enamel;

- **D1a** – the earliest of the visually detectable lesions. It is found under a big quantity of plaque, usually cervical. Its location is near the gingival border. The size coincides with the location of the tooth plaque. No pigmentation is seen. Becomes visible after the tooth plaque has been removed by means of professional hygiene. Continuous drying and airing is needed. Only then the lesion becomes discernible from the healthy enamel. Within the lesion the enamel has lost its gloss. Slight hardly detectable whitening can also be observed. It is undetectable if drying has not been applied, though;

- **D1b** – white enamel lesion, clearly visible, no cleaning and drying being conducted. It can be active, stationary or regressing. Depending on its activity, the lesion can have the qualities of each of these types. It can also be combined. Must be studied for gloss, smoothness, borders and plaque. At this stage microporosity can be discovered, but no enamel cavitation is found;

- **D2** – white enamel lesion within which one or a couple of small cavitations or one bigger and deeper cavitation can be seen. Around these cavitations a white

diffuse active lesion is usually located. Zones of gradual transition to healthy enamel can be observed. The lesions are restricted and clearly delineated which is indicative of the lesions becoming stationary. Accordingly, the diffuse and broad lesions are indicative of progression of the lesion;

- **D3** – dentine caries.

**The D1a diagnostic threshold is used** – the diagnosing of D1a lesion is the border between the healthy and carious enamel.

## **RESULTS AND DISCUSSION**

The DMFT and DMFS indexes do not give us information on the character of the lesions that have occurred. If all the composite elements of the indexes is considered separately, which is very rarely done in epidemiological studies, the maximum information we can get is on the obturated and carious teeth or surfaces. Let alone that it can only lead us to operative intervention and is irrelevant as far as non-operative intervention is concerned. Since it was our aim to change the way we think of dental intervention and promote non-operative operation, we created a supplementary index that can enrich the information we have and reveal the possibilities for non-operative intervention in each group studied and individual examined. This index determines the correlation between reversible and irreversible carious lesions and can be designated as IR – index of reversibility of the process of caries.

The diagnostic criteria employed in the conduction of the epidemiological study allow us to determine which lesions are reversible and which are irreversible. The reversible lesions are D1a, D1b and D2. The irreversible lesions are D3 and D4. For each age group the indexes DMFT and DMFS were determined along with the average number of reversible and irreversible lesions.

The newly created IR index is obtained from the correlation between reversible and irreversible lesions.

**IR = a : b**

a = reversible carious lesions

b = irreversible lesions

#### **Interpretation of the values received for IR:**

**1. When only reversible lesions are present** and irreversible lesions are absent, the value of the index is received from the sum of the reversible lesions.

For instance: 5 reversible lesions : 0 irreversible;  
Index IR = 5

**2. When the number of reversible and irreversible carious lesions is equal**, the value of the index will be 1, the value of the DMFT or DMFS index showing the number of reversible and irreversible lesions.

For instance:

1 reversible : 1 irreversible – IR = 1; DMFT = 2;

5 reversible : 5 irreversible – IR = 1; DMFT = 10.

These two examples supported by the two indexes make it possible for us to analyse and provide us with information that allows us to chose the treatment required.

In the first case, when the IR is 1, the value of the index means that the number of the reversible and irreversible lesions is equal. If the concomitant value of DMFT is 2, it becomes immediately clear that the child is in need of non-operative treatment of the first lesion and of operative treatment of the second lesion. In the next case the value of IR is 1, but the value of DMFT is 10. This means that the value of DMFT - 10 must be divided by two. Then we have 5 reversible and 5 irreversible lesions. Consequently, 5 of the lesions require operative treatment and the other 5 - non-operative treatment.

**3. When the irreversible lesions outnumber the reversible ones**, the values of the IR index are below 1.

For instance: 8 reversible lesions: 10 irreversible - IR = 0.8; DMFT = 18

**4. Each value of the index above 1** shows a preponderance of the reversible lesions, the real volume of which is determined with regard to the DMFT index.

For instance: 8 reversible lesions: 2 irreversible - IR = 4; DMFT = 10

Usage of the IR and DMFT indexes for the determination of the reversible and irreversible carious lesions:

When the values of the two indexes are known, the DMFT and DMFS are divided by IR + 1 and the number of the irreversible lesions is obtained by means of the following formula:

$$a + b = \text{DMFT or DMFS}$$

$$a : b = \text{IR}$$

$$b = \text{DMFT or (DMFS)} : (\text{IR} + 1)$$

There are two ways of determining the value of the reversible lesions.

One is by means of the DMFT or DMFS index and the value obtained for b (irreversible lesions):

$$a = (\text{DMFT} - b)$$

The other is by means of the value obtained for irreversible lesions (b) and the IR index:

$$a = (b \times \text{IR})$$

Determining the reversible lesions through the DMFT (DMFS) index:

The number of the irreversible lesions is subtracted from the value of the DMFT index.

For instance: we know that DMFT is 20 and IR - 3

First, the number of irreversible lesions is calculated: DMFT: (IR+1) = 20:(3+1) = 5 irreversible lesions (b)

After that the number of reversible lesions is calculated:

$$a = \text{DMFT} - b$$

$$a = 20 - 5 = 15 \text{ reversible.}$$

Determining the reversible lesions through the IR index:

$$a = b \times \text{IR or}$$

$$a = 5 \times 3 = 15 \text{ reversible lesions;}$$

For each age group of the 1000 children examined the values of the DMFT and DMFS indexes, the number of the reversible and irreversible lesions and the IR index were calculated.

**Table 1.** Age dynamic of the IR reversibility index, of the number of reversible and irreversible carious surfaces as well as of the DMFS index, the diagnostic threshold being D1a

age	Reversible lesions			Irreversible lesions			DMFS	IR index
	x	Σ	Δ	x	σ	Δ		
6	2,73	2,10	0,20	0,09	1,78	0,18	2,82	30,33
7	4,85	3,56	0,35	1,55	2,01	0,20	6,40	3,12
8	4,11	2,98	0,29	1,76	2,28	0,20	5,87	2,33
9	6,02	1,82	0,18	1,82	2,24	0,20	7,84	3,30
10	6,01	1,80	0,18	3,23	2,12	0,20	9,22	1,86
11	7,36	1,65	0,16	3,51	1,96	0,20	10,87	2,09
12	7,17	1,69	0,17	4,40	1,78	0,18	11,57	1,63
13	11,64	0,98	0,09	6,36	1,56	0,15	18,00	1,83
14	8,54	1,23	0,12	10,66	0,88	0,09	19,20	0,80
15	12,09	0,88	0,08	9,56	1,98	0,10	21,65	1,26

A couple of important facts become clear from the results presented. The first one is the high degree to which the process of caries has afflicted the tooth surfaces of the children within the group studied. Obvious is the progressive character of the process observed. Each next age group has a higher value of the DMFS index. This fact shows that the children examined made no effort to control the process of caries and model the present risk factors. Hence the incessant emergence of new carious lesions and the erosion of new tooth surfaces.

The second important regularity that can be observed is the prevalence of the reversible carious lesions. In any of the age groups studied the number of reversible lesions was many times bigger than the number of irreversible lesions. This tells us what kind of treatment is preferable in the case of children. Irreversible lesions require operative treatment, but they are just a small part of the pathology observed. It is reversible lesions that are the major pathology here and them we should treat non-operatively and preventively. Non-operative preventive treatment requires management of the current process of caries by modelling the specific risk factors and through applying remineralisation treatment of the carious lesions.

The third fact is that the values of the index are bigger than one, excluding the group of the 14-year old. Only in the case of the 14-year old does the number of irreversible lesions exceed the number of reversible lesions. All groups of children examined turned out to have a big number of reversible lesions requiring non-operative preventive treatment, though. For all these lesions operative treatment would be inappropriate.

If the epidemiological study was to be restricted to the information obtained by means of the DMFT and DMFS

indexes, the IR index not being represented in the study, the information obtained would be highly insufficient, had we even obtained – by means of the DMFT or DMFS index – information on the internal distribution between carious teeth (D), teeth extracted because of caries (M) and obturated teeth (F). There is no way of knowing what part of the carious surfaces are reversibly affected and what part are irreversibly affected. Consequently, there is no way of choosing the adequate treatment so that the condition of the group of patients could be improved.

If the IR index is implemented within the epidemiological study along with the DMFT or DMFS index, the correlation between reversible and irreversible lesions becomes immediately visible and an adequate treatment of the group can be specified. Such a combination of indexes can really improve the quality of epidemiological researches. It provides us with the information necessary for non-operative preventive treatment, non-operative preventive treatment being the modern tendency in the treatment of tooth caries

#### CONCLUSIONS:

1. The DMF index (T or S) is not informative as far as the reversible carious pathology is concerned;

2. This index does not make it possible for us to take the right therapeutic decisions with regard to the pathology present;

3. A IR reversibility index has been created that supplements the information obtained otherwise by showing the correlation between the reversible and irreversible carious lesions thus allowing us to make the right therapeutic decisions;

4. The IR reversibility index can be applied in epidemiological studies.

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