# ACTIVITY OF THE CARIES PROCESS

Milena Peneva
*Department of Children's dental medicine*
*Faculty of Dental medicine,* Medical university - Sofia, Bulgaria

**SUMMARY**

The contemporary non-operative approach in cariesology requires a new type of diagnosing. It is an approach that embraces the early detection of the caries lesions and the early specification of the character of the caries process at the moment of examination. Such an approach allows the early diagnosing of the active caries process as well as the early modelling of the process.

The broadly used in epidemiological studies DMF index provides no information for the activity of the caries process, for the quantity of the reversible lesions as well as for what non-operative treatment should be applied. The index has been created as early as 1930 when the operative treatment was dominant.

On the basis of the epidemiological study of a 1000 children aged 6 - 15 as well as with the help of a methodology embracing strict criteris for the separate diagnostic bands and for the activity of the caries lesions, an IA index was created showing the strength of the current caries process and supplementing the information obtained by means of the DMFT and DMFS indexes. The index could be very helpful in obtaining information within any epidemiological study and would facilitate the choise adequate therapeutic approach in accordance with the caries process observed.

The preventive strategy in contemporary cariesology – aimed at non-operative preventive treatment – requires early diagnosing of the caries process (3, 4, 7, 11, 17, 24). Such a strategy presupposes the ascertainment of the character of the developing process and the intensity of the caries lesion, and not simply the finding of the mere caries lesions, however early they are (8, 9, 10, 12, 14, 15). In order that the dental doctor's behaviour is efficient and the best choice of therapy is made, it must be found out if a caries lesion is at a stage of progression, if it has been made stationary or has undergone a reverse development (22, 23, 25, 26, 27).

There are two possible approaches to answering the above question. The first approach requires the longitudinal tracing of the lesion, while the second approach requires the determination of the clinical characteristics of each lesion, as they manifest themselves in a single clinical test.

Such an approach to determining the character of the caries lesions is applicable in an epidemiological study as well as in the separate checkup of a separate patient.

Determining the intensity of the caries lesion is considered to be the "Holy Grail" of contemporary cariesology. It can provide us with the necessary basic data concerning the character of the caries process (1, 2, 5, 6, 13, 16, 18, 19, 20, 21, 28).

The clinical - visible and tactile - ctiteria for caries intensity have been created by Ekstrand and Nyvad. Ismail introduces the concept of active lesion.

The contemporary epidemiological researches must not only be able of detecting the present lesions. They must also be able of providing us with information concerning the character of the caries process within the current checkup. The indexes of epidemic incidence, DMFT and DMFS, are a good sourse of information. They do not provide us with information concerning the character of the caries process and the therapeutic approach that should be applied. So that the new preventive approach in cariesology could be employed, a new system of indexes must be created. It is indexes created specially for the purpose of determining the character of the caries process.

It is the aim of this research to create a supplementary index for determining the intensity of the caries process at the moment of the checkup. It is an index supplementary to the DMFT and DMFS indexes.

**MATERIAL AND METHODOLOGY**

An epidemiological examination was conducted aimed at studying the incidence of dental caries in 1000 children and adolescents aged 6 - 15, distributed in ten age groups. The checkups were carried out in the office of a highschool dentist – on a dentist's chair with the help of focused light, water and air. Dentist's mirror was used in the examination. Sound was not used in the detection of any of the lesions.

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

A multiexaminer experiment was conducted involving calibration and validation. The coefficient of agreement between the different examiners reaching 0,96.

**Diagnostic scale of the caries lesions**:
- **D0** – healthy enamel;

- **D1a** – a sublevel introduced for the purposes of the research characterising the earliest visually detectable lesions. A great quantity of plaque – usually cervical - was discovered. Such lesions were situated near the gingival edge. The size of the different lesions was identical with the size of the dental plaque. No pigmentation was observed. Such lesions are detected after professionally cleaning the dental plaque. Continuous drying and cleaning is necessary for the lesions to become observable. Only following such a procedure can the lesion be distinguished from the healthy enamel. Within the lesion the enamel has lost its gloss. A slight whitening can also be detected – only after drying and airing, though;

- **D1b** – white enamel lesion, easily visible without a previous cleaning and drying. It can be active, stationary or regressing. Depending on its intensity, the lesion may have different qualities. It can also be a combined type of lesion. The shine of the lesion, its smoothness, transperancy, location, borders as well as the occurrence of plaque are studied. At this stage microporosity can be found. No enamel cavitation occurs, though;

- **D2** – white enamel lesion combined with one or two small cavitations or one bigger and deeper cavitation. Around such cavitations a diffuse white active lesion can be found. Zones with gradual transition to healthy enamel can be observed. The delineated and clearly marked lesions are indicative of a stationary character. The lesions are diffuse and broad which is indicative of progression;

- **D3** – dentine caries. This category includes the hidden and open dentine lesions.

- **D4** – caries lesions with complications in the pulp and the periodoncium.

The caries lesions are classified - with regard to criteria stated in advance – as active and inactive.

**Criteria for the intensity of a lesion monitored**:

- lesions located in zones predisposed to the development of caries – along fissures, pits and furrows; near the gingival border of vestibular or oral lesions; along the approximal surfaces;

- lesions situated under plaque;
- Loss of gloss;
- Loss of transperancy;
- Depigmentation, usually into whitish, white or chalk-white;
- Loss of smoothness – rough and porous to the feel;
- Lack of clear delineation from the healthy enamel. The lesions can be small or big, diffusive or comprising the cervix of the tooth;
- Bad oral hygiene.

**Criteria for a stationary lesion:**

- Lesion located at a distance from the places where caries typically develops;

- Cavitated or non-cavitated;
- Limited in size;
- Clear borders with the healthy enamel;
- The colour can range from white to brown or black;
- Lack of plaque.

The DMFT and DMFS indexes were calculated for each age group. The oral and hygienic status was established by means of the indexes for oral hygiene of Silness and Lцe and Green, Vermillion.

A supplementary IA index was created on the basis of the criteria for activity of the caries lesion.

## RESULTS AND DISCUSSION

The active and inactive lesions were determined in the case of each group examined so that their correlation could be seen and the character of the environment within which the teeth function could be categorised. So, an index for activity was created to supplement the DMFT index.

**The index of the activity IA** is obtained by separating the ascertained active lesions from the existing inactive lesions.

$$IA = a : i$$

IA = index of the activity of the caries process

a = active lesions

i = inactive lesions

The value of the index starts at 0, when no activity of the process is ascertained; values between 0 and 0,99 are indicative of the fact that the inactive lesions outnumber the active ones; the index can have any value over 1, the value of the index then showing the strength of activity.

**When only active lesions are present** (and inactive lesions are missing), the index has the value of the active lesions.

**Value of IA = 0**. When a balance is achieved in the oral environment between the aggressive and protective factors or when the balance has been tipped in favour of the protective factors, no active lesions are observed and the index will be equal to 0. Such a value of the index can be ascertained at any level of the pathology. Even in the case of irreversible yet succesfully obturated lesions the oral environment can be inactive. For instance, in the case of a child with five obturated teeth and one stationary white enamel lesion if no new active lesions occur and if the oral hygiene is good, A will be = 0.

**Value of IA between 0 and 0,99**. Each value of the index between 0 and 1 shows that the active lesions in the child examined are less in number than the inactive lesions, yet the active lesions are there and must be treated by means of modelling the active risk factors. Such a result can be achieved if the child has for instance 3 active and 5 inactive caries lesions. The value A = 0.6 then and the index will lead us to determining the risk factors that brought about the emergence of the active lesions.

**Value of IA = 1.** The value of the index equal to 1 is indicative of there being an equality between the active and inactive lesions. If a child has 3 active and three inactive lesions the index will be equal to 1. In the case of such a value the child must examined so that the concrete risk factors could be discovered and then done away with by means of a successful non-operative preventive treatment.

**Value of the index bigger than 1.** Each value of the index bigger than 1 is indicative of the prevalence of the active lesions and represents a serious syndrome of a grave disturbance in the balance of the factors active in the oral environment. Such a value of the index requires the determination of all the risk factors at all levels – the tooth surface, the oral environment and the child as an individual. The bigger tha value of the index , the bigger the strength of activity of the caries process. The intensity of activity of the caries process will determine the volume of the programme to be implemented so that the caries process could be managed.

It was in terms of this index that the results obtained were processed.

**Table № 1.** Age dynamic of the A index of activity

| Age | Active lesions | | | Inactive lesions | | | Index |
|---|---|---|---|---|---|---|---|
| | x | σ | Δ | x | σ | Δ | IA |
| 6 | 2,82 | 3,16 | 0,81 | 0,0 | 0 | 0 | 2,82 |
| 7 | 6,34 | 3,6 | 0,36 | 0,06 | 0,42 | 0,04 | 105,66 |
| 8 | 5,36 | 4,56 | 0,45 | 0,42 | 1,04 | 0,1 | 42 |
| 9 | 7,27 | 4,9 | 0,49 | 0,55 | 0,78 | 0,07 | 13,21 |
| 10 | 8,5 | 5,72 | 0,58 | 0,74 | 1,34 | 0,45 | 11,48 |
| 11 | 9,66 | 5,58 | 0,75 | 1,21 | 2,06 | 0,2 | 7,98 |
| 12 | 8,79 | 8,34 | 0,83 | 2,78 | 3,39 | 0,39 | 3,16 |
| 13 | 16,7 | 7,36 | 0,73 | 1,3 | 2,18 | 0,21 | 12,84 |
| 14 | 14,39 | 8,45 | 0,84 | 4,81 | 5,26 | 0,52 | 2,99 |
| 15 | 18,19 | 9,01 | 0,9 | 3,46 | 4.65 | 0,46 | 5,25 |

It is seen from the table that within the 100 children examined there is not a single group of children whose caries activity is low, or between 0 and 1. All values are well above 1, in some cases drastically above 1. This situation corresponds to an oral environment out of control, an environment in which the the balance has been drastically tipped towards the risk factors. In such an environment the progression of the caries process is ensured, which is pretty evident from all the results obtained. The children studied have in principle a bad oral hygiene, this being true of all age groups. Such a strongly disturbed and very active oral environment requires a close study, so that additional factors could be discovered that presuppose and facilitate the processes in the mouth. Such an analysis will be made in the next chapter.

In order that a better picture of the index is drawn, we picked up separate cases from the separate groups. It is cases in which index A of activity has different values.

Within the group of children aged 11 the following single cases were established:

Case 1:   1 active caries lesion : 2 inactive   IA = 0,5
Case 2:   0 active lesions          : 17 inactive IA = 0
Case 3:   0 active lesions          : 0  inactive  IA = 0

These cases show that within the totality of children whose oral environment has been strongly changed there can be single cases of inactive oral environment, proper treatment and preventive measures. Even in case 2 where we have 17 caries lesions these lesions were obturated at the moment of examination, had no caries connected with the obturation and the oral hygiene had an index 0. This is an excellent example that at any level it is never late an equilibrium to be achieved, the protective factors to be strengthened and the risk factors to be supressed. In such cases an environment that obviously used to be active turned into an environment conducive to health.

In such a way the index IA proposed can be very useful in determining the activity of the oral environment both in each child separately and in a group of children or in the society as a whole. The index does not require a minimum of one year for the presence of activity to be detected and only then for treatment to be administered. Results are obtained at the moment of examination, which is a big advantage if prevention and treatment is to be planned.

In epidemiological studies, if the IA index is added to the average DMFT index a clear picture concerning the therapeutic needs of a group will be obtained. A proof of this is case 2 mentioned above in which the child had DMFT = 17, but IA = 0. It would be impossible for us to estimate the real situation in the group and in the separate individuals had we not this supplementary index.

## CONCLUSION

The epidemiological reserch conducted allowed us to determine the active caries lesions. The IA index created, showing the activity of the caries process at the moment of checkup, is a good supplement to the DMFT and DMFS indexes. The supplementary index can be used in mass epidemiological studies aimed at determining the character of the current caries process and at choosing an adequate therapeutic approach to the corresponding group. This index can also be used in comparative studies following the application of preventive and therapeutic programmes aimed at managing the caries process.

**BIBLIOGRAPHY:**

1. Axelsson P. An introduction to risk prediction and preventive dentistry, Quintessence, 1999, 1-7.

2. Axelsson P. Risk Prediction and preventive dentistry, Quintessence, 2000

3. Bader JD, Shugars DA, Bonito AJ: A systematic review of the performance of methods for identifying carious lesions. J Public Health Dent 2002;62:201-213.

4. Baelum V, Fejerskov O: Caries diagnosis: A mental resting place on the way to intervention?; in Fejerskov O, Kidd EAM (eds): Dental Caries - The Disease and Its Clinical Management. London, Blackwell Munksgaard, 2003, pp 101-110

5. Baelum V, Machiulskiene V, Nyvad B, Richards A, Vжth M: Application of survival analysis to carious lesion transition in intervention trials. Community Dent Oral Epidemiol 2003;31:252-260.

6. Ekstrand K., D. Ricketts, C. Longbottom, N. Pitts. Visual end tactile assessment of arrested initial enamel carious lesions: an in vivo pilot study. Caries Res. 39, 2005, 173-77.

7. Featherstone J. The continuum of dental caries-evidence for a dynamic disease process. J Dent Res, 83, 2004 (Spec iss C): 39-42.

8. Featherstone J, S Adiar, M Anderson et al. Caries management by risk assessment: consensus statement, April, 2002, J Calif Dent Assoc, 2003, 31, 257-269.

9. Fejerskov O, V Baelum, Changes in prevalence and incidence of the major dental diseases. In: Oral biology at turn of century - misconceptions, Truths, Chalenges and prospects. Guggenheim B, Bazel: Karger, 1998,1-11.

10. Fejerskov O., E. Kidd. Dental karies, the disease and its clinical management. Bleckwell, Munksgaard, 2004.

11. Fejerskov, O. Changing Paradigms in Concepts on Dental Caries: Consequences for Oral Health Care, Caries Res 2004; 38: 182-191.

12. Fyffe H E, Deery C H, Nugent, Z J, Nuttall N M, Pitts N B. Effect of diagnostic threshold on the validity and reliability of epidemiological caries diagnosis using the Dundee Selectable Threshold Method for caries diagnosis (DSTM). Community Dent Oral Epidemiol.2000; 28: 42-51.

13. Hausen H. Caries prediction – state of art. Commulity Dent Oral Epidemiol., 1997, 25, 87-96.

14. Horowitz A, P Anderson. Methodes Employed for Non-RTI/UNC Systematic Reviews. Consensus Development Program, 2000, dentistry.library@umich.edu

15. Horowitz AM: A report on the NIH consensus development conference on diagnosis and management of dental caries throughout life, J Dent Res, 83, 2004, 15-17. .

16. Hunter M., H. Rodd. History, examination, risk assessment, and treatment planning. Pediatric Dentistry, Third Edition, Edited by Richard Welbury, Monty Duggal, Marie-Terese Hosey, Oxford, 2005.

17. Ismail A., H. Hasson, W. Sohn. Dental Caries in the Second Millenium, J Dent Educ 2001;65:953-959

18. Ismail AI, Tellez M, Sohn W, Sen A. Reliability of the International Caries Detection and Assessment System (ICDAS). Community Dent Oral Epidemiol, 2005.

19. Ismail AI. Diagnostic levels in dental public health planning. Caries Res 2004b;38:99- 203.

20. Ismail AI. Visual and Visuo-tactile Detection of Dental Caries. J Dent Res 83, 2004a, 56-66.

21. McDonald R., D. Avery, G. Stokey. Dental Caries in the Child and Adolescent. Dentistry for the Child and adolescent, Mosby, 2004.

22. Nyvad B., J. ten Cate, C. Robinson. Cariology in the 21st century – state of the art and future perspectives. Caries Res. 38, 2004, 167-329.

23. Nyvad, B. Diagnosis versus Detection of Caries Caries Res 2004; 38: 192-198 (DOI:10.1159/000077754)

24. Pitts NB Are we ready to move from operative to non-operative/preventive treatment of dental caries in clinical practice? Caries Res 2004:38, 294–304.

25. Pitts NB, "ICDAS" – an international system for caries detection and assessment being developed to facilitate caries epidemiology, research and appropriate clinical management, Community Dental Health, 21, 2004, 193-198.

26. Pitts NB, Fejerskov O, von der Fehr FR: Caries epidemiology, with special emphasis on diagnostic standards; in Fejerskov O, Kidd EAM (eds): Dental Caries - The Disease and Its Clinical Management. London, Blackwell Munksgaard, 2003, pp 140-163.

27. 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.

28. Winston A, S Bhaskar. Caries prevention in the 21st century, J Am Dent Assoc, 129, 1998, 1579-1587.

**Adress for corespondense:**
Milena Peneva
Department of Pediatric Dentistry, Faculty of Dental Medicine,
1, Georgi Sofiiski str., 1431 Sofia, Bulgaria
E-mail: milenapeneva@mail.bg