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International Journal of Current Research
Vol. 8, Issue, 01, pp.25713-25716, January, 2016

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

REVIEW ARTICLE

THE COMPLETE REVIEW OF CARIES ASSESSMENT SYSTEMS

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ARTICLE INFO

Article History:
Received 24th October, 2015
Received in revised form
10th November, 2015
Accepted 04th December, 2015
Published online 31st January, 2016

Key words:

Caries assessment,
DMF index,
Significant caries index,
ICDAS, Specific caries index,
PUFA, PRS, CAST.

ABSTRACT

In view of the global epidemic of untreated caries in children there is an urgent need to establish a scoring system that both assesses and quantifies various advanced stages of caries. The DMF index despite having limitations has been widely utilized in oral epidemiological surveys. It is recommended by the WHO for measuring and comparing the experience of dental caries in populations. The future new research in caries epidemiology will depend on finding an ideal caries index. There are many promising new caries indices purposed, but still there is a need for further studies to evaluate their validity and reliability before they can replace DMFT index.

Citation: **Vijender Khokhar, 2016.** "The complete review of caries assessment systems", *International Journal of Current Research,* 8, (01), 25713-25716.

INTRODUCTION

Dental caries is as a dynamic process, which is affected by numerous modifiers tending to push the mineral equilibrium in one direction or another, i.e. towards remineralization or demineralization. In the developed countries, Caries incidence is declined due to proper availability of fluoride products, better oral health services. At the same time incidence of caries is increasing in developing countries due to high consumption of cariogenic food, the negligence in daily oral health practices and irregular dental check-ups. Research over the years has shown that caries is a preven Table and controllable disease. To apply measures which can prevent or control caries, a reliable picture of it in a population is prerequisite; this can only be obtained if we have a reliable caries assessment system (index). For several decades DMF index developed by Klein, Palmer and Knutson in 1938 is used for assessing dental caries. World health organization has adopted this index in its oral health assessment form for conducting national oral health surveys. Various reasons can be stated for its continued use for assessing caries, foremost of them are: it is simple to use, valid and reliable, that is why it is still being used for assessment and comparison of caries status of the population groups around the world. However DMF index is facing criticism on various points.

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Major drawbacks of DMF index

- DMF values are not related to the number of teeth at risk
- It assesses only cavitated lesion extended into dentin
- DMF index is invalid in elderly population, as teeth can be lost for reasons other than caries
- Cannot be use to assess root caries
- Rate of caries progression cannot be assessed
- Does not give account for treatment needs
- DMF index gives equal weight to missing, untreated decayed and well restored teeth
- Assigning the maximum possible value for the 'M' component of DMFS (Surfaces) leads to overestimation of an individual's caries experience, and in any associated comparisons of in-caries experience, whereas assigning the minimum possible value for the 'M' component has the opposite effect (there is no such problem with the DMFT index).

From the general population health point of view, major disadvantage of using DMF index is that it records only cavitated lesions and ignore incipient carious lesions. These lesions can be reversed by application of various preventive measures like fluorides if detected at earlier stages. So an index should be able to record these lesions to apply primary preventive measures in a population. The objective of this literature review is to critically evaluate major caries assessment systems and try to build up requisites for an ideal caries index.

Significant Caries (SiC) Index

This index was introduced by Brathall to overcome limitation of the mean DMFT value in accurately assessing the skewed distribution of dental caries in a population especially in developed countries leading to incorrect conclusion that the caries situation for the whole population is controlled, while in reality, several individuals still have caries. The study conducted in Nevada which confirmed that dental caries remains a common chronic disease among Nevada youth, and the mean SiC score was significantly higher than DMFT scores within each survey year across comparison groups. SiC is calculated by sorting individuals according to their DMFT values, than one third of the population with the highest caries scores is selected and the mean DMFT for this subgroup is calculated. This value is the SiC Index. The usefullness of this index is more of significance in population where caries prevalence is low and has a skewed distribution. Main disadvantage of SiC index is that this index is just an extension of DMF index as it follows same criteria for assessing dental caries and will have same limitations in assessing caries in a population as DMF index.

International Caries Detection and Assessment System (ICDAS) – I and II

The ICDAS I was developed in 2002 and was later modified to ICDAS II in 2005. The ICDAS I and II criteria incorporate concepts from the research conducted by Ekstrand *et al* (1995, 1997) and other caries detection systems described in the systematic review conducted by Ismail *et al.* (2004). ICDAS-I was meant to include detection (D) of caries by stage of carious process, topography and anatomy, assessment (A) of caries process (whether cavitated or non-cavitated and active or arrested caries (Table 1). But the ultimate index included detection of coronal caries and the assessment of lesion activity. The advantages of the ICDAS-II are that it includes stages of carious lesion progression in the enamel and it has found to be a valid and reliable caries assessment system especially for clinical trials assessing effectiveness of caries preventive/ control agents.

Shortcomings of ICDAS-II include: it is a complicated index due to the recording of non-primary caries lesion related conditions, does not correlate well with the detection and assessment of the conditions and various type of restorations and may lead to an overestimation of seriousness of dental caries experience.

Specific caries index

This index was purposed by Acharya with the objective to develop a reproducible, surface specific caries index that would provide qualitative and quantitative information about untreated dental caries in an individual based on clinical examination. The scoring criteria of the index are shown in Table below. (Table 3) The index has shown good reliability and validity in the study conducted by original author. Some *drawbacks* of this index were - it employs same caries detection criteria as DMF or DMFS; in cases of large lesions, which cover more than one surface, only an assumption can be made regarding the originating lesion; the inability of this index, if used alone, to capture information useful for treatment planning; and the lack of provision for assessing root caries.

PUFA (pulp-ulcer-fistula-abscess) index

The failure of DMF index to provide information on the clinical consequences of untreated dental caries, such as pulpal abscess, which may be more serious than the carious lesions themselves, is the basis for the development of PUFA index. In 2010, an index of clinical consequences of untreated caries (PUFA) was introduced by Monse et al. This index records the advanced stages of untreated caries lesions so that caries data collected should have impact on health decision makers, which is not possible with DMF index. The 'Untreated Caries, PUFA Ratio' is calculated as

PUFA+pufa/D+d ×100

Scoring method of PUFA index is described in Table 4. In many developing countries, access to oral health services is

Table 1. Scoring criteria for ICDAS-II

Code	Description
0	Sound tooth surface: No evidence of caries after 5 sec air drying
1	First visual change in enamel: Opacity or discoloration (white or brown) is visible at the entrance to the pit or fissure seen after prolonged air drying
2	Distinct visual change in enamel visible when wet, lesion must be visible when dry
3	Localized enamel breakdown (without clinical visual signs of dentinal involvement) seen when wet and after prolonged drying
4	Underlying dark shadow from dentine
5	Distinct cavity with visible dentine
6	Extensive (more than half the surface) distinct cavity with visible dentine

Table 2. Caries-Associated with Restorations and Sealants (CARS) Detection Criteria

Code	Description
0	Sound tooth surface with restoration and sealant
1	First visual change in enamel
2	Distinct visual change in enamel/dentin adjacent to restoration/sealant margin
3	Carious defect of > 0.5mm, with signs of code-2
4	Marginal caries in enamel/dentin/cementum adjacent to restoration/sealant, with underlying dark shadow from dentin
5	Distinct cavity adjacent to enamel/dentin
6	Extensive distinct cavity with visible dentin

limited and teeth are often left untreated or are extracted because of pain or discomfort, such an index can provide useful information for researches and authorities. Strong points of this index can be simple to record, can be used for primary and permanent teeth and results can be presented alongside with DMF index. There are certain limitations appearing after a recent study suggesting that there are few subjects with score "u" (ulcer) and assessment of abscess and fistula can be combined into one code.

Table 3.The specific caries index

Code	Description
0	No carious lesion detected.
1	Carious lesion occurring on the occlusal, buccal pits and fissures of molars and premolars and the lingual pits of the anterior teeth.
2	Proximal caries affecting the molars and premolars.
3	Carious lesion situated on the proximal surface of the anterior teeth and not involving the incisal angle
4	Carious lesion situated on the proximal surface of the anterior teeth, involving the incisal angle.
5	Carious lesion situated on the cervical region of the tooth
6	Carious lesion situated on the occlusal cusp tips of molars and premolars and on the incisal edges of incisors;
6A	Grossly decayed tooth/ root stumps indicated for extraction

Table 4. PUFA index scoring system

Code	Criteria
P/p	Pulpal involvement is recorded when the opening of the pulp chamber is visible or when the coronal tooth structure have been destroyed, the carious process and only roots or root fragments are left. No probing is performed to diagnose pulpal involvement
U/u	Ulceration due to trauma from sharp pieces of tooth is recorded when 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
F/f	Fistula is scored when pus releasing sinus tract related to a tooth with pulpal involvement is present
A/a	Abscess is scored when a pus containing swelling related to a tooth with pulpal involvement is present.

Table 5. Codes and Description of PRS index

Code	Characteristics	Description
P/p	Pulpal involvement	Caries process reached pulp chamber
R/r	Roots	Caries process destroyed tooth structures to non-restorable stage
S/s	Sepsis	A pus-releasing sinus tract or a pus containing swelling related to the tooth is present

Table 6. Codes and Description of CAST index

Codes	Characteristic	Description
0	Sound tooth	No visible evidence of a carious lesion is present.
1	Sealed	Pits and/ or fissures are at least partially sealed with a sealant material.
2	Restored	A cavity has been restored with an (in) direct restorative material.
3	Enamel	Distinct visual change in enamel only. A clear caries discoloration is visible with or without localised enamel breakdown.
4	Dentine	Internal caries related discolouration in dentine. The discoloured dentine is visible through enamel which may or may not exhibit a visible localized breakdown of enamel.
5	Dentine	Distinct cavitation into dentin. The pulp chamber is intact.
6	Pulp	Involvement of pulp chamber. Distinct cavitation reaching the pulp chamber or only root fragments is present.
7	Abscess/Fistula	A pus containing swelling or pus releasing sinus tract related to a tooth with pulpal involvement.
8	Lost	The tooth has been removed because of dental caries.
9	Others	Does not correspond to any of the other categories

PRS (Pulpal involvement root sepsis index)

As regards the presentation of treatment needs, the construction of the PUFA index is not sufficient. There have some doubts with regard to the description of code P in PUFA. The inclusion of two different clinical situations in a single code, i.e. teeth with cariously exposed pulp and teeth considered for extraction in which the carious process results in an extensive destruction of the crown with remaining roots or their fragments, causes that it is difficult to assess the actual treatment needs. Frencken *et al* and de Souza *et al* also raised the issue of reasonableness of separating the codes relating to dental sepsis – a fistula (F) and an abscess (A) – as they both were a manifestation of the same condition and might interchange into each other. The Codes and Description of PRS index is shown in Table 5. The prs index is a useful instrument for the evaluation of clinical consequences of untreated dental caries in the surveyed population and it provided additional information on dental status compared to the pufa index.

Caries assessment spectrum and treatment (CAST) index

This index was developed because of the need to find a reliable and easy to read reporting system which is based on the strengths of PUFA and ICDAS-II indices and provide a link to the widely used DMF index (M and F component). CAST index stands out with its simple hierarchical structure including the full spectrum of the disease, the categorization of the caries process according to its progression. This index covers the full spectrum of caries stages, from a sound surface(code 0), pit and fissure sealants(code 1), dental fillings(code 2), caries lesions in enamel and dentin (code 3,4,5,6), a pulpal (code 6)

and periapical inflammation, to a tooth loss due to caries (Code 8). The Codes and Description of PRS index is shown in Table 6. It does not record active and inactive carious lesions. Other limitation can be that it does not provide data on treatment or preventive measures required for each code.

Conclusion

This review found that while new caries detection criteria measured different advanced stages of the caries process, there were inconsistencies on how the caries process was measured. The future of research, practice, and education in cariology requires the development of an integrated definition of dental caries and uniform systems for measuring the caries process. Many new indices have been developed to assess caries but we are far away from finding an ideal caries index which can replace or overcome limitations of DMF index.

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