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A comparison of DMFT, ICDAS II and CAST

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Abstract
Introduction: Epidemiological indices are frequently used for oral health research, they are used to quantify and compare the prevalence of dental caries and periodontal diseases. They allow to know the clinical stage of the disease in each individual which facilitates the comparison between populations.
Objective: To analyze the literature on the advantages and disadvantages of caries evaluation systems such as the decayed, missing and filled teeth index (DMFT), the International Caries Detection and Assessment System index (ICDAS ll) and the Caries Assessment Spectrum and Treatment (CAST) from the pediatric dentistry point of view.
Methodology: Systematic review of the literature on the clinical detection of caries and among the research criteria for measuring dental caries with application in pediatric dentistry with the DMFT, ICDAS ll and CAST measurement systems.
Results: Based on the literature it was found that the DMFT, despite being the quickest method to apply, had the disadvantage of underestimating the occurrence of lesions. ICDAS ll, on the other hand, records detailed information on caries severity through a time-consuming measurement. CAST allows information on disease distribution, lesion severity, and preventive/therapeutic needs to be obtained at a similar time rate as DMFT.
Conclusions: The measurement systems for clinical caries detection (DMFT, ICDAS ll and CAST) have a strong correlation on the results of each other, suggesting that the overall caries status can be inferred on the basis of these systems, with CAST being a better evaluation system in the area of pediatric dentistry.

Keywords: Caries, prevalence, DMFT, ICDAS II, CAST

1. Introduction

In the last two and a half years the world has faced a pandemic generated by SARS-CoV-2, aggravating multiple public health problems worldwide. Such is the case of chronic non-communicable diseases associated with poor eating habits, especially the high intake of processed foods and sugary drinks [1].
Dental caries not only affects most adults, but also affects 60%-90% of the child population. The first permanent molars are the teeth that most commonly present carious lesions in the pediatric population [2]. They play a key role in establishing the dental occlusion of each individual. Poor prevention and early detection of carious lesions results in many children requiring restorative treatment and/or extractions [3]. Thus there is a strong correlation between the experience of dental caries in early childhood and the experience of dental caries in early adolescence [4]. The findings attest to the great importance of reinforcing preventive measures in order to have a better control of dental caries prevention among young people [5]. The timely detection of carious lesions in epidemiological surveys should be carried out properly, using detection instruments that are not complicated, that are validated, and that can meet the required objectives [6]. However, the estimation of caries prevalence using different caries assessment methods gives inconsistent results in many occasions. The actual burden of dental caries prevalence varies with the assessment tool used. In this paper we analyzed the literature on caries diagnostic assessment systems, such as the decayed, missing and filled teeth index

(DMFT), the International Caries Detection and Assessment System (ICDAS II) and the Caries Assessment Spectrum and Treatment (CAST) indices.

2. Materials and Methods
Articles on the subject published through the PubMed, SCOPUS and Google Scholar databases were analyzed, with emphasis on the last 5 years. The quality of the articles was evaluated using guidelines, i.e., identification, review, choice and inclusion. The quality of the reviews was assessed using the measurement tool for evaluating systematic reviews. The search was performed using Boolean logical operators AND, OR and NOT, with the keywords: "caries", "prevalence", "DMFT", "ICDAS II", "CAST". The keywords were used individually, as well as each of them related to each other.

3. Results and Discussion
3.1 DMFT Index
Dental caries is the most common chronic childhood disorder worldwide. The DMFT index (decayed, missing and filled primary teeth) is one of the most important epidemiological indices in the field of dentistry [7]. The evaluation of this indicator in the population can help us in the future planning of health care programs [7]. This index was developed more than 80 years ago. Operating in the permanent dentition, it is the sum of the number of teeth (range 0-28) or surfaces (range 0-128) that are decayed (D), missing (M) or filled (F) in an individual. The diagnostic threshold for the carious tooth component (D) in DMFT is the cavitated dentin lesion [8]. This method has the advantage that it is easy to apply, reaching high levels of reproducibility. however, it excludes the pre-cavitation stages from the measurement of carious lesions [8].

The World Health Organization (WHO) estimate of DMFT for 12-year-old children reported that in the 188 countries that were included in their database, worldwide, 200, 335 and 280 teeth were found decayed, filled or missing [9]. The prevalence of dental caries is expressed as the mean DMFT value which does not correctly reflect the skewed distribution, leaving high caries subgroups unidentified in the population [9]. The most commonly used epidemiological scale to determine dental status is the DMFT index of permanent teeth [7], which can be used in future studies to more accurately reflect the severity of the caries epidemic in terms of lesions affecting the tooth surface [13]. Age plays an important role in such an assessment for caries prevalence [14].

Epidemiological changes in the dental caries picture over the past 2-3 decades have made it increasingly evident that mean DMFT values do not capture the development of carious lesions, thus there is a more skewed distribution of carious lesions [10]. Caries prevalence should not be based on the DMFT index, but on cavitated dentin carious lesions, as the M and F components do not give reference to a stage of the disease per se [11].

The average DMFT score for Nevada youth, although higher than the national average and in some of the subgroups higher than the target average DMFT of 3.0, demonstrates how skewed the current problem of carious lesions present is and that it does not truly reflect the true extent of the prevalence or severity per se of carious lesions in all subgroups of the population [12].

Despite being the quickest method to apply and likewise having easy reproducibility, it has as a disadvantage according to its classification for the clinical evaluation of caries, that it underestimates the presence of non-cavitated carious lesions.

3.2 International Caries Detection and Assessment System II (ICDAS II)
International Caries Detection and Assessment System (ICDAS) was developed in 2001. It aims to create a caries detection method that can be used universally and allow clinicians, researchers and epidemiologists to measure and identify caries disease at different stages [8]. It is practical, has content validity, correlational validity with histological examination of pits and fissures in extracted teeth and discriminant validity. [15]. This method was updated as ICDAD II for the coronal and root surface, and for the evaluation of caries associated with restorations and sealants (CARS) [8]. It is a method which has a two-digit coding; For caries, the method ranges from healthy teeth (code 0), through enamel caries lesions (codes 1-3), to carious lesions in dentin (codes 4-6); for sealant and restoration, on the other hand, the method varies from 0 = Sound, 1 = Sealant, partial, 2 = Sealant, complete, 3 = Tooth-colored restoration, 4 = Amalgam restoration, 5 = Stainless steel crown, 6 = Porcelain or gold or porcelain-fused-to-metal (PFM) crown or veneer, 7 = Missing or broken restoration, 8 = Temporary restoration. Each surface is examined/coded [8]. According to the standard criteria required by WHO, ICDAS has a greater impact on carious lesion estimates [16]. Its inclusion of non-cavitated lesions affected the estimates of prevalence and extent of dental caries, mainly when ICDAS was used as a tool. However, no impact was observed between caries association and population socioeconomic variables [16]. ICDAS obtains more detailed information on lesion severity. However, it was a slow to apply and difficult to analyze [17].

ICDAS employs standard examination procedures. An important and essential element of this tool is the cleaning of the tooth surface to properly facilitate the detection of carious lesions, since these lesions can develop where there is a stagnation of dentobacterial plaque [18].

In order to perform the application of this method, the system requires the tooth surface to be completely dry in order to assess and diagnose early carious lesions of the enamel, which makes epidemiological surveys more time and money consuming [3]. Moreover, this method is not practical, especially in developing and underdeveloped countries, as well as in socioeconomically disadvantaged populations in developed countries [3]. ICDAS II is a method sensitive to interpretation and the use of codes, which is not desired for a caries diagnostic system that is intended to be used internationally [22].

ICDAS aims to evaluate the different stages of carious lesions and describes the restorative status of the tooth, thus promoting new preventive approaches and curative needs. However, further studies should be performed to confirm these findings [19]. It is important to introduce an early diagnosis of dental caries from the presence of incipient lesions; in this way, it would be possible to reinforce community public oral health programs, inserting preventive activities from the first years of life [20]. The ICDAS method is so far the best option for preventive purposes [21].

The reproducibility of the ICDAS II criteria is high for the diagnosis of lesions limited to the enamel as well as those that penetrate deep into the dentin [23].

ICDAS-II takes twice as long to apply compared to the DMFT system, according to WHO criteria, however, it provides us with more information on non-cavitated caries lesions [24]. The ICDAS II system showed higher validity for

assessing occlusal caries in primary molars [25]. Furthermore, it is an index of choice for the detection and assessment of occlusal caries in the primary dentition [26].

It is important to remember that the treatment strategies used for the management of carious lesions have changed considerably over the last few years. These strategies have shifted from surgical and restorative interventions to non-surgical and minimally invasive management aimed at preserving tooth structure throughout the life cycle [24,27].

The ICDAS method has several benefits, including high accuracy, as it codes the various stages of carious lesions, helping clinicians and researchers to differentiate the different stages of carious lesions. However, as previously reported, ICDAS has lower reproducibility compared to DMFT.

3.3 Caries Assessment Spectrum and Treatment (CAST)

Caries Assessment Spectrum and Treatment (CAST) index reveals a range of carious lesion development from a non-cavitated state to advanced carious lesions [28,29]. Presenting a simple hierarchical structure of the caries spectrum. Likewise, it is a promising index for complex epidemiological studies [30]. It aims to provide a valid reporting system that can be combined with ICDAS II and DMFT methods [8]. Such a system covers from the sound stage, through sealant, restoration and up to different stages of carious lesions. It can be used at both surface and tooth level. The code is increasing as the severity of the lesions increases due to the caries process [8]. One of the great advantages of this index is that it does not require the tooth surface to be dry, which makes it a simple diagnostic tool [8]. It detects the entire spectrum of dental caries, including preventive, restorative treatments, as well as caries with enamel and dentin involvement, and this in turn is able to record the advanced stages of caries progression, as well as pulp involvement, whether they present a periapical lesion or fistula or the eventual loss of teeth [8]. This system also complies with all WHO criteria for the correct diagnosis of caries [8].

A limitation of the CAST system is the total absence of lesion activity [29]. Its reproducibility in clinical studies was evaluated as substantial to almost perfect depending on the age of the participants [31]. Reproducibility for use in the primary dentition of children aged 2 to 6 years and children aged 6 to 9 years was "substantial" to "almost perfect". The reproducibility for use in the permanent dentition of 19 to 30 year olds was "near perfect". That is why this system can be reliably carried out in epidemiological studies covering such age ranges [6].

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Its application in epidemiological surveys is very promising. However, it needs to be validated and its reliability and usefulness needs to be tested in different age groups in different countries and cultures [33]. For full spectrum detection of carious lesions [3].

This system describes very well the distribution of the disease and identifies the severity of such lesions and the preventive, curative needs and time required for its application. The CAST system shows similarities with the DMFT system [17].

It provides us with a full range of the dental caries treatment spectrum for proper disease planning and management [34]. Which can allow an overview of the proper severity of the disease and classification of individuals into mild, moderate or severe levels of dental caries when using the new formula [35]. This same discriminates caries risk factors similar to the DMFT index when caries experience was the outcome [36].

CAST system advantages, according to WHO criteria [37], it is a simple and easy to apply index, to have an international use [38], as it shows enough promise to be the future for quantifying the caries spectrum [39]. However, there is currently not enough research investigating the effect of magnification on the use of CAST visual scoring systems for detection of carious lesions in permanent dentition [40].

The Caries Assessment Spectrum and Treatment (CAST) index has demonstrated a high value given its efficacy for the detection and assessment of carious lesions, detecting the full spectrum of caries.

4. Conclusions

Accuracy, reproducibility and WHO criteria for caries diagnostic assessment systems such as DMFT, ICDAS II and CAST are extremely important for developing and planning effective health actions. Although there is controversy regarding the measurement systems for clinical caries detection (DMFT, ICDAS II and CAST), there is a strong correlation on the results of each, suggesting that the overall caries status can be inferred based on these systems, with CAST being a better assessment system in the area of pediatric dentistry.

5. Conflict of Interest

Not available

6. Financial Support

Not available

7. References

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