

REVIEW ARTICLE

Dental Indices in Pediatric Dentistry: Clinical Applications, Critical Appraisal and Contemporary Perspectives

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ABSTRACT

Dental indices provide standardized methods for converting clinical observations into numerical measures that can be used for individual assessment, clinical research and population-based oral-health surveillance. Their importance is particularly evident in pediatric dentistry, where oral conditions change continuously with growth, eruption and transition from primary to permanent dentition. An appropriate index can assist in assessing oral hygiene, plaque accumulation, gingival inflammation, periodontal status, dental caries, developmental enamel defects, fluorosis, malocclusion and traumatic dental injuries, while also supporting evaluation of preventive interventions and treatment needs. However, the existence of numerous indices creates an important challenge: an index that is suitable for one clinical or epidemiological purpose may be inappropriate for another. This narrative review integrates established and contemporary concepts related to dental indices, with emphasis on their application in children and adolescents. The characteristics and classification of indices are discussed, followed by consideration of commonly used systems for oral hygiene, plaque and calculus, gingival and periodontal conditions, dental caries, enamel defects, fluorosis, malocclusion and dental trauma. Particular attention is given to the influence of age, dentition, feasibility, examiner calibration and the distinction between screening and definitive diagnosis. The review emphasizes that selection of an index should be guided by the clinical question, characteristics of the population and intended use rather than familiarity with a particular scoring system. Properly selected and standardized indices

remain valuable tools for pediatric clinical practice, research and public-health planning.

Introduction

The importance of indices is particularly evident in pediatric dentistry. Children experience eruption and exfoliation of teeth, transition from primary to mixed and permanent dentition, and considerable changes in oral-hygiene behavior and disease susceptibility. Therefore, an index used in children should be appropriate for the child's developmental stage and dentition [1-3]. Indices are useful for establishing baseline status, evaluating preventive interventions, assessing treatment needs, motivating children and caregivers, and generating data for oral-health programs.

The evolution of dental indices represents an attempt to balance accuracy and sensitivity with simplicity and feasibility. Comprehensive systems provide greater detail but require more examination time, whereas simplified systems are easier to apply but may provide less information [4-6]. This balance is particularly relevant in children because cooperation and examination time may influence the reliability of observations. This narrative review integrates the major dental indices relevant to pediatric dentistry, focusing on their purpose, application, limitations and appropriate selection rather than describing each index as an isolated scoring system.

Thematic Section

Concept, Classification and Characteristics of Dental Indices

A dental index is a graduated numerical scale with defined criteria that allows a particular oral condition to be expressed quantitatively. Depending on its design, an index may measure presence, extent, severity, cumulative disease experience or treatment requirement [1,2,5].

Indices can be classified in several ways. Cumulative or irreversible indices record evidence of present and past disease, whereas reversible indices permit monitoring of improvement or deterioration. DMFT/dmft is a classic cumulative measure, while plaque and gingival indices can demonstrate changes following preventive

intervention [2,5].

They may also be full-mouth or partial-recording indices. Full-mouth systems provide comprehensive information but require more time, whereas simplified systems examine selected teeth or surfaces to improve feasibility. The choice should depend on whether the selected sites adequately represent the condition being investigated.

According to purpose, indices may be used for individual clinical assessment, clinical trials, epidemiological surveys, disease assessment or treatment-need assessment [2,5]. A useful index should demonstrate validity, reliability, clarity, objectivity, quantifiability, sensitivity, acceptability and feasibility [1,2,5]. Examiner training and calibration are especially important because differences between examiners can otherwise be mistaken for actual differences in disease status [6,7].

Indices for Oral Hygiene, Plaque and Calculus

Oral Hygiene and Plaque Indices

The Oral Hygiene Index (OHI) developed by Greene and Vermillion quantified oral cleanliness by combining debris and calculus measurements. The Simplified Oral Hygiene Index (OHI-S) reduced the number of surfaces examined and consequently improved practicality for surveys and routine assessment [5].

Although OHI-S is widely used, its original selection of teeth and surfaces was developed mainly around erupted permanent teeth. Its direct application in young children or mixed dentition may therefore be inappropriate in some situations [5,8]. Recent efforts to develop child-oriented oral-hygiene indices emphasize the importance of systems specifically applicable to primary and mixed dentition [7,8].

Plaque-specific indices, including the plaque component of the Periodontal Disease Index, Quigley-Hein and its modifications, Silness-Löe Plaque Index and Plaque Control Record, were developed for different clinical and research purposes [9-11]. Their principal difference lies in whether they emphasize the amount, distribution or percentage of plaque-covered surfaces.

In children, plaque indices are particularly useful for

baseline assessment, motivation and monitoring of oral-hygiene interventions. They are also relevant during orthodontic treatment, when fixed appliances create plaque-retentive areas. However, complex scoring methods may reduce cooperation and reproducibility in younger children.

Calculus Indices

Specific systems such as the Calculus Surface Index, Calculus Surface Severity Index and Marginal Line Calculus Index permit focused assessment of calculus accumulation [12,13]. Their application in pediatric dentistry is generally selective because plaque is often a more relevant outcome in younger children. Calculus-specific assessment becomes useful when mineralized deposits themselves constitute the research or clinical outcome.

Gingival Inflammation and Bleeding Indices

Gingival indices are important in pediatric dentistry because gingival inflammation is common and is frequently associated with plaque accumulation.

The Papillary-Marginal-Attached (PMA) Index provided an early method of assessing the distribution of gingival inflammation. The Gingival Index of Löe and Silness subsequently provided graded assessment based on clinical inflammatory changes [14-16]. These systems can be used to monitor changes following oral-hygiene intervention.

Bleeding-based indices provide another approach to gingival assessment. Because bleeding is a clinically observable manifestation of inflammation, such indices can be useful for evaluating changes over time. However, probing technique and force must be standardized.

In children, examination should be as atraumatic as possible. Excessive probing, prolonged procedures or complicated scoring can reduce cooperation and increase measurement variability. Consequently, the most detailed index is not necessarily the most appropriate one for every pediatric setting. Examiner calibration remains essential when gingival scores are compared across examiners or study groups [17,18].

Periodontal Assessment and Treatment-Need Indices

The Periodontal Index of Russell, Periodontal Disease Index of Ramfjord and Extent and Severity Index represent important developments in quantitative periodontal assessment [19-22].

Their application in children requires caution because pediatric periodontal tissues cannot simply be considered smaller versions of adult periodontal tissues. Gingivitis is relatively common in children, whereas destructive periodontal disease is considerably less common in healthy young populations. Eruption and exfoliation also influence the appearance of gingival tissues and the selection of recording sites.

The Community Periodontal Index of Treatment Needs (CPITN) was developed to combine periodontal findings with treatment requirements and facilitate population-level planning [23]. However, screening indices should not be interpreted as comprehensive diagnostic examinations.

The development of Periodontal Screening and Recording (PSR) and Basic Periodontal Examination (BPE) further demonstrates the distinction between screening and diagnosis [24-26]. Such systems can identify areas requiring further investigation, but detailed clinical and radiographic assessment remains necessary when periodontal disease is suspected.

Therefore, pediatric periodontal index scores should always be interpreted according to age, eruption status, dentition and the expected pattern of periodontal health.

Dental Caries Indices

DMFT/dmft

The DMFT index remains one of the most widely used measures of dental caries experience. It records decayed, missing and filled permanent teeth, with the corresponding lower-case notation used for primary teeth [27,28].

Its principal advantages are simplicity, familiarity and comparability across populations. However, DMFT/dmft is primarily a measure of cumulative caries experience. It does not fully describe lesion activity, early non-cavitated disease, lesion distribution or the clinical differences between children with the same total score.

Mixed dentition creates additional challenges because primary and permanent teeth coexist. Accurate

identification of dentition and the reason for tooth loss is essential to avoid incorrect classification.

Modified and Severity-Oriented Caries Measures

Several modifications have been developed to address limitations of conventional DMFT. Anaise investigated modifications intended to improve representation of caries experience and severity [28,29].

The appropriate caries index depends on the objective. A simple cumulative measure may be sufficient for broad epidemiological comparison, whereas a clinical trial investigating preventive interventions may require a more sensitive measure of disease progression or severity.

Thus, caries measurement should clearly distinguish whether the intended outcome is prevalence, cumulative experience, severity, progression or treatment history.

Pit and Fissure and Root Caries

Specialized systems have also been developed for pit and fissure caries, including approaches described by Horowitz and Backer-Dirks [30,31]. These are particularly relevant to children because newly erupted permanent molars are susceptible to fissure caries.

The Root Caries Index developed by Katz provides a standardized approach to root-surface caries assessment [32]. Although root caries is predominantly an adult concern, selective assessment may be relevant in particular adolescent populations.

Developmental Enamel Defects and Fluorosis

Developmental enamel defects may manifest as changes in enamel color, structure or morphology. Their standardized assessment is important because they may influence esthetics, sensitivity and susceptibility to caries.

The Developmental Defects of Enamel (DDE) Index and its modifications provide standardized approaches to recording enamel abnormalities. The Modified DDE Index developed by Clarkson and O'Mullane refined this approach for epidemiological application [33].

In children, developmental defects must be

differentiated from acquired conditions such as caries, trauma and post-eruptive changes. Standardized illumination, drying and examination criteria are therefore important. Recent pediatric research continues to demonstrate the epidemiological relevance of developmental enamel defects [34].

Dental fluorosis

Several indices have been developed for dental fluorosis because its appearance varies considerably in severity. Dean's Fluorosis Index provided an early and practical method for individual and community assessment [35]. Other systems, including the Tooth Surface Index of Fluorosis and Thylstrup-Fejerskov Index, allow more detailed surface-based or severity-oriented assessment [36-38].

The choice should correspond to the objective. A community survey may favor simplicity, whereas detailed clinical or research assessment may require greater sensitivity.

Treatment-Need And Bone Assessment Indices

Treatment-need indices are designed to estimate the level of care required rather than simply describe disease. CPITN represents an important example of linking periodontal findings with treatment requirements [23]. Such indices can assist public-health planning but should not independently determine treatment for an individual child.

The Gingival Bone Count developed by Dunning and Leach represents an earlier approach to assessing periodontal supporting structures [39]. In pediatric patients, radiographic evaluation of alveolar bone should nevertheless be based on appropriate clinical indications rather than routine index scoring.

Malocclusion And Orthodontic Treatment-Need Indices

Malocclusion is multidimensional and can involve tooth position, overjet, overbite, crossbite, open bite and other occlusal characteristics. Consequently, different indices have been developed for treatment priority, severity and treatment outcome.

The Handicapping Labio-lingual Deviation Index, Index of Orthodontic Treatment Need (IOTN), Dental Aesthetic Index (DAI), Occlusal Index and Peer Assessment Rating (PAR) Index represent different

approaches [40-45].

The IOTN focuses on orthodontic treatment priority, whereas the DAI provides a standardized description of selected occlusal characteristics [41,43]. The PAR Index is particularly useful for assessing changes produced by orthodontic treatment rather than simply determining treatment need [46].

In pediatric dentistry, these indices must be interpreted in relation to growth and dental development. The developing occlusion is dynamic, and some features may change naturally with eruption and growth. Therefore, an index score should complement clinical judgment rather than function as an isolated determinant of treatment.

Dental Trauma Indices

Traumatic dental injuries are important in childhood and may involve enamel, dentin, pulp, periodontal tissues and supporting structures. Standardized classification facilitates epidemiological recording, clinical documentation and research.

The Dental Trauma Guide provides a structured approach to recording traumatic injuries and treatment recommendations [47]. The Modified Eden Baysal Dental Trauma Index further expanded classification to include soft-tissue injuries [48].

However, trauma indices cannot capture every clinically relevant feature. Pulp status, periodontal injury, displacement, root or alveolar fracture, extra-alveolar time and radiographic findings may require separate assessment. Thus, trauma indices should be considered standardized recording systems rather than substitutes for comprehensive diagnosis.

Discussion

Clinical Applications in Pediatric Dentistry

Dental indices have several important applications in pediatric dentistry.

Clinical assessment: Index scores can establish a baseline and permit monitoring of changes following preventive or therapeutic interventions.

Patient motivation: Numerical scores can help children and caregivers visualize improvement in oral hygiene and reinforce preventive behavior.

Clinical research: Indices provide standardized

outcome measures in clinical trials. The selected index should correspond directly to the primary research objective.

Epidemiological assessment: Standardized indices permit estimation of disease burden and comparison between populations, provided that examination criteria are consistent.

Treatment planning: Treatment-need indices can assist in estimating population requirements, although individual treatment decisions require comprehensive clinical assessment.

Preventive programs: Repeated measurements can help evaluate the effect of oral-hygiene education, fluoride interventions and other preventive strategies.

Critical Appraisal and Selection of an Appropriate Index

The availability of numerous dental indices provides flexibility but also creates the possibility of inappropriate selection. The first consideration should be what exactly is being measured. Plaque reduction requires a plaque-related measure, cumulative caries experience may be assessed using DMFT/dmft, fluorosis requires a fluorosis-specific system, and orthodontic outcome requires an index capable of detecting occlusal change.

The age and dentition of the population are equally important. An index developed primarily for permanent teeth cannot automatically be assumed to be appropriate for primary or mixed dentition. Examination time, child cooperation, equipment and examiner training should also be considered.

Finally, validity and reliability must be considered together. A simple index with clearly defined criteria and good calibration may provide more useful data than a highly detailed system that cannot be applied consistently [7,18].

Limitations and Future Perspectives

An index necessarily reduces a complex biological condition to a numerical value and therefore cannot capture every clinical characteristic. Two children with identical caries scores may have different lesion distributions, disease activity and treatment needs. Similarly, an overall oral-hygiene score may conceal localized problems.

Partial-recording indices improve feasibility but may not always represent the entire mouth, whereas comprehensive systems require more time and effort. In addition, indices developed for specific populations

may not be directly transferable to all age groups or dentitions.

Future development should emphasize child-specific indices, particularly for primary and mixed dentition. Recent efforts to develop pediatric oral-hygiene assessment systems demonstrate this need [8]. Digital records and photographic documentation may improve data recording, but technology cannot replace clearly defined diagnostic criteria and examiner calibration.

Future indices may also need to represent disease activity and severity more effectively. This is particularly important for dental caries, where early lesions may not be adequately represented by traditional cumulative measures. Integration of clinical measures with patient-centered outcomes may further improve assessment of pediatric oral health.

Conclusion

Dental indices provide standardized methods for measuring oral conditions and remain important tools in pediatric clinical practice, research and public-health planning. Their applications extend across oral hygiene, gingival and periodontal conditions, dental caries, enamel defects, fluorosis, malocclusion and dental trauma.

In children, index selection requires particular attention to age, dentition, developmental stage, purpose of assessment, feasibility and examiner calibration. No single index can adequately describe all aspects of pediatric oral health. The most appropriate index is therefore not necessarily the most detailed or most widely used, but the one that best answers the specific clinical or research question.

Ultimately, dental indices should complement rather than replace comprehensive clinical assessment. Their greatest value lies in providing reproducible, meaningful measurements that can support diagnosis, monitoring, prevention, research and oral-health planning.

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