A Comparative Study of DMF Index and ICDAS in Pediatric Caries Monitoring

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Abstract: Dental caries remains a prevalent oral health issue globally, significantly affecting children's health and overall well-being in the United Kingdom. Despite improvements over the past two decades, caries continues to be the most common oral disease among children, impacting their physical and psychological health, as well as their academic performance. Effective monitoring and assessment of dental caries are crucial for the development of preventive strategies and public health initiatives. This study compares the Decayed, Missing, and Filled (DMF) Index and the International Caries Detection and Assessment System (ICDAS) in the context of UK children's oral epidemiological surveys. Key aspects such as cost, feasibility, examination time, training requirements, and the value of collected data are analyzed to evaluate the advantages and limitations of each system. The findings suggest that while the DMF Index is a cost-effective, straightforward tool suitable for large-scale epidemiological assessments, ICDAS provides a more detailed and nuanced evaluation of carious lesions, particularly beneficial for early detection and prevention in smaller, focused studies. The study concludes that the DMF Index is better suited for broad epidemiological surveys in the UK due to its practicality and simplicity, while ICDAS is more appropriate for detailed clinical research aimed at early caries prevention.

***Keywords*:** dental caries, DMF index, ICDAS, pediatric oral health, epidemiology

1. Introduction

Oral health is a global public health priority essential for enhancing quality of life, preventing diseases, and promoting societal well-being. Dental caries is the most common oral disease, affecting millions worldwide[1]. In the United Kingdom, despite notable improvements over the past 20 years, dental caries remains prevalent among children and adolescents, with nearly a third (27.9%) of five-year-olds still affected as of 2012[2]. Caries can lead to pain, infection, difficulties in eating and speaking, and negative impacts on self-esteem and school performance. Importantly, most cases are preventable.

Accurate and effective monitoring tools are vital for understanding the prevalence of dental caries and informing public health strategies. Several indices, such as the Decayed, Missing, and Filled (DMF) Index and the International Caries Detection and Assessment System (ICDAS), are used to assess caries in populations. The choice of assessment method affects the quality of epidemiological data, which is essential for guiding public health policies and interventions [3]. An ideal dental index should cover the full spectrum of caries progression, from early demineralization to advanced decay, and be valid, cost-effective, non-invasive, and easy to use [4].

The DMF Index, ICDAS, and standards from the British Association for the Study of Community Dentistry (BASCD) are widely used in the UK for dental surveys [5].

This study compares the DMF Index and ICDAS based on five aspects: cost, feasibility, examination time, training requirements, and data value. The goal is to determine why the DMF Index may be a more suitable tool for large-scale epidemiological surveys in the UK.

2. Background

The DMF Index has been the primary indicator for caries experience in dental epidemiology for approximately 50 years[6]. It quantifies the number of decayed, missing, and filled teeth (DMFT) or surfaces (DMFS), providing a simple yet effective measure of caries prevalence. For primary dentition, the method adapts to account for up to 20 teeth, where "d" and "f" represent decayed and filled deciduous teeth [7]. It is extensively used to assess community oral health and guide policy development [8].

ICDAS offers a more detailed and nuanced assessment of dental caries, advancing the understanding of caries initiation and progression in both epidemiological and clinical research contexts. Developed in 2002 and refined into ICDAS II in

2005, it classifies carious lesions on a scale from early enamel demineralization to extensive cavities, thereby promoting early intervention[9][10]. However, due to its complexity, ICDAS requires comprehensive training and longer examination times.

The National Dental Epidemiology Program for England's 2022 survey utilized the DMF Index, focusing on recording plaque presence and assessing dentine caries. This approach aligns with the need for robust statistical data for local authorities, illustrating the practical advantages of the DMF Index[5].

3. Comparison of DMF Index and ICDAS

3.1 Resources

The DMF Index is more cost-effective than ICDAS. ICDAS requires specialized equipment, such as compressed air for tooth surface drying, which adds to the cost and may not be feasible in resource-limited settings [11]. Additionally, the complexity and longer examination time of ICDAS necessitate more trained personnel, increasing labor costs. In contrast, the DMF Index only requires basic tools (dental probes, mirrors, light sources) and is accessible across different socio-economic contexts, making it a practical option.

3.2 Feasibility

The DMF Index has proven to be practical and reproducible, offering quick and reliable data collection suitable for large-scale epidemiological studies in the UK. ICDAS, although providing detailed caries classification, is limited by its need for specialized training and equipment, which may hinder its nationwide application. Studies have shown that the reproducibility of ICDAS is lower than that of the DMF Index, further supporting the latter's practicality for broad surveys [12][13].

3.3 Time Efficiency

The DMF Index is faster, averaging 3.8 minutes per examination, which facilitates smoother and quicker data collection[12]. ICDAS, requiring detailed examination and surface drying, takes longer (around 8.9 minutes), which may lead to lower participation rates, especially among children [14]. The simplicity of the DMF Index also reduces preparation and training time, while ICDAS requires extensive training programs.[15]

3.4 Training Requirements

The DMF Index is widely recognized and easy to learn, reducing training costs. In contrast, ICDAS demands rigorous and lengthy training to ensure diagnostic accuracy. The complexity of ICDAS, including its detailed coding system, necessitates continuous education and calibration, adding to overall costs and limiting its use in quick, large-scale studies. [13]

3.5 Value of Collected Data

While the DMF Index provides essential information on caries prevalence, it may underestimate early, non-cavitated lesions, potentially missing opportunities for early intervention. ICDAS addresses this gap by detecting early carious changes, providing a comprehensive assessment from early demineralization to advanced decay. This detailed data is valuable for tailored interventions but may not be necessary for general epidemiological assessments [16].

4. Conclusion

Both the DMF Index and ICDAS have unique strengths. The DMF Index excels in practicality, cost-efficiency, and ease of use, making it suitable for large-scale epidemiological studies in the UK. Conversely, ICDAS offers a detailed evaluation of carious lesions, useful for early detection and prevention strategies in focused research settings. For nationwide surveys, the DMF Index remains the more appropriate tool due to its straightforwardness, cost-effectiveness, and compatibility with large-scale implementation.

5. Recommendation

For future investigations, using a mixed approach or a phased approach, in which the DMF index is used for initial screening and cases identified as at risk are further evaluated using ICDAS for detailed assessment.

References

[1] Kassebaum, N.J., Smith, A.G.C., Bernabé, E., Fleming, T.D., Reynolds, A.E., Vos, T., Murray, C.J.L., Marcenes, W.,

Abyu, G.Y., Alsharif, U., Asayesh, H., Benzian, H., Dandona, L., Dandona, R., Kasaeian, A., Khader, Y.S., Khang, Y.H., Kokubo, Y., Kotsakis, G.A., Lalloo, R., Misganaw, A., Montero, P., Nourzadeh, M., Pinho, C., Qorbani, M., Blancas, M.J.R., Sawhney, M., Steiner, C., Traebert, J., Tyrovolas, S., Ukwaja, K.N., Vollset, S.E. and Yonemoto, N. 2017. Global, Regional, and National Prevalence, Incidence, and Disability-Adjusted Life Years for Oral Conditions for 195 Countries, 1990–2015: A Systematic Analysis for the Global Burden of Diseases, Injuries, and Risk Factors. Journal of Dental Research. 96(4), pp.380-387.

[2] Levine, R.S. 2021. Childhood caries and hospital admissions in England: a reflection on preventive strategies. British Dental Journal. 230(9), pp.611-616.

[3] Larmas, M. 2010. Has Dental Caries Prevalence Some Connection with Caries Index Values in Adults? Caries Research. 44(1), pp.81-84.

[4] Douglas, G. 2024. Oral Epidemiology, Screening and Survey Methods_G Douglas.pptx. [Online].

[5] GOV.UK. 2022. National Dental Epidemiology Programme (NDEP) for England: oral health survey of 5 year old children 2022. [Online].

[6] Broadbent, J.M. and Thomson, W.M. 2005. For debate: problems with the DMF index pertinent to dental caries data analysis. Community Dentistry and Oral Epidemiology. 33(6), pp.400-409.

[7] Osteoporosis, M.a.F.s. 2021. Epidemiology of Dental Caries. [Online].

[8] Moradi, G., Mohamadi Bolbanabad, A., Moinafshar, A., Adabi, H., Sharafi, M. and Zareie, B. 2019. Evaluation of Oral Health Status Based on the Decayed, Missing and Filled Teeth (DMFT) Index. Iran J Public Health. 48(11), pp.2050-2057.

[9] Pitts, N., Ekstrand, K. and Foundation, T.I. 2013. International Caries Detection and Assessment System (ICDAS) and its International Caries Classification and Management System (ICCMS) – methods for staging of the caries process and enabling dentists to manage caries. Community Dentistry and Oral Epidemiology. 41(1), pp.e41-e52.

[10] Ekstrand, Kim R., Gimenez, T., Ferreira, Fernanda R., Mendes, Fausto M. and Braga, Mariana M. 2018. The International Caries Detection and Assessment System – ICDAS: A Systematic Review. Caries Research. 52(5), pp.406-419.

[11] Frencken, J., de Amorim, R.G., Faber, J. and Leal, S.C. 2011. The Caries Assessment Spectrum and Treatment (CAST) index: rational and development. International Dental Journal. 61(3), pp.117-123.

[12] Campus, G., Cocco, F., Ottolenghi, L. and Cagetti, M.G. 2019. Comparison of ICDAS, CAST, Nyvad's Criteria, and WHO-DMFT for Caries Detection in a Sample of Italian Schoolchildren. International Journal of Environmental Research and Public Health. 16(21), p4120.

[13] de Amorim, R.G., Figueiredo, M.J., Leal, S.C., Mulder, J. and Frencken, J.E. 2012. Caries experience in a child population in a deprived area of Brazil, using ICDAS II. Clin Oral Investig. 16(2), pp.513-520.

[14] Castro, A.L.S., Vianna, M.I.P. and Mendes, C.M.C. 2018. Comparison of caries lesion detection methods in epidemiological surveys: CAST, ICDAS and DMF. BMC Oral Health. 18(1), p122.

[15] Ahlawat, P., Parolia, A., Hasan, Z., Smales, F.C., Pau, A. and Toh, C.G. 2014. Comprehensive Implementation of the International Caries Detection and Assessment System (ICDAS) in a Dental School and University Oral Health Centre: A Stepwise Framework. Dentistry Journal. 2(1), pp.41-51.

[16] Banava, S., Fattah, M., Kharrazifard, M.j., Safaie, T., Askarzadeh, S., Safaie Yazdi, M., Amaechi, B.T. and Fazlyab, M. 2012. Clinical Comparison of Dental Caries by DMFT and ICDAS Systems. Journal of Iranian Dental Association. 24(3), pp.146-151.