Article:
Levine, RS (2019) Might one simple question indicate a child's caries risk and guide preventive advice? British Dental Journal, 227 (9). pp. 834-836. ISSN 0007-0610

https://doi.org/10.1038/s41415-019-0858-6

Might one simple question indicate a child's caries risk and guide preventive advice?

Running title: **Might one simple question indicate a child's caries risk and guide preventive advice?**

Dr R S Levine OBE

Hon. Senior Research Fellow in Child Health
Academic Unit of Obstetrics, Gynaecology and Paediatrics
University of Leeds

and

Department of Oral Surgery
Leeds Dental Institute
University of Leeds
Worsley Building
Clarendoon Way
Leeds LS2 9LU
UK

r.s.levine@leeds.ac.uk

Abstract

That the extraction of carious teeth is the most common reason for hospital admission of under 18 year olds in England suggests that a reappraisal of preventive advice in primary dental care for this age-group is now urgently needed. Dental professional working under time constraints in areas of social deprivation and high caries prevalence need a simple approach to derermining caries risk and simple, acceptable preventive messages to convey. The advice not to give sugars sweetened food or drink in the hour before bedtime and especiallly not to put infants to bed with a feeding bottle, other than one containing just water, coupled with supervised twice daily toothbrushing with the fluoride toothpaste containing at least 1000 ppm of fluoride might be a pragmatic

way of reducing the burden of caries in such communities and the need for hospital admission for a largely preventable disease.

Introduction

That the extraction of carious teeth is the most common reason for hospital admission of under 18 year olds in England has rightly been condemned both by professional healthcare bodies and in the media as a failure to control a largely preventable disease [1]. The prevalence of caries is greatest almost the lowest socioeconomic groups and the social and emotional impact of caries and dental treatment on families is a factor sometimes overlooked, but not by those healthcare professionals who deal with its consequences. Often more long-lasting is the emotional, psychological and developmental impact on the developing child of adverse experiences, collectively termed toxic stress, of which dental extractions under general anaesthesia in an unfamiliar hospital environment must be included [2]. That the number of admissions continues to increase for the five to nine year age group and at over 26,000 admissions in 2017-2018, it is more than double that for acute tonsillitis, suggests that a reappraisal of preventive advice in primary dental care for both pre-school children and in older age groups is now urgently needed.

Assessing the risk factors for any acquired morbidity is the essential component for disease prevention both at a public health level and at an individual level. Since the beginning of the last century our understanding of caries aetiology has progressed to the point where we now can claim to have a mature and comprehensive understanding of the interlinked factors that determine caries risk.

We now see that risk as the outcome of the interaction between two groups of factors; those that combine to attack the tooth surface and favour progression

and those that combine to resist the attack and impede progression [3]. Of the latter group there are factors within the oral environment such as the fluoride concentration in the oral fluids and in plaque, the volume and composition of saliva and especially it's buffering capacity and the fluoride content of the hydroxyapatite crystals of which enamel and dentine are composed. These are the principal factors that determine the tooth surface ability to resist acid attack, which is the basic mechanism of caries initiation.

However it is the former group of factors that combine to initiate and drive the carious process forward. They are the primarily the simple dietary sugars, essentially mono and disaccharides such as sucrose, glucose and fructose [4]. These sugars are an obsequious part of our diet and on entering the mouth are taken rapidly up by organisms within the plaque on tooth surfaces and metabolised into organic acids causing a rapid fall in pH and leading to a transient period of demineralisation of the enamel surface. The length of time taken for plaque pH to return to normal is dependent on a number of factors, but primarily saliva flow rate and buffering capacity. Once plaque pH neutrality is achieved a gradual remineralisation of the enamel surface can occur. It is the balance between periods of demineralisation and remineralisation that determine whether the carious process is initiated and progresses [5]. Indeed, caries can be said to occur when net demineralisation exceeds net remineralisation over a given time period.

While the introduction of fluoride toothpaste containing at least 1000 ppm of fluoride, but not less has proved to be a major benefit for caries reduction by influencing the demineralisation/ remineralisation balance, like dietary change it requires personal compliance. Community water fluoridation is the only caries preventive measure that is effective without personal compliance or professional application and if implemented in areas with the highest caries prevalence would be of the greatest benefit. The United States Centers for Disease Control rank

water fluoridation as one of the top 10 public health achievements of the 20th century.

While good oral hygiene aimed at plaque reduction is an important tool for the prevention of both caries and periodontal disease it is nevertheless impossible to reduce plaque levels by conventional mechanical oral hygiene techniques to the point where caries could not occur, irrespective of the intake of simple sugars. It is for this reason that caries prevention advice places emphasis on reducing both the amount and frequency of intake of simple sugars and the use of fluoride. However, there is evidence that there are variations and deficiencies in the approach of some dentist to the core activity of preventing caries in young children, some giving advice not supported by the evidence base [5,6]. The aim of this paper is to explore the possibility of reducing the assessment of caries risk and associated preventive advice to one simple question - are sugar sweetened drinks or snacks consumed in the hour before bedtime?

Caries risk assessment tools

The delivery of effective oral health advice is a time consuming process. Whether provided by a salaried dental professional or a fee-earning practitioner there is no direct or immediate benefit to be gained by the recipient, but rather the hope that the development of oral disease can be prevented. Nevertheless since most oral disease is preventable it is incumbent upon all dental health professionals to provide appropriate preventive advice. Although general advice can be given at a population level, for an individual targeted and appropriate preventive advice and treatment where required must be based on an individual risk assessment. Apart from assessing oral hygiene habits and the past caries experience of the patient and older siblings the process of risk assessment can be both a difficult and tedious task. Emphasis has been placed rightfully on dietary analysis to investigate the frequency and amounts of items containing free sugars within the diet and this is especially important for risk assessment in children. Practitioners are encouraged to use dietary analysis, typically in the

form of a three-day record completed by the patients or parents. However completion of these diaries are fraught with difficulty and possibly quite unreliable [7,8]. While the essential problem is the weakness of self-reported evidence other difficulties relate to the nature of the food and drink item, the amounts consumed and the time and duration of consumption

Over recent years a number of caries risk assessment tools (CRAT) have been developed and validated. These include the Cariogram [9], Caries Management by Risk Assessment (CAMBRA®) [10] American Dental Association (ADA) [11] and American Academy of Pediatric Dentistry (AAPD) [12] The Cariogram model is a computer based CRAT which in its full form requires saliva tests including saliva flow rate, saliva buffering capacity and streptococcus mutans estimation using test strips. However a recent study suggests that the saliva tests can be omitted without impairing validity [13] While a two-year follow-up study of 7 to 9 year old children provided positive validation for Cariogram [14], a study on preschool children found that it provided caries prediction of limited value [15]. The CAMBRA, ADA and AAPD CRATs all use detailed questionnaire model coupled with a clinical examination.

While numerous studies have been conducted on the evaluation of CRATs, the results have been mixed. A recently published evaluation[16] concluded that - there is insufficient evidence to assert that CRA models are effective in determining patients' actual caries risk or in predicting their probability of developing new carious lesions. Moreover, the validity of standardised CRA models is still limited. Another review [17] concluded that - The evidence on the validity for existing systems for CRA is limited. There is an urgent need to develop valid and reliable methods for caries risk assessment that are based on best evidence for prediction and disease management rather than opinions of experts. Yet a third review [18] concluded that evidence available on the validity of a number of existing systems for caries risk assessment is limited and weak.

Caries and bedtime free sugars intake

Dental professionals working in clinical settings which provide little time and facilities for complex caries risk assessment need the means to identify simple and relevant risk factors that are amenable to behavioural change. While the majority of studies suggest that past caries experience, as indicated by the presence of existing cavities or restorations is the best indicator of future caries development, the evidence is not conclusive for all age groups and does not provide a basis for behavioural change advice [19,20,21,22]. Nor does past caries experience help achieve primary prevention. There is a need for the identification of a simple risk factor that can be easily identified and immediately eliminated by offering the parent/child simple, comprehensible and above all acceptable advice. One possible factor is the consumption of food or drink containing free sugars before the child goes to sleep. The physiological basis for the suggestion is the well-established evidence that salivary secretion falls to almost zero during sleep [23,24]. This can result in a prolonged period of enamel demineralisation following from the slow clearance of free sugars consumed before bed and a prolonged period of low plaque pH. It is now an accepted concept that caries occurs when over a period of time periods of enamel demineralisation exceed periods of remineralisation and a net demineralisation of the enamel surface follows [3].

The role of saliva in the carious process is well understood [25]. The decline of salivary flow rate during sleep and oral clearance times of food has focused attention on the bedtime consumption of sugar-sweetened food or drink by children. A study of the dietary habits of 405 11-14-year-old children found that 48% of sugars were consumed after 16.00 hrs and 27 % of sugars after 18.00 hrs [26]. A survey of 4 year-old children with a wide range of caries experience showed that only 11% had some food before bed, while 55% had a drink [27]. While the survey found a direct relationship between caries experience and frequency of sugar-sweetened snacks, the relationship with bedtime sugary

intake was not investigated. Some evidence on the relationship between bedtime drinks, but not foods and caries was provided by the 1992/3 UK National Diet and Nutrition (NDNS) Survey of pre-school children and the NDN survey of young people aged 4 to 18 years, conducted in 1997 [28,29]. However neither of these UK national surveys provides evidence on the association between both sugar-sweetened food and drinks at bedtime and caries experience.

The 2018 NDNS shows the largest reduction in free sugars intake as a percentage of total energy over a 9 year period were seen in children [30]. Children aged 1.5 to 3 years, 4 to 10 years and 11 to 18 years had reduction of 2.7, 2.4 and 3.5 percentage points since 2008. While this is good news, the free sugars intake as a percentage of total energy remains above the 5% target of the WHO nutrition guidelines and the survey results do not provide information on bedtime intake.

Evidence for an association between bedtime consumption of free sugars and caries experience has come from several studies. A study of 600 children aged 2 to 16 years from two communities in northern England with high overall caries levels who attended two general dental practices as new patients found that those in the 12-16 year age group who consumed free sugar sweetened food and drinks before bed had four times the mean DMFT score (1.24) of those who consumed neither (0.31). For the 2-5 year olds the difference in dmft was highly significant as it was independently for dmft and DMTF scores in the 6-11 year old group, [31]. A small scale cross-sectional, observational study of 128 subjects aged 12-13 from the cities Manchester and Newcastle-upon-Tyne found that the consumption of free sugars within the hour before bed revealed a statistically significant difference between the cavity/no cavity groups ($p=0.002$) with an odds ratio of 2.4 for free sugars consumption before bedtime [32]. While a carefully conducted systematic review of the association between the bedtime consumption of free sugar sweetened foods and drinks and caries in children found the quality of existing studies was poor because of confounding factors, all of the few relevant studies showed a positive and consistent association [33].

Together with the theoretical basis for this association the available evidence has led Public Health England to advise “avoid sugar sweetened food and drink at bedtime” in the widely accepted publication - Towards better dental health an evidence-based toolkit [34]. However this simple recommendation does not appear in the summary sections of prescriptive preventive advice but as a bullet point in the section on healthy eating advice, together with an extended and detailed description of the use of a 3-day diet diary. Dental professionals should be encouraged to read this document and be guided by its prescriptive recommendations.

Since the highest levels of caries in the UK are concentrated in socially deprived communities especially in northern areas, with extraction under general anaesthesia of carious deciduous teeth being the most common reason for hospital admission, a pragmatic approach to caries risk assessment and preventive advice is now urgently needed. It is appreciated that the evidence base for an association between bedtime consumption of free sugars and caries risk is not strong however the available evidence is consistent and is supported by a sound scientific basis. Further research is clearly needed to substantiate this association. However for a dental professional working under time constraints in areas of social deprivation and high caries prevalence amongst young children, the simple advice not to give sugar sweetened food or drink in the hour before bedtime coupled with supervised twice daily toothbrushing with fluoride toothpaste containing at least 1000 ppm might be a pragmatic way of reducing the burden of care in such communities and the need for hospital admission for a largely preventable disease.

References

1. https://digital.nhs.uk/data-and-information/publications/statistical/hospital-admitted-patient-care-activity/2017-18. Accessed 08/04/2019.

2. Franke HA. Toxic stress: effects, prevention and treatment. Children (Basel). 2014 Dec; 1(3): 390–402. doi: 10.3390/children1030390.

3. Levine R S & Stillman-Lowe CR. (2019): The Scientific Basis of Oral Health Education, 8th (International) ed. Springer Nature AG, Switzerland.

4. Levine R S. The aetiology of dental caries - an outline of current thought. Int Dent J 1977; 27;341-348.

5. Franki J, Hayes MJ, Taylor JA. The provision of dietary advice by dental practitioners: a review of the literature. Community Dent Health. 2014 Mar;31(1):9-14.

6. Threlfall AG[1], Milsom KM, Hunt CM et al. Exploring the content of the advice provided by general dental practitioners to help prevent caries in young children. Br Dent J. 2007 Feb 10;202(3):E9; discussion 148-9. Epub 2007 Jan 26. DOI:10.1038/bdj.2007.46.

7. Black A E, Prentice A M, Goldberg G R et al. Measurements of total energy expenditure provide insights into the validity of dietary measurements of energy intake. J Am Diet Assoc 1993; 93: 572–79.

8. Subar A F et al, Addressing Current Criticism Regarding the Value of Self-Report Dietary Data, The Journal of Nutrition, 2015;145, 2639–2645. https://doi.org/10.3945/jn.115.219634

9. Bratthall D, Petersson GH. Cariogram: a multifactorial risk assessment model for a multifactorial disease. Community Dent Oral Epidemiol 2005;33:256–64.

10. Featherstone JDB, Chaffee BW. The Evidence for Caries Management by Risk Assessment (CAMBRA). Adv Dent Res. 2018;29(1):9-14.

11. Caries Risk Assessment and Management, Center for Scientific Information, ADA Science Institute, American Dental Association 2017.

12. American Academy of Pediatric Dentistry. Policy on use of a caries-risk assessment tool (CAT) for infants, children, and adolescents. Pediatr Dent 2008;30:29–33.

13. Dou, L. , Luo, J. , Fu, X. et al. The validity of caries risk assessment in young adults with past caries experience using a screening Cariogram model without saliva tests. Int Dent J, 2018, 68: 221-226. doi:10.1111/idj.12378.

14. Campus G[1], Cagetti MG, Sale S, et al. Cariogram validity in schoolchildren: a two-year follow-up study. Caries Res. 2012;46(1):16-22. doi: 10.1159/000334932.

15. Birpou, E, Agouropoulos, A, Twetman, S et al. Validation of different Cariogram settings and factor combinations in preschool children from areas with high caries risk. Int J Paediatr Dent. 2019; 00: 1–8. https://doi.org/10.1111/ipd.12476.

16. Leal SC. Are standardised caries risk assessment models effective? Evid Based Dent. 2018 Dec;19(4):102-103. doi: 10.1038/sj.ebd.6401338.

17. Tellez, M, Gomez, J, Pretty, I, Ellwood, R, Ismail, AI. Evidence on existing caries risk assessment systems: are they predictive of future caries?. Community Dent Oral Epidemiol 2012. © 2012 John Wiley & Sons A/S. Volume41, Issue1 February 2013. doi.org/10.1111/cdoe.12003

18. Carson SJ. Limited evidence for existing caries assessment systems. Evid Based Dent. 2013 Mar;14(1):10-1. doi: 10.1038/sj.ebd.6400911.

19. Twetman S[1], Fontana M, Featherstone JD. Risk assessment - can we achieve consensus? Community Dent Oral Epidemiol. 2013 Feb;41(1):e64-70. doi: 10.1111/cdoe.12026.

20. Mejàre I[1], Axelsson S, Dahlén G et al. Caries risk assessment. A systematic review. Acta Odontol Scand. 2014 Feb;72(2):81-91. doi: 10.3109/00016357.2013.822548. Epub 2013 Sep 2.

21. Ha DH, Spencer AJ, Slade GD, Chartier AD. The accuracy of caries risk assessment in children attending South Australian School Dental Service: a longitudinal study. BMJ Open. 2014 Jan 29;4(1):e004311. doi: 10.1136/bmjopen-2013-004311.

22. Chaffee BW, Cheng J, Featherstone JD. Baseline caries risk assessment as a predictor of caries incidence. J Dent. 2015 May;43(5):518-24. doi: 10.1016/j.jdent.2015.02.013. Epub 2015 Feb 27.

23. Schneyer LH, Pigman W, Hanahan L, Gilmore RW. Rate of flow of human parotid, sublingual, and submaxillary secretions during sleep. J Dent Res 1956;35(1):109-114.

24. Dawes c. Salivary flow patterns and the health of hard and soft oral tissues. JADA 2008;139(5 suppl):18S-24S

25. Edgar W M & O'Mullane D M (1990). Saliva and Dental Health. pp 1-24. London, BDJ Books.

26. Hackett, A. F., Rugg-Gunn, A. J., Appleton, D. R., Allinson, M., and Eastoe, J. E. (1984): Sugars-eating habits of 405 11 to 14 year old English children. British Journal of Nutrition **51,** 347-56.

27. Holt, R. D. (1991): Food and drinks at four daily time intervals in a group of young children. British Dental Journal **170**,137-143

28. Hinds K. and Gregory J.R. National diet and nutrition survey: children aged 1 ½ to 4 ½ years. Volume 2: Report of the dental survey, London: HMSO, 1995.

29. Walker A, Gregory J, Bradnock G, Nunn, J, White D. National Diet and Nutrition survey: young people aged 4 to 18 years. Volume 2: Report of the Oral Health Survey. TSO, London, 2000.

30. https://data.gov.uk/dataset/22d06941.../national-diet-and-nutrition-survey-years-5-9. Accessed 08/04/2019.

31. Levine R S. Caries experience and bedtime consumption of sugar-sweetened foods and drinks - a survey of 600 children. Community Dent Health 2001;18:228-231.

32. Goodwin M, Patel DK, Vyas A et al. Sugar before bed: a simple dietary risk factor for caries experience. Community Dent Health. 2017 Mar;34(1):8-13. doi: 10.1922/CDH_3926Goodwin06.

33. Baghlaf, K., Muirhead, V., Moynihan, P., Weston-Price, S., & Pine, C. (2018). Free Sugars Consumption around Bedtime and Dental Caries in Children: A Systematic Review. JDR Clinical & Translational Research, 3(2), 118–129. https://doi.org/10.1177/2380084417749215.

34. Public Health England. Delivering better oral health: an evidence-based toolkit for prevention – summary guidance tables. Third edition. London: Public Health England, 2017. https://www.gov.uk/government/uploads/...data/.../Delivering_better_oral_health.pdf. Accessed 08/04/2019.