

Dental erosion – changing prevalence? A review of British national childrens' surveys

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Summary. *Objectives.* To investigate the change in the prevalence of dental erosion, over time, by a review of the data from the published national dental surveys of young people in the UK. A subsidiary objective was to investigate the relationship between erosion and possible associated risk factors.

Design. The review was based on cross-sectional prevalence studies incorporating a clinical dental examination and structured interviews.

Sample. The data were collated from the 1993 UK childrens' dental health survey and the dental report of the two National Diet and Nutrition Surveys (NDNS) of children aged 1½–4½ in 1992/3 and 4–18 years in 1996/7. The criteria used for data collection were comparable between the three different studies.

Results. Comparing the data from the different studies, the prevalence of erosion was seen to increase from the time of the childrens' dental health survey in 1993 and the NDNS study of 4–18-year-olds in 1996/7. There was a trend towards a higher prevalence of erosion in children aged between 3½ and 4½ and in those who consumed carbonated drinks on most days compared with toddlers consuming these drinks less often. Drinks overnight were associated with an increased prevalence of erosion. More 4–6-year-olds with reported symptoms of gastro-oesophageal reflux had erosion compared with symptom-free children. On multivariate analysis, the strongest independent association with erosion was geography, with children living in the North having twice the odds of having erosion compared with those in London and the South-east.

Conclusions. Comparing prevalence data from cross-sectional national studies indicates that dental erosion increases between different age cohorts of young people over time. Dietary associations with erosion are present but weak. Similarly, there is an association apparent between erosion, symptoms of gastro-oesophageal reflux and socio-demographic variables such as region of domicile, social class, and receipt of social benefits.

Introduction

Epidemiological studies of dental erosion have established that the prevalence is high in young

people and adolescents [1–3]. This is not a universal finding however, as in the United States, erosion has not been shown to be a prevalent condition, although this probably has more to do with the way in which the Americans record tooth wear than with real differences in prevalence [4]. There is also acknowledgement that the aetiology of dental erosion is multifactorial, with extrinsic factors such as diet

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playing a significant part [2,5–7] but intrinsic factors like gastro-oesophageal disease and other medical conditions being responsible for some dental erosion [8–11]. Whereas the prevalence of dental erosion in young people is acknowledged to be a problem, much less is known about the incidence of the condition [5,12].

The largest epidemiological study of dental erosion in young people in the UK was the national children's dental health survey of 1993 [13]. A similar assessment of dental erosion was also included in the oral health surveys conducted as part of the National Diet and Nutrition Surveys of preschool children in 1992–3 [14] and of school-age children in 1996/7 [15]. These do not constitute incidence studies but the three surveys give an indication of the prevalence of dental erosion for different age cohorts at different time periods. In addition, the surveys provide some evidence as to the relationship between diet, medical factors, and erosion. This paper aims to review the published data on the prevalence of dental erosion as recorded in these national oral health surveys of young people. In addition, it looks at the relationship between dental erosion and the intrinsic as well as extrinsic factors known to influence its prevalence and incidence, although these were not incidence studies per se.

Method

The national survey of Children's Dental Health as well as the oral health components of both the 1½–4½-year-old's and the 4–18-year-old's National Diet and Nutrition Surveys (NDNS) all used the same criteria for the assessment of dental erosion [13–15] (Table 1). The index was essentially a modification of the Smith and Knight Index [16] as the latter is a wear index and not designed to assess dental erosion specifically. Community dental officers who had all undergone similar training and

calibration exercises with the same trainers used the index. The exception was for the toddler's survey (NDNS for 1½–4½ year olds) where training had been undertaken using slides only.

In both the children's survey [13] and the 1½–4½-year-old's NDNS Survey [14], the labial and palatal surfaces of the primary or permanent maxillary incisors were examined for erosion. In the NDNS 4–18-year-old's survey [15], the labial and palatal surfaces of primary or permanent maxillary incisor teeth as well as the occlusal surfaces of the first primary and/or first permanent molar were included in the assessment of erosion.

Details of a child's diet were collected in the survey of 1½–4½-year-olds from a 4-day weighed dietary intake record and in the NDNS survey of 4–18-year-olds, from a 7-day weighed dietary intake record. In addition, the latter survey asked young people, in an oral health questionnaire, about food and drinks consumed during the day and night, including how drinks were consumed and how long they made a drink last [15]. Similar, appropriate questions were addressed to the parents of the 1½–4½-year-olds. No dietary questions were included in the national children's dental health survey [13].

Because of the possible link between aspects of general health and the potential for dental erosion, the oral health questionnaire of the NDNS survey of the 4–18-year-olds asked about asthma and chest problems as well as symptoms indicative of gastro-oesophageal reflux [15]. Where appropriate, logistic and multiple regression analyses were undertaken on the data.

Results

The number of children available for the oral examination was 17,061, 1451 and 1726 in the Children's Dental Health Survey, the NDNS 1½–4½-year-olds and NDNS 4–18-year-olds surveys, respectively. Data for right and left teeth as well

Table 1. Criteria for the assessment of dental erosion.

Code 0	Normal
Code 1	Enamel only – on incisor teeth there is a loss of developmental ridges resulting in smooth, glazed or 'ground glass' appearance. On occlusal surfaces the cusps appear rounded and there may be depressions producing 'cupping'.
Code 2	Enamel and dentine – there is loss of enamel exposing dentine. On incisors this may resemble a 'shoulder preparation' parallel to the crest of the gingivae, particularly on palatal surfaces. The incisors may appear shorter and there may be chipping of the incisal edges. On occlusal surfaces 'cupping' and rounding-off of cusps is evident. Restorations may be raised above the level of the adjacent tooth surface.
Code 3	Enamel, dentine and pulp – loss of enamel and dentine resulting in pulpal exposure.
Code 9	Assessment cannot be made.

Table 2. Proportion of children with any erosion.

	Incisors Buccal surface	Incisors Palatal surface	Ds	6s
NDNS 1½–4½ year olds (1992/3)				
1½–2½ yr	7*	9*	–	–
2½–3½ yr	10*	18*	–	–
3½–4½ yr	14*	29*	–	–
Children's Dental Health Survey (1993)				
5–6 yr	18*	51*	–	–
7–10 yr	5	14	–	–
11–15 yr	11	28	–	–
NDNS 4–18 year olds (1996)				
4–6 yr	9	10	46	–
7–10 yr	9	25	56	12
11–14 yr	23	42	–	26
15–18 yr	36	56	–	34

*primary incisors.

Ds = first primary molars.

6s = first permanent molars.

as for males and females have been combined as the prevalence was shown to be very similar.

Table 2 shows the prevalence of any erosion affecting incisors and molars in young people taking

part in the three surveys spanning the five years 1992–97. For all ages and both dentitions, erosion is seen to increase with age. This is the case for incisors as well as molar teeth. However, the prevalence of any erosion in both primary and permanent incisors is greater in the NDNS school-age study than in similar-aged young people in the children's dental health survey conducted three years earlier. For example, amongst 4–6-year-olds, 18% of labial surfaces of primary incisors were affected by erosion in 1993 as compared with 38% in 1996/7. The data for palatal surfaces are however, similar (Fig. 1). For permanent teeth in 11–14-year-olds, the disparity was less but still present; 11% of labial surfaces of permanent incisors affected in 1993 compared with 23% in 1996/7. On palatal surfaces there was virtually no difference between the three years with only a slight increase in erosion into dentine, from 1% to 3% (Fig. 2). Although it is acknowledged that these snapshots are in reality serial, cross-sectional data, the cohort effect deserves consideration. For example, 11–15-year-olds in the 1993 child dental health survey were in the 15–18-year-old-cohort in the 1996/7 NDNS school-age survey. There was

CDH 1993
(5/6-year-olds)

18% (1%)
CI: 17–19 (1–1)

51% (24%)
CI: 49–53 (23–25)

Base = 3310

NDNS 1996/7
(4–6-year-olds)

38% (4%)
CI: 33–43 (2–7)

58% (19%)
CI: 53–63 (15–23)

Base = 348

Data in brackets refer to erosion in dentine/pulp
CI = Confidence intervals

Fig. 1. Prevalence, with confidence intervals, of any erosion (and dentine/pulp) of primary incisors: 1993 (5–6-year-olds) and 1996/7 (4–6-year-olds).

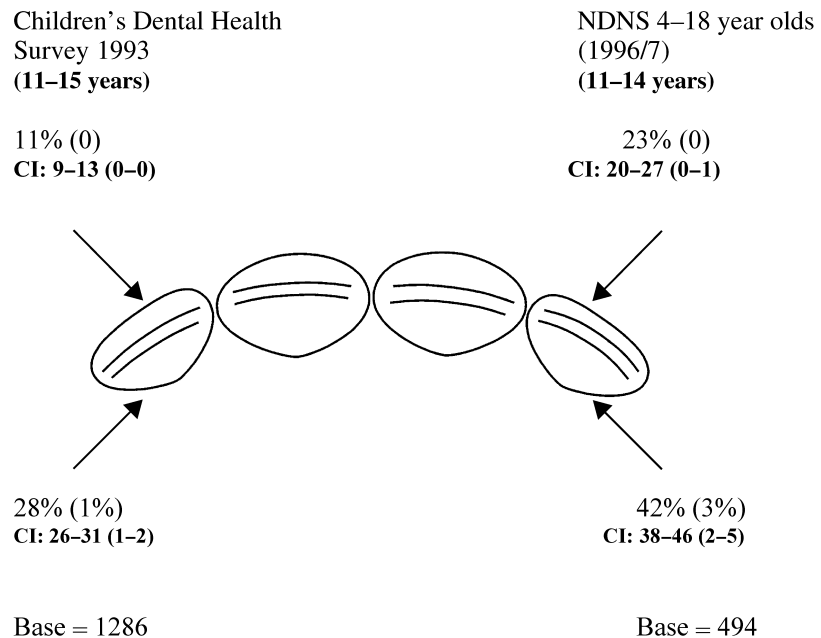


Fig. 2. Prevalence, with confidence intervals, of any erosion (and dentine/pulp) of permanent incisors: 1993 (11–15-year-olds) and 1996/7 (11–14-year-olds).

Data in brackets refer to erosion into dentine/pulp
CI = Confidence intervals

more erosion recorded in the latter survey on both buccal and palatal surfaces of maxillary permanent incisors. Likewise, 7–10-year-olds in 1993 were in the cohort of 11–14-year-olds in 1996/7. Again, the prevalence of erosion recorded in this group had increased.

There were no dietary data collected in the UK children's dental health survey. Data from the 1½–4½-year-olds survey, although not showing any statistically significant correlation between reported dietary or other practices and dental erosion did indicate some positive trends. For example, 3½–4½ year-olds consuming carbonated drinks on most days had more buccal and palatal erosion than toddlers consuming these drinks less frequently, 19% and 43% as compared with 12% and 28%, respectively. Sugary drinks at night were seen to lead to a higher prevalence of erosion especially if they were taken from a mug, cup or glass (Table 3)

In the NDNS survey of 4–18-year-olds, no such associations were seen. Food and drink consumption was divided into tertiles for the purposes of analysis. There was no statistically significant difference in the amount of erosion in young people consuming

Table 3. Erosion and drinking habits amongst children 3½–4½ years of age.

	Proportion of Children with Erosion into Dentine/Pulp	
	Buccal	Palatal
Drinks at night:		
In bottle	3%	3%
Feeder cup	2%	9%
Mug, cup, glass	3%	15%
Fluids at night:		
Milk	—	7%
Water	1%	11%
Sugary drink	7%	17%

the highest amounts of acidic foods and drinks compared to their contemporaries who consumed smaller amounts. Although the differences did not reach statistical significance, in the primary dentition of 7–10-year-olds, 47% of the lowest tertile consumers of soft drinks had erosion compared with 58% of those in the highest tertile of consumption. The manner in which young people consumed drinks was also thought to be as important as how

much they had. However, making drinks last longer compared with drinking them straight away had no impact on the prevalence of erosion.

There is known to be a relationship between gastro-oesophageal reflux and dental erosion. Symptoms of this may be overt vomiting, indigestion or a chronic cough and asthma. A sore throat or croaky voice on waking in the morning may be signs that reflux is occurring, albeit asymptotically. For these reasons, the oral health questionnaire referred to all these aspects of general health.

Of the conditions listed above, asthma was the most prevalent, affecting 10% of the 7–10-year-olds and 18% of the 15–18-year-olds. A slightly smaller proportion of the subjects were affected by the other conditions. No relationship was found between asthma or any of the other conditions and tooth erosion, although 79% of the 4–6-year-olds that had reported symptoms related to gastro-oesophageal reflux had dental erosion compared with 62% who did not have such symptoms ($P \leq 0.05$).

Multivariate analysis of the data indicated that the only factors showing independent association with the presence or absence of erosion were socio-demographic. Region showed the strongest association with erosion. The odds of having erosion were almost double for those young people living in the North compared with those in London and the South-East (OR 2.38, $P < 0.001$). In the youngest age group, the most significant association was with household type, that is, living with both parents and siblings compared with, for example, as an only child or with a single parent (OR 2.44, $P < 0.001$) and receipt of benefit (OR 1.55, $P < 0.05$). For adolescents, the associations that were strongest were again geographical, north versus south (OR 2.54, $P < 0.001$), social class of the head of household, manual versus non-manual (OR 1.66, $P < 0.01$) and the age, older versus younger teenager (OR 1.63, $P < 0.01$).

Discussion

It should be emphasized that this review has been conducted using published cross-sectional data on dental erosion in young people in the UK. No real inferences therefore can be drawn from these data as to the true incidence of dental erosion. In addition, despite intensive training, there have been concerns over the assessment of erosion, in particular the difficulties of standardizing the large numbers of examiners that take part in these national dental surveys.

There is concern, certainly within Europe, over the seemingly very widespread nature of dental erosion. Case reports and cross-sectional studies have all alerted the dental profession to the insidious nature of erosion. Very little is known about the incidence of erosion in young people.

The epidemiology of dental erosion as recorded in the three large national oral health surveys in the United Kingdom confirms the view that erosion is prevalent. Without data on its incidence it is difficult to say whether erosion is assuming the public health importance that dental caries has held for many decades. However, the fact that one third of our toddlers and a half of teenagers all exhibit some signs of erosion indicates that the problem is serious.

There are concerns that the assessment of dental erosion, particularly in the early stages, is difficult. This is not unlike the problem in recording the early caries lesion. The calibration data from some of the national surveys imply that caution should be used in interpreting the data as variability between examiners is high.

The similar criteria and training opportunities for the examiners in all three national surveys allow a degree of comparison between these cross-sectional studies taking account of the aforementioned concerns.

Although undertaken only three years apart, the national children's dental health survey and the NDNS school-age survey showed an increase in erosion of incisor teeth, for both labial and palatal surfaces. Not all authors have been able to reproduce these trends; Williams *et al.* [1] in their study of 14-year-olds showed that labial erosion was more prevalent than palatal erosion, 17% and 12%, respectively.

This difference is less marked on the palatal surfaces in the primary dentition perhaps because in 4–6-year-olds, 'saturation' has been reached and that, just prior to shedding, these tooth surfaces are unlikely to erode further. The cohort study by Milosevic *et al.* [5] also showed that erosion develops rapidly; six subjects in their control group of young people with erosion into enamel only, had to be excluded from the analysis because they had developed erosion into dentine in the space of a year.

Much of the advice aimed at preventing or minimizing dental erosion is based on the evidence from case reports and some *in vitro* and *in vivo* work. The assumption has been that extrinsic sources of acids, predominantly dietary factors, are the cause in this age group [2,5–7]. Others acknowledge that this may be too simplistic and that other factors such as

oral hygiene levels, social, cultural, medical, occupational, and geographical area may be relevant factors [1,17–19]. However, as in the national studies, the authors have failed to show any relationship with some of these other factors even although erosion was prevalent in their study groups [1,5].

Attention is now focusing on underlying medical conditions as a source of intrinsic acid, even in children [8]. In children in Birmingham, UK, a similar number of young people were affected with asthma as in the national sample reported here, 15.8% compared with 10%–18%, depending on age. However, the young people with asthma in the national sample showed no increase in prevalence of dental erosion, as did the Birmingham study [11]. Gastro-oesophageal disease, often asymptomatic, is relatively prevalent in young people and is a potential cause of dental erosion [8,18]. Authors are divided as to whether this is a true association but it may depend on severity and frequency of reflux, a phenomenon seen more often in some groups than others [9,10]. Symptoms related to gastro-oesophageal disease were the only ones to show a statistically significant relationship with dental erosion in the NDNS study of 4–18-year-olds.

It was evident from the outset that the prevalence of dental erosion is significant in young people in the UK. Although these are all cross-sectional studies, comparison of cohort data indicate that the prevalence of dental erosion may be increasing.

Whereas dietary associations with erosion are weak in many studies, gastro-oesophageal disease may be a more significant aetiological factor than has previously been thought [18]. However, like dental caries, erosion must be seen as having a multifactorial aetiology; apart from gastro-oesophageal reflux, the factors shown to relate positively to erosion in the latest of the national studies, as well as others, are socio-demographic [19]. A more comprehensive model to investigate all the likely aetiologies and their interaction should be researched if we are not to make naive assumptions about the cause of dental erosion and thus hinder our efforts at effective maintenance and prevention.

Résumé. *Objectifs.* Evaluer le changement dans le temps de prévalence de l'érosion dentaire, par une revue des données publiées issues d'enquêtes dentaires nationales chez la population jeune du Royaume-Uni. Un objectif secondaire a été d'évaluer la relation entre l'érosion et de possibles facteurs de risque associés.

Protocole. La revue a été basée sur des études transversales de prévalence comprenant un examen clinique et des entretiens structurés.

Echantillon. Les données ont été recueillies à partir de l'enquête de 1993 de santé dentaire des enfants du RU et du rapport des deux Enquêtes Nationales de Nutrition et Alimentation (NDNS) chez les enfants âgés de 1 an $\frac{1}{2}$ à 4 ans $\frac{1}{2}$ en 1992/3 et de 4 à 18 ans en 1996/7. Les critères utilisés pour la collecte des données ont été comparables entre les trois différentes études.

Résultats. Lorsque les données des trois études sont prises en compte, la prévalence de l'érosion est en augmentation entre l'enquête de 1993 et l'étude de la SDSD de 1996/7 chez les 4–18 ans. Il y a une tendance vers une prévalence accrue de l'érosion chez les enfants âgés de 3 ans $\frac{1}{2}$ à 4 ans $\frac{1}{2}$ et chez ceux qui consomment des boissons sucrées presque tous les jours comparés à ceux qui les consomment moins souvent. Les boissons prises toute la nuit sont associées à une augmentation de la prévalence de l'érosion. Les enfants de plus de 4–6 ans avec un reflux gastro-oesophagien avéré avaient une érosion comparable à celle des enfants sans reflux. Selon l'analyse multivariée, l'association indépendante la plus forte à l'érosion était la géographie, les enfants vivant dans le Nord ayant de fois plus de risque de présenter une érosion que ceux de Londres ou du Sud-Est.

Conclusions. Les données comparées des enquêtes nationales transversales indiquent que l'érosion dentaire est en augmentation dans le temps entre différentes cohortes d'âge de la population jeune. Des associations nutritionnelles avec l'érosion sont présentes mais faibles. De la même façon, il y a une association apparente entre érosion, symptômes de reflux gastro-oesophagien et variables socio-démographiques telles la région de domicile, la classe sociale et le fait de bénéficier d'avantages sociaux.

Zusammenfassung. *Ziele.* Die Untersuchung der Veränderung der Prävalenz von Zahnerosion im Laufe der Zeit anhand von Daten der nationalen Mundgesundheitsuntersuchungen bei jungen Menschen in Großbritannien. Ein Nebenziel war es, die Zusammenhänge zwischen Erosion und möglichen Risikofaktoren zu untersuchen.

Design. Diese Übersicht wurde auf Querschnittstudien gestützt, in welchen eine Mundgesundheitsuntersuchung in Verbindung mit einem strukturierten Interview durchgeführt worden war.

Stichprobe. Die Daten wurden gewonnen aus folgenden Studie: Der UK childrens dental health survey von 1993, und dem zahnmedizinischen Bericht von zwei nationalen Diät- und Ernährungsstudien von Kindern von 1½–4½ Jahren (1992/3) sowie 4–18 Jahren (1996/7).

Ergebnisse. Bei dem Vergleich der Daten aus diesen unterschiedlichen Studien war eine Zunahme der Erosion von 1993 bis 1996/7 zu beobachten. Es zeigte sich ein Trend zu mehr Erosione bei Kindern von 3½ bis 4½ Jahren, und bei solchen Kindern, die kohlenensäurehaltige Getränke an der Mehrzahl der Tage zu sich nahmen (verglichen mit Kindern, welche diese Getränke nur seltener erhielten). Auch die Verabreichung von Getränken nachts war mit einer erhöhten Prävalenz von Erosionen begleitet.

Kinder von 4 bis 6 Jahren, bei denen ein gastroösophagealer Reflux berichtet worden war, hatten häufiger Erosionen als symptomfreie Kinder.

In einer multivariaten Analyse war die stärkste unabhängige Assoziation mit Erosionen die geographische Lage des Wohnortes, Kinder aus dem Norden hatten eine 2fache odds ration verglichen mit Kindern aus London oder dem Südosten.

Schlussfolgerungen. Beim Vergleich der Prävalenzzahlen aus nationalen Querschnittstudien zeigten sich eine Zunahme der Erosion in verschiedenen Altersgruppen. Assoziationen mit der Ernährung ist vorhanden, wenn auch nur schwach. Ähnliche Assoziationen sind vorhanden zu Refluxerkrankung, soziodemographischen Größen wie Wohnort, soziale Schicht und Inanspruchnahme von sozialen Vergünstigungen.

Resumen. Objetivos. Investigar el cambio en la prevalencia de la erosión dental, en el tiempo, con una revisión de datos publicados de estudios odontológicos nacionales sobre gente joven en GB. Un objetivo subsidiario fue investigar la relación entre erosión y posibles factores de riesgo asociados. **Diseño.** La revisión se basó en estudios de prevalencia transversal que contenían un examen clínico y encuesta estructuradas.

Muestra. Los datos se recogieron del estudio de salud dental en niños de GB, en 1993 y del informe dental de los dos Estudios Nacionales sobre Dieta y Nutrición (ENDN) de niños con 1½–4½ en 1992/3 y 4–18 años en 1996/7. Los criterios usados para la recogida de los datos fueron comparables entre los tres estudios diferentes.

Resultados. Comparando los datos de los diferentes estudios, se vio un aumento de la prevalencia de erosión desde el momento del estudio de salud dental de los niños de 1993 y el estudio ENDN de 4–18 años de 1996/7. Había una tendencia hacia una prevalencia más alta de la erosión en niños entre 3½–4½ años y en aquellos que consumían bebidas carbonatadas la mayoría de días comparados con los de la misma edad que consumían con menos frecuencia estas bebidas. Las bebidas por la noche estaban asociadas con una mayor prevalencia de la erosión. Además, niños de 4–6 años que informaban de síntomas de reflujo gastroesofágico tenían erosión comparados con niños libres de síntomas. En el análisis multivariante la asociación independiente más fuerte con erosión fue la geografía con niños que viven en el Norte teniendo dos veces más de probabilidad de tener erosión comparados con los de Londres y el Sureste.

Conclusiones. La comparación de la prevalencia de los datos de los estudios nacionales transversales indica que la erosión dental aumenta entre las diferentes cohortes de edad de gente joven en el tiempo. Asociaciones de la dieta con la erosión están presentes pero son débiles. De manera similar, hay una asociación aparente entre erosión, síntomas y reflujo gastroesofágico y variables demográficas tales como región del domicilio, clase social y recepción de beneficios sociales.

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