VERIFIABLE CPD PAPER

IN BRIEF

- A wide range of foods and drinks were associated with tooth wear and dental erosion but the strengths of association (Odds Ratios) were generally low.
- Dentists should question patients, even teenagers, with dental erosion about heart burn, reflux and any positive family history of reflux disease.
- Teenagers know little about acids and dental erosion, thus dentists need to educate parents and children about the risks to dental health using patient information leaflets and commercially available literature etc.

Epidemiological studies of tooth wear and dental erosion in 14-year old children in North West England. Part 2: The association of diet and habits

A. Milosevic,[1] P. F. Bardsley[2] and S. Taylor[3]

Objective To determine the strength of association (expressed as Odds Ratios) of potential risk factors with erosion and tooth wear in 14-year-old schoolchildren.

Design A random sample of 2,385 children were selected by a stratified two-stage technique based on schools and children.

Setting Schools in NW England.

Methods Tooth wear was assessed by one examiner on three surfaces of all 12 anterior teeth (labial, incisal and palatal) and the occlusal surface of all four first molars using a four-point scale. Enamel wear was scored 0, dentine exposure <1/3 scored 1, >1/3 scored 2 and secondary dentine or pulpal exposure, scored 3. A questionnaire enquired about general health, dental health, habits and the frequency of intake of a wide range of foods and drinks.

Results The Odds Ratios for tooth wear on any surface for habits, reflux and certain foods were: bruxism, 1.10; stomach upset, 1.45; pickles 1.86; vinegar 1.36; salt and vinegar crisps 1.33; brown/other sauces 1.57. Similarly, the odds ratios for potentially erosive drinks were: fizzy drinks 1.32; sport drinks 1.58; herbal/lemon tea 3.97. The frequency of intake was bi-modal with 397 children drinking a can per day and 207 drinking two cans per day. A significant number drank acidic beverages at bedtime but this was not associated with dental erosion.

Conclusion Although odds ratios greater than unity indicate an association, this was not high for carbonated beverages and many other acidic foods or drinks. Examining at fourteen years may not be ideal, as the determinants of erosion/tooth wear have not acted for long, the indices do not discriminate sufficiently and proportionately few subjects have dentine exposed on smooth surfaces.

[1]*Honorary Senior Lecturer and Consultant in Restorative Dentistry, Dept of Restorative Dentistry, Liverpool University Dental Hospital [3]Research Associate, Centre for Medical Statistics and Health Evaluation, University of Liverpool,[2]Consultant, Dept. of Restorative Dentistry, Birmingham Dental School

*Correspondence to: A. Milosevic, Dept of Restorative Dentistry, Liverpool University Dental Hospital, Pembroke Place, Liverpool L3 5PS

Email: a.milosevic@liv.ac.uk

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INTRODUCTION

Recent research has attempted to determine the causal relationship between a variety of putative risk factors and dental erosion.[1-6] Researchers face a difficulty in that erosion is used as a descriptor of the disordered dentition and as well as a cause. Three factors need to be considered in the assessment of causal relationship: the cause must precede the disease; the strength of the association; agreement with current knowledge.[7] Furthermore, causality at the individual patient or subject level is aided by history taking and questionnaire respectively. Studies have described the degree of enamel wear and how much dentine is exposed (usually either less than or more than a third of the surface) and attributed this to acid erosion. Proximal and inter-occlusal contact sites wear by attrition (direct tooth to tooth contact) whereas most surfaces are susceptible to wear by abrasion and/or erosion. Despite the plethora of *in vitro* studies demonstrating acid dissolution of enamel and dentine by fruit juices and soft drinks,[8-10] few epidemiological studies have found a strong link between risk factors for erosion and the outcome of eroded teeth. For example, it has proved much harder to provide the evidence for a strong association between acid drinks, especially carbonated beverages and dental erosion in population groups. Some studies have described a statistically greater prevalence of tooth wear and/or erosion in subjects with a high intake of potentially erosive foods or frequent self-induced vomiting in eating disorders but reporting such differences does not indicate the strength of association.[1,11] Surprisingly, many studies on children have reported no association between potential aetiological factors and erosion or tooth wear. In 210 London 12-year-olds, no relation was found between tooth wear and salivary flow rate, buffering capacity, the intake of carbonated drinks, symptoms of gastro-oesophageal reflux or vomiting.[3] A larger study in two inner city London boroughs on 525 14-year-olds found no associations between swimming, vomiting, tooth brushing or diet and erosion as assessed on labial and palatal surfaces of the upper incisors.[4] All teeth in a sample of 418 children in Birmingham, also aged 14 years, were assessed for erosion and dietary intake of a wide range of foods and drinks.[5] Unfortunately, the authors did not report the values for the Spearman correlation coefficients but the probabilities (significance values) for all the food/drink items

cited were significant.[5] An increased risk of erosion in Finnish adults was reported when citrus fruit was eaten more than twice a day (Adjusted OR 37), apple vinegar ingested weekly (AOR 10), soft drinks daily (AOR 4) or sport drinks were drunk weekly (AOR 4).[16] We reported[2] previously in 14-year-olds that drinking carbonated beverages was a more significant predictor of tooth wear than bruxism although the Odds Ratios were lower than those reported by Järvinen *et al.*[19] A Cochrane style review of the enamel erosion literature from 1980 to 1998 concluded that despite the increase in the body of knowledge, the overall quality of publications had not changed over the specified time frame.[12] Moreover, the incorporation of more oral factors had not resulted in substantially better research designs, or superior statistical analysis and it was not possible to identify the roles of oral factors in the process of erosion.[12]

This study aimed to assess the strength of association between dietary factors, oral hygiene and bruxism with tooth wear. Local research ethics committee approval was sought and gained for this study.

METHODS

The North West Dental Public Health Resource Centre in Preston was tasked to plan the 1999 survey of dental health in 14-year-old school children. The total number of schools in all districts were provided by the resource centre. The sample of children were randomly selected by a multi-stage sampling procedure, first by random selection of 55 schools from the total of 30 districts, followed by random selection of the children. Sample size determination and examination for tooth wear is as previously described in Part 1.[20] It should be remembered that the tooth wear index used in this study assessed the labial, incisal and lingual/palatal surfaces of the 12 anterior teeth and the occlusal surface of all four first molars. Enamel wear was classified as 'wear not into dentine' and was scored 0. Dentine exposed for <1/3 of the surface or just visible cupping was scored 1 and if dentine was visible for >1/3 of the surface a score 2 was given. Pulp or secondary dentine exposure scored 3.

The questionnaire used in this study was modified from that used by Milosevic *et al.* in a case control study on 14-year-old children.[2] It was longer, with 34 questions in discrete sections on dental health, general health, diet and dental knowledge. The questionnaire targeted putative risk and protective factors for all types of tooth wear and erosion. Questions were related to clenching/grinding, tooth brushing habits, asthma, stomach problems, body image/weight, use of chewing gum and diet. The frequency of intake of 17 food items and several drinks were ascertained in five categories: never (0); less than once a week (1); at least once a week (2); on average, once a day (3); more than once a day (4). Specific questions asked about ability to purchase drinks at school, drinking before bed time or overnight and favourite drinks at parties. The final section on dental knowledge aimed to assess respondent's knowledge regarding the erosive process with questions such as 'Is sugar involved in erosion?' The questionnaire was piloted on a sample of 14-year-old children who found the format and questions straight forward.

All questions and responses were coded into SPSS. The tooth wear data were transferred from proformas into SPSS for statistical analysis.

RESULTS

A total of 2,385 children were examined for tooth wear and completed the questionnaire; of these, 1,139 (48%) were male and 1,246 (52%) were female. The sample was drawn from 55 schools in 12 districts, with the breakdown shown in Table 1.

Questionnaires were distributed to all 2,385 children; all were returned, but not all tick boxes were completed. Children with exposed dentine on any surface were categorised as cases and thus all the remaining children were controls (no dentine exposed on the examined surfaces). All cases were newly diagnosed, and defined as incident cases. Controls would have been cases had they too exhibited dentinal exposure. The total number of children with exposed dentine was 1,276 and 1,109 children did not exhibit exposed dentine. The gender distribution was 48% male and 52% female (Table 1).

The questionnaire was broken down for analysis by questions relating to dental health, general health and lifestyle habits, diet (food and drink consumption) and dental knowledge. Each question provided observed frequencies in the case and control groups. In order to calculate the Odds Ratios in two by two tables it was necessary to combine some answer categories.

It is worth noting that 76% of respondents had visited the dentist at least twice in the preceding 12 months, whilst 5% had not seen a dentist for over a year. Sixty six per cent were happy with the appearance of their teeth and most brushed their teeth at least twice a day (78%), with 19% brushing only once a day and 2% claiming to brush once a week. The frequency of tooth brushing was not statistically different between the case and control groups.

The raw data for clenching or grinding habits in response to question 3 ('Do you clench or grind your teeth?') is shown in Table 2; there were 17 missing responses.

In order to calculate the odds ratio in a two by two contingency table, the categories 'never' and 'not noticed' were combined to represent absence of a grinding habit, and categories 'occasionally' and 'regularly' were combined to generate a bruxist group. Results are shown in Table 3. Thirty nine per cent of the cases and 37% of the controls claimed to grind or clench their teeth occasionally or regularly. The calculated Odds Ratio was 1.10, with 95% confidence interval (CI) ranging between 0.93 and 1.30.

Table 1 Sample distribution by district and gender

District	Gender Male	Female	Total	% of sample
Liverpool	69	51	120	5
Warrington/ North Cheshire	371	412	783	33
Salford	46	46	92	4
Burnley/ East Lancs	6	12	18	1
Wirral/ West Cheshire	41	64	105	4
East Cheshire	40	36	76	3
Tameside/ Glossop	55	22	77	3
South Cheshire	370	482	852	36
Sefton	0	36	36	1.5
Wigan/ Leigh	34	16	50	2
Blackpool	99	62	161	7
Cheshire/Halton	8	7	15	0.5
Total	**1,139 (48%)**	**1,246 (52%)**	**2,385 (100%)**	

Table 2 The number of cases and controls who claim to clench or grind

Question 3	Cases	Controls	Total
Never	453 (36%)	433 (39%)	886
Occasionally	430 (34%)	363 (33%)	793
Regularly	71(5%)	48 (4%)	119
Not noticed	313 (25%)	257 (24%)	570
Total	**1,267 (100%)**	**1,101 (100%)**	**2,368**

Table 3 Frequency of tooth wear for clenching or grinding habit

		Tooth wear (any surface)	
		Present	Absent
Clenching or grinding?	Yes	501 (39%)	411 (37%)
	No	766 (61%)	690 (63%)

OR=1.10 (95%CI 0.93, 1.30)

Questions 8 to 18 related to general health, medication, exposure to stomach acid, satisfaction with body shape/weight and exercise. Ninety per cent of the respondents considered themselves to be fit and healthy, with 17% claiming to take regular medicines or prescriptions; the type of medication was not investigated. Sixteen percent of the sample claimed to have asthma, and 0.3% suffered with diabetes; there were no significant differences in tooth wear observed in these groups compared with the total sample. Twenty per cent of the respondents claimed to suffer from indigestion, and the effect of this on tooth wear on any surface produced an Odds Ratio of 1.24, with 95% CI ranging between 1.01 to 1.52. Three per cent (N=72) regularly suffered with stomach upsets or vomiting which was a significant risk for tooth wear with an OR of 1.45 (95% CI 0.87, 2.42), see Table 4. Although 352 children (15%) gave a positive response to 'Do you ever get an acid taste in your mouth?', this was not associated with tooth wear. Likewise, questions referring to dissatisfaction with body shape/weight or exercise found no differences.

Table 4 Frequency of responses to 'Do you suffer with stomach upsets or frequent vomiting?'

		Tooth Wear (any surface)	
		Present	Absent
Stomach upset/vomiting	Regularly	45(2%)	27(1%)
	Never/occasionally	1,230(52%)	1,071(45%)

OR=1.45 (95% CI 0.87,2.42)

Considering that 83% of all the children claimed to exercise regularly, it was interesting to note that 1,916 (81%) drank sports drinks when categories 'occasionally' and 'regularly' were combined (question 19), allowing calculation of odds ratios (OR) for tooth wear on any examined surface, as shown in Table 5.

Table 5 Presence of tooth wear according to consumption of sports drinks

		Tooth wear (any surface) Present	Absent
Do you drink sports drinks?	Yes	1,034 (81%)	882 (80%)
	No	240 (19%)	223 (20%)

OR=1.32 (95% CI 0.88-1.34)

Question 20 investigated the number of cans of fizzy drink consumed on a daily or weekly basis and compares the results by gender. Males drank significantly more fizzy drinks per week than females with, on average, boys drinking two cans more per week (mean of 8.64 cans per week, compared with 6.62 for females). T-Test for equality of means showed this to be highly statistically significant (F=27.048, df=2303, p>0.001).

A stem and leaf plot (Fig. 1) was produced to show the response to 'How many cans of fizzy drink do you have a week?' Stem width was 1, with each leaf representing eight cases and '&t' denoting fractional leaves. The stem and leaf plots displayed a bimodal pattern, with peaks at 7 and 14 cans per week (or 1 and 2 cans per day). Separate stem and leaf plots for males and females showed the same distribution. Raw data for question 20 was analysed further by dividing cases and controls for tooth wear on any surface into those drinking ≤7 or >7 cans per week (Table 6).

Table 6 Tooth wear by fizzy drink consumption (Q20)

		Tooth wear (any surface) Present	Absent
Drinks =7 or ≤7 cans per week	>7	365	272
	≤7	873	795

OR=1.22 (95% CI 1.01-1.48)

Figure 1 Stem and leaf plot of weekly fizzy drink consumption

Frequency	Stem	Leaf
126.00	0	0000000000000000
157.00	1	00000000000000000000
235.00	2	00000000000000000000000000000000
237.00	3	00000000000000000000000000000000
154.00	4	0000000000000000000
278.00	5	00000000000000000000000000000000000000
84.00	6	000000000
397.00	7	00000000000000000000000000000000000000000000000000000000
50.00	8	000000
13.00	9	00
98.00	10	000000000000
4.00	11	&t
30.00	12	0000
8.00	13	0
207.00	14	00000000000000000000000000
18.00	15	00
4.00	16	&t
2.00	17	&t
203.00	Extremes	(>=18)

Only four per cent of the sample (92 children) were vegetarian and ten children (0.4% of the sample) had been vegetarian for all of their life.

Questions 24 and 25 were multi-part questions that considered frequency of consumption of a variety of foods and drinks. In question 24 there were five consumption categories: never (0), less than once a week (1), at least once a week (2), once a day (3) and more than once a day (4). In order to calculate the Odds Ratio in a two by two table for each dietary variable, categories were combined thus dichotomising consumption to 'yes' = more than once a day (4), and 'no' = all other categories (0,1,2 and 3). The Odds Ratios are presented in Table 7 for a variety of dietary items.

Table 7 The strength of association for various dietary items and tooth wear on any surface expressed as the Odds Ratio with 95% Confidence Intervals.

Dietary Variable	Odds Ratio	95% Confidence Interval
Fresh oranges	0.86	0.70, 1.07
Apples	0.97	0.81, 1.15
Grapefruit	1.32	0.82, 2.13
Tinned fruit	0.99	0.73, 1.34
Yoghurt	1.12	0.86, 1.45
Tomato ketchup	1.16	0.97, 1.39
Brown/other sauces	1.57	1.02, 2.42
Salad dressing	1.20	0.85, 1.52
Vinegar	1.36	1.12, 1.65
Baked beans/pasta shapes	1.13	0.85, 1.49
Pickled onions	1.37	0.97, 1.95
Other pickles	1.86	0.79, 4.44
Relishes	1.05	0.28, 3.95
Stoneground bread	0.94	0.60, 1.48
Cheese	0.98	0.76, 1.25
Salt and vinegar crisps	1.33	1.02, 1.72
Curry/spicy food	1.26	1.00, 1.58

In question 25 there were five consumption categories for drinks: never (0), once a week (1), 2-4 times a week (2), once a day (3) and two or more times a day (4). Categories were combined when analysing raw data, dichotomising consumption to 'Frequent intake' = two or more intakes a day (4), and 'Less frequent' = all other categories (0,1,2 and 3). Considering cases and controls for tooth wear on any surface, odds ratios were calculated in a two by two table for each drink variable; Table 8 presents the raw data for fizzy drinks consumption and Table 9 presents the combined/dichotomised categories for calculation of odds ratio. Table 10 shows the calculated odds ratios and 95% confidence intervals for the other drink variables.

Erosion commonly occurs on the smooth labial and palatal surfaces, therefore, further analysis was carried out by excluding the incisal edges and occlusal surfaces which are likely to undergo

Table 8 Raw data example for question 25: how often do you drink.....

Fizzy drinks?	Cases	Controls	Total
Never	79 (6%)	97 (9%)	176
Once a week	187 (15%)	215 (20%)	402
2-4 times per week	346 (28%)	299 (27%)	645
Once a day	326 (26%)	257 (24%)	583
2 or more times a day	319 (25%)	223 (20%)	542
Total	1,257 (100%)	1,091 (100%)	2,348

Table 9 Frequency of consumption of fizzy drinks and the outcome of tooth wear

		Tooth wear (any surface)	
		Present	Absent
Do you drink fizzy drinks?	Frequent (≥2intakes/day)	319 (25%)	223 (20%)
	Less frequent	938 (75%)	868 (80%)

OR=1.32 (95% CI 1.08, 1.62)

Table 10 Strength of association for several drink items and tooth wear on any surface expressed as Odds Ratios with 95% CI

Drink variable	Odds ratio	95% Confidence interval
Natural fruit juice	1.07	0.85, 1.35
Diluted fruit juice/squash	1.00	0.82, 1.21
Fizzy drinks	1.32	1.08, 1.62
Low calorie fizzy drinks	1.30	0.96, 1.76
Sports drinks	1.58	1.10, 2.28
Fizzy mineral water	1.08	0.67, 1.75
Milk	0.92	0.77, 1.10
Herbal/lemon tea	3.97	1.26, 13.89
Normal tea	1.01	0.83, 1.23

attritive wear. This re-calculation for the strength of association for all the dietary items and smooth surface wear produced similar odds ratios to those gained when looking at all surfaces that were examined.

Analysis was further repeated for questions 24 and 25 using different dichotomisation criteria by the combination of categories 3, 'once a day' and 4, 'or more than once a day' and categories 'never', 'less than once a week' plus 'at least once a week' (0,1 or 2). Similar odds ratios and confidence intervals with this different dichotomisation of intake frequency were gained when analysing for tooth wear on all surfaces or labial/palatal surfaces only.

Eighty per cent of respondents had a drink before bedtime and were asked to write down what this was. The various items are shown in Figure 2.

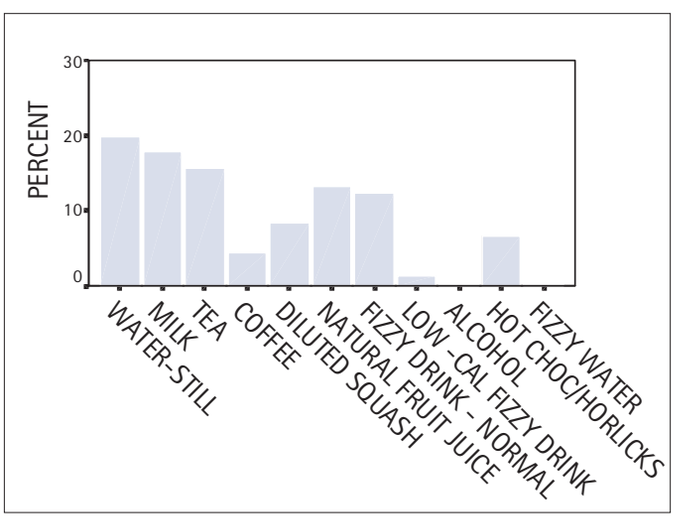

Fig. 2 Distribution of bedtime drink

Table 11 Favourite party drinks

Drink	Valid percent	Drink	Valid percent
Fizzy drinks	65.2	Alcopop	2.6
Low calorie fizzy drinks	5.0	Spirit +/- mixer	2.3
Sports/ high energy	0.4	Squash	2.0
Mineral water	1.3	Natural juice	4.9
Still water	1.7	Alcohol unspecified	3.5
Tea or coffee	0.3	Wine	0.4
Beer/ lager/ cider	10.0	Milk	0.5

In response to question 28, respondents listed their favourite drink at parties or discos (Table 11).

Over half of respondents had heard of tooth wear or dental erosion and 39% correctly answered that acid was involved with erosion, whilst 6% answered incorrectly that 'acid was not involved' and 55% 'did not know'. Seventy five per cent of the sample knew that sugar was involved in decay, with 2% saying it was not involved and 22% not knowing. A further 44% believed that sugar was involved in erosion, 10% said that it was not, and 46% did not know.

DISCUSSION

This study focused on determining the strength of association of various risk factors for the outcome of dental erosion and tooth wear. The Odds Ratio (OR) is an estimate of relative risk in the sample under investigation and values above unity represent an effect so that an OR of <1.0 indicates that there is no association and an OR of 2.5 is indicative of marked association. The 95% confidence interval expresses the degree of certainty that the true value of OR for the population lies between the quoted odds ratios. Tooth wear was assessed on labial, incisal and palatal/lingual surfaces of all twelve anterior and the occlusal surface of all first molars. Partial recording of 12 anterior teeth in older adults, termed index teeth, enabled detailed and sensitive analysis to be made, without missing wear cases.[13] The occlusal surface was included in this index because these were commonly worn through to dentine, especially the lower first molars.[14,15]

Results regarding bruxism indicate that this habit alone is not associated with tooth wear in this sample of children. Our previous work did find an effect, in that 47% of wear cases reported occasional or regular clenching/grinding compared with 31% of the control group, with an Odds Ratio of 2.4 (95% CI 0.88,6.54).[2] Aspects of general health that may influence wear include gastro-oesophageal reflux, medication for asthma, long term aspirin use in juvenile rheumatoid arthritis and possibly xerostomia-inducing medication. Despite the low number of children (N=72) with regular stomach upset/vomiting, it was notable that this was a risk for tooth wear. Indeed, many more children (N=495) responded to the less specific question 'Do you get indigestion?' and this was also associated with tooth wear on any surface, OR 1.24 (95% CI 1.01,1.52). The result for the questions regarding an acid taste in the mouth did not reveal any association with tooth wear on all examined surfaces nor on labial/palatal surfaces. Bartlett *et al.* reported that the prevalence of tooth wear was actually lower in the sample of 12-year-old children who suffered with either heartburn, GOR symptoms or vomiting compared with those who stated they did not have these problems.[3] Subjects who reported regurgitation did exhibit higher maxillary tooth wear index scores. Because children suffering with regurgitation reported lower intakes of acid food and drink, the authors speculated that the regurgitated acid was the cause of the increased maxillary tooth wear. The results presented here confirm that reflux disease can contribute to dental erosion in teenagers, and dentists therefore, should ask routinely about heartburn, reflux and whether any family members suffer with digestive or gastro-intestinal problems which may indicate an incompetent lower oesophageal sphincter.

Asthmatics have an increased risk of reflux and the pH of powdered anti-asthmatic medication was significantly lower than aerosol varieties.[16] None of the questions regarding medication, asthma or satisfaction with weight or body shape elicited any positive relationship with tooth wear. Few children stated they had any medical problem and questions about weight and body shape may be deemed insensitive or intrusive and thus not elicit a true response. These questions were aimed at identifying any child with a tendency toward an eating disorder, which has been recognised in adolescents.[17]

Most of the questions asked about eating and drinking habits. The foods listed in Table 7 are acidic and have erosive potential. It is surprising, therefore, to find that the odds ratios are generally low and for consumption of oranges there is no association. Apples and tinned fruit are on the borderline of having an association whereas pickles and sauces have the greatest causal association with tooth wear in this cohort of children. There has been little research on the erosive or abrasive potential of food as opposed to drinks. Processed foods can have amongst their ingredients a variety of acids including spirit vinegar, citric acid, maleic acid and ascorbic acid. Hence the inclusion of tinned pasta shapes/baked beans which contain spirit vinegar. Although fruits make an important contribution to vitamin C (ascorbic acid) intake, the demand for and supply of fresh fruit all year round may lead to the consumption of more unripe fruits containing a variety of organic acids because during ripening, the concentration of acid falls as sugar concentration increases. The list of foods in Table 7 is similar to the one published by Al-Dlaigan *et al.*[5] Dentists should question parents and teenagers about dietary intake of all these items. Despite the low values for the odds ratios, it must be remembered that adolescents may have a strange diet that includes an excessive consumption of pickles, relishes, salt and vinegar crisps and brown sauce. All these foodstuffs increase the likelihood of eroded teeth. The interaction of acidic foods and drinks has not been investigated in any great detail in this study, but a minority of children will probably eat significant quantities of acidic food that initially may seem innocuous but the cumulative erosive effect in combination with other acidic foods/drinks could be significant.

Boys drank more soft drinks than girls, this is in general agreement with the results reported by Al-Dlaigan *et al.*[18] They found the total consumption between the genders to be similar, but more boys had a medium to high level of cola intake than girls. In this study, males drank on average two cans per week more than the females which puts them at greater risk of erosion, manifest as greater dentinal exposure and/or more eroded teeth. The frequency of fizzy drink intake per week (Fig. 1) shows that the majority of children drank carbonated beverages during the week. The bimodal distribution falls predictably into children who drank on average a can per day and those who drank two cans per day. Two hundred and three children reportedly drank more than 17 cans per week. The data could be analysed to see if these children had more tooth wear but this study was designed to determine the strength of association rather than simply find differences between groupings. Clearly, these 203 children are at greatest risk. Table 10 shows that milk, 'normal' tea and diluted squash have no or little potential for erosion, which is expected, but carbonated drinks have similar erosive potential as their low calorie (artificially sweetened) counterparts. Herbal/lemon tea and sport drinks exhibited the highest risk for tooth wear which corroborates previous results by Jarvinen *et al*[19] and Al-Dlaigan *et al*[5] although the former study found higher odds for sport drinks. It should be remembered, however, that children in the fluoridated district of South Cheshire are included in this analysis and therefore odds for tooth wear and erosion would be greater if these children are excluded (see part I of this paper[20]). An intake of 'four to six or more per week' for soft drink consumption resulted in an Odds Ratio of 4.0 (95% CI, 2-10) and similarly for sport drinks an OR of 4.0 (95% CI, 1-14) was found by Jarvinen *et al.*[19] This was on a smaller sample of 106 erosion cases but with a mean age of 33 years. The examination for tooth wear or erosion is probably easier in older age groups, assuming the wear has progressed and it is easier to see and score. The determinants have been present that much longer so that establishing the association may also be easier. Generally, tooth wear/erosion studies have 'piggy backed' on caries surveys in 12- or 14-year-old schoolchildren. A recommendation from this study is that future research on determining cause should assess the older teenager or young adult rather than cohorts of 12- or 14-year-olds.

The lack of conclusive evidence that the risk factors are strongly linked to the outcome of erosion or wear may indicate that other, as yet unidentified factors, may influence the erosive process. Saliva has been investigated but with conflicting results. In the London study of 12-year-old children,[3] no relationship was found between tooth wear and salivary flow or buffering capacity. In adults, certain salivary parameters were different in the male cases compared with male controls but not between female cases and controls.[19] There is the need for a large scale study of saliva and its relationship to erosion/tooth wear.

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