



# A 4 year prospective longitudinal study of progression of dental erosion associated to lifestyle in 13–14 year-old Swedish adolescents



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## ABSTRACT

**Objectives:** To evaluate the progression of dental erosion in 13–14 year-olds after 4 years, and its association with lifestyle and oral health.

**Methods:** 227 randomly selected 13–14 year-olds from a Public Dental Clinic, Örebro, Sweden, were investigated. A clinical examination was performed which included dental caries/gingival/plaque status, as well as grading of dental erosion at the tooth surface and participant levels in “marker teeth”, including buccal/palatal surfaces of 6 maxillary anterior teeth (13–23), and occlusal surfaces of first molars. An interview and a questionnaire regarding drinking habits and other lifestyle factors were completed. All investigations were repeated at follow-up. The participants were divided into high and low progression erosion groups and logistic regression statistics were applied.

**Results:** 175 individuals participated at follow-up. Progression occurred in 35% of the 2566 tooth surfaces. 32% of the surfaces had deteriorated by one severity grade ( $n=51$  individuals) and 3% by two grades ( $n=2$  individuals). Boys showed more severe erosion than girls at the follow-up. Among the variables predicting greater progression, a lower severity of erosive wear at baseline had the highest OR (13.3), followed in descending order by a “retaining” drinking technique, more frequent intake of drinks between meals, low GBI and lesser sour milk intake, with reference to the baseline recording. Using these five variables, sensitivity and specificity were 87% and 67% respectively, for predicting progression of erosion.

**Conclusions:** Progression of erosive lesions in Swedish adolescents aged 13–14 years followed up to age 17–18 years was common and related to certain lifestyle factors.

**Clinical Significance:** In permanent teeth, dental erosion may develop early in life and its progression is common. Dental health workers should be made aware of this fact and regular screenings for erosion and recording of associated lifestyle factors should be performed.

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## 1. Introduction

Since the mid-90s, dental erosion among children and adolescents has been investigated in many parts of the world and found to be a common condition [1]. A recent meta-analysis estimated the prevalence of erosive wear in permanent teeth of children and adolescents to be about 30% [2].

In groups of 12–14 year-olds, the prevalence of erosion varies widely between 8–65% [3–10]. In Danish 15–17 year-olds, 14% had

more than three surfaces eroded [11], while figures for 15 year-old Icelanders and 15–19 year-old Brazilians were 22% and 21% respectively [12,13]. The variations in prevalence in the above mentioned reports, aside from participant selection, may most likely be accounted for by the methodology and grading criteria applied in the different studies. The availability of studies applying more defined criteria for scoring erosive damage, as well as studies conducted on older adolescents, are relatively rare. In 20 year-old Saudi men, the prevalence of dental erosion with dentin involvement was 16% [14], while 22% of Swedish 18–19 year-olds and 15% of Norwegian 16–18 year-olds had erosive lesions into dentin [15]. In a recent study on Swedish 20 year-olds, 18% had severe erosion into dentin [16].

Higher prevalence and severity of dental erosion are more frequently observed in boys than in girls [3,4,8,15,17–20], although

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a few studies have also found the opposite or no gender differences [5,16,21,22]. Dietary factors, especially consumption of acidic drinks, have in a large number of studies been found to be the main etiological factor of dental erosion [3,5,8,19,23–25], while others have not [12,26–27]. Besides consumption of acidic drinks, a lifestyle that may be conducive to such consumption, such as sedentary living, excessive screen viewing activity, as well as being overweight, may contribute to the development of erosive wear [28–35]. But, it is clear that other factors may also contribute to erosive damage, for instance method of drinking and the consumption of sour sweets [23,25,36–39]. Intake of medicines and oral hygiene practices are regarded as risk factors for erosive wear [5,39,40].

The progression of dental erosion has not been thoroughly studied and reports in the literature are scant. In British children, progression of erosion was seen in 27% of those between the ages of 12–14 years [8]. In a 3-year longitudinal study of Dutch children between 11–15 years of age, the progression was common in those with dental erosion [17].

Our aim was to study prospectively the progression of dental erosion over four years in a group of 13–14 year-old adolescents, and its association with some lifestyle and oral health factors. The hypothesis was that dental erosion would progress during the study period, among both genders and especially so in boys, and also be associated with a certain lifestyle and oral health.

## 2. Methods

### 2.1. Participants and procedures

The baseline study for this follow-up took place during 2005–2007 [3]. In that study, 303 adolescents aged 13–14 years at the Public Dental Service in Nora and Storå, Region Örebro County Council, Örebro, Sweden, were offered to participate of which 227 accepted. The present study is a follow-up after 4 years, and all of the original 227 participants (who had remained as recall patients within the Public Dental Service during the study period, May 2009–January 2012) were invited to participate. Data collection took place during the participant's regular dental examination. Clinical and questionnaire examinations were identical to the baseline study except for addition of recording of consumption of alcoholic beverages to the questionnaire [3].

### 2.2. Clinical examination

Assessment of dental erosion was performed according to previously described methodology and grading was done according to a commonly used erosion scale (Table 1) [14]. An additional scale was used for grading molar cupplings (Table 2) [3]. The two scales were combined based on the highest erosion grades scored on the anterior teeth (Table 1) and first molar teeth (Table 2): no erosion (score 0), mild erosion (score 1), moderate erosion (score 2), severe erosion (score 3) and very severe erosion (score 4),

(Table 3). So, the severest score, either for incisors or molars, determined the "holistic" score in Table 3. For example, if an individual had a molar with >1 mm cupping (grade 3) but only grade 1 affecting the incisors, the individual was graded as severe erosion (grade 3).

All gradings were performed by the principal investigator (AH) and intra-examiner concordance was tested by performing two successive blind assessments after an interval of two to four weeks in 13 individuals, who did not participate in this study. The tooth surfaces were dried using compressed air and grading was performed in an ordinary clinical setting. In cases of difficulties with deciding the severity of dental erosion between two grades on the scale, the lower grade was chosen. Surfaces that were impossible to grade because of orthodontic brackets, retainers, fillings or enamel hypoplasia were excluded, which was also the case on some surfaces that had been intensely polished after removal of orthodontic brackets.

Visible plaque index (VPI) and Gingival bleeding index (GBI) were recorded as "yes" or "no" in maxillary anterior teeth, according to Ainamo and Bay [41]. In order, VPI was assessed first followed by GBI, and if necessary, the teeth were then polished with prophylaxis paste before grading of tooth wear. Dental caries, DMFT and DMFS, was recorded and radiographic examination performed on the basis of individual indication. The examiner (AH) was blinded from baseline data and the result from questionnaires during the follow-up examination.

### 2.3. Questionnaire investigation

The questionnaire was divided into two parts. The first part was a written inquiry, regarding some lifestyle factors. It was filled in by the patient at home, and returned by mail to the clinic. The questions comprised oral hygiene routines, oral or gastrointestinal symptoms (never/monthly/weekly/daily/always), intake of medicines (yes or no), general health (often sick—yes or no) and if they had a habit of retaining acidic soft drinks in the mouth before swallowing (yes or no). Other questions included: frequency of physical activity (frequency per week), screen-viewing habits (hours per day), body height/weight, whether they had tried to increase or reduce their weight (yes or no), and if either parent were born outside Sweden (Sweden/Nordic countries/Europe/Others). Types and frequency of intake of certain dietary items were estimated and recorded as numbers of times per month/week or day. These were: water, all types of acidic soft drinks, milk, yogurt, sour milk, tea, coffee, sweets, sour sweets, chewing gum, ice cream, popsicle, biscuits, snacks, cheese, dried and fresh fruits. The second part of the questionnaire was conducted as an oral interview by a specially trained dental assistant during the clinic visit. All current beverage consumption, and estimated previous consumption one year ago, was recorded in detail; carbonated soft drinks, still drinks, sport drinks, juice, water, milk, tea, coffee, and some alcoholic beverages (wine, beer, cider, alcopop). The amount and frequency of each portion was estimated, and the daily or

**Table 1**  
Ordinal scale used for grading severity of dental erosion on buccal and lingual surfaces of maxillary anterior teeth [14].

Grade	Criteria
0	No visible changes, developmental structures remain, macro-morphology intact.
1	Smoothed enamel, developmental structures have totally or partially vanished. Enamel surface is shiny, matt, irregular, "melted", rounded or flat, macro-morphology generally intact.
2	Enamel surface as described in grade 1. Macro-morphology clearly changed, faceting or concavity formation within the enamel, no dentinal exposure.
3	Enamel surface as described in grades 1 and 2. Macro-morphology greatly changed (close to dentinal exposure of large surfaces) or dentin surface exposed by $\leq 1/3$ .
4	Enamel surface as described in grades 1, 2 and 3. Dentin surface exposed by $>1/3$ or pulp visible through the dentin.

Note: Approximal erosion and presence of "shoulder" should be recorded.

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