

# Dental anxiety and oral health in 15-year-olds: a repeated cross-sectional study over 30 years

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**Objectives:** To report the prevalence of dental anxiety in Swedish 15-year-olds over a 30-year period (1973–2003) and how dental anxiety relates to oral health. **Basic research design:** The study used a repeated cross-sectional design. **Participants:** In 1973, 1983, 1993, and 2003, random samples of 96 to 107 15-year-olds were selected from the city of Jönköping, Sweden, 405 overall. **Main Outcome Measures:** Dental anxiety (DA) and its association with oral health (caries, gingivitis, plaque, fillings) were analysed ( $\alpha=0.05$ ). **Results:** The proportions of dentally anxious during the period were 38% (n=37) in 1973, 26% (n=28) in 1983, 18% (n=15) in 1993 and 13% (n=12) in 2003 a clearly decreasing trend with time. The strongest predictor of DA was gender, with girls reporting higher levels of DA. In three of the four examination years, adolescents with DA had more filled permanent surfaces than those without DA. Those with DA had a greater caries experience only in 1973. No associations were found between DA and plaque or gingivitis. Multivariate logistic modelling confirmed that DA decreased over time and that girls had higher levels of DA. **Conclusions:** This study showed a clear decrease in DA in 15-year-olds over a 30-year period, with a greater proportion of girls being more dentally anxious. The results also indicate a relationship between DA and oral health; the dentally anxious having more filled surfaces and, only in 1973, more decayed tooth surfaces.

**Key words:** adolescence, dental anxiety, oral health, dental caries, prevalence, Sweden

## Introduction

The worldwide measured prevalence of dental anxiety (DA) and dental fear among adolescents ranges between 3.3 and 19.0% (Bedi *et al.*, 1992; Milgrom *et al.*, 1992; Poulton *et al.*, 2001; Skaret *et al.*, 1998; Stenebrand *et al.*, 2013; Thomson *et al.*, 1997). The variability in DA prevalence may result from different measurement methods, the samples' ages or the diversity of geographies and cultures. Thomson *et al.* (1997) and Bedi *et al.* (1992), for example, used the same measurement method and similarly aged adolescent samples but in different countries finding DA prevalences of 10.9% and 7.1% respectively. Overall though, DA is relatively common.

Changes in the prevalence of DA over time appear difficult to establish, partly because of the variability described above. A probable decrease in prevalence over time has been identified among samples aged around 15 years using cross-sectional studies (Milgrom *et al.*, 1992; Stenebrand *et al.*, 2013) and a longitudinal study (Thomson *et al.*, 1997) but this trend is not as apparent in studies with a wider age range (Bedi *et al.*, 1992; Poulton *et al.*, 2001; Skaret *et al.*, 1998). There still appears to be a lack of time trend studies of DA in younger adolescents. To obtain that information, repeated cross-sectional studies would need to be carried out using the same measure of DA and similar samples in the same region.

If not properly managed, DA is associated with avoidance of dental care (Klingberg *et al.*, 1995) and, in the long run, also with negative social and emotional consequences (Abrahamsson *et al.*, 2000). Adult patients with severe DA

have poorer oral health than the general population (Schuller *et al.*, 2003). Similarly, children with DA had more carious surfaces than those without DA (Klingberg *et al.*, 1995). For adolescents, findings conflict with Kruger *et al.* (1998), for example, finding that DA is likely to be a predictor of dental caries and possibly a risk factor for dental caries incidence, but Thomson *et al.* (2000) finding no association between DA and caries.

The dental treatment experience itself could also play a significant aetiological role with respect to the onset of DA. From this perspective, fillings signify both poor oral health and the experience of invasive dental treatment. Among 18-year-olds, mean DA scores for those who had received either conservative or surgical treatment were higher than those who had not undergone these treatments and DA correlated with painful experiences (Skaret *et al.*, 1998). Likewise in 15-year-olds, pain in dental treatments was the strongest predictor of DA (Stenebrand *et al.*, 2013).

Against this background the present study was carried out to report the time trend in prevalence of DA in Swedish 15-year-olds over a 30-year period (1973–2003) and to find out how DA relates to oral health.

## Methods

In 1973, 1983, 1993 and 2003, random samples of 15-year-olds were selected from the medium-sized southern Swedish city of Jönköping. The randomization was performed by a registrar at the County Council produced a sample with an ethnic composition similar to that of the Swedish

15-year-olds in general. In 1973, the participants were listed in chronological order according to date of birth. The first 100 individuals who accepted to participate were included in the study. In 1983, 1993 and 2003, 130 individuals were randomly selected each year from individuals having their birthdays in the months of March through May then sent a personal letter of invitation to participate in the investigation. They were informed about the purpose of the investigation, the details of the examination procedures, and about the questionnaire that they would be asked to fill in at the clinic before the examination. For various reasons, of those invited 18% in 1983, 22% in 1993 and 26% in 2003 declined to participate. Those reasons were typically “no special reason”, “not interested” and “no time”. Further information about the sampling procedure and routines, detailed reasons for not taking part in the study, and the numbers of non-respondents is provided by Hugoson *et al.* (2005a).

The questionnaire gathered data regarding background and DA. The number of permanent teeth, clinical and radiographic caries, restorations, decayed and filled surfaces, plaque and gingivitis were recorded according to a standard protocol which has previously been reported (Hugoson *et al.*, 2005b). If recent radiographs were available, they were obtained from each individual’s general dentist. All the examinations in 1973, 1983, 1993 and 2003 were performed in a dental clinic by dentists with considerable experience of clinical investigations. The dentists, from the Department of Paediatric Dentistry, were calibrated via a consensus discussion prior to the study according to the diagnostic criteria used.

DA was assessed using three single-item questions: “Do you feel uncomfortable before a dental visit?”, “Do you feel anxious before a dental visit?” and “Do you feel sick before a dental visit?” with response options *yes* or *no*. Participants who answered yes to one or more of the three single-item questions were considered as dentally anxious. The single-item Dental Anxiety Question has been used previously (Neverlien, 1990; Poulton *et al.*, 2001), and has been found to be a reliable and valid measurement of DA (Neverlien, 1990).

The permanent teeth were recorded and clinical caries was examined on all tooth surfaces available for clinical evaluation. Radiographic caries was recorded as lesions seen on the proximal tooth surfaces as clearly defined reductions in mineral content according to the criteria described by Koch (1967). Then caries was divided into initial caries and manifest caries. Hereafter, caries means the sum of initial and manifest lesions. For each tooth surface, the presence of any restoration was also recorded. The number of decayed and filled permanent surfaces was calculated.

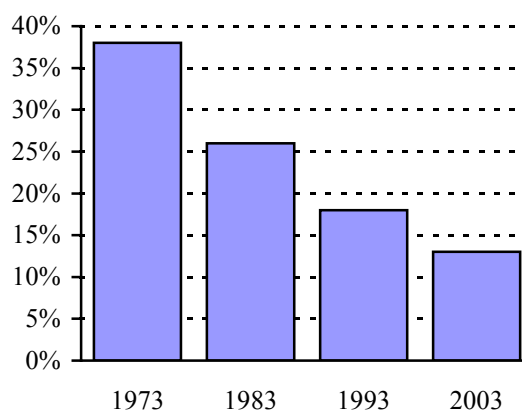
The presence of visible plaque was recorded for all tooth surfaces after drying with air, according to the criteria for Plaque Indices (Silness and Løe, 1964). The occurrence of gingival inflammation was recorded for each tooth surfaces if the gingivae bled on gentle probing (Løe and Silness, 1963).

The statistical analysis included the Chi-square test, the Mann-Whitney U test, two-way between-groups analysis of variance, and logistic regression. All analyses are based on the year of the four different survey occasions. Chi-square test was used for categorical variables. As the distributions of the oral health variables are skewed, Mann-Whitney U Tests were conducted to compare differences with regard to the different variables. A two-way between-groups analysis of variance (ANOVA) was conducted to compare the scores of the oral health variables between the different examination years and to consider the impact of DA in any findings. The ANOVA included the Tukey HSD test for post-hoc comparisons. Multivariate logistic regression was performed to assess the impact of factors on the likelihood of reporting DA. The variables incorporated in the analysis were based on previous bivariate analyses. The logistic regression contained three independent variables with the variable ‘filled surfaces’ categorised as: no fillings, 1-2 fillings and 3 or more fillings.

Throughout, the study followed the ethical rules of the Helsinki Declaration. The study conducted in 2003 was approved by the Ethical Committee at the University of Linköping, Linköping, Sweden. The earlier studies did not require research ethical permission when they were performed.

## Results

The proportions of dentally anxious 15-year-olds were 38% (n=37) in 1973, 26% (n=28) in 1983, 18% (n=15) in 1993 and 13% (n=12) in 2003 (Figure 1) - clearly decreasing with time. More girls than boys reported DA (Table 1) with that differences being significant in 1983 ( $\chi^2 = 8.1$ ,  $p < 0.004$ ) and 1993 ( $\chi^2 = 7.8$ ,  $p < 0.005$ ) were significant.



**Figure 1.** The declining dental anxiety trend between the observed study years. ( $\chi^2$  test for trend = 18.4,  $p < 0.0001$ )

**Table 1.** Number of participating adolescents (np), number of valid answers (nv) and number and percentage of adolescents with dental anxiety (DA) by year of examination

	1973			1983			1993			2003		
	np	nv	DA (%)	np	nv	DA (%)	np	nv	DA (%)	np	nv	DA (%)
Boys	45	44	13 (30)	52	51	7 (14)	51	38	2 (5)	45	44	3 (7)
Girls	55	53	24 (45)	55	55	21 (38)	51	45	13 (29)	51	50	9 (18)
All	100	97	37 (38)	107	106	28 (26)	102	83	15 (18)	96	94	12 (13)

Not all of the adolescents included in the study answered all three questions concerning DA. Answers to all three questions were received from 97 (97%) subjects in 1973, from 106 (99%) subjects in 1983, from 83 (81%) subjects in 1993 and from 94 (98%) subjects in 2003, with a distribution of affirmative answers presented in Table 2.

**Table 2.** Number and percentage of valid affirmative answers concerning dental anxiety by survey year

Number of affirmative answers	1973		1983		1993		2003	
	n	%	n	%	n	%	n	%
0	60	62	78	74	68	82	82	87
1	34	35	23	21	15	18	10	11
2	3	3	5	5	0	0	1	1
3	0	0	0	0	0	0	1	1
Total	97		106		83		94	

Table 3 presents the mean values for the five oral health variables with respect to DA. Filled surfaces (FS) were more often observed in adolescents with DA in three out of four examination years (not 1993). For DS and DFS there were only significant differences in 1973. Concerning plaque and gingivitis there were no differences associated with DA.

According to ANOVA the mean score for filled surfaces differed between all the years with a significant value of  $p < 0.0001$ , except for between 1983 and 1993, where the value was  $p < 0.05$ . The main effect for DA was also significant ( $p < 0.005$ ). Regarding the other oral health measures, the analyses showed no clear relationship with DA.

**Table 3.** Mean values for decayed surfaces (DS), filled surfaces (FS), decayed and filled surfaces (DFS), surfaces with plaque and surfaces with gingivitis with respect to dental anxiety by survey year

	Dental anxiety			No dental anxiety			Whole adolescent sample			Mann-Whitney U Test, p	
	Mean	SD	95% CI	Mean	SD	95% CI	Mean	SD	95% CI		
<b>1973</b>	DS	22.1	9.1	19.1,25.1	18.5	9.3	16.1,20.9	20.0	9.3	18.2,21.9	<b>&lt;0.05</b>
	FS	19.9	8.2	17.2,22.7	16.0	8.4	13.8,18.2	17.8	8.7	16.1,19.5	
	DFS	42.1	14.6	37.2,46.9	34.5	14.8	30.7,38.3	37.8	15.3	34.8,40.8	
	Plaque	34.2	24.3	26.1,42.3	35.0	23.8	28.8,41.1	34.9	23.8	30.2,39.7	
	Gingivitis	25.5	23.3	17.7,33.3	29.7	25.6	23.1,36.3	28.0	24.5	23.2,32.9	
<b>1983</b>	DS	8.1	9.1	4.5,11.6	9.4	9.7	7.2,11.6	9.1	9.5	7.3,10.9	<b>&lt;0.05</b>
	FS	8.2	4.0	6.7, 9.8	6.2	4.9	5.1, 7.3	6.7	4.7	5.8, 7.6	
	DFS	16.3	11.2	11.9,20.6	15.6	13.2	12.6,18.6	15.8	12.6	13.4,18.2	
	Plaque	26.0	30.4	14.2,37.8	28.9	28.7	22.4,35.3	28.4	29.1	22.8,33.9	
	Gingivitis	19.0	23.9	9.7,28.3	20.5	23.6	15.2,25.9	20.4	23.7	15.9,25.0	
<b>1993</b>	DS	7.3	8.3	2.7,11.8	9.8	12.8	6.7,12.3	9.3	11.6	7.0,11.6	<b>&lt;0.05</b>
	FS	8.9	3.2	7.1,10.6	9.0	3.4	8.1, 9.8	8.7	3.5	8.0, 9.4	
	DFS	16.1	9.6	10.8,21.5	18.7	14.1	15.3,22.1	18.0	12.8	15.5,20.5	
	Plaque	17.5	18.5	7.3,27.8	37.6	33.1	29.6,45.6	35.2	32.1	28.9,41.5	
	Gingivitis	14.7	9.5	9.4,19.9	23.9	19.2	19.2,28.5	22.6	18.5	19.0,26.3	
<b>2003</b>	DS	6.5	9.1	0.7,12.3	4.2	5.7	3.0, 5.5	4.7	6.6	3.4, 6.1	<b>&lt;0.05</b>
	FS	4.1	4.2	1.4, 6.8	1.4	2.8	0.8, 2.0	1.7	3.1	1.1, 2.4	
	DFS	10.6	11.5	3.3,17.9	5.6	6.6	4.2, 7.1	6.5	7.9	4.9, 8.1	
	Plaque	16.9	13.3	8.4,25.4	12.1	7.3	10.5,13.7	13.5	11.9	11.1,15.9	
	Gingivitis	15.5	12.0	7.9,23.1	9.6	9.3	7.5,11.6	11.1	13.1	8.5,13.8	

The results of the multivariate logistic regression analysis are shown in Table 4. The full model containing all predictors was statistically significant ( $\chi^2=43.7$ ,  $p < 0.0001$ ) indicating that the model was able to differentiate between respondents who reported and those who did not report DA. The model as a whole explained 16% (Nagelkerke  $R^2$ ) of the variability in DA, classifying 76% of the cases correctly. Gender and time both made a unique and significant contribution to the model and were strong predictors of DA. Girls were more than three times more likely than boys to report DA. The time trend indicated that the risk of DA reduced over the decades. The variable 'filled surfaces' was not significant in the model; however, the categories indicated a gradient in the odds ratios with more filled surfaces predicting greater risk of DA.

**Table 4.** Logistic regression to assess the impact of factors on the likelihood of reporting dental anxiety

Variable	Odds ratio	95% C.I.	p value
Gender, Ref: Boys	3.18	1.87,5.41	<b>&lt;0.0001</b>
Time	0.70	0.53,0.91	<b>0.009</b>
Filled surfaces, Ref:0 surfaces			0.112
1-2	1.45	0.35,5.98	0.604
$\geq 3$	2.92	0.93,9.19	0.067



## Discussion

This study found a decreasing prevalence of DA in Swedish 15-year-olds over the 30-year period 1973 to 2003. The strongest predictor of reporting DA was being female. In three out of four examination years, the adolescents with DA had more filled permanent surfaces, compared with those without DA and the more restorative treatment, the stronger the association with DA.

Other studies of adolescents of similar age, but elsewhere and using different measures, also found the prevalence of DA has decreased over time (Milgrom *et al.*, 1992; Stenebrand *et al.*, 2013; Thomson *et al.*, 1997). Likewise other studies also concluded that more girls than boys reported DA (Bedi *et al.*, 1992; Skaret *et al.*, 1998; Stenebrand *et al.*, 2013; Thomson *et al.*, 1997). The strengths of the present study are the consistently repeated cross-sectional design over a 30 year period with four examinations using of the same measure of DA and same sampling method. Weaknesses that may be considered are the relatively small sample sizes which may indicate a statistical power issue, moreover, the samples were local rather than national and may not be representative of Sweden.

One reason for the decreased prevalence of DA among 15-year-olds over this 30-year period may be improvements in dental care, e.g. communication skills of dental staff, pain reduction, instruments, and recall intervals. Another reason may be improved oral health, leading to less invasive dental treatment.

Interestingly, the results of the present study indicate a relationship between invasive dental treatment and DA, as the correlation between the number of filled surfaces and DA implies. Concerning filled surfaces, a measure indicating experience of invasive dental treatment, there were differences noted in the present study between those with and those without DA in three out of four examination years. This result contradicts the results of Thomson *et al.* (2000), who found no such differences. As noted earlier, experience of invasive dental treatment, here measured in terms of restorative treatment or filled surfaces, could be a factor in the onset of DA. Invasive dental treatment may be painful and if there was a lack of pain control during the treatment, this could contribute to the onset of DA (Skaret *et al.* 1998; Stenebrand *et al.*, 2013). However, this is merely speculation, as the cross-sectional design of these and the present studies can not determine the direction of causality between DA and filled surfaces.

The variable 'fillings' may thus mirror different aspects of dental care: firstly, it may indicate previous experiences of dental care and include communication in the dental situation between the patient and the dental care provider. It has been suggested that the patient-dentist interaction is related to a patient's feelings of security and control as well as to avoidance behaviour (Corah *et al.*, 1988). DA can thus be acquired after the adolescent has felt a lack of control in the dental treatment situation (Milgrom *et al.*, 1992), and has been reported to be associated with the adolescents' sense of coherence (Jaakkola *et al.*, 2013). Secondly, the variable 'fillings' may indicate possible experiences of painful and stressful dental care, as stated above. This may have taken place when the adolescent was younger. A lack of trust in the ability of children to report pain may, in fact, result in less than optimum pain control during dental treatment

(Nakai *et al.*, 2000). Moreover, fillings are also a definite measure of oral disease over time. However, this complex measure was linked to likelihood of perceived DA: the more restorative treatment, the stronger the likelihood of DA. Regarding whether DA is likely to be a significant predictor of dental caries incidence or not, studies on adolescents have produced divergent results (Kruger *et al.*, 1998; Thomson *et al.*, 2000).

The results of the present study revealed that for decayed surfaces there were only differences for adolescents with and without DA in the 1973 examination, a finding that might be explained in part by simple dental pain; not from invasive dental treatment, but from toothache caused by the carious lesions which were greatest in number in that year (Hugoson *et al.*, 2005b). However, the results of Kruger *et al.* (1998) supported a relationship between DA and caries, who argued that the findings raised questions about the direction of causality between DA and caries experience and whether individuals with greater caries experience require more invasive dental treatment, with consequent negative dental experiences leading to DA.

Despite the observed decrease in the prevalence of adolescent DA, there are still patients with DA who need dental treatment, and measures should be taken to prevent DA. The results confirm not only the importance of maintaining oral health to prevent oral symptoms and negative experiences of dental care, but also the need to achieve positive and safe treatment experiences. Dental patients at the age of 15 and younger are often dependent on the adults around them to ensure that they are not exposed to more treatment than they can handle at the time. The adult does not necessarily have to be a parent or a relative, but might be a member of the dental staff. Adolescents with high DA more often than other patients perceived their interaction with dental staff negatively. They may perceive their interaction with the dental staff more positively if staff succeed in creating a positive, trusting, approving and supportive atmosphere (Jaakkola *et al.*, 2014). A relationship based on empathic understanding, warmth and respect may therefore reduce a patient's fear (Kulich *et al.*, 2000) and presumably also the risk of DA.

To conclude, the present study, using a repeated cross-sectional design, showed a decreased prevalence of DA in Swedish 15-year-olds over a 30-year-period. There was a correlation between DA and caries experience in 1973. No differences were found between DA and plaque/gingivitis. The results also indicate a relationship between restorative treatment and DA; the more filled tooth surfaces, the greater the likelihood of being dentally anxious.

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