

Dental caries and changes in dental anxiety in late adolescence

Esther Kruger¹, W. Murray Thomson¹,
Richie Poulton², Simon Davies²,
R. Harvey Brown¹ and Phil A. Silva²

¹Department of Oral Health, School of Dentistry, and ²Dunedin Multidisciplinary Health and Development Study, Department of Preventive and Social Medicine, The University of Otago, Dunedin, New Zealand

Kruger E, Thomson WM, Poulton R, Davies S, Brown RH, Silva PA: Dental caries and changes in dental anxiety in late adolescence. *Community Dent Oral Epidemiol* 1998; 26: 355–9. © Munksgaard, 1998

Abstract – Little is known about changes in dental anxiety with ageing and their association with changes in oral health. This study examined the relationship between changes in dental caries experience and dental anxiety from 15 to 18 years of age among adolescent participants in the Dunedin Multidisciplinary Health and Development Study. Dental anxiety was estimated using the Corah Dental Anxiety Scale (DAS), and individuals with a DAS score of 13+ were identified as being dentally anxious. Dental examinations were performed on 649 individuals at ages 15 and 18, and a DMFS score was computed for each. Caries prevalence among those who were dentally anxious at both 15 and 18 years was significantly higher than for those who were not at either age. Regression analysis revealed that dental anxiety predicted caries incidence between ages 15 and 18 years. Dental anxiety is likely to be a significant predictor of dental caries experience, and may be a risk factor for dental caries incidence.

Key words: adolescents; behavioral science; dental anxiety; oral health

Esther Kruger, Department of Oral Health, School of Dentistry, The University of Otago, P.O. Box 647, Dunedin, New Zealand
Tel: +64 3 479 7115. Fax: +64 3 479 7113
E-mail: esther.kruger@stonebow.otago.ac.nz

Accepted for publication 4 December 1997

Dental anxiety is very common (1), but little is known about how individuals acquire it. Most knowledge in this area is derived from cross-sectional studies which have relied upon people's recall of salient past dental experiences. There are two main problems with the cross-sectional approach to investigating the development and natural history of dental anxiety: (a) recall difficulties are a possible source of bias; and (b) the time-ordering of crucial events may not be certain (2). Despite these concerns, the following patterns are apparent from the studies published to date: (a) people with high levels of dental fear and anxiety have most often attributed them to aversive conditioning processes which have usually occurred during childhood; (b) a smaller percentage are attributed to vicarious learning in childhood (that is behaviour modelled on that of parents, siblings and other significant persons); and (c) personality factors play a part, whereby particular personality types may be more prone to dental anxiety, and in some individuals, dental anxiety may be part of a wider group of co-existing general anxiety or psychiatric disorders (3). An alternative classifica-

tion of dentally anxious people simply divides them according to the source of their anxiety into (a) an endogenous (internal) group and (b) an exogenous (external) group. The latter group's dental anxiety is understood to be a simple conditioned phobia arising from direct or vicarious negative dental experience (4).

Dental anxiety has been shown to be associated with a range of adverse behavioural and dental health characteristics: studies of children (5–7) and adults (8–11) have reported that dental anxiety is associated with less favourable self-care behaviour and partial or total avoidance of dental care, and also with poorer health outcomes. However, little is understood of the relationship (1), and no theoretical model has been proposed to account for the observed associations. The few longitudinal studies that have examined changes in dental anxiety prevalence and severity suggest that, while changes in dental anxiety status can occur at any age (12–14), the greatest instability in dental anxiety occurs during the middle to late adolescent period (14).

We recently reported on the distribution of participants in an ongoing cohort study of young New Zealanders across four groups according to their dental anxiety status at ages 15 and 18: the *Chronic* group were those who were dentally anxious (DAS score of 13+) at both ages; the *Incident* group were only dentally anxious at age 18; the *Remitted* group were only dentally anxious at age 15; and the *Never* group were dentally anxious at neither age. There were considerable changes in DAS scores in the *Incident* and *Remitted* groups over the 3-year period, and it is possible that some of the changes in the former group were associated with the presence of aversive-conditioning dental experiences on one or more occasions between 15 and 18 years of age, particularly given recent work on the same study, which showed that the amount of early dental caries experience was positively associated with the development of dental fear by age 15 (15). However, mid-to-late adolescence is a time of emergence of psychological symptoms, and it is therefore also possible that the onset of dental anxiety was part of a general upsurge of these symptoms for some individuals in the *Incident* group. It is currently unclear whether people who are dentally anxious have more disease as a result of their anxiety, or whether their anxiety is a conditioned response to earlier treatment of their disease. The aim of this study was to examine the association of dental caries experience and self-reported dental health with 3-year changes in dental anxiety among adolescent participants in a longitudinal study.

Methods

Participants in the Dunedin Multidisciplinary Health and Development Study (DMHDS) have been followed (with periodic collection of health and developmental data, including dental examinations) since birth. The aims, establishment and methodology of the study have been described elsewhere (16). Those eligible for the sample were babies born at the Queen Mary Hospital between 1 April 1972 and 31 March 1973, whose mothers lived within the Dunedin Metropolitan Health District boundaries (16). During that 12-month period, there were 1661 live births to eligible mothers. Of these, 12 died before age 3, and 510 were living outside Otago. This left 1139 children eligible for enrolment in the DMHDS; of these, 68 were parental refusals, and 34 were not located in time to be included. This meant that the initial sample was

1037 (91% of the eligible sample) children (comprising 527 boys and 510 girls; 1013 single babies and 24 twins). They were assessed within a month of their third birthday. Those not followed up at age 3 did not differ systematically in terms of their perinatal characteristics, although there is evidence that the sample followed up was slightly under-representative of the highest and lowest socio-economic status levels, and that the rate of ex-nuptial births was higher among those not followed up. Compared to the rest of the New Zealand population, the DMHDS sample is slightly more advantaged socio-economically. Follow-up rates for the sample have been very impressive and are a major strength of the DMHDS, with all but one phase (at age 13, where it was 82%) recording rates of over 90%. At age 15, 95% of the original sample were involved, rising to 97% at age 18 (16).

A self-completed health questionnaire was used to collect dental anxiety data with the Corah Dental Anxiety Scale, or DAS (17), at ages 15 and 18. A DAS score was computed for each participant (sum of responses to the four DAS items), and used as a point estimate of dental anxiety severity. Sample members with a DAS score of 13 or more were designated the "high" dental anxiety group.

Self-assessed dental health was evaluated at ages 15 and 18 by examination participants' responses to the question "In general, compared to other persons your age, would you say your dental health is: *among the best*; *better than average*; *below average*; *among the worst*," (possible responses in italics). Responses were dichotomised to indicate either better (first two options for each) or worse (last two options for each) self-perceived oral health in comparison to peers.

Dental examinations of participants were performed at ages 15 and 18. No evaluations of inter- and intra-examiner reliability were undertaken because logistical and time constraints on the full study program precluded repeat examinations. A DMFS score was computed for each individual at age 15 and 18, and the 3-year DMFS increment was computed by subtracting the age-15 from the age-18 estimate.

Data were analysed with the SPSS program (18). The computation of univariate statistics was followed by examination of bivariate associations among the variables using analysis of variance (ANOVA). Differences among three or more groups were tested with the one-way ANOVA least squares difference test for multiple comparisons, and the Bonferroni correction was used to mini-

mise the chance of Type I error. Log transformations of the DMFS data were undertaken to normalise their distribution.

To examine the direction of the putative causal relationship between caries experience and dental anxiety, linear regression was used to test the hypothesis that caries experience predicts dental anxiety, and Poisson regression was used to test the hypothesis that dental anxiety predicts higher levels of caries experience.

Results

The characteristics of the participants and non-participants in the DAS and dental examinations at both ages have been previously reported (14). There were no observed differences according to gender, family disadvantage, reason for last dental visit, or enrolment as adolescents in the New Zealand General Dental Benefit Scheme (by which adolescents receive free dental care up to age 18).

Data on self-rated oral health and dental caries

prevalence, severity and 3-year increment are presented in Table 1. Self-rated oral health was worst in the *Chronic* group, and most favourable in the *Never* group. Overall caries prevalence (with a case definition of 1+ DMFS) among participants was 85.5% at age 15 and 92.1% at 18 years, representing a net increase of 6.6% over the 3-year period. At both 15 and 18, there were clear gradients in caries prevalence, with the highest in the *Chronic* group and the lowest in the *Never* group. The mean DMFS (caries severity) among study participants was 5.97 (SD 4.59) at age 15, and 8.34 (SD 6.91) at age 18, representing a mean 3-year caries increment of 2.37 (SD 3.91). At both ages, the only statistically significant differences in caries severity were those observed between the *Never* (lowest mean DMFS at both 15 and 18) and the *Chronic* (highest mean DMFS at 15 and 18) groups.

The results of the linear regression and Poisson analyses are presented in Table 2. When controlled for DAS15 (dental anxiety score at age 15) and DMFS15 (DMFS score at age 15), DAS increment

Table 1. Self-reported dental health, dental caries prevalence, severity and increment by DAS study group

	DAS group				
	Chronic	Incident	Remitted	Never	All
Self-reported oral health at 18 better than others same age ^a	11 (36.7)	32 (52.5)	28 (62.2)	423 (76.4)	494 (71.6)
Age 15					
Caries prevalence (%)	27 (100) ^b	55 (93.2)	38 (88.4)	435 (83.7)	555 (85.5)
DMFS (SD) ^c	7.67 (4.77)	6.84 (5.81)	5.95 (3.68)	5.75 (5.75)	5.97 (4.59)
Log (DMFS)	1.86 (0.62) ^d	1.64 (0.77)	1.57 (0.71)	1.46 (0.79)	1.51 (0.78)
Age 18					
Caries prevalence (%)	27 (100.0) ^b	58 (98.3) ^d	42 (97.7)	471 (90.6)	598 (92.1)
DMFS (SD) ^c	11.00 (9.29)	9.16 (7.45)	8.10 (5.07)	8.11 (6.80)	8.34 (6.91)
Log (DMFS)	2.12 (0.74) ^d	1.94 (0.76)	1.83 (0.81)	1.76 (0.87)	1.80 (0.85)
3-year DFS increment	3.33 (5.53) ^d	2.63 (2.98)	2.65 (3.09)	2.54 (3.98)	2.59 (3.91)

^a $P < 0.01$.

^b $P < 0.05$.

^c Mean DMFS for those with 1+DMFS.

^d One-way ANOVA: LSD test for multiple comparisons: *Chronic* differs from *Never*.

Table 2. Multivariate models

<i>Model 1: 3-year DAS increment as dependent variable</i>				
Independent variable	B	SE	<i>t</i>	<i>P</i>
DAS at age 15	-0.490	0.036	-13.517	<0.05
DMFS at age 15	0.060	0.023	2.570	<0.05
3-year DMFS increment	0.024	0.027	0.882	0.38
<i>Model 2: 3-year increment as dependent variable</i>				
DMFS at age 15	0.067	0.003	17.639	<0.05
DAS at age 15	0.031	0.009	3.400	<0.05
3-year DAS increment	0.021	0.008	2.349	<0.05

was not predicted by DMFS increment. Thus, an increase in caries experience did not have an independent, statistically significant effect on dental anxiety at age 18. However, DMFS increment was predicted by DAS increment when DMFS15 and DAS15 were controlled for.

Discussion

The longitudinal study design is a powerful one, and serves two main purposes: (i) to describe patterns of change (that is, the natural history of disease and health); and (ii) to establish the direction and magnitude of putative causal relationships. No other design can provide such information. The principal disadvantage of the longitudinal study design is sample attrition over time, which can result in unrepresentative findings and compromise a study's external validity (19). However, the participants in this study have been previously reported to be largely representative of their peers (14), and was therefore an unlikely threat to validity.

Individuals who were not classified as dentally anxious at either 15 or 18 (the *Never* group) had the lowest caries severity at each age as well as the lowest caries increment. Conversely, those who were dental anxiety sufferers at both ages (the *Chronic* group) had the highest caries severity and increment. Interestingly, this suggests a close relationship between overall disease incidence and dental anxiety status which has, to date, not been demonstrated elsewhere. Implicit in previous work has been the assumption that, while overall caries prevalence in non-anxious and anxious individuals was similar, the contributions of the individual components to the DMFS index may vary (7, 8, 10, 11). It was also implicitly assumed that caries *incidence* did not differ between anxious and non-anxious people (6, 7). The caries experience of anxious individuals in some studies was not markedly worse than that of their non-anxious counterparts, but the negative dental health attitudes and behaviour of the former suggested that their dental health might have deteriorated over time had repeated observations been made.

In this study, caries prevalence and incidence were highest among the dentally anxious group and lowest among the non-anxious individuals, thus offering support for the hypothesised relationship between dental anxiety and caries. Self-perceived oral health was also worse among anxious than among non-anxious individuals. The findings

raise questions about the direction of causality between dental anxiety and caries experience, if indeed the relationship is causal. Future studies are necessary on the following hypotheses as possible explanations: (a) that individuals with high levels of caries experience require more invasive dental treatment, and consequent negative dental experiences lead to dental anxiety; and (b) that dentally anxious individuals avoid dental treatment and neglect oral self-care, thereby leading to their high levels of caries experience.

The present multivariate analysis indicated that high dental anxiety is a predictive variable for dental caries experience in adolescents. It is thus possible that dental anxiety may be a risk factor for dental caries incidence, which in turn lends a degree of biologic plausibility to the observed caries severity scores and increments in the four groups. The exact mechanism by which high levels of anxiety lead to an increase in caries is currently unclear. Considering the existing literature in this field, possible factors that we wish to explore in future analyses are the neglect of oral self-care and the higher prevalence of dentition-threatening practices such as cariogenic snacking among dentally anxious individuals (10); and the avoidance of dental care leading to unchecked disease progression. Perhaps the true situation is a combination of these factors.

References

1. Locker D, Shapiro D, Liddell A. Who is dentally anxious? Concordance between measures of dental anxiety. *Community Dent Oral Epidemiol* 1996;24:346–50.
2. Locker D, Shapiro D, Liddell A. Negative dental experiences and their relationship to dental anxiety. *Community Dent Health* 1996;13:86–92.
3. Schuur AHR, Duinvoorden HJ, Makkes PC, van Velzen Thoden SK, Verhage F. Personality traits of patients suffering extreme dental anxiety. *Community Dent Oral Epidemiol* 1988;16:38–41.
4. Weiner A, Sheehan D. Etiology of dental anxiety: psychological trauma or CNS chemical imbalance? *Gen Dent* 1990; Jan-Feb: 39–43.
5. Kleiman MB. Fear of dentists as an inhibiting factor in children's use of dental services. *J Dent Child* 1982;49:209–13.
6. Vignesh H, Chellappah NK, Milgrom P, Going R, Teo CS. A clinical evaluation of high- and low-fear children in Singapore. *J Dent Child* 1990;57:224–9.
7. Bedi R, Sutcliffe P, Donnan PT, Barret N, McConnachie J. Dental caries experience and prevalence of children afraid of dental treatment. *Community Dent Oral Epidemiol* 1992;20:368–71.
8. Hakeberg M, Berggren U, Grondahl H-G. A radiographic study of dental health in adult patients with dental anxiety. *Community Dent Oral Epidemiol* 1993;21:27–30.
9. Locker D, Liddell A. Clinical correlates of dental anxiety

- among older adults. *Community Dent Oral Epidemiol* 1992;20:372–5.
10. Wisloff TF, Vassend O, Asmyhr O. Dental anxiety, utilisation of dental services, and DMFS status in Norwegian military recruits. *Community Dent Health* 1995;12:100–103.
 11. Cohen ME. Dental anxiety and DMFS status: association within a US naval population versus differences between groups. *Community Dent Oral Epidemiol* 1985;13:75–8.
 12. Locker D, Liddell A. Stability of Dental Anxiety Scale scores: a longitudinal study of older adults. *Community Dent Oral Epidemiol* 1995;23:259–61.
 13. Neverlien PO, Backer Johnsen T. Optimism-pessimism dimension and dental anxiety in children aged 10–12 years. *Community Dent Oral Epidemiol* 1991;19:342–6.
 14. Thomson WM, Poulton RG, Kruger E, Davies S, Brown RH, Silva PA. Changes in self-reported dental anxiety in New Zealand adolescents from age 15 to 18 years. *J Dent Res* 1997;76:1287–91.
 15. Poulton RG, Thomson WM, Davies S, Kruger E, Brown RH, Silva PA. Good teeth, bad teeth and fear of the dentist. *Behav Res Ther* 1997;35:327–34.
 16. Silva PA, Stanton W. From child to adult: the Dunedin Multidisciplinary Health and Development Study. Auckland: Oxford Univ Pr; 1996.
 17. Corah NL. Development of a dental anxiety scale. *J Dent Res* 1969;48:596.
 18. SPSS for Windows, Release 6.1. Chicago: SPSS; 1994.
 19. Menard S. Longitudinal research. Newbury Park: Sage; 1991.