

# Changes in Self-reported Dental Anxiety in New Zealand Adolescents from Ages 15 to 18 Years

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**Abstract.** Little is understood of the natural history of dental anxiety. The aim of this study was to examine three-year changes in self-reported dental anxiety among adolescent participants in the Dunedin Multidisciplinary Health and Development Study. Dental anxiety was estimated at ages 15 and 18 by means of the Corah Dental Anxiety Scale (DAS). A DAS score of 13+ defined high dental anxiety. Participants were assigned to one of four dental-anxiety study groups (*Chronic*, *Incident*, *Remitted*, or *Never*) on the basis of changes in reported level of anxiety from ages 15 to 18. Results are reported for the 691 participants who completed the DAS at both ages. The sample's overall dental anxiety score decreased significantly from age 15 (mean, 8.79) to 18 (8.52) (paired *t* test,  $t = 2.37$ ;  $P < 0.05$ ). The *Chronic* and *Never* groups had small negative DAS increments, the *Incident* group showed a substantial positive increment, and the *Remitted* group recorded an even larger negative increment. Multivariate analysis showed that the DAS score at age 15 was the sole predictor of the change in DAS score for the *Chronic* and *Remitted* groups, and was a co-predictor for the *Incident* and *Never* groups. An episodic dental visiting pattern was a strong predictor of a positive change in DAS score for the *Incident* group; and for the *Never* group, a higher DMFS score at age 15 predicted a positive change in DAS score at 18, but being female was predictive of a decrement. This study indicates lower stability of dental anxiety in late adolescence than has been reported from other age groups.

**Key words:** dental anxiety, incidence, remission, adolescence.

## Introduction

Little is understood of the natural history of dental anxiety. A paucity of published reports indicates that opportunities for studying temporal changes in self-reported dental anxiety are infrequent. The two studies which have reported on its temporal stability have been from widely different age groups. A preliminary study by Neverlien (1994) examined five-year changes in Dental Anxiety Scale (DAS; Corah, 1969) scores in a group of 94 adolescents (who comprised only 58% of the baseline sample) and suggested that the stability of scores was not great in that age group. In contrast, DAS scores appear to be far more stable among older adults. A small overall decline in dental anxiety prevalence and severity (measured by the DAS)—but a generally high degree of stability—was observed over a three-year period among participants aged 50+ in a Canadian longitudinal study (Locker and Liddell, 1995). Severity increased slightly for females but decreased among males. Locker and Liddell speculated that the general stability of scores suggested that few people change their level of dental anxiety in later life.

Studying temporal changes in dental anxiety among a large group of adolescent participants in an established longitudinal study has two principal advantages. First, it offers the opportunity to enhance knowledge of the natural history of dental anxiety, and the influence of aging; and second, it enables the magnitude and direction of changes to be estimated in different dental anxiety groups in what appears to be a key period in the development of clinically significant anxiety syndromes (Andrews *et al.*, 1994). In New Zealand, variations in dental attendance become apparent once individuals move from the primary school system (where free care is provided, usually on-site, by school dental services) to secondary schooling, where there is universal entitlement to, but variable uptake of, free care provided by private-sector dentists as part of the General Dental Benefits (GDB) Scheme (de Liefde, 1988). The late-adolescent period is also a time when third molars begin to emerge (Hugoson and Kugelberg, 1988) and undergo removal, and this may provide an aversive conditioning experience (Milgrom *et al.*, 1995) which may increase dental

**Table 1.** Comparison of key characteristics of participants and non-participants<sup>a</sup>

Characteristic	Completed DAS at Both Ages	Excluded
Proportion female	48.6	47.7
Not enrolled in GDB Scheme	2.6	5.8
Symptom-driven last dental visit	4.4	2.6
Mean DAS score at age 18 (SD) <sup>b</sup>	8.49 (3.06)	8.57 (2.47)
Proportion with DAS 13+ at age 18 <sup>c</sup>	13.1	6.0

<sup>a</sup> Data are percentages unless otherwise indicated.

<sup>b</sup> ANOVA;  $P > 0.05$ .

<sup>c</sup>  $\chi^2 = 3.58$ ; 1 df;  $P > 0.05$ .

anxiety levels in some individuals. Rajasuo *et al.* (1993) reported that at least one third molar had been extracted from 10% of a sample of 876 Finnish male military conscripts whose mean age was 19.9 years (SD 1.1 years). It is reasonable to expect that a similar (if slightly lower) proportion of 18-year-old participants in a longitudinal study will have recent experience of such a procedure.

The aim of this study was to examine three-year changes in self-reported dental anxiety among adolescent participants in a longitudinal study. The study hypothesis was that the level of anxiety was stable between the ages of 15 and 18.

## Materials and methods

### Sample selection

The Dunedin Multidisciplinary Health and Development Study (DMHDS) commenced when data were first collected from a birth cohort of children who were born at the Queen Mary Hospital, Dunedin, New Zealand, in 1972-73. They have been followed since that initial baseline collection, with periodic collections of health and developmental data, including dental examinations. Full details of the aims, establishment, and methodology of the study have been reported elsewhere (Silva and Stanton, in press). Ethical approval for the dental section of the study when the participants were aged 15 and 18 was obtained from the Ethics Committee of the Otago Area Health Board; each participant signed the informed consent statement approved by the Ethics Committee.

### Measurement

Dental anxiety data were collected at ages 15 and 18 by means of the Dental Anxiety Scale (DAS; Corah, 1969) as part of a self-

completed health questionnaire. The DAS was used because of its generally high internal reliability and extensive use in previous studies. A DAS score was computed for each participant by summing the responses to the four DAS items and was used as a point estimate of the severity of dental anxiety. In the current analysis, the case definition for "high" dental anxiety was a DAS score of 13 or more (Corah *et al.*, 1978). Two comparisons were made for each participant. First, the estimate at 15 years of age was compared with that from 18 years so that the net change in DAS score over the three-year period could be computed. Second, Locker's (1995) approach to investigating temporal changes in xerostomia status was used to examine membership of the high-anxiety group at 15 and 18 years. This involved the assignment of each participant to one of four dental anxiety study groups so that changes in high dental-anxiety status could be examined: those who were in the high-anxiety group at both ages were assigned to the *Chronic* group; participants who were not in the high-anxiety group at 15 but were at 18 years were designated the *Incident* group; those who were in the high-anxiety group at 15 but not at 18 years comprised the *Remitted* group; and the remainder made up the *Never* group.

Socio-demographic data were collected, as well as information on uptake of GDB care since participants left the School Dental Service, and the reason for the last dental visit. Calibrated dentists performed dental examinations at ages 15 and 18, and a DMFS score was computed for participants at each age.

### Statistical analysis

Data analysis was performed by means of the SPSS computer program (SPSS for Windows, Release 6.1; Chicago, SPSS Inc., 1994). The computation of univariate statistics was followed by examination for bivariate associations between DAS scores and

**Table 2.** Dental anxiety prevalence and severity by gender at ages 15 and 18

	Age 15 Years		Age 18 Years	
	Females	Males	Females	Males
Prevalence of moderate-to-severe dental anxiety (DAS 13+)	11.3%	10.5%	14.9%	11.6%
Severity (SD)	8.95 (2.86)	8.46 (2.97) <sup>a</sup>	8.81 (3.11)	8.16 (2.96) <sup>b</sup>

<sup>a</sup> ANOVA;  $P < 0.05$ .

<sup>b</sup> ANOVA;  $P < 0.01$ .

**Table 3.** Distribution of participants according to change in dental anxiety-group status and gender

Dental Anxiety Group at 15	Dental Anxiety Group at 18	
	High (DAS = 13+) 91 individuals	Low (DAS <13) 600 individuals
High (DAS = 13+) 75 individuals	<i>Chronic</i> 30 (4.3%)	<i>Remitted</i> 45 (6.5%)
Low (DAS <13) 616 individuals	<i>Incident</i> 61 (8.8%)	<i>Never</i> 555 (80.3%)

socio-demographic and dental service-use variables, with the Chi-square test used for categorical variables, and *t* tests or ANOVA used for continuous variables. Linear regression analyses were used to examine significant associations of the observed changes in DAS score for each of the study groups.

**Results**

Results reported here are for the 691 participants who completed the DAS instrument at both 15 and 18 years. This was equivalent to 81.5% of those who did so at age 15. Table 1 compares their characteristics with those excluded because complete DAS data collection at both ages was not possible. There were no significant differences according to gender, reason for last dental visit, or enrollment as adolescents in the New Zealand General Dental Benefits Scheme. While there was no difference in mean DAS score at age 18, the distribution of scores differed, with 6.0% of the excluded group having a DAS score of 13+, compared with 13.1% of the others.

The internal reliability of responses to the scale at 15 and 18 was high, with values for Cronbach’s  $\alpha$  of 0.825 and 0.832, respectively. DAS scores at ages 15 and 18 showed moderately high correlation ( $r = 0.50$ ;  $P < 0.001$ ). The distribution of DAS scores was approximately normal at age 15 (skewness, 0.88), but was more positively skewed at age 18 (skewness, 0.83). The sample’s overall DAS score decreased significantly from age 15 to 18, with mean DAS scores of 8.79 and 8.52, respectively (paired *t* test,  $t = 2.37$ ;  $P < 0.05$ ). In contrast, the prevalence of high dental anxiety increased from 10.9% to 13.2%, but this difference was not statistically significant. There were gender differences in the

severity of dental anxiety at both ages, with females scoring higher than males, but there were no significant differences in prevalence (Table 2).

Table 3 presents the changes in dental anxiety status by dental anxiety study group. Over 80% of the group reported low dental anxiety at each age. The *Remitted* group was comprised of 6.5% of participants, the *Chronic* group 4.3%, and the *Incident* group 8.8%. Females appeared to be over-represented in the *Incident* group (at 57.4%), but this was not statistically significant. Proportions for the *Chronic*, *Remitted*, and *Never* groups were 50.0, 51.1, and 47.5% females, respectively.

Table 4 presents the magnitude of the change in DAS score in each of the groups: The *Chronic* and *Never* had small negative increments, the *Incident* group showed a substantial positive increment, and the *Remitted* group recorded an even larger negative increment. Numbers in the latter two groups were substantially greater than those in the *Chronic* group.

Table 5 presents the outcome of the multivariate analyses. Independent variables used in the initial models were: DAS score at age 15, gender, dental visiting pattern, DMFS score at age 15, extraction of third molars in the preceding three years, and enrollment in the General Dental Benefits Scheme. The DAS score at age 15 was the sole predictor of the magnitude of change in age-18 DAS scores for the *Chronic* and *Remitted* groups, and was a co-predictor for the *Incident* and *Never* groups. A greater DAS score at age 15 predicted a negative change in DAS score at 18 for each of the groups, as well as for all combined. A symptom-driven dental visiting pattern was a strong predictor of a positive change in DAS score for the *Incident* group. For the

**Table 4.** Change in DAS score between ages 15 and 18 by DAS study group

DAS study group	Mean Change in DAS Score (SD)	Range of Changes in DAS	Percent Changing DAS Score by 4+ Points	Number of Individuals
Chronic	-0.6 (2.4)	- 5 to + 7	13.3	30
Incident	+4.5 (2.3)	+ 1 to +12	63.9	61
Remitted	-5.1 (2.7)	-12 to - 1	62.2	45
Never	-0.4 (2.3)	- 7 to + 7	7.8	555
All combined	-0.3 (3.0)	-12 to +12	16.6	691

**Table 5.** Multivariate modeling of change in DAS scores for each study group

DAS Study Group	Predictor(s) of Change in DAS	B	T	Significance of T	Adjusted R <sup>2</sup>
<i>Chronic</i>	DAS at 15	-1.00	- 5.17	< 0.001	0.52
	<i>Incident</i>	DAS at 15	-0.91	- 8.72	
<i>Remitted</i>	Visit for problem	3.66	4.07	0.002	0.32
	DAS at 15	-0.86	- 4.88	0.002	
	<i>Never</i>	DAS at 15	-0.68	-14.92	
<i>All combined</i>	Female	-0.42	- 2.29	0.02	0.23
	DMFS at 15	0.07	3.14	0.002	
	DAS at 15	-0.51	-12.74	< 0.001	
	DMFS at 15	0.09	3.56	< 0.001	
	Enrolled in GDB Scheme	0.74	2.07	0.038	

*Never* group, having a higher DMFS score at age 15 predicted a positive change in DAS score, but being female predicted a decrement. For all groups combined, a positive change in DAS score was predicted by a higher DMFS score at age 15, and having been enrolled in the GDB Scheme.

## Discussion

A disadvantage of the longitudinal study design is that the loss of participants over time may bring about a gradual deterioration in sample representativeness, and this may, in turn, compromise the external validity of findings from later stages of the investigation. There are two issues to be considered in the examination of sample representativeness in the current study: First, to what extent are the study participants overall representative of their peers? and second, Were there any systematic differences between those who did and did not complete the DAS instrument at ages 15 and 18? Concerning the first issue, one of the remarkable features of the DMHDS is its very high retention rate for participants: This was 95.6% at age 5, 94.1% at age 15, and actually increased to 97.2% at age 18. At baseline, the recruited individuals comprised 91.0% of the cohort of babies born at Queen Mary Hospital (which was the only maternity hospital in the greater Dunedin area) and who were resident in the province of Otago at three years of age. This high recruitment rate—together with the extremely high retention rate—suggests that the study participants can indeed be considered to be representative of their age group. Concerning the second issue, the data in Table 1 suggest that there appeared to be no systematic differences between individuals for whom DAS scores were obtained at 15 and 18, and those for whom a score was unavailable at one or the other age.

The greater dental anxiety in females was not surprising, given recent reports which have highlighted greater prevalence and severity among females, in a recent cross-sectional study (Thomson *et al.*, 1996) and in longitudinal studies (Neverlien, 1994; Locker and Liddell, 1995). In the latter studies, the higher baseline scores of females increased, whereas those of males decreased over time.

The modest decrease in dental anxiety scores observed

across the whole sample may have been statistically significant, but its clinical significance is unlikely to be substantial. Moreover, it masked some large differences among subgroups. The *Never* and *Chronic* groups showed considerably greater DAS score stability than the *Incident* and *Remitted* groups, among whom the magnitude of change was substantial. It is assumed that these data reflect actual changes in dental anxiety rather than any inherent instability of the DAS itself. It is also conceivable that the changes were due, in part, to regression-toward-the-mean effects, although this would have had more currency with weaker correlations than those which were actually observed between the age-15 and age-18 DAS scores (Bland and Altman, 1994). However, that the DAS score at age 15 was the sole predictor of the magnitude of change for the *Chronic* and *Remitted* groups suggests that regression toward the mean may have been largely responsible for the changes observed in those two groups. The 16.6% of individuals who had DAS changes of 4 or more scale points is substantially higher than the 9% reported for elderly Canadians (Locker and Liddell, 1995); this suggests a greater instability of dental anxiety in adolescence. There is support for this contention in the relatively large proportions showing changes of 4 or more scale points in both the *Incident* and *Remitted* groups. There are considerable challenges in accounting for the magnitude of the changes in the latter two groups. Aside from the likelihood of regression toward the mean in the *Remitted* group, there appear to be two possibilities. First, their dental anxiety might be exogenous (Locker *et al.*, 1996); that is, it might have been occasioned by actual or vicarious dental experiences. Second, their dental anxiety may be endogenous, arising (or, for the *Remitted* group, resolving) as part of a pre-existing, more generalized anxiety syndrome of which dental anxiety is but one facet. The true situation may be a combination of these (Andrews *et al.*, 1990).

The explanatory power of each of the multivariate models was considerable, despite the limited numbers of independent variables. This suggests that dental anxiety at age 15 is largely predictive of dental anxiety three years later, despite the observed lack of stability in DAS scores for some groups. The finding that an episodic dental visiting

pattern was a predictor of increased dental anxiety among the *Incident* group offers some support for the existence of what has been described as a "vicious cycle" of dental anxiety, whereby initial avoidance of dental visits leads to untreated disease which, once it produces symptoms, is by then at a stage which is sufficiently advanced to require the seeking of emergency treatment which serves only to exacerbate the initial dental anxiety (Thomson *et al.*, 1996).

The use of a DAS score of 13+ to define high dental anxiety has been used previously (Corah *et al.*, 1978; Locker and Liddell, 1991), as have 12+ and 17+ (Schwarz and Birn, 1995). To confirm the observed pattern, and to ensure that this study's outcome was not somehow an artifact resulting from the cut-off point which had been chosen, we repeated the bivariate analysis using a DAS score of 17+ to define high dental anxiety. Although the numbers of participants in each of the *Incident*, *Remitted*, and *Chronic* study groups were considerably reduced (the *Never* group comprised over 96%), patterns observed in the magnitude and direction of change in DAS scores among the groups were similar to those presented in Table 4. This suggests that examining the findings based on the 13+ DAS cut-off gave a reasonable indication of the changes in dental anxiety which occurred among study participants between ages 15 and 18.

This study has provided information on the natural history of dental anxiety in late adolescence, a period in which instability appears to be greater than in late middle-aged and elderly stages of life. That stage of life may be critical in determining an individual's lifelong interaction with the dental care system, and thus, his or her likelihood of retaining a functional, intact dentition. Although the results of this study should be considered tentative until confirmed elsewhere, dental practitioners should acknowledge the possibility that adolescent patients may change their dental anxiety status in the period between routine recalls, and be prepared to alter their approach where this has occurred.

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