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Incidence of dental anxiety in young adults in relation to dental treatment experience

W. Murray Thomson[1], David Locker[2] and Richie Poulton[3]

[1]Department of Oral Health, School of Dentistry, Dunedin, New Zealand, [2]Community Dental Health Services Research Unit, Faculty of Dentistry, The University of Toronto, Toronto, Ontario, Canada, [3]Dunedin Multidisciplinary Health and Development Research Unit, Department of Preventive and Social Medicine, Dunedin School of Medicine, The University of Otago, Dunedin, New Zealand

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Abstract – *Objectives:* To document the incidence of dental anxiety among individuals aged 18 years at baseline and 26 years at follow-up, and to determine if dental treatment experience continues to play a significant etiological role with respect to the onset of dental anxiety in young adults. *Methods:* Dental anxiety scale (DAS; Corah, 1969) scores at ages 15, 18 and 26 were obtained for Study members in the Dunedin Multidisciplinary Health and Development Study. Dental examinations were conducted, and sociodemographic and dental service-use data were collected using a self-report questionnaire. Using a case definition of a DAS score of 13 or more, age 18–26 incident cases were identified and their dental treatment experience and service-use characteristics compared with the remainder. *Results:* DAS scores at 18 and 26 were available for 792 (80.8%) of the 980 26-year-old Study members. An increase in dental anxiety prevalence was observed over the eight-year period, with an annualized incidence of 2.1%. Fewer incident cases had visited a dentist in the previous eight years, and there were no differences between incident cases and others in their eight-year DFS, FS or tooth-loss increments. A subgroup of ''recurrent'' cases was identified who were dentally anxious at 15 and 26 but not at 18, and their eight-year incidence of tooth loss due to caries was substantially higher than non-cases. *Conclusions:* Aversive conditioning experiences appear to be unrelated to the adult onset of dental anxiety, and it may be that particular temperamental or psychological traits are associated with the condition.

Key words: adults; cohort study; dental anxiety, dental caries; incidence; oral health; utilization

W. M. Thomson, School of Dentistry, PO Box 647, Dunedin, New Zealand.
Tel: 643 479 7116
Fax: 643 479 7113
e-mail: mthomson@gandalf.otago.ac.nz

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In spite of three or four decades of research, a number of epidemiological questions concerning dental anxiety have not been answered. For example, little is known about its incidence at different points in the life span, its course over time and the etiological pathways which lead to the development of anxiety about dental treatment. There are two reasons for this. First, dental anxiety is generally considered to have its origins in childhood and to develop as a result of aversive conditioning experiences and family influences (1). As a consequence, issues such as onset in adulthood have been neglected (2). Second, most studies of etiology have relied on clinical or highly selected populations, with retrospective self-reports being used to determine modes of acquisition (3). While the majority of dentally anxious individuals attribute their anxiety to traumatic dental experiences, problems with recall and retrospective reinterpretation mean that uncertainty persists about their precise causal role. Prospective studies are required in order to clearly establish the contribution of conditioning experiences and other factors to the development of dental anxiety. According to Kent (4),

one of the main limitations of research into dental anxiety is the almost complete lack of longitudinal data (4).

Exceptions to this are studies by Murray et al. (5), Locker & Liddell (6) and Thomson et al. (7). Murray et al. (1989) studied children and found increases in dental anxiety scores between the ages of 9 and 12 years (5). Locker & Liddell (1995) examined changes in Dental Anxiety Scale (DAS) scores (8) over three years in a population of adults aged 50 years and over (6). Over the period of observation, the DAS scores of these individuals were broadly stable. The mean score was 7.6 at baseline and 7.4 at follow-up. The proportion with scores of 13 or more declined slightly from 7.0% to 5.4%. The incidence of dental anxiety at this age was 1.5%. Much more volatility was reported in a study of New Zealand adolescents (7), among whom the prevalence of dental anxiety increased from 10.9% to 13.2% between the ages of 15 years and 18 years. Of those individuals who were dentally anxious at age 15, only 40.0% were anxious at age 18. On the other hand, 9.9% of those who were not anxious at 15 years became anxious by the age of 18 years. Moreover, of the 78 individuals who were dentally anxious at age 18, only 24 (30.7%) had been anxious at 15. This confirms the findings of studies in which substantial proportions of dentally anxious individuals reported onset occurring in adolescence rather than childhood (2, 9).

The New Zealand study also found evidence to indicate that conditioning played a role in the development of dental fear between the ages of 15 years and 18 years (10). Using DMFT scores as an index of dental treatment experience, individuals with a DMFT score of one or more at age 15, indicating some experience of invasive treatment, were 5 times as likely to be dentally fearful at age 18 when compared with those with a DMFT score of zero. Together with a study of children aged 5 to 11 years conducted by Milgrom et al. (11), this suggests that conditioning is an important contributor to dental fear in childhood and adolescence. However, recent work by Locker et al. (2) suggested that certain psychological traits (such as general fearfulness and trait anxiety) are more important than aversive conditioning experiences with respect to adult onset dental anxiety. It should be borne in mind that those findings were based on cross-sectional data, with the attendant limitations of recall and reinterpretation, and a lack of clarity with respect to temporal relationships.

This paper uses longitudinal data to document the incidence of dental anxiety among individuals aged 18 years at baseline and 26 years at follow-up, and to determine if dental treatment experience continues to play a significant etiological role with respect to the onset of dental anxiety in young adults.

Methods

Data sources

Data on dental anxiety in adolescence and early adulthood were obtained from the Dunedin Multidisciplinary Health and Development Study (DMHDS) (12). This is a longitudinal study of a birth cohort of children who were born at the Queen Mary Hospital, Dunedin, New Zealand between 1 April 1972 and 31 March 1973 and whose mothers lived within the Dunedin Metropolitan Health District boundaries. The sample that formed the basis for the longitudinal study comprised 1037 children, who were assessed initially within a month of their third birthdays. Periodic collections of health and developmental data (including dental examinations) have been undertaken since then, and the current study uses data collected at ages 15, 18 and 26. Compared to the rest of the New Zealand population, the DMHDS sample is slightly advantaged socio-economically.

The impressive follow-up rates for the sample are a major strength of the DMHDS with, for example, 96.2 per cent of the eligible sample participating in the age-26 assessment. Ethical approval for the dental section of the study was obtained from the Ethics Committee of the Southern Regional Health Authority. Study members signed an informed consent statement approved by that Committee.

Measurement of dental anxiety

Dental anxiety was measured at ages 18 and 26 using the four-item Corah Dental Anxiety Scale (8). For most Study members, a DAS score was also available from the assessment undertaken at age 15 years, and this was used to distinguish between new and recurrent cases of dental anxiety at age 26. The scores from the item responses were summed to give a point estimate of dental anxiety severity at each age. Dentally anxious individuals were defined as those with a DAS score of 13 or more (13). Incident cases were those who were not dentally anxious at age 18 but were dentally anxious at age 26. The characteristics of that group were compared with those who were not dentally anxious at either of those ages.

Dental visits between the ages of 18 and 26 years

Information on dental visits between the ages of 18 and 26 years was obtained by asking Study members how long it had been since their last visit to a dentist, and whether that visit was for a check-up or a problem. On the basis of that information, Study members were assigned to one of three dental-use groups: *avoiders*, who had not seen a dentist in the previous 8 years; *symptomatic visitors*, who had seen a dentist in that time and their last visit was because of a problem; and *preventive visitors*, who had seen a dentist in that time and their last visit was for a check-up.

Dental examination data

Dental examinations at ages 18 and 26 were conducted using calibrated dental examiners, and DMFT and DMFS scores were calculated. Time constraints (the breadth of data collection meant that the assessment day for each Study member was a very busy one) meant that repeat examinations were not possible. The tooth-loss increment due to caries between ages 18 and 26 was obtained by observing – for each tooth which had been present at 18 – its presence or absence at 26, and ascertaining the reason for its absence at that age. Third molars were not included in the computation of tooth loss due to caries, but their loss was enumerated separately. Dental caries incidence and increment were computed by comparing caries status at 18 and at 26 years for each surface. The net increment was computed by subtracting the number of reversals from the gross increment. Teeth which had been extracted or crowned since the baseline examination were omitted from the analysis of caries increment, as it was considered that any bias arising from this would be considerably less than that which would arise from assigning them an arbitrary number of surfaces in the increment. DMFS scores at 18 and 26 years and DMFS increments between 18 and 26 years were used as indexes of dental treatment experience.

Statistical analysis

Incidence rates for dental anxiety between 18 and 26 years were calculated for Study members overall, and males and females separately. Following the computation of univariate statistics, differences in disease levels and dental treatment experience between incident cases and non-cases were tested for statistical significance using Chi-square tests (for categorical dependent variables) or independent samples *t*-tests (for continuous dependent variables).

Results

Response

At age 26, 980 (96.2%) of the surviving cohort participated in the DMHDS. DAS scores at ages 18 and 26 were available for 790 individuals (80.7% of those taking part at age 26), of whom 50.7% were male. DAS scores at ages 15, 18 and 26 were available for 679 individuals (69.4% of those taking part at age 26). Dental examination data at ages 18 and 26 were available for all individuals who completed the Dental Anxiety Scale. Individuals for whom DAS scores were available at ages 18 and 26 did not differ from those for whom they were not in terms of their sex, dental visiting pattern, oral hygiene practices, time since last dental visit, or their number of missing teeth at age 26.

Dental anxiety at 18 and 26 years

At age 18, the mean DAS score was 8.5 and at 26 years it had risen to 9.7 ($P<0.001$: paired *t*-test) (Table 1). The prevalence of dental anxiety also increased with age, from 12.5% at 18 to 21.1% at 26 years (McNemar's test: $P<0.001$). Increases in

Table 1. Mean (SD) DAS scores and percent dentally anxious at ages 18 and 26 years ($n=791$)

Mean (SD) DAS score at:	Age 18 years	Age 26 years
All study members	8.5 (3.0)	9.7 (3.7)
Females	8.8 (3.1)	10.2 (3.7)
Males	8.3 (3.0)	9.2 (3.6)
P-values: females vs males	<0.01	<0.01
Percent with DAS score of 13+ at:	**Age 18 years**	**Age 26 years**
All study members	12.5	21.1
Females	14.9	24.1
Males	10.2	18.2
P-values: females vs males	<0.05	<0.05

Table 2. Distribution of study members according to dental anxiety status at ages 18 and 26 years

Group:	Anxious at 18 years	Anxious at 26 years	Number of study members
Chronic	Yes	Yes	52
Remitted	Yes	No	47
Incident	No	Yes	115
Non-cases	No	No	577

Table 3. Distribution of study members and incidence of dental anxiety by use of dental services between ages 18 and 26 years

Group:	Number of study members (%)	Number of incident cases (%)
Avoiders	77 (9.7)	25 (32.5)*
Symptomatic visitors	330 (41.8)	56 (17.0)
Preventive visitors	383 (48.5)	33 (8.6)

* $P<0.01$.

mean DAS scores and the dentally anxious proportion were observed in both males and females, with the apparently greater increase among females not reaching statistical significance (General Linear Model; $P> 0.05$). The distribution of Study members across four possible combinations of dental anxiety status at 18 and 26 is shown in Table 2. Of the 99 individuals who were anxious at 18, only 52 (52.5%) remained anxious at 26; of the 692 who were not anxious at 18, 115 (16.6%) were anxious at 26. This represents an annualized incidence rate of 2.1%. Of those 115 cases, DAS scores at age 15 were available for 97. These indicate that 79 (81.4%) became dentally anxious for the first time during the eight-year observation period and may be regarded as 'new' cases. The remaining 18 individuals were not anxious at 18 years but had been anxious at the assessment undertaken at 15 years of age, and may be regarded as 'recurrent' cases. The mean changes in DAS scores among the non-cases, recurrent cases and new cases between ages 18 and 26 were 0.6 (sd, 2.2), 4.7 (sd, 1.8) and 6.5 (sd, 2.5) respectively.

Dental visits

Of the 790 individuals included in the age 18–26 analysis of dental anxiety, 713 (90.3%) reported one or more dental visits in the previous eight years; this was lower among the incident dental anxiety cases than among the remainder (78.1 and 92.3% respectively; $\chi^2=22.5$; 1 df; $P<0.01$). Some 341 (43.2%) reported that their last dental visit was because of a problem rather than a check-up. The incidence of dental anxiety was 18.2% among those whose last visit was because of a problem, and 11.6% among those whose last visit was for a check-up (Relative risk=1.6; $P<0.01$).

The distribution of Study members across the three dental-use groups and their incidence of dental anxiety is presented in Table 3. The highest incidence rate was observed among the *avoiders*, who had not seen a dentist in the previous 8 years, and the lowest among the *preventive visitors.*

Dental caries and treatment experience

Among the 790 Study members, 354 (44.8 per cent) lost at least one tooth between the ages of 18 and 26 years: 82 (10.4%) had lost one or more teeth because of caries, and 314 (39.7%) had had one or more third molars extracted. A net DFS increment was experienced by 611 individuals (77.3%), and the mean net DFS increment was 4.97 (sd, 5.96; range −2 to 57). A net FS increment was experienced by 502 individuals (63.5%), and the mean net FS increment was 3.21 (sd, 4.79; range 0 to 45).

Dental treatment experience and dental anxiety

There were no significant differences between the incident cases and the non-cases in their mean DMFS scores at 18 and 26 years, or in their mean

Table 4. Dental treatment experience according to case-status at 26 years

	Incident cases:		
	Non-cases* ($n=535$)	New cases ($n=79$)	Recurrent cases ($n=18$)
Mean DMFS at 18 yrs	8.0 (7.3)	7.8 (6.2)	10.4 (5.4)
Mean DMFS at 26 yrs	11.5 (9.7)	11.3 (9.1)	15.3 (13.0)
Mean DFS increment	4.8 (4.5)	5.0 (6.0)	7.4 (8.6)
Mean FS increment	3.2 (4.5)	3.1 (5.0)	4.5 (7.0)
% losing one or more teeth due to caries	8.0	13.9	22.2†
% losing one or more 3rd molars	40.0	38.0	38.9
% with any tooth loss	43.9	46.8	50.0

* Number differs from the 577 in Table 2 because age-15 DAS scores were unavailable for 112, of whom 42 were in this group.
† $P<0.05$.

DFS and FS increments over the eight-year period. Nor were there any differences in the proportions losing one or more teeth to caries or having one or more third molars extracted. However, when the data were reanalyzed separating the 79 'new' cases and the 18 'recurrent' cases, the recurrent cases had higher values on all measures than the 'new' cases and the non-cases (Table 4). These differences reached statistical significance for the percentage losing one or more teeth due to dental caries.

Discussion

The Dunedin Study's high participation rate is exceptional among cohort studies. It enables the generation of useful information on the natural history of dental anxiety at a stage of the life-course (adolescence and early adulthood) for which incidence data are scarce. The eight-year period covered by the current study featured a marked increase in the prevalence and severity of dental anxiety, with the increase in the latter being more marked among females (which shows a degree of consistency with current understanding of sex differences in dental anxiety). The annualized late-onset (after 18 years) dental anxiety incidence rate of two per cent is noteworthy. It is not known if that rate was constant over the study period, but it is debatable whether it would continue unabated; prevalence data from older age groups suggests that it would not (6, 14, 15), but little enough is known about the natural history of the condition for there to be considerable ignorance about patterns of onset and remission through the adult decades.

The study findings raise important questions about the aetiology of late-onset dental anxiety. It is noteworthy that the incidence of dental anxiety was greatest among those who had not visited a dentist at all during the study period, and that it was lowest among the group described as "preventive visitors". Aversive conditioning did not appear to be a contributing factor for most of the incident cases between ages 18 and 26, although there was a small group (the "recurrent" cases) whose dental treatment experiences in the previous eight years did seem to play a role. Estimates for every measure of dental treatment experience were higher for that group than among the non-cases and new cases. Although only the incidence of tooth loss due to caries was significantly different, the differences on other variables were of sufficient magnitude to indicate that, had the sample been larger, they would probably have reached statistical significance. That aversive conditioning may contribute to the recurrence of previously-remitted dental anxiety (that is, dishabituation [16–18]) is an intriguing notion worthy of further research.

Measures that represent direct contact with dental treatment are regarded as good indicators of conditioning experience and have been found to predict dental fear in young children (11) and adolescents (10). However, it may be that there were important differences among Study members in that respect. It was not possible to gather information on the "aversiveness" of their dental treatment experiences, given the constraints of the current study design, and it must be assumed – other factors being equal – that dental treatment experiences were largely similar for Study members with the same DFS increment or number of teeth lost due to caries between 18 and 26 years of age.

In this large, representative population sample assessed three times over an 11-year period using well-known and validated measures of the constructs of interest, data show – consistent with Locker et al. (2) – that putative conditioning experiences do not appear to be the main etiological factor in adult onset of dental anxiety. If aversive conditioning is not the primary determinant in the development of late-onset dental anxiety, what is?

It is now generally accepted that dentally anxious individuals are not a homogenous group but differ in terms of the origins and manifestations of their anxiety about dental treatment (19). Weiner and Sheehan (20) suggested that they could be classified into two groups – exogenous and endogenous – with respect to the source of their anxiety. In the former, dental anxiety is the result of conditioning via traumatic dental experiences or vicarious learning; in the latter, it has its origins in a constitutional vulnerability to anxiety disorders, as evidenced by general anxiety states, multiple severe fears and disorders of mood (21–23). Consequently, the marked increase in dental anxiety in early adulthood may be a product of developmental changes in psychological states. For example, early adulthood is a period characterized by the onset of various fears, such as agoraphobia and claustrophobia, which have been linked by some investigators to dental anxiety (24). Locker et al. (2) found that individuals who reported that their dental anxiety arose in adulthood were characterized by multiple severe fears, while those reporting child- or adolescent-onset anxiety were not. Clearly, further longitudinal enquiries are needed which assess the relative con-

tribution of aversive experiences and psychological factors to the onset of dental anxiety at different points in the life course.

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