“Dental treatment needs among youth: an opportunity to reduce dental anxiety? A panel study based on the Tromsø study, Fit Future 1 & 2”

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Abstract

Objective. Identify predictive variables related to the development and maintenance of high dental anxiety among young people over two years and assess differences between youths reporting increased, decreased or stable dental anxiety scores over time.
Methods. Observational panel study of young people in Tromsø and Balsfjord region following students from their first to their last year of upper secondary school (2010/11 – 2012/13, age group 15–21 years). Logistic regression was used to estimate odds ratios and their 95% confidence intervals (CI) of possible predictive variables assessed at baseline when using dental anxiety score from the second wave as a dichotomous dependent variable. We used Wilcoxon signed rank-test and Kruskal-Wallis test to analyse differences between groups with different changes in DAS score, HSCL-10 scores and anticipated pain scores between waves.
Results. Psychological distress (HSCL-10), dental status (DMFS) and dental anxiety score (DAS) at baseline predicted high dental anxiety scores after two years. Gender, motivation related to oral hygiene and avoidance due to fear at baseline did not contribute significantly to our model. DMFS and HSCL-10 were higher among young people who reported a substantial change in DAS score (2.0 > IQR), irrespective of the direction of change. Reported anticipated pain changed consistently with a change in dental anxiety score.
Conclusion. The study finds that dental treatment needs are associated with both reduced and increased dental anxiety among young patients. Thus, dental treatment needs in this patient group can be regarded as an opportunity for dental practitioners to provide positive treatment experiences that reduce dental anxiety.

Introduction

Dental fear and anxiety in youth are estimated between 5% and 20%[1] and can have serious detrimental effects on oral health both in the short and long term.[2-5] In order to explain development of dental anxiety in young people, studies point to the impact of negative or traumatic events (conditional events) relating to dental treatment,[1] and in particular pain.[6]

While many studies have addressed the onset of dental anxiety in young age, relatively few in comparison have investigated what contributes to changes or maintenance in dental anxiety among youth. Seligman et al.[1] proposed an extension of the vicious cycle model of dental anxiety/fear[4,7] for youth. In this model, repeated painful experiences lead to avoidance behaviour, which over time leads to deterioration of oral health. This in turn leads to negative thinking about dental treatment, which increases avoidance tendencies. What others think or express concerning dental treatment (familial and cultural beliefs) also contributes to this process. Thus, avoidant behaviour is an important factor in maintenance of dental anxiety, leading to avoidance of dental treatment despite treatment need.[8,9] Importantly, avoidance effectively prevents experiencing non-painful dental treatment, which could serve as an equivalent to exposure to a feared situation in line with cognitive-behavioural treatment models of dental phobia.[10,11] Correspondingly, research has pointed to the protective factor of positive dental treatment experiences and maintaining regular use of dental health services concerning dental anxiety.[12,13]

In addition to the impact of negative, conditional events on dental anxiety, some authors have argued that individual, psychological characteristics or traits might influence dental anxiety among young individuals. For instance, psychological disorders have been associated with the stability of high dental anxiety,[14] and Locker et al. found that both psychological and conditional variables were important in the development of dental anxiety in young adulthood.[15] Arguably, there should be an interplay between the perception of potential conditional events and psychological variables, since it is reasonable to assume that differences in psychological functioning will influence how an individual perceives a dental treatment situation or dentistry related stimuli in general.[16] In accordance with this, psychological functioning has been shown to act as a mediator between dental anxiety and pain perception.[17] Also, irrespective of pain perception, expectations of pain have important behavioural consequences, as we tend to avoid situations where we anticipate pain or unpleasantness. Patients with high dental anxiety expect dental treatment to be more painful than non-anxious patients,[18] and research indicates that management of pain expectations

might lower pain perception.[19] Thus, how patients think about and anticipate pain could be related to changes in dental attendance and dental anxiety.

We use the terms "young people" or "youths" to describe the study population of individuals aged 15 to 21 years, in accordance with the UN's definition of youth as "people aged between 15 years and 24 years".[20] This life phase is of particular interest, as health-related behaviours and health outcomes during this period have a continued effect in adulthood.[21] Several studies have pointed to youth being more vulnerable to the onset of dental anxiety[22,23] and that this age span shows instability in dental anxiety compared to other ages.[13] Hence, this age group presents an opportunity for dental healthcare providers to promote positive health behaviours and attitudes that build a foundation for future oral health. We need a better understanding of what contributes to the development and changes in dental anxiety in youth to improve age-relevant prevention and treatment approaches.

The main objective was to identify predictive variables in the development and maintenance of high dental anxiety from the first to the last year of upper secondary school in the Tromsø and Balsfjord region of Norway. We also wanted to assess differences between youths reporting increased, decreased or stable dental anxiety scores over time.

1. Are there differences in oral health measures (DMFS) between youths reporting increased, decreased or stable dental anxiety scores over time?
2. Are there differences in psychological distress (HSCL-10) between youths reporting increased, decreased or stable dental anxiety scores over time?
3. Do changes in dental anxiety scores reflect changes in anticipated pain at the dentist?

Method

Fit Futures is an expansion of the Tromsø study.[24] These studies have a general health focus and the collected data are based on extensive self-reporting questionnaires, and a wide range of clinical examinations, including a dental examination and collection of biological samples. All participants gave written consent. In Fit Futures 1 (FF1, 2010/2011) 92.9 % of all first-year upper-secondary school students in the two neighbouring municipalities of Tromsø and Balsfjord in northern Norway volunteered to participate (N = 1,038; 508 females and 530 males). Two years later, Fit Futures 2 (FF2, 2012/2013) invited previous participants and new registered students in third-year upper secondary school for a second study. We included the participants that had measures of dental anxiety scores in both waves and that were under the age of 18 during the first wave, leaving 685 (377 females and 308 males) eligible for final

analysis, a 69.5% follow-up rate (Figure 1). The Regional Committee of Medical and Health Research Ethics (reference number 2014/1093/REK nord) approved the study in September 2014.

In terms of measurements, dental anxiety was measured by Corah's Dental Anxiety Scale (DAS).[25] The scale yields a score of 5 to 20, with high scores indicating greater anxiety. We classified individuals with DAS scores of 13 or more as dentally anxious.[5,13,14] With regard to what constitutes a change in dental anxiety, we decided to register a change if DAS score differed by more than 2.0 (IQR) over two years (Y_1 (Sum score DAS in FF1) - Y_2 (Sum score DAS in FF2)). This approach was chosen to safeguard against spurious effects and to focus on more substantial changes. We ended up with three different groups indicating change: increased dental anxiety, decreased dental anxiety, and no change.

In an effort to describe oral health as more than the presence or absence of caries,[26] we decided to include questionnaire items regarding oral health attitudes and motivation. Dental status was registered by the decayed-missing-filled surfaces index (DMFS).[27] Description of the clinical oral examination can be found in a previous article on this dataset describing the caries prevalence.[28] A DMFS score above zero was set to indicate dental treatment needed in this study. The rationale behind this decision was the interpretation of what DMFS values reflect in this healthy young population. Decayed surfaces in this study are defined as dentin caries which require operative treatment.[29] All restorations were registered as filled, including fillings with secondary caries.[30] The quality of fillings assessed during clinical and radiographic examination[31] showed that 35% of the participants had fillings that needed replacement, mainly due to secondary caries.[30] The dentists who performed the dental examination in the first wave referred study participants with treatment needs to the Public Dental Health Services. Thus, we assume that existing dental treatment need at baseline would be addressed before second wave data collection.

An exploratory factor analysis was performed for 23 questionnaire items regarding oral health knowledge and behaviour. Details can be found in a previous paper describing dental anxiety at baseline[32] however, we chose to remove three items that loaded under 0.4 in the current study. The resulting scales are called Self-Motivation concerning oral health knowledge and behaviour and Social Motivation related to oral health and behaviour. The Cronbach's alpha coefficient of these scales is 0.89 and 0.85 respectively.

Avoidance due to fear was measured with participants responding "yes" to the question: "Have you ever missed a dental appointment due to fear?" We refer to this as Avoidance in the Results and Discussion sections.

Anticipated pain reflects the students' reports on how painful they judged a typical visit to the dentist to be. They were to indicate pain on a scale from 0 (no pain) to 10 (worst conceivable pain).

Psychological distress was measured using the Hopkins Symptom Checklist (HSCL-10). HSCL-10 is validated and recognized for use in epidemiological studies and in clinical work among youth measuring symptoms of depression and anxiety.[33] An average HSCL-10 score over 1.85 was set as an indicator for symptoms of anxiety and/or depression as recommended by former research.[34]

The study utilized a prospective design. Dental anxiety was assessed twice, over the course of two years. Psychological distress, Dental status, Self-Motivation, Social Motivation, Avoidance, and demographics assessed at baseline were treated as predictors of high dental anxiety scores in the second wave in a logistic regression model.

All analyses were performed using IBM Statistical Package for the Social Sciences (SPSS) Statistics version 24. We performed a logistic regression analysis with DAS score in the second wave as a dependent variable and included DAS score in the first wave as one of the independent variables. We used Wilcoxon signed rank-test for repeated measurements (FF1 and FF2) of dental anxiety and psychological distress. Kruskal-Wallis tests was used to analyse differences between groups with changes in DAS score, HSCL-10 scores and pain scores between waves (FF1 and FF2). Chi-squared tests and Mann-Whitney U tests were used to evaluate the impact of loss to follow-up. The pairwise exclusion was used for missing data; hence, the number of observations varies in the respective analyses.

Results

There were significant changes over the two years in dental anxiety scores and psychological distress. DAS scores significantly decreased from first (Md = 7.0) to senior year (Md = 6.0) in high school, $z = -2.81$, $p = .005$. The HSCL-10 sum scores, however, significantly increased from first (Md = 1.3) to senior year (Md = 1.4), $z = -3.14$, $p = .002$ (Table 1).

To assess the predictive value of our measures on high dental anxiety, we performed a logistic regression with DAS in FF2 (DAS FF2) as a dichotomous dependent variable. The model contained seven variables from the first wave: Sex, Dental Anxiety Scores, DMFS scores, Psychological Distress, Avoidance, Self-Motivation and Social Motivation. We chose not to include the measure of Anticipated Pain in the first wave due to the substantial correlation (> .7) with Dental Anxiety Score in the same wave, avoiding problems due to

multicollinearity. The full model was statistically significant, χ^2 (7, N = 609) = 187.35, p < .0001, indicating that the model was able to distinguish between respondents who reported high and low dental anxiety scores. The model explained 52% (Nagelkerke R squared) of the variance in dental anxiety, and correctly classified 90.6 % of cases. The goodness of fit was satisfactory according to a Hosmer and Lemeshow test (p > .17). Three of the independent variables made a significant contribution to the model: DAS score in the first wave, DMFS, and Psychological Distress. The strongest predictor is Psychological Distress with an odds ratio of 2.03 (Table 2).

The calculation of change scores in DAS between the first and second wave (Y_1 (Sum score DAS in FF1) - Y_2 (Sum score DAS in FF2)) showed that 476 participants reported no change, 108 reported less dental anxiety, and 78 reported more dental anxiety. A Kruskal-Wallis test revealed a statistically significant difference in dental status (DMFS) between these, χ^2 (2, n = 652) = 21.47, p < .001. The median DMFS score was lowest in the group with no change in dental anxiety (Md = 3), while both groups with changes in dental anxiety recorded higher DMFS-scores (Md = 5). Regarding psychological distress, a Kruskal-Wallis test showed a statistically significant difference in average HSCL-10 scores in the first wave between the groups, χ^2 (2, n = 648) = 6.25, p = .044. The median was lowest among the adolescents reporting no change in DAS score (Md = 1.30) and higher in the groups where changes were reported (both Md = 1.40). Changes in anticipated pain at the dentist followed dental anxiety scores: Adolescents that got more anxious reported higher levels of anticipated pain (anticipated pain levels increased by Md = 2.00), and those feeling less anxious reported less anticipated pain (Md = -2.00), χ^2 (2, n = 660) = 65.24, p < .001 (Figure 2).

In our study, we lost 30.5% of the participants to follow-up. To evaluate the possible bias on this account, we compared the baseline information between those who participated in both waves and dropouts with Chi-square and Mann-Whitney U tests on several variables. There was a statistical difference on Avoidance, Anticipated Pain, DMFS, Sex and Quality of worst filling, but not in DAS or HSCL-10 score. Details are presented in a separate online Appendix.

Discussion

The results show that dental anxiety decreased significantly over two years, but that the proportion of adolescents categorized with high dental anxiety remained constant. This implies that from a clinical viewpoint in this population there was no actual reduction in the number of individuals assumed to require adaptation of treatment and more professional

resources due to dental anxiety, in spite of an overall reduction of dental anxiety scores. Reporting high psychological distress, more caries experience and high dental anxiety scores in the first wave are important predictors of high dental anxiety scores at the second wave, implying that these particular factors are instrumental in sustaining dental anxiety over time among youth. Interestingly, psychological distress emerges as the strongest predictor, indicating that mental health problems might serve as a vulnerability factor among young individuals relating to the development and maintenance of dental anxiety. Earlier findings relating to stressful life events and mental health problems in adolescents have indicated that stressful life events are linked to psychiatric morbidity through disruption of the adaptive processing of emotion.[35] This period of life is especially relevant, considering the increase in psychopathology and exposure for stressors,[35] and the current findings support this notion with regard to dental anxiety.

Youth who reported changes in dental anxiety, irrespective of the direction of change, were more similar with regard to dental status compared to those reporting unchanged dental anxiety scores. As argued earlier, a score on the DMFS scale in this population could function as a measure of dental treatment need. Seeing as dental treatment needs predict both increases and decreases in dental anxiety scores, there appears to be a potential for reducing the dental anxiety in youth during regular treatment sessions. However, in addition to treatment need at baseline, youths reporting both decreased and increased dental anxiety scores also reported similar levels of psychological distress. Also, they did not differ significantly on any of the other measured variables. In light of this, we can speculate that the difference related to their change trajectories on dental anxiety lies in how they perceived their dental treatment experiences between study waves.

The anticipated pain as measured in this study is most likely a result of both experienced and expected pain level at the dentist, since we did not measure it during dental treatment. Also, this study cannot account for effects of experience with dental treatment because the dental attendance of participants in between measurements is unknown. In general, however, positive treatment sessions could reduce dental anxiety by disconfirming negative preconceptions/expectations, or serve as an exposure session to feared objects or situations. In contrast, one or more negative dental treatment experiences could serve to affirm or worsen the dental anxiety. Reported changes in anticipated pain over the two years of this study support this argument, since higher anticipated pain levels correspond with higher levels of dental anxiety, and lower anticipated pain levels to lower levels of dental anxiety. This study could indicate that dental treatment, as performed in the public dental

health service, can contribute to a reduction in both dental anxiety and anticipated pain. This may be regarded in contrast to the vicious cycle of dental fear that focuses on how dental treatment negatively influences dental anxiety and fear.[7] The current results can serve to redefine dental treatment need in young individuals as a "window of opportunity", where dental health professionals have an opportunity to ensure a positive experience for the individual patient. A conceptual model (see Figure 3) illustrates the "window of opportunity" as an expansion of the vicious cycle. Since patients with higher anxiety levels require more time, knowledge and effort from dental health professionals in order to lower their anxiety level in the chair, [10,11,36,37] the focus needs to be on the quality of the services provided from a patient perspective.

A high attendance rate at baseline probably provides a fair representation of the young population, but the representativeness of the participants at the second wave is compromised due to the statistically significant difference of these groups on important measures at baseline. Both dental caries experience and dental avoidance due to fear are higher among the dropouts; we could speculate that if we had been able to include these youths in the study, it probably would increase the association between these measures, but not change the overall direction of the results.

Another limitation is our assumption that the youth with dental treatment needs actually received treatment between study waves. Despite being offered treatment, there is a possibility that they could have declined or avoided treatment. Considering the evidence, however, with regard to the negative effect of avoiding necessary dental treatment on dental anxiety, we assume that avoiding or declining treatment would not decrease dental anxiety for these individuals.

There is a potential for both reducing and increasing dental anxiety scores in youth through current dental practice in the public dentistry. Changes in dental anxiety in youths are most likely due to an interplay between individual vulnerability and subjective experiences. Avoiding pain in dental treatment is essential to bring about positive changes, but ensuring positive treatment experiences involves more than the absence of pain or discomfort. Going forward, resources should be put into implementing existing knowledge about dental anxiety and patient centred treatment in standard care.

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Tables

Table 1. Changes in dental anxiety and mental health symptoms high school

	Total	N	Female	N	Male	N
DAS score	Median (IQR)		Median (IQR)		Median (IQR)	
FF1	7.0 (5.0)	951	8.0 (6.0)	464	6.0 (4.0)	487
FF2	6.0 (4.0)*	685	7.0 (6.0)**	377	5.0 (3.0)**	308
Average HSCL-10 score						
FF1	1.3 (.6)	952	1.4 (.7)	465	1.2 (.5)	487
FF2	1.4 (.8)*	684	1.5 (.9)*	378	1.2 (.6)	306

*

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* Wilcoxon Signed Ranks Test P < .001

** Wilcoxon Signed Ranks Test P < .05

Table 2. Logistic regression with DAS score in FF2 as the dependent variable

Variables	B	S.E	Wald	Df	P	Odds Ratio	95% CI for OR	
							Lower	Upper
Sex	-.69	.41	2.77	1	.096	.50	.22	1.13
DMFS	.058	.02	7.19	1	.007	1.06	1.02	1.11
DAS score FF1	.44	.05	65.73	1	.000	1.55	1.40	1.72
HSCL-10	.71	.28	6.48	1	.011	2.03	1.18	3.49
Avoidance	.93	.56	2.73	1	.099	2.53	.84	7.60
Self-motivation	.242	.35	.49	1	.484	1.27	.65	2.51
Social motivation	.044	.049	.82	1	.366	1.045	.95	1.15
Constant	-8.66	1.24	45.76	1	.000	.00		
χ^2				*187.35*				
Df				*7*				

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* *Ref group for dichotomous variables was set to first, no one of the dichotomous variables had a significant impact on this model.*

Figure Legends:

Figure 1. Flowchart, participation in Fit Future 1 & 2 in selected adolescents with repeated measures of dental anxiety score

Figure 2. Distribution of changes in reported pain level at the dentist across different changes in dental anxiety.

Figure 3. Possible outcomes in adolescents presented with a dental treatment need, a conceptual model.