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Dental behaviour management problems: the role of child personal characteristics

ANNIKA GUSTAFSSON[1,2], ANDERS BROBERG[3], LENNART BODIN[4], ULF BERGGREN[5,†] & KRISTINA ARNRUP[1]

[1]Department of Pedodontics, Postgraduate Dental Education Center, Public Dental Service, Örebro, Sweden, [2]Institute of Odontology, the Sahlgrenska Academy, Göteborg University, Sweden, [3]Department of Psychology, Göteborg University, Sweden, [4]Clinical Research Centre, Örebro University Hospital, Sweden, and [5]Unit of Dental Behavioural Sciences, Institute of Odontology, the Sahlgrenska Academy, Göteborg University, Sweden

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Aim. This study aimed to investigate the role of dental fear (DF) and other personal characteristics in relation to dental behaviour management problems (DBMP).

Design. A study group of 230 patients (7.5–19 years old; 118 girls), referred because of DBMP, was compared to a reference group of 248 same-aged patients (142 girls) in ordinary dental care. Patients and their parents independently filled in questionnaires including measures of fear and anxiety, behavioural symptoms, temperamental reactivity, and emotion regulation.

Results. Study group patients referred because of DBMP differed from the reference group in all investigated aspects of personal characteristics. In the multivariate analyses, DF was the only variable with consistent discriminatory capacity through all age and gender subgroups. Aspects of anxiety, temperament, and behavioural symptoms contributed, but differently for different subgroups and at different levels of dental fear.

Conclusions. Among older children and adolescents, DF deserves to be re-established as the single most important discriminating variable for DBMP at clearly lower scores than commonly used. Further research should focus on the different patterns of DBMP development, considering various personal characteristics that may trigger, maintain, or exacerbate young patients' vulnerability to DF and DBMP.

Introduction

Children's or adolescents' uncooperative behaviours towards dental treatment are known as 'dental behaviour management problems' (DBMP). DBMP is a collective term for behaviours resulting in the delay or cancellation of treatment[1], as determined by the treating dentist or dental staff. The prevalence of DBMP has been reported in two Swedish population-based studies as 8.5 and 10%, respectively[2,3].

DBMP has been discussed in a multi-factorial context where personal, environmental, and situational factors interact[1]. Children and adolescents vary in age, competence, temperament, personality, intellectual capacity, and maturity. They also differ greatly in life experience, family situation, and cultural background. All these aspects affect the child's or adolescent's ability to tolerate dental examinations and treatment[4]. Some children are able to cope well with potentially stressful situations, such as a visit to the dentist; other children, however, are more vulnerable to their fears and impulses, and hence more prone to react with emotional or behavioural symptoms.

Personal characteristics, such as fear and anxiety problems, behavioural symptoms, and temperamental aspects, previously associated with DBMP may be seen as facets of this vulnerability. Dental fear (DF) stands out as an especially important factor[5–7], to such a degree that the distinction between DF and DBMP has not always been made clear[1]. On

Correspondence to:
Annika Gustafsson, Department of Pedodontics, Postgraduate Dental Education Center, Public Dental Service, Box 1126, SE-701 11 Örebro, Sweden.
E-mail: annika.gustafsson@orebroll.se
[†]Deceased

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its own, however, DF does not suffice to explain DBMP – at least not among children. In a Swedish urban sample of 4505 children aged 3 to 11 years, 27% of children with records of DBMP were also assessed as dentally fearful[6]. In another Swedish study of children referred because of DBMP, there were subgroups with low or moderate levels of DF[7]. One of these subgroups was characterized by an externalizing, impulsive temperamental and behavioural profile. Blomqvist *et al.*[8] have shown that DBMP was more common among children with attention deficit/hyperactivity disorder (ADHD) as compared with controls.

Temperament has become an important concept in developmental psychology and psychopathology. It refers to different, but relatively stable, characteristics of response to the environment[9]. One important aspect of temperament is an individual's typical reaction to a new situation, for example how a child reacts during a first dental visit[4]. Shyness, in terms of being 'slow to warm up' in new situations, has in some studies been found to predict DBMP on its own[10], in combination with DF[11], or as part of a profile of fear and inhibition[7,12]. Other studies, however, did not find a relation between shyness and DBMP[13,14]. The temperamental aspects of activity (tempo and vigour)[13,14] and impulsivity (a tendency towards impatience and lack of perseverance)[7] have emerged as predictive factors for DBMP. Negative emotionality, a tendency to become easily and intensely upset, especially when frustrated, may also influence children's ability to cope with dental treatment, since it leads to aggressive and/or refusal behaviour[7,14]. In a Swedish case-control study, negative emotionality was the most important predictive variable after DF for referrals due to DBMP[12].

Temperament is often conceptualized in terms of 'reactivity' and 'emotion regulation'[15]. Reactivity is the child's intensity and promptness of reactions (e.g. frustration, anger, shyness, fear) to different stimuli. Emotion regulation is the ability to control emotional arousal in order to secure social functioning[16]. Every child has to learn ways to regulate his or her emotions and to cope with challenging situations. From a functional perspective, emotions are not only responses to be regulated, but are themselves regulators of environmental interaction[17]. Emotion regulation can be effected as self-control or control with the help from others[18]. Poor regulation of anger and exuberance has been associated with externalizing problems (angry), and poor regulation of fear with internalizing (sad) problems[19].

DBMP is a clinically significant phenomenon in child and adolescent dental care that has been associated with fear and anxiety problems, behavioural symptoms, and temperamental aspects[7,8,10–14]. Most research on DBMP has been performed on children, while studies focusing on adolescents are rare. Among Norwegian adolescents, DBMP was more likely among those who had negative beliefs about dentists and who had higher levels of dental anxiety[20]. The present study focuses on the discriminating power of selected personal characteristics for DBMP in older children and adolescents in dental care.

The aim of the study was to investigate fear and anxiety, behavioural symptoms, temperamental reactivity, and emotion regulation in a group of children and adolescents referred for specialized paediatric dental care because of DBMP, and to compare these patients to a reference group of children and adolescents in ordinary dental care.

Materials and methods

Participants and procedures

The study included one study group and one reference group of child and adolescent dental patients and their accompanying parents. The first inclusion criterion for study group patients was referral to the Clinics of Specialized Paediatric Dentistry in the counties of Östergötland ($n = 203$), Örebro ($n = 40$), and Jönköping ($n = 10$), Sweden, because of DBMP in combination with a need for dental treatment. Consecutive patients so referred (from 35 public dental clinics) during the study period (2004–2006) and their parents were asked to participate. Children with known communicative disorders or psychiatric

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diagnoses according to the Diagnostic and Statistical Manual of Mental Disorders (DSM IV)[21] were not included. In addition, patients were only included if their accompanying parent's Swedish was adequate for an interview in Swedish at the beginning of the treatment period. Among the 253 eligible patients invited to join the study group, 230 (118 girls; 51%) agreed to participate. The patients were at least 7.5 years but not 20 years of age at referral.

The reference group patients had no known DBMP, which was controlled for in their dental records by their dentists. Reference group patients and their parents were consecutively asked to participate when they came for routine recall examination ($n = 214$) at four public dental clinics (three in Östergötland and one in Jönköping) or made orthodontic check-up visits ($n = 31$; Östergötland). The public dental clinics were selected to represent both urban and rural areas as well as different socio-economic areas. Exclusion criteria were the same as for the study group. A total of 245 patients (141 girls; 58%) formed the reference group.

Study group patients and their parents were interviewed according to a semi-structured interview protocol at their first visit to the specialized paediatric dentistry clinics. Following the interview the patient and the parent independently filled in questionnaires, parts of which are included in the present report. Reference group participants were interviewed by their ordinary dental team according to a similar semi-structured protocol, modified for use among patients in ordinary dental care. Patients and their parents completed the entire study protocol at one single visit in conjunction with their regular recall or control schedule. All participants received information (both verbal and written) about the study, including that participation was voluntary. Approvals from the Research Ethical Committee of the Linköping County Council and the Örebro County Council were obtained prior to the study.

Gender and age distribution of the study and reference groups are shown in Table 1. There were no differences between the groups in relation to age or gender. Most of the responding parents in both groups

Table 1. Sample characteristics and background data for study and reference groups.

		Study group					Reference group				
			Age in years	Socio-economic status (SES)		Not living with both parents		Age in years	Socio-economic status (SES)		Not living with both parents
		n	Mean	Mean	SD	*n* (%)	*n*	Mean	Mean	SD	*n* (%)
Children (7.5–12 years)	Girls	68	10.2	30.7	11.9	29 (43%)	78	10.5	37.9	12.2	22 (28%)
	Boys	69	10.3	29.9	10.6	34 (49%)	74	10.8	40.0	12.2	17 (23%)
Adolescents (13–19 years)	Girls	50	16.1	27.6	9.7	29 (58%)	63	15.7	34.7	9.2	20 (32%)
	Boys	43	16.8	28.5	11.4	27 (63%)	30	15.8	39.9	11.4	6 (20%)
All subjects (7.5–19 years)		230	12.8	29.5	10.9	119 (52%)	245	12.6	37.9	11.5	65 (27%)

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were mothers (85%; 86% study group and 84% reference group). As a measure of socioeconomic status (SES), we used the Hollingshead four-factor index of social position (range 8–66)[22], modified for use in Sweden by Broberg (Broberg AG, *Swedish adaptation of the Hollingshead four-factor index of social position*. Unpublished paper from the Department of Psychology, Göteborg University, Göteborg, Sweden, 1992). The family's SES, as indexed by both parents' educational level and occupation scores, differed between groups, with the parents of the study group showing significantly lower SES levels compared with the parents of the reference group (mean score 29.5 vs. 37.9; $P < 0.001$; Table 1). A significantly higher proportion in the study group compared with the reference group had parents who did not live together (52 vs. 27%; $P < 0.001$; Table 1).

Key psychometric measures

The Children's Fear Survey Schedule – Dental Subscale (CFSS-DS)[23], a 5-point Likert scale consisting of 15 items, was used to assess dental fear. Item scores range from 1 (not afraid at all) to 5 (very afraid), giving a totals range of 15–75. The Swedish version of CFSS-DS[24] used in this study was primarily designed for parental ratings and was adapted with minor modifications for self-ratings by the children and adolescents. Crohnbach's alphas varied between 0.84 and 0.91 for self- and parental ratings, in the study and reference groups respectively.

General fear was assessed using the Swedish parental version[6] of the short form of the CFSS-SF[25], containing 18 items to be rated from 1 (not afraid) to 5 (very afraid), giving total scores ranging 18–90 (Crohnbach's alphas were 0.87 in both study and reference groups).

The Multidimensional Anxiety Scale for Children (MASC)[26] (Swedish translation by Ivarsson,[27]) was used for children's and adolescents' self-ratings of their anxiety problems. MASC contains 39 items to be rated from 0 (the symptom never applies to me) to 3 (the symptom often applies to me) and has four subscales describing physical symptoms (alphas 0.83 & 0.82), social anxiety (alphas 0.84 & 0.82), separation anxiety/panic (alphas 0.70 & 0.71), and harm avoidance (alphas 0.84 & 0.82). An anxiety disorders index can also be calculated using items from the different subscales (alphas 0.61 & 0.59).

The Strengths and Difficulties Questionnaire (SDQ)[28] (Swedish translation by Smedje *et al.*[29]) was used as a generic measure of emotional and behavioural problems. The SDQ, which can be used for both self- and parental ratings, has 25 items to be rated from 0 (not at all like my child/me) to 2 (very much like my child/me) divided between five scales of five items each, generating scores for child and parental ratings for emotional symptoms (alphas 0.66–0.76), conduct problems (alphas 0.50–0.76), hyperactivity-inattention (alphas 0.46–0.62), peer problems (alphas 0.22–0.55), and prosocial behaviour (alphas 0.64–0.71).

The EASI temperamental survey[30] (Swedish translation by Hagekull and Bohlin[31]) was used to measure five aspects of temperament. It contains 25 items on a Likert-type scale from 1 (not at all like my child/me) to 5 (very much like my child/me) and was adapted by us with minor modifications to be used for self-assessments. The EASI measures 'negative emotionality', a tendency to high autonomic arousal, expressed as irritability or aggression (alphas 0.71–0.77), activity level, i.e. tempo and vigour (alphas 0.54–0.78), sociability, a preference for the presence of others to being alone (alphas 0.57–0.68), shyness, a tendency toward inhibition or slowness to warm up in new situations or when meeting strangers (alphas 0.61–0.79), and impulsivity, a tendency toward impatience and lack of perseverance (alphas 0.54–0.73). Each temperamental dimension is measured by 5-item subscales of the EASI instrument, giving mean scores ranging 1–5 for each dimension.

The Emotionality, Emotion Regulation, and Adaptation questionnaire (EMOREA)[32] was used for parental ratings of children's temperamental reactivity and capacity for emotional regulation. The items focus on four emotions: sadness, anger, fear, and positive emotions/exuberance. All items are scored on 5-point Likert scales from 1 (does not apply at all) to 5 (applies very well to my/this child). 'Reactivity' was measured with 16 questions

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regarding the occurrence and intensity of reactions (range 16–80; alphas 0.89 in both study and reference groups). 'Emotional self-regulation' was measured by twelve questions regarding the child's ability to regulate anger, fear, and sadness independently (range 12–72; alphas 0.90 & 0.91) and 'emotional regulation with the help of others' by 12 additional questions (range 12–72; alphas 0.92 & 0.94).

Statistical methods

Results are presented using descriptive statistics (means, SD). Group differences were analysed using student's *t*-test for two independent groups and effect sizes were estimated with Cohen's *d*[33].

Multivariate comparisons of the study and reference groups were performed using logistic regression analyses with group (study or reference) as dependent and selected measures (see result section) as potentially discriminatory variables. Odds ratios (OR) with 95% confidence intervals (CI) were calculated. To facilitate the understanding of the structure of the study and reference groups and to estimate rapid and simplified prediction rules for classifying individuals, we used tree-based modelling or recursive partitioning[34,35]. Tree-based modelling forms rules based on optimized cut-offs for the set of discriminating factors, and these cut-offs successively split the study sample into smaller and smaller sets of higher homogeneity. Tree-based modelling is an alternative to discriminant analysis and has the advantage of not being dependent on linear additive functions of the variables in concern. The result of the tree analysis is most often visualized in graphs and tables of estimated probabilities for correct classifications.

The level of significance was set at 5% ($P < 0.05$). The statistical analyses were performed using SPSS version 15.0 and SPLUS 2000.

Results

Personal characteristics – bivariate analyses

The study group had higher scores than the reference group on both dental fear (mean differences 12.3 and 18.4 for self- and parental ratings respectively; $P < 0.001$; effect sizes, Cohen's $d = 1.4$ and 2.2) and general fear (mean difference 9.6; $P < 0.001$; $d = 1.0$). In addition, the study group children had significantly higher mean values on three of the Anxiety subscales (physical symptoms, social anxiety, and separation anxiety) and on the anxiety disorders index (Table 2).

Regarding strengths and difficulties as measured by the SDQ, significantly higher scores were revealed for the study group as compared with reference group children on all problem-related subscales (emotional symptoms, conduct problems, hyperactivity-inattention, peer problems; Table 2). The fifth scale, prosocial behaviour, was scored significantly higher among children in ordinary dental care as compared with the study group.

A similar pattern was found for the temperamental dimensions, where the subscales for negative emotionality, shyness, and impulsivity were scored significantly higher in the study group, while the reverse was indicated for the subscales activity and sociability (Table 2). In the emotional reactivity and regulation measures, children in the study group had higher scores on reactivity (emotional reactions were reported to occur more often and to be more intense) as compared with reference group children. In addition, study group children were rated by their parents as less able to regulate their emotions both on their own (regulation-self) and with help from others (regulation-parental; Table 2).

Multivariate analysis

Variables that in the bivariate analyses (Table 2) differed significantly between study and reference groups were entered into a sequence of multiple logistic regression analyses with group (study group 1; reference group 0) as the dependent variable. In a first step, the independent variables were tested one by one without and with the inclusion of age (two levels) and gender (data not shown). Variables without discriminatory capacity were excluded from further analyses. In a second step, the variables still under investigation were included simultaneously in the model, without and with the inclusion of age and

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Table 2. Mean scores of individual factors for study and reference groups.

Variable	Study group		Reference group		*t*-test		
	Mean	SD	Mean	SD	*t*	*P*-value	Cohen's *d*
Dental fear (CFSS-DS)							
Self ratings	34.8	10.0	22.5	7.4	−22.6	< 0.001	1.4
Parental ratings	38.8	10.8	20.4	5.5	−14.9	< 0.001	2.2
General fear (CFSS-SF; p)	40.1	10.8	30.5	8.3	−10.7	< 0.001	1.0
Anxiety (MASC; s)							
Physical symptoms	9.6	6.4	4.7	4.6	−9.35	< 0.001	0.9
Social anxiety	9.7	6.4	7.5	5.3	−3.7	< 0.001	0.4
Separation anxiety	7.4	5.0	5.7	4.2	−4.0	< 0.001	0.3
Harm avoidance	16.1	5.0	16.1	4.3	−0.06	0.954	0
Anxiety disorders	12.6	4.7	10.6	3.9	−4.6	< 0.001	0.5
Emotional and behavioural problems (SDQ)							
Emotional symptoms							
Self ratings	4.3	2.5	1.9	1.9	−11.4	< 0.001	1.1
Parental ratings	3.1	2.5	1.0	1.5	−10.8	< 0.001	1.1
Conduct problems							
Self ratings	2.5	1.8	1.3	1.2	−8.4	< 0.001	0.9
Parental ratings	2.1	1.8	0.8	1.1	−9.1	< 0.001	0.9
Hyperactivity-Inattention							
Self ratings	4.6	2.0	3.4	2.1	−5.8	< 0.001	0.6
Parental ratings	4.0	2.6	2.2	2.0	−8.6	< 0.001	0.8
Peer problems							
Self ratings	2.5	1.8	1.3	1.2	−8.6	< 0.001	0.8
Parental ratings	2.1	1.9	1.1	1.5	−6.3	< 0.001	0.6
Prosocial behaviour							
Self ratings	8.0	1.8	8.4	1.5	2.7	0.006	0.2
Parental ratings	8.2	1.7	8.5	1.6	1.8	0.07	0.2
Temperament (EASI)							
Negative emotionality							
Self ratings	2.9	0.9	2.5	0.8	−5.2	< 0.001	0.4
Parental ratings	2.9	0.9	2.4	0.7	−6.7	< 0.001	0.6
Activity							
Self ratings	3.3	0.8	3.7	0.7	5.4	< 0.001	0.5
Parental ratings	3.6	0.9	3.7	0.7	1.1	0.26	0.1
Shyness							
Self ratings	2.4	0.8	2.0	0.7	−4.7	< 0.001	0.5
Parental ratings	2.1	0.8	1.9	0.7	−2.7	0.008	0.3
Sociability							
Self ratings	3.7	0.8	4.0	0.7	3.3	0.001	0.4
Parental ratings	3.6	0.8	3.7	0.6	0.7	0.45	0.1
Impulsivity							
Self ratings	2.7	0.8	2.2	0.7	−6.4	< 0.001	0.7
Parental ratings	2.7	0.9	2.2	0.7	−7.0	< 0.001	0.6
Emotional reactivity and regulation (EMOREA; *p*)							
Reactivity	44.8	13.1	37.4	11.1	−6.6	< 0.001	0.6
Emotional self-regulation	42.2	9.7	47.2	9.0	5.7	< 0.001	0.5
Emotional regulation with the help of others	38.1	10.1	42.8	10.6	4.8	< 0.001	0.5

(*s* = self ratings, *P* = parental ratings), *n* by group varies between 213 and 239 according to missing data on single item.

gender (data not shown). In a third step, a stepwise conditional inclusion of the remaining variables was performed without and with control for parental characteristics (SES, not living with both parents), age and gender (data not shown). Variables that were significantly associated with DBMP in any of the third step models were in a final step, without (not shown) and with control for parental characteristics (Table 3), simultaneously included in the analyses. All inter-correlations between variables were checked for and varied for variables in the final model between 0.22 and 0.4. The forced inclusion of SES and not

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Table 3. Multiple logistic regression models (in total and separately by age and gender subgroups) for assignment to referral (to the Clinic of Specialized Paediatric Dentistry) because of DBMP.

Model	Variable (*s* = self ratings, *P* = parental ratings)	OR	95% CI	*P*-value	Predicted percentage correct
Main model[1] (all; *n* = 352)	Dental fear (CFSS-DS; *s*)	1.1	1.0–1.2	< 0.001	90.6
	Dental fear (CFSS-DS; *p*)	1.3	1.2–1.4	< 0.001	
	Temperament; impulsivity (*s*)	1.2	1.0–1.3	0.046	
	Anxiety; social anxiety	0.8	0.7–0.9	< 0.001	
	Emotional and behavioural problems; emotional symptoms (*s*)	1.7	1.3–2.2	< 0.001	
	Emotional and behavioural problems; peer problems (*s*)	1.5	1.1–2.1	0.006	
Subgroup models Children					
Girls[2] (*n* = 105)	Dental fear (CFSS-DS; *p*)	1.6	1.2–2.3	0.001	94.8
	Emotional reactivity and regulation; emotional regulation with the help of others	0.8	0.7–1.0	0.006	
	Anxiety; physical symptoms	1.3	1.0–1.7	0.039	
	Anxiety; anxiety disorder	0.4	0.2–0.8	0.013	
	Emotional and behavioural problems; emotional symptoms (*s*)	7.1	1.7–29.2	0.007	
Boys[3] (*n* = 104)	Dental fear (CFSS-DS; *p*)	1.3	1.2–1.5	< 0.001	89.0
	Anxiety; social anxiety	0.8	0.7–1.0	0.034	
	Emotional and behavioural problems; emotional symptoms (*s*)	2.2	1.3–3.8	0.003	
Adolescent					
Girls[4] (*n* = 92)	Dental fear (CFSS-DS; *p*)	1.1	1.0–1.3	0.058	93.1
	Dental fear (CFSS-DS; *s*)	1.3	1.1–1.6	0.004	
	Emotional and behavioural problems; conduct problems (*p*)	3.3	1.1–9.7	0.032	
Boys[5] (*n* = 55)	Dental fear (CFSS-DS; *p*)	1.5	1.2–2.1	0.003	98.3
	Anxiety; physical symptoms	1.3	1.0–1.6	0.019	

OR (95% CI) for background variables controlled for in the analyses were for the different models 1–5:
[1]SES 0.9 (0.9–1.0) not living with both parents 2.6 (1.1–6.0).
[2]SES 0.9 (0.8–1.0) not living with both parents 5.9 (0.3–117.3).
[3]SES 0.9 (0.9–1.0) not living with both parents 5.9 (1.3–27.9).
[4]SES 1.0 (0.8–1.0) not living with both parents 2.5 (0.6–9.7).
[5]SES 1.0 (0.9–1.1) not living with both parents 1.8 (0.1–22.1).
Variables not reported in the table did not enter the model.

living with both parents caused an increase in OR for 'emotional symptoms' (from 1.4 to 1.7) and for 'impulsivity' (from failed to enter the main model to OR 1.2), while 'conduct problems' left the model. Other variables were unaffected (data not shown).

The main model ('all', Table 3) showed group differences in dental fear, impulsivity, emotional symptoms, and peer problems. Emotional symptoms followed by peer problems were the variables showing the highest ORs for allocation to the study group (Table 3). Supplementary analyses for age and gender subgroups showed differentiated models as reported in Table 3. In the youngest subgroups, the higher ORs (2.2, 7.1) for emotional symptoms pointed to its clear and significant contribution to DBMP. For the adolescent girls, conduct problems were the only addition to DF and for the adolescent boys, physical symptoms were the only addition (Table 3). Parent-rated DF (OR = 1.3 in the main model; Table 3) was the only variable with discriminatory function in all subgroups, while self-rated DF entered the model only for adolescent girls (Table 3). The ORs for parent-rated DF indicated a stronger contribution among young girls and adolescent boys.

Tree analysis

The first tree-based modelling was performed as a complementary discrimination analysis between study and reference groups. In the

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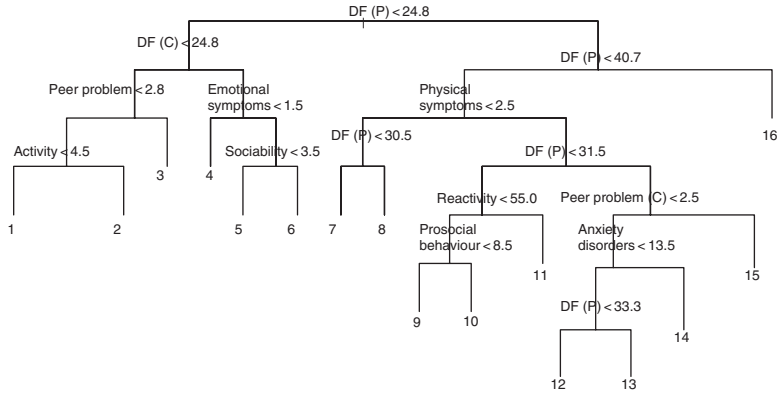

n (%)

Node	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Study	0	1	4	1	1	**10**	2	**8**	**12**	**12**	5	**9**	**15**	**11**	**27**	**80**
group	(0)	(5)	(21)	(7)	(10)	**(53)**	(18)	**(62)**	**(100)**	**(63)**	(38)	**(90)**	**(100)**	**(65)**	**(100)**	**(100)**
Reference	**113**	**18**	**15**	**14**	**9**	9	**9**	5	0	7	**8**	1	0	6	0	0
group	**(100)**	**(95)**	**(79)**	**(93)**	**(90)**	(47)	**(82)**	(38)	(0)	(37)	**(62)**	(10)	(0)	(35)	(0)	(0)

Fig. 1. Tree-based modelling with minimum final subsets (terminal nodes) of 20 subjects. Correct classification = 90%. Fulfilment of the classification criterion leads to the left, non-fulfilment leads to the right. (DF = dental fear; Peer problems = Emotional and behavioural problems; peer problems; Activity = Temperament: activity; Sociability = Temperament: sociability; Physical symptoms = Anxiety: physical symptoms; Emotional symptoms = Emotional and behavioural problems: emotional symptoms; Reactivity = Emotional reactivity and regulation: reactivity; Prosocial behaviour = Emotional and behavioural problems: prosocial behaviour; Anxiety disorders = Anxiety: anxiety disorders. Illustration of an application of the tree diagram: A subject with parental rated DF higher than cut-off score 24.8, DF below cut-off score 40.7, physical symptoms higher than cut-off score 2.5, DF higher than cut-off score 31.5 and peer problems higher than cut-off score 2.5 will belong to the study group, probability 100%).

tree-based modelling, personal characteristics variables showing discriminatory ability during any step in the sequence of multiple logistic regression analyses were included. The classification process was allowed to proceed until subsets including a minimum of 20 individuals and 16 terminal nodes were revealed, with an overall probability of correct classification of 90% (Fig. 1). Parent-rated DF higher than 40.7 by itself explained placement in the study group (node 16; probability 100%; Fig. 1). For parent-rated DF in the range 24.8–40.7, self-rated anxiety problems and emotional symptoms (Anxiety-physical symptoms, Emotional and behavioural problems-emotional symptoms) as well as parent-rated reactivity further contributed to classification with varying probabilities for study versus reference group (nodes 7–15; Fig. 1). Parent-rated DF below 24.8 lead to placement in the reference group (nodes 1–5; Fig. 1), with the only exception being node 6, which illustrates a pattern of high emotional problems and high sociability.

The second tree modelling was conducted to explore for simple screening procedures for use in ordinary dental care to identify patients in potential need of special attention due to their risk of developing DBMP. By pre-specifying the minimum size of subsets to 150 subjects, thus reducing sampling variability, the tree modelling was restricted to four terminal nodes (correct classification 87%), with DF as the outstanding discriminating variable. With a cut-off at 24.8, parent-rated DF clearly discriminated between study and reference groups (Fig. 2).

Discussion

Our results are in line with earlier findings that children referred for specialized paediatric dental care because of DBMP differ from same-aged patients in ordinary dental care in several personal characteristics[5–7].

DBMP in relation to fear and emotional and behavioural problems

Being referred because of DBMP was most clearly explained by dental fear, emotional symptoms, and peer problems,

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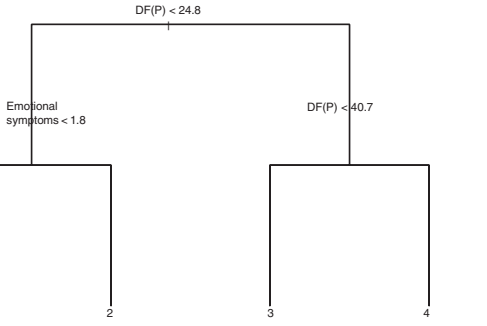

n (%)				
Node	1	2	3	4
Study group	2 (2)	15 (16)	**101 (74)**	**84 (100)**
Reference group	**98 (98)**	**80 (84)**	36 (26)	0 (0)

Fig. 2. Tree-based modelling with minimum final subsets (terminal nodes) of 150 subjects. Correct classification = 87%. Fulfilment of the classification criterion leads to the left, non-fulfilment leads to the right. (DF = dental fear; Emotional symptoms = Emotional and behavioural problems: emotional symptoms. Illustration of an application of the tree diagram: A subject with DF higher than cut-off score 24.8 will belong to the study group).

with parent-rated DF as the single most important variable. The strong association we found between DF and DBMP among our group of 7.5- to 19-year-old patients differs from the limit overlap previously shown for 3- to 11-year-olds[6]. We interpret this to indicate that as children grow older the relationship between DBMP and more externalizing problems weakens, whereas the relation of DBMP to fear and internalizing problems gets stronger. This would mean that older children and adolescents are more similar to adults with dental phobia than they are to younger children, implying that their treatment for DBMP should be more similar to the evidence-based treatments for adults[36–38]. The relationship between DBMP and anxiety problems in general is further strengthened by the significantly higher scores for the study group patients on the Anxiety measure, a well-documented measure of anxiety disorder problems among older children and adolescents[27].

DBMP was, however, related not only to fear and anxiety. Instead we replicated the relations between DBMP and various emotional and behavioural problems that have been shown previously by others[39,40]. Having DBMP was related to higher scores on every subscale of the emotional and behavioural problems measure, one of the most used screening instruments for psychological problems among children and adolescents. This comes as no surprise. One of the more robust findings in developmental psychopathology is that, contrary to often-held beliefs, troubled children and adolescents are not *either* sad (internalizing problems) *or* angry (externalizing problems), but rather are sad *and* angry (correlations between internalizing and externalizing problems being in the 0.50–65 range[41]).

DBMP in relation to temperament

Study group patients' higher scores on negative emotionality, impulsivity, shyness, and emotional reactivity also are in accordance with previous findings on younger children[7,14]. In addition, these findings were extended through both time (from childhood on into adolescence) and depth (using a new measure specifically directed towards emotional reactivity: emotional reactivity and regulation[32]).

Study-group patients were characterized not only by higher emotional reactivity but also by deficits in emotion regulation compared with children in ordinary dental care. This indicates the difficulties study-group patients have with both the emotion- and problem-focused coping strategies that children use to handle the potentially stressful dental situation[42,43].

The logistic regressions. The logistic regression analysis for the main model confirmed that personal characteristics such as dental fear, anxiety problems, behavioural problems, and temperamental aspects all impacted on DBMP, but dental fear was the only variable that consistently entered models for both the total sample and the subgroups.

Predictable differences in experiences due to age, gender, and hormonal changes of puberty can impact on the variables under study. Therefore we analysed the relationship between personal characteristics and DBMP separately for girls versus boys and for children 7.5–12-years-old, who typically have not reached puberty, versus adolescents

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13–19 years old. The different age and gender subgroups revealed different models, pointing to the importance of this differentiation when trying to predict DBMP. In line with earlier studies[7,40], emotional symptoms entered the model for both girls and boys in the younger age groups. The impact of lowered capacity to use the parent as an auxiliary means of emotion regulation was shown only for the girls in this age group. This may indicate that, at least as seen by the accompanying parent, parent-aided emotion regulation was more crucial for girls than for boys in the dental situation. For adolescent girls, parent-rated conduct problems contributed. This may indicate that these girls bring unrelated oppositional behaviour into the dental treatment situation, where it is interpreted as DBMP. However, their self-rated DF, although possibly camouflaged by their oppositional conduct, needs seriously to be considered. Among adolescent boys, only the Anxiety; physical symptoms subscale (and DF) entered the model, possibly indicating (i) that this is a genuinely 'fearful' group and (ii) that anxiety in males (regardless of age), at least initially, often show up as physical symptoms rather than as 'worrying'. Both of these possibilities must be taken into consideration when establishing the treatment alliance. The reversed relationship found for social anxiety (in the main model and subgroup child boys) may be interpreted as having an inhibiting effect, when simultaneously entered with intercorrelated (although not strongly) variables.

We added tree-based modelling as a complement to the logistic regression analyses for two reasons. The first was to use the opportunity for variables to enter the model at different stages in the sorting process. DF emerged as the first sorting variable to discriminate study group from reference group patients. Very high DF scores (>40.7) by themselves explained referral with 100% certainty, while almost all children and adolescents with very low DF scores belonged to the reference group. Only 9% (n = 17) of the study group patients versus 83% (n = 178) from the reference group had DF scores <24.8. Our results indicate that (i) from a screening perspective, DF scores far below the commonly used CFSS-DS ≥ 38 could be recommended, and (ii) for patients scoring in the 25–40 point range aspects other than dental fear should also be taken into special consideration. The second reason for the tree analysis was to search for a clinically practical way (using only a very few instruments) to identify children and adolescents in need of special care. As shown in Fig. 2, it took only two instruments (parent-rated CFSS-DS & emotional subscale) to correctly classify 87% of the patients as belonging to the study versus the reference group.

The strength of this study is the variety and number of personal characteristics we have measured, which generate hypotheses for further research. Using Cohen's d for assessment of effect size allows an evaluation of the practical value of the differences between groups. Cohen's d from 0.2 and above is seen as small but not is seen as trivial[33]. Some of the differences were lower than 0.2, none of them entered the multivariate models. From that point of view, the obvious limitation, that the study sample may be seen as a highly selected group, is not central but should be acknowledged. Since study group inclusions were based primarily on referral forms (with many different dentists' opinions and descriptions of the children's and adolescents' dental fear and lack of cooperation), a great variability in DBMP within the group must be assumed. However, by allowing that variability, the study clearly reflects clinical practice, thus favouring clinical relevance. Furthermore, it is important to bear in mind that our reference group is not a norm group, since 'no known DBMP' was one of the inclusion criteria for the reference group. In addition, the present investigation does not allow any evaluation of the impact of oral health status on the relationships between personal characteristics and DBMP.

To summarize, both the logistic regression analyses and the tree-based modelling indicate that DF was the single most important potential predictor of DBMP, but to fine-tune our understanding of these patients' problems a number of other personal characteristics should be taken into consideration.

In conclusion, this study revealed that children and adolescents referred because of

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DBMP had significantly higher scores on fear and anxiety, behavioural symptoms, and temperamental reactivity as compared with same-aged patients in ordinary dental care. Dental fear emerged as the first and most important potential predictor for DBMP at scores of 25 and above on the CFSS-DS for parental ratings. The role of dental fear was consistent between age- and gender-differentiated subgroups, while other aspects varied. Further research should focus on different patterns of DBMP development, considering various personal characteristics that may trigger, maintain, or exacerbate young patients' vulnerability to DF and DBMP. Given the important role of DF in the development of DBMP in this age-group, it would be especially important to study different developmental pathways of DF from a longitudinal perspective, especially during early and middle childhood when other factors seem to be of equal importance.

What this paper adds

- This paper provides support for the re-establishment of dental fear as the single most important variable, discriminating for DBMP.
- DF scores in the range of 25–40 alone did not explain referral; aspects other than DF should be taken into special consideration.
- This paper presents a potential screening method for DBMP using only two instruments to identify patients with a need for special attention.

Why this paper is important to paediatric dentists

- Deeper knowledge and understanding of DBMP, including the impact of dental fear and other personal characteristics, will help dental personnel to meet and treat children and adolescents according to their individual needs and thereby act for the prevention of DBMP.

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