DOI: 10.1111/j.1365-263X.2009.00998.x

INTERNATIONAL JOURNAL OF PAEDIATRIC DENTISTRY

REVIEW ARTICLE

Empirical evidence of the relationship between parental and child dental fear: a structured review and meta-analysis

MARKUS THEMESSL-HUBER[1], RUTH FREEMAN[2], GERRY HUMPHRIS[3], STEVE MACGILLIVRAY[4] & NATHALIE TERZI[5]

[1]Department of Behavioural and Social Sciences, CQUniversity, Rockhampton, Qld, Australia, [2]Dental Health Services Research Unit, University of Dundee, Dundee, UK, [3]Bute Medical School, University of St Andrews, St. Andrews, UK, [4]Tayside Institute for Health Studies, Abertay University, Dundee, UK, and [5]Physiotherapy Department, Ninewells Hospital, NHS Tayside, Dundee, UK

International Journal of Paediatric Dentistry 2010; 20: 83–101

Background. The relationship between parental and child dental fear has been studied for over a century. During this time, the concept of dental fear as well as methodological approaches to studying dental fear in children have evolved considerably.

Aim. To provide an overview of the published empirical evidence on the link between parental and child dental fear.

Design. A structured literature review and meta-analysis.

Results. Forty-three experimental studies from across the six continents were included in the review. The studies ranged widely with respect to research design, methods used, age of children included, and the reported link between parental and child dental fear. The majority of studies confirmed a relationship between parental and child dental fear. This relationship is most evident in children aged 8 and under. A meta-analysis of the available data also confirmed an association between parental and child dental fear.

Conclusion. The narrative synthesis as well as the meta-analysis demonstrate a significant relationship between parental and child dental fear, particularly in children 8 years and younger.

Introduction

Child dental fear is a significant factor in the provision of paediatric oral health care. The prevalence of dental fear among children has been reported to range between 5% and 20% with a mean prevalence of 11%[1]. Dental fear is not only a common occurrence among children it may also compromise their oral and general health. Anxious and uncooperative children tend to avoid dental care and tend to have worse oral health compared with their less anxious and more cooperative peers[2–4]. Uncooperative and anxious children are also likely to have a less productive and enjoyable dental care experience[4,5], and they are also likely to experience other behavioural or emotional problems[6]. As a result, dental fear in children may lead to high personal and community costs and to a reduction in their health and wellbeing[7].

Dentally anxious children present a considerable challenge to parents, dentists, and the healthcare system. The influence parents, and particularly mothers, have on their children in the dental situation has been investigated for over a century[8–12]. Inherent in these investigations is the quality of the relationship between mother and child and in particular the mother's ability to withstand and cope with her child's anxiety. Whether this maternal ability is perceived in terms of personality strength or containment of affect, what is of importance is how the functionality of the mother's personality enables her child cope with internal fears provoked by such situations as dental treatment[13].

Observational work with mothers and children has highlighted a number of interactions

Correspondence to:
Markus Themessl-Huber, Department of Behavioural and Social Sciences, CQUniversity, Bruce Highway, Rockhampton, 4701 Qld, Australia.
E-mail: m.themessl-huber@cqu.edu.au

which are felt to be pertinent in this regard. These include nurturing interactions, permissive interactions, and authoritarian interactions between parent and child. These observations have given rise to three recognizable mother–child dyads which reflect the functionality of the mother–child relationship. These dyads are first the competent mother–child dyad which is characterized by nurturing and encouraging psychological growth; secondly, the aggressive mother–child dyad characterized by inconsistency and emotional detachment, and thirdly the anxious mother–child dyad characterized by ambivalence and intrusiveness[14,15]. Considering that aggressive behaviours act to screen anxiety then the dentally anxious child caught up in the anxious and/or aggressive mother–child dyad will be left to manage her dental fear which will be intensified by mother's inconsistent and ambivalent behaviours. To quote Freeman:

The functionality of the family and the ability of the parents to form positive, consistent, and nurturing interactions with their children (competent mother–child dyads) are central to the ability of children to cope appropriately and contain their anxieties during dental treatment.[13]

To date, however, the research literature provides conflicting evidence about parents' effect on their child's dental fear. Some of the evidence suggests that parents with a high level of dental anxiety struggle to prepare their children adequately for the dental visit[16], and that parental attitudes and behaviours significantly affect children's reaction to medical and dental stressors[17–21]. Other evidence suggests that compared with other factors, parental fear may not be of significance in the child's aetiology of dental fear[6]. Earlier reviews also reported inconsistent findings about the relationship between maternal and child anxiety in the dental situation[22].

Various reasons for these inconsistencies were proposed, ranging from the complexity of the concept of fear to methodological matters. Fear is associated with complex and variable behaviours, which are manifest on cognitive, affective, and behavioural levels[4,23]. Theories on the aetiology of dental fear were formulated by a variety of schools of thought, including psychoanalysis, behaviourism, and social learning theory[24–26]. As a conclusion of the above theories on the aetiology of fear, the acquisition of fear was proposed to follow three different paths; dental fear may be a result of direct conditioning, acquired through model learning, or a consequence of negative information[25,27,28].

Personal, environmental, or situational aspects[29–32] as well as previous medical and dental experiences[33] have all been proposed to play a part in dental fear development[34]. It may be a consequence of an overall general anxiety trait[35], or acquired through interactions with family members[8,35–37]. Dental fear in children also appears to be related to their age[22,37–39]. Some authors suggest that the parental influence on dental fear is limited to younger children[8,37], whereas others suggest that the level of psychological development is a better indicator than chronological age[39]. Mostly, however, the aetiology of dental fear is widely regarded to be multi-factorial[40,41] and multi-dimensional[1,42].

Methodologically, two main issues have been identified in the current literature with regard to establishing a link between parental and child dental fear. One criticism referred to the measurement tools used. While early reports lacked objective validation[8], later studies often used established and validated tools to assess anxiety both in parents and children[43]. Moreover, the use of behaviour problems as a proxy to dental anxiety in research studies has been criticized. Particularly assumptions about the strong link between problem behaviour and dental fear have been questioned[2]. Problem behaviours, as mentioned above, may be linked to other factors, including psychological development, personality traits, and attachment issues[38]. This distinction gains importance if it is considered that within paediatric dentistry behavioural management techniques, alone or in combination with pharmacological sedation, are the method of choice to address dental fear[29].

The aim of this study is to provide an overview of the available evidence-base on the degree to which parental and child dental fear are related. It reports the outcomes of a struc-

tured literature review of the available evidence on the potential relationship between parental and child dental anxiety. Particular emphasis was placed on studies, which used established behaviour and anxiety measures to assess parental and child dental anxiety or child behaviour.

Material and methods

A series of different literature searches were performed looking at the relationship between parental mental health and child dental fear. Initially, a number of scoping searches were conducted aimed at identifying relevant search terms to find this body of literature. The literature search followed a structured rather than a systematic approach for the following reasons. The topic of this review demanded the inclusion of a diverse area of research. It was not possible to systematically identify studies on the association between child and parental dental fear as this relationship is often not indexed as a keyword or mentioned in the abstracts. Sensitivity was therefore sacrificed for specificity. Subsequent reviews should be able to build on this study and conduct systematic reviews on each of the study objectives. As a result, studies providing data on the relationship between child and parental dental fear may have been missed. This constitutes a limitation of this review.

Based on the information, a detailed search strategy was devised, which is shown in its entirety in Table 1. The search was limited to publications in English and German, which investigated the relationship between parental and child dental fear and included children and young people aged 0–19. The following databases were searched via OVID (15th July 2008): CINAHL (1982 to July Week 1 2008), EMBASE (1980–2008 Week 28), MEDLINE (1950 to July Week 1 2008), PsycINFO (1806 to July Week 2 2008), Cochrane/DARE EBM.

This search returned 977 publications. The abstracts retrieved through this search were screened by three of the authors. This screening process identified 50 articles, which met the inclusion criteria. The full text versions of these 50 publications were then retrieved and their reference lists screened for further relevant publications. Checking reference lists and background sections identified another 26 relevant articles. Thus, a total of 76 publications were found meeting initial inclusion criteria. These 76 publications were then examined to assess whether or not they reported the outcomes of experimental studies addressing the relationship between parental and child dental anxiety.

A total of 43 publications met these final inclusion criteria and represent the total data set included in this structured review. An

Table 1. Literature search strategy.

1. exp Phobic Disorders/
2. exp Anxiety/ or exp Anxiety Disorders/ or exp Dental Anxiety/
3. exp Fear/
4. exp Anticipatory Anxiety/
5. exp Anxiety Neurosis/
6. exp Phobias/
7. exp Anxiety Management/
8. or/1–7
9. exp dental care for children/
10. (dent$ adj4 child$).mp. [mp = ti, ot, ab, nm, hw, kw, tx, sh, ct, it, tn, dm, mf, tc, id]
11. (oral adj1 health adj4 child$).mp. [mp = ti, ot, ab, nm, hw, kw, tx, sh, ct, it, tn, dm, mf, tc, id]
12. (child$ adj1 oral adj2 health).mp. [mp = ti, ot, ab, nm, hw, kw, tx, sh, ct, it, tn, dm, mf, tc, id]
13. or/9–12
14. 8 and 13
15. remove duplicates from 14
16. (parental mental health or mentally ill parent$ or parental psychopathology or ((parent$ or maternal or paternal or mother$ or father$) adj2 psychiat$) or ((parent$ or maternal or paternal or mother$ or father$) adj2 mental$) or ((parent$ or maternal or paternal or mother$ or father$) adj2 depress$) or ((parent$ or maternal or paternal or mother$ or father$) adj2 anx$) or ((parent$ or maternal or paternal or mother$ or father$) adj2 psycho$) or ((parent$ or maternal or paternal or mother$ or father$) adj2 affect$) or ((parent$ or maternal or paternal or mother$ or father$) adj2 dsm) or ((parent$ or maternal or paternal or mother$ or father$) adj2 icd)).mp.
17. exp Dental Staff, Hospital/ or exp Societies, Dental/ or exp Health Education, Dental/ or exp Dental Care/ or exp Group Practice, Dental/ or exp Dental Health Surveys/ or exp Dental Caries/ or exp Dental Records/ or dental.mp. or exp Hypnosis, Dental/ or exp General Practice, Dental/ or exp Schools, Dental/ or exp Dental Research/ or exp Dental Anxiety/ or exp Dental Hygienists/ or exp Ethics, Dental/ or exp Dental Health Services/ or exp Dental Offices/ or exp Dental Staff/ or exp Dental Service, Hospital/ or exp Dental Care for Children/ or exp Specialties, Dental/ or exp dental patient/ or exp dental surgery/ or exp dental health/ or exp dental treatment/ or dentist$.mp.
18. (dent$ adj1 anx$).mp.
19. (dent$ adj1 phob$).mp.
20. or/17–19
21. 16 and 20
22. remove duplicates from 21
23. 15 or 22
24. remove duplicates from 23

overview of all included publications can be found in Table 2. In addition to a detailed qualitative investigation of the included articles a quantitative meta-analytic approach was adopted. Those articles, which provided sufficient quantitative estimates of association between parental and child measures to enable transformation into effect sizes were entered into the meta-analytical routine. The programme Comprehensive Meta-analysis (version 2) was employed. The indices of association amenable to effect size conversion included: raw correlations, *t*-value for association, odds ratio, and *P*-value for correlation. Age group was adopted as a single grouping factor to explore the level of aggregated associations across studies. Further factors such as quality of measures reported in each study were not investigated, because of the limited number of total studies available and risks of inflating a type 2 error. Random effects modelling was applied to allow for the wide variance between studies. Rosenthal's 'fail safe N' procedure was applied to estimate the number of negative studies that would be required to overturn the total aggregated result. To assess publication bias Egger's regression asymmetry test was used.

Results

Study pool characteristics

The publication dates of the studies included ranged from 1968 to 2007, with a median publication date of 1998 (see Table 2). Two studies were published in the 1960s, ten in the 1970s, five in the 1980s, six in the 1990s, and 20 studies were published since 2000. Twenty-three studies were conducted in Europe, 15 in North America, two in South America, and one each in Africa, Asia, and Australia. The majority of articles reported the outcomes of observational cohort ($n = 14$) and cross-sectional ($n = 18$) studies. Ten articles featured comparative or controlled cohort ($n = 7$), and cross-sectional ($n = 4$) studies. Two articles reported on randomized controlled or comparative studies, and one consisted of a retrospective data analysis. The study sample sizes range from 14 to 3166 participants, with a median size of 89. Thirteen of 43 studies were conducted in more than one setting. The remainder took place in a variety of settings including specialist dental centres, schools, and participants' homes.

Participant characteristics

The age of children participating in all studies ranged from 2 to 19 years. The studies used a wide variety of age ranges. Among the 43 studies involved in this review 29 used different age ranges. The most often used age range (six studies) included children aged 3–7, followed by 3–6 and 4–11 (three studies each). Four further age ranges were used by two studies each, whereas 23 studies used age ranges not shared by any other. Information about the various reasons for visiting the dentist is shown below.

Assessment measures used

Of the 43 studies reviewed, 13 used unspecified or self-styled tools to assess both or either parental and child dental fear and 30 used established measures.

Evidence on the link between parental and child dental anxiety

Forty-three studies were identified, which reported on the link between parental and child dental anxiety. Across all 43 studies, 34 established a relationship between parental and child dental anxiety. These studies used a range of different methods to measure both parental and child dental anxiety. Differentiating the studies according to the quality and types of measures used, however, produces a heterogeneous picture. The strengths of the relationship between parental and child dental anxiety appears to be affected by the assessment methods used.

Relationship between parental and child dental fear by age

The studies were categorized into three groups that differed with respect to the maximum age of children included. Two major

Table 2. Overview of the studies included in the review.

References	Country	Type	*N*	Age	Subjects	Context	Anxiety-related measures: child	Anxiety-related measures: parents	Outcome
29,48	Sweden	Co, Comp	86	4–12	Dental behaviour management problems	Specialist Paediatric Dental Clinic	Dental fear General fear Behaviour rating by parents and dentist CFSS-DS CFSS-SF	(DAS Self-rating (emotional distress) during child's dental appointment Parents' attitudes to dental care	No significant relationship between parental and child anxiety
49	Sweden	C-S, Ran, Cont	199	4–12	Dental behaviour management problems	Specialist Paediatric Dental Clinic; control group: Dental Clinic for check-up	SES CFSS-DS Oral health behaviour (perceived by parents)	DAS Dental knowledge Priorities Responsibility-taking	Uncooperative children had significantly more parents with higher level of dental fear than cooperative children
37	USA	C-S	80	9–12	40 patients with acute dental pain, 40 patients referred to preventive dental clinic	Dental Clinic and Preventive Dental Clinic	Dental Questionnaire (self-styled), CMAS, Dental Behaviour Evaluation form (self-styled)	Dental Questionnaire (self-styled), MAS	Anxiety scores of 9 ($P = 0.002$) and 10 ($P = 001$) year old children were significantly related to their mothers' anxiety scores; 11- and 12-year-old children did not show significant relationship
50	UK	C-S, Cont	50	3–14	Children requiring general anaesthetic and their parents	Dental Institute	VPT	Self-styled questionnaire for demographic information, Anxiety measurement with Visual Analogue Scale; telephone interview	No relationship between the anxiety of the child and that of the parents
3	Nigeria	Co	260	2–15	Children attending one of three dental clinics in one city	Dental Clinic	Frankl's Behavioural Rating Scale The Tell, Show, Do method	n/a	Maternal anxiety influences the behaviour of children during some stages of the dental treatment but not in others
28	Dutch	C-S	107	4–5 & 8–9	Children with low & high dental fear	Centre for Special Dental Care & Private Paediatric Dental Practice	CFSS-DS	A-PARI	No relationship between parental dental fear and child dental fear was found (0.08, $P > 0.05$).
51	Brazil	Co	20	6–12	Children requiring physical restraint for dental treatment	Paediatric Dentistry Clinic	CSS	Rutter's Parent Scale A2 Dental Fear Survey Lipp's Stress Symptoms Inventory	Mothers of children who require physical restraint are more dentally anxious (M: 53.5, p, 0.01) than mothers of children not requiring restraint (M 38).
52	Brazil USA	C-S	177	3–6	Attending patients	Paediatric Dental Clinics	Behaviour during dental appt Oral health Status Dental history	Occupation Education Anxiety during appt	Parental anxiety is related to child's behaviour.

Table 2. Continued.

References	Country	Type	*N*	Age	Subjects	Context	Anxiety-related measures: child	Anxiety-related measures: parents	Outcome
53	UK	Co	60	7	Random selection of attending patients	School	Interview Unspecified dental anxiety questionnaire Behaviour Screening Questionnaire	Interview DAS GHQ	Mothers' dental anxiety status was significantly related to child dental anxiety status ($P = 0.001$); Mothers GHQ status was significantly related to child dental anxiety status ($P = 0.001$)
54	Nigeria	C-S	81	8–13	Consecutive child patients attending for the first time	Dental Clinic	Dental anxiety (CFSS-DS)	Dental anxiety (DAS)	No significant correlation High anxiety in parents: mothers = 7.5, fathers = 1.2% Stronger relationship between mother and child anxiety than father-child.
17	UK	T, Rand, Comp	20	2–12	Children and their parents attending for one or more uncomplicated tooth extractions	Paediatric Dentistry Unit	MCSFS	MASFS	Low correlation between child and parent distress scores pre-operatively ($r = 0.30$), post-operatively ($r = 0.33$) and at 15-min post-operatively ($r = 0.47$), $P < 0.001$
55	Sweden	C-S, Cont	478	7–19	Referred for dental behaviour management problems + need dental treatment Consecutive patients for routine examination or check-up	Dental Clinic	SES Family situation Medical and psychosocial history Psychosocial adjustment Everyday life	Dental anxiety (DAS)	Higher parental dental anxiety Psychosocial adjustment was worse
56	USA	Co	47	2–8	Consecutive patients visiting a dentist for the first time	Dental Clinic	Unspecified behaviour rating scale	Unspecified anxiety questionnaire	Mothers' self-rated anxiety was significantly related to negative child behaviour†
35	Sweden	Co, Cont	202	3–16	101 consecutive children referred because of management problems, 101 children matched to intervention group	Specialised Pedodontics Clinic	Behaviour rating scale	Structured interview based on established questionnaire	Children of dentally anxious parents are 14× more likely to be at risk of behavioural management problems
57	USA	C-S	60	3–7	Children undergoing dental extraction	Paediatric Hospital & Dental Centre	Frankl's Behavioural Rating Scale Past dental experience	MAS	Children of mothers with high dental anxiety showed more negative dental behaviour

Table 2. Continued.

References	Country	Type	*N*	Age	Subjects	Context	Anxiety-related measures: child	Anxiety-related measures: parents	Outcome
21	USA	Co	67	3–7	Random sample of children unaware of receiving dental examination	Medical Outpatient Department	Frankl's Behavioural Rating Scale (used a 5 separate intervals by 2 independent observers)	Brief history form on child's dental experience and family environment MAS	Children of mothers with high anxiety scores demonstrated significantly more negative dental behaviour than did children of mothers with low anxiety scores ($\chi^2 = 21.19$, $P < 0.0001$).
5	USA	C-S, Cont	127	3–7	60 children underwent a dental extraction 67 children received dental examination during visits for various medical reasons	Dental Clinics & Hospital	Frankl's Behavioural Rating Scale (used a 5 separate intervals by 2 independent observers)	MAS Brief history form on child's dental experience and family environment Short questionnaire on mothers' ratings of child's behaviours in the medical and dental setting	Children of mothers with high-anxiety scores demonstrated significantly more negative dental behaviour than children of mothers with low-anxiety scores in both the extraction ($\chi^2 = 24.20$, $P < 0.001$) and examination groups ($\chi^2 = 21.19$, $P < 0.001$).
58	Dutch	C-S	80	4–11	Referral due to dental fear	Specialist Dental Care Clinic	Dental anxiety (CFSS-DS)	Dental anxiety	Moderate correlation between mothers' fear score and the child's CFSS-DS score
6	Dutch	Co	26	4–11	Children referred as new patients for behaviour management problems	Specialist Dental Care Clinic	CFFS-DS CBCL Video-recording, scored using the Venham scale	Self-reported dental fear assessed on Likert scale	No correlation between parental and child dental fear scored with the CFSS-DS
36	Sweden	Retro A	99	2–18	Children of adult patients with dental fear	Dental Fear Clinic	Management of problem behaviour noted in dental records	Remarks of parental dental fear in dental records	45% of children of parents with severe dental fear showed problem behaviour compared to 3–7% in population studies
2,38,59	Sweden	C-S	3166	4–11	Children from areas with different socio-economic standards. Parents were sent questionnaires to their homes to fill out for themselves and their children	5 Dental Clinics in one city Survey	CFSS-DS CFSS-SF	DAS	Mothers' DAS was strongly correlated with child dental fear ($r = 0.66$, $P = 0.001$) and general fears in children ($r = 0.63$, $P = 0.001$). Fathers' DAS was also strongly correlated with child dental fear ($r = 0.40$, $P < 0.001$) & general fears ($r < 0.40$, $P = 0.001$)

Table 2. Continued.

References	Country	Type	*N*	Age	Subjects	Context	Anxiety-related measures: child	Anxiety-related measures: parents	Outcome
60	USA	Co, Cont	165	3–13	Attending patients	Study 1 Private Pedodontic Practice Study 2 Pedodontic Dental Centre	Study 1 Pre-treatment interview Venham's Picture Test Behaviour ratings (Frankl scale) Study 2 Measures as in Study 1 Viewing video-tapes of a child's reaction to a restorative procedure *versus* a control videotape of a child engaging in a game	Study 1 Corah's DAS Melamed *et al.* scale for children Bending's abbreviation of the MAS Wright & Alpern's Maternal Questionnaire	Children's self-reported dental anxiety was not related to any measures of maternal anxiety
61	USA	C-S	181	6–10	Patients undergoing extractions, restorations, X-radiography, appliance adjustments, dental examinations, etc.	Dental Clinic	Verbal rating of nervousness in dental situation VPT Spielberger's How I feel questionnaire Behaviour Profile Scale Frankl Scale State anxiety rated by mother	Wright & Alpern's Maternal Questionnaire Self-Evaluation Questionnaire Melamed's Scale of Dental Anxiety Dental anxiety (DAS)	Maternal anxiety (state, trait, dental) did not predict child's behaviour during treatment Inconsistent correlations between maternal and child dental anxiety
62	USA	Co	86	3–7	Consequential selection of children without previous dental experience	Pedodontic Clinic	Behavioural rating scale adapted from Frankl Independent behaviour ratings (2 observers)	Brief history form MAS (before initial visit) M-C SDS (on 2nd visit)	Children of mothers with high-anxiety scores demonstrated significantly more negative behaviour than children of mothers with low-anxiety scores
63	USA	C-S	80	6–12	Attending patients	Hospital Dental Clinic & Private Practice	CBSS STAIC CFSS-DS MBPRS	Background questionnaire MBSS STAI	No significant relationship between parental and child dental anxiety; this holds true for both age groups (6–8 and 9–12).
64	India	Co	60	3–7	Children with no previous dental contact	Pedodontics Outpatient Department	Frankl's Behavioural Rating Scale	MAS One item to elicited state anxiety	Significant relationship between maternal manifest anxiety ($t = 13.12$, $P < 0.001$) as well as maternal state anxiety ($\chi^2 = 22.28$, $P < 0.001$) and negative child behaviour in the dental setting
65,66	Croatia	Co	89	5–12	Randomly selected pre-school and schoolchildren with and without dental trauma	Pedodontics University Clinic	DAS CMFQ Hollingshead Two Factor Index of Social Position	DAS	Maternal anxiety has some influence on child anxiety

Table 2. Continued.

References	Country	Type	*N*	Age	Subjects	Context	Anxiety-related measures: child	Anxiety-related measures: parents	Outcome
67	USA	Co, Comp	14	5–6	Randomly sample of new patients without prior injection experience seeking treatment for maxillary infiltration or mandibular block	Paediatric Dentistry Department	Video of procedure, behaviour rated using a modified Frankl scale Needle shown *versus* not shown prior to local anaesthetic administration	Self-styled questionnaire of mothers' attitudes toward dentistry and disciplining of child Dental experience Dental and other fears Child's personality	Mothers of uncooperative children were more likely to report fear of dentistry (100% *vs* 52%, $P = 0.003$) and other fears (65% *vs* 30%, $P = 0.001$); boys' mothers were more likely to report fear of dentistry ($P = 0.002$) and other fears ($P = 0.00$)
68	Sweden	Co	186	4–6	Children referred because of un-cooperative behaviour	Dental Institute	DDST Dental records	Interview	55% of uncooperative children had one or both parents who expressed dental anxiety
69	UK	C-S	1437	5	Children living in the study area; questionnaires sent to parents	Survey	DMFT SES Dentist attendance (regular basis or when symptomatic) Dental anxiety (reported by parents)	Dental anxiety	Anxious children had more caries experience More likely to be irregular attendees More likely to have anxious parents More likely to have undergone dental extraction in the past
70	Sweden	Co	646	4–8	Consecutive children visiting participating dentists	Dental Clinics in the study region	Self-styled behaviour rating scale for children	Self styled behaviour rating scale for parents	Clear connection between tense and worried parents and children showing increased tendency towards anxiety.
71	Israel	C-S	88	6–14	Attending patients	School of Dental Medicine	Dental anxiety (DAS) Time since last visit to dentist Previous experience in dental situation	Dental anxiety (DAS) Age Gender Country of birth Education	Correlation between children and parents anxiety Higher anxiety in children who reacted negatively to previous dental treatment
72	Finland, Italy	C-S	378	3–13	Attending patients	Dental Clinics	Unspecified questionnaire on dental anxiety	Unspecified questionnaire on dental anxiety	Parental anxiety associated with child's anxiety Problematic first visit is strong predictor of dental anxiety (modified by subsequent number of visits)

Table 2. Continued.

References	Country	Type	*N*	Age	Subjects	Context	Anxiety-related measures: child	Anxiety-related measures: parents	Outcome
73	Finland	C-S	1474	3–15	Participants in a survey on occurrence and distribution of dental caries	Survey	DFSS-C Oral hygiene habits Caries experience Diet Oral health status Sex City of residence	Dental fear Parent's education	Children's dental fear associated with family members' dental fear
74	USA	Co	30	3–7	Attending patients	Pedodontic University Department	Frankl's Behavioural Rating Scale	Pre-operative questionnaire adapted from Johnson and Baldwin STAI	Children of mothers with high-anxiety scores displayed significantly more negative behaviour than of mothers with low scores ($r = -0.345$, $P < 0.05$)
24	UK	Co, Cont	200	5–12	Children referred for dental anxiety ($n = 100$); – randomly selected non-anxious children ($n = 100$)	Dental Hospital	Dental anxiety in both groups of children was assessed via dental records and reaction to prophylaxis	Structured interview based on self-styled questionnaire	Dental anxiety in mothers is associated with dental anxiety in children χ^2 (2, $N = -200$) = 12.39, $P < 0.001$
75	UK	C-S	60	7–14	New patients	Clinic for specialised dental treatment	DAS DBS FSS-II Dental pathology	Maternal behaviour DAS DPIS SAS	Three main variables explaining dental fear Number of traumatic visits Dentist's empathy Maternal state anxiety
23	Finland	Co	113	7–12	Children attending an annual dental check	Primary schools	DMF score, Visual Plaque Index, Child dental anxiety was assessed (no, little, strong fear) via direct question by dentist during dental visit	DAS	Children's dental anxiety was correlated positively with maternal ($r = 0.23$) and paternal ($r = 0.21$) dental anxiety
76	USA	C-S	26	3–5	No prior dental experience	Participants in a longitudinal project	Heart rate Behaviour rating by independent observers Development. data Personality data	Child-rearing data (STIM: quantity and quality of social, emotional and cognitive stimulation at home + CRPQ: child-rearing attitudes and behaviour)	Children with more anxious dental responses tended to have mothers who lacked self-confidence and felt inadequate

Table 2. Continued.

References	Country	Type	*N*	Age	Subjects	Context	Anxiety-related measures: child	Anxiety-related measures: parents	Outcome
39	Australia	Co	307	5–9	Children attending participating primary schools	Primary schools	Pictorial Dental Anxiety scale (modified DAS)	Self-styled questionnaire used to elicit demographic information and parental attitudes and experiences	No significant relationship between parental and child dental anxiety (χ^2 = 12.45, d.f. = 8, $P > 0.05$)
77	Canada	Co	62	3–6	No prior dental experience	Pedodontist Clinic	Frankl's Behavioural Rating Scale The Tell, Show, Do method	Brief history form MAS Mothers' self rating of their anxiety	Significant relationship between mothers' dental anxiety and the child's cooperative behaviour. The association was stronger in children aged 36–47 months than those aged 48–67 months
8	Canada	Co, Cont, Rand	124	3–6	Attending patients	Dental Clinic	Cooperative behaviour rated independently by 2 observers at four time points	Intervention group received pre-appointment letter, control group did not; All mothers received: Anxiety-related (self-styled) questionnaire MAS	Control group: significant relationship between maternal anxiety scores and uncooperative behaviour of children from 36 to 47 months of age. No significant relationship found for older children and intervention group
78	USA	Co, Rand	895	5–11	Children attending participating primary schools	Primary schools	CFSS-DS	DFS	Significant relationship between parental and child dental fear. The relationship is a consequence of direct conditioning and parent modeling factors

C-S, cross-sectional study; Co, cohort study; T, trial; Retro A, retrospective analysis of clinical records; Ran, random sample; Cont, control group; Comp, comparison group; SES, socioeconomic status.

Table 3. Established measures used in the article reviewed.

Established anxiety measures used:
CFSS-DS – Children's Fear Survey Schedule – dental subscale; CFSS-SF - Children's Fear Survey Schedule –Short Form; CMFQ - Broome's Child Medial Fear Questionnaire; CSS – Child Stress Scale; DAS - Dental Anxiety Scale; DBS – Dental Beliefs Survey; DFSS-C – Dental Fear Survey Schedule for Children; FSS –II - Fear Survey Schedule-II; MAS – Manifest Anxiety Scale & CMAS Child's form of the MAS; SAS – Spielberger's State Anxiety Scale; STAI – State Trait Anxiety Inventory; STAIC – State Trait Anxiety Inventory for Children; DFS – Dental Fear Survey.
Established behavioural measures used:
BPS – Behaviour Profile Scale; BSQ – Behaviour Screening Questionnaire; CBCL – Child Behaviour Checklist; CBSS – Children's Behavioral Style Scale; Frankl's Behavioural Rating Scale; MBSS – Miller Behavioural Style Scale; MBPRS – Melamed Behavior Profile Rating Scale.
Established pictorial measures used:
MCSFS – Modified Child/Adult Smiley Faces Scale; PAS – Pictorial Anxiety Scale (based on DAS); VPT – Venham Picture Test.

Table 4. Relationship between parental and child dental anxiety.

Types of studies	Yes (%)	No (%)	Total (%)
All studies	34 (79)	9 (21)	43 (100)
All studies using behaviour measures only*	16 (89)	2 (11)	18 (100)
Studies using established behaviour rating scales only†	9 (82)	2 (18)	11 (100)
All studies using anxiety measures	14 (70)	6 (30)	20 (100)
Only studies using established anxiety scales	11 (69)	6 (31)	17 (100)
Studies using pictorial measures only‡	0 (0)	2 (100)	2 (100)
Other measures§	3 (100)	0 (0)	3 (100)
Across all established measures	20 (71)	8 (29)	28 (100)

*Dental anxiety was measured via the rating of children's behaviour.
†All of these studies used Frank's rating scale.
‡All measures used were established, 2 studies used pictorial measures in combination with dental anxiety measures; these studies are reported in each relevant row.
§These measures included medical and psychosocial history, psychosocial adjustment, everyday life, DDSST, dental records, and reaction to prophylaxis.

issues in relation to reporting age-related outcomes have to be noted: (i) the age ranges defined by studies varied widely; and (ii) the age spans defined by a considerable number of studies were large[3–16]. Most of the studies did not report a median or mean participant age. The following results need to be viewed under the proviso of these limitations.

All studies including children under 8 years only (n = 14) reported a significant relationship between parental and child dental fear. Eight of these studies used established behaviour rating scales; they all used Frankl's scale for children, seven in combination with an established rating scale for parents (i.e., MAS, STAI). Only one of the studies in this youngest age group used established anxiety scales for both parents and children. Four studies used unspecified or self-styled questionnaires for parents, and one study asked parents to rate their child's anxiety.

Two of five studies including children up to the age of 10 reported a significant association between parental and child dental fear. Neither of these studies used established assessment tools. The three studies reporting no relationship between parental and child dental anxiety all used either established behaviour rating or dental anxiety scales (Frankl's, Pictorial DAS, VPT, CFSS-DS). Sixteen out 21 studies including children and young people up to the age of 16 reported a significant association; as did ten of 18 studies using either established behaviour rating or anxiety scales. Studies including children and young people up to age 19 reported a positive relationship, yet none of these studies used established instruments.

The meta-analysis supports the detailed study-by-study review. The statistics derived from the 32 studies included consisted of the following: correlation coefficients (19 studies), odds ratios (eight studies), t-values (two studies), P-value of correlation (three studies). The overall correlation was 0.243 (95% CI: 0.164–0.319) $z = 5.91$, $P < 0.00001$). These effect sizes were split into the four age group breakdown employed in the descriptive report above. The effects (and 95% CIs) for each age group are displayed in Fig. 1 and show strong positive associations in the studies that focus on the two younger age groups (i.e., <8 and 10 years of age). The aggregated correlation for the 13 studies with children with a maximum age range of <13 years was also positive (0.296,

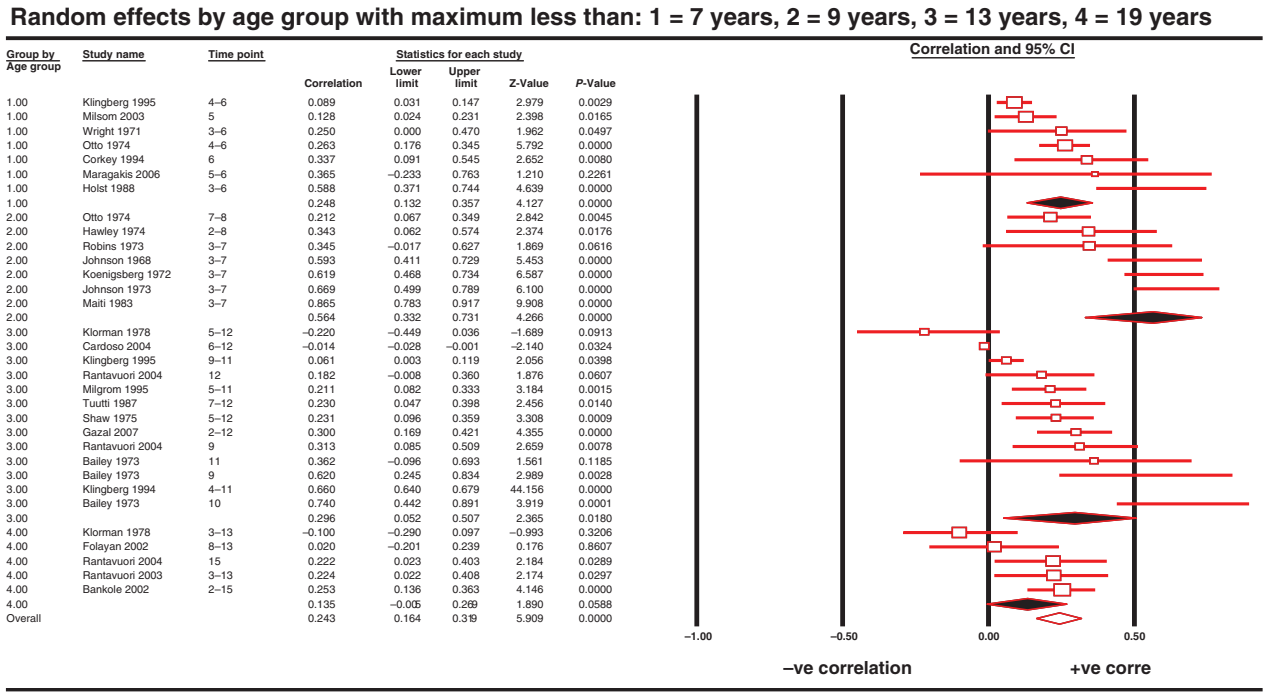

Fig. 1. Meta-analysis of the relationship between parental and child dental fear.

Table 5. Relationship between parental and child dental fear by context of the dental visit.

	All studies			All studies using established scales			Established behaviour rating scales only			Established anxiety scales only		
Setting of dental visits*	**Yes**	**No**	***N***	**Yes**	**No**	***N***	**Yes**	**No**	***N***	**Yes**	**No**	***N***
Specialist dental centres	9	5	14	5	5	10	1	1	2	4	4	8
Dental clinics	10	7	17	5	8	13	4	2	6	1	6	7
Hospital settings	5	1	6	4	1	5	4	0	4	0	1	1
Dental schools	4	0	4	3	0	3	2	0	2	1	0	1
Schools	3	1	4	2	1	3	0	0	0	2	1	3
Surveys	4	0	4	2	0	2	0	0	0	2	0	2
Total (%)	36 (73)	12 (27)	49 (100)	21 (58)	15 (42)	36 (100)	11 (79)	3 (21)	14 (100)	10 (45)	12 (55)	22 (100)

*Some studies compared different settings; these studies are counted in each relevant category.

P = 0.018) and significant. The group with the five studies with a maximum age range of <19 years showed a weak positive association (0.135, P = 0.059).

The fail safe N-value, which calculates the number of missing studies that would bring the P-value to less than the alpha of 1.96 was found to equal 4,583. Egger's regression intercept was 3.42, SE = 1.63 which gave a t-value of 2.10, d.f. = 30, and a P-value of 0.044 which indicated possible publication bias.

Relationship between parental and child dental fear by context of the dental visit

The review results show varying degrees of associations between parental and child dental anxiety depending on the context of the dental visit and the types of measures used. For example, all studies using surveys report a significant relationship between parental and child dental fear whereas in dental clinics the result is more ambivalent or even the reverse. Similarly, across all studies and

Table 6. Relationship between parental and child dental fear by reasons for dental visits.

	Across all studies			Across all studies using established scales			Established behaviour rating scales only			Established anxiety scales only		
Reason for dental visit	**Yes**	**No**	***N***	**Yes**	**No**	***N***	**Yes**	**No**	***N***	**Yes**	**No**	***N***
Behavioural problems	5	2	7	2	2	4	0	0	0	2	2	4
First dental experience	6	1	7	3	1	4	3	0	3	0	1	1
Invasive treatment	3	2	5	3	2	5	2	0	2	1	2	3
Routine treatment	4	1	5	3	1	4	1	0	1	2	1	3
Dental fear	2	1	3	1	1	2	0	0	0	1	1	2
Survey	4	0	4	2	0	2	0	0	0	2	0	2
Mixed reasons for visit	9	3	12	5	5	10	2	2	4	3	3	6
Total (%)	33 (77)	10 (23)	43 (100)	19 (61)	12 (39)	31 (100)	8 (80)	2 (20)	10 (100)	11 (52)	10 (48)	21 (100)

irrespective of the type of measure used, almost three of four report a significant relationship between parental and child dental fear. If only studies using established anxiety measures are taken into account, the direction of the evidence is reversed. More than half of the studies using anxiety measures for parents and children (55%) did not detect a significant association between parental and child dental fear.

Relationship between parental and child dental fear by reasons for dental visits

A further factor to consider in the exploration of the relationship between parental and child dental anxiety are the reasons for the child's dental visit. The studies included in this review listed a variety of reasons. For the purpose of this review the reasons provided were grouped into seven categories (Table 6).

The numbers of studies in each cell of the table are small. Thus, any interpretations have to be treated with caution. With this caveat in mind, it can be seen that the trends in the data once more provide a varied picture. Across all studies and irrespective of the types of measures used, three of four found a significant relationship between parental and child dental fear. If only studies using established anxiety scales for parents and children are considered, just over half (52%) reported a significant link. If all studies are taken into account, the majority of studies in each category reported a significant relationship between parental and child dental fear. If only studies using established anxiety measures are considered, only the survey group reported a significant relationship between parental and child dental fear.

Discussion

Dental fear has the potential to play an important and detrimental role in a child's future dental and general health. For that reason, considerable effort has been invested in understanding the aetiology, development, and treatment of dental fear in children[22]. Within this broader context, the potential relationship between parental and child dental fear has been of continuing interest to researchers and clinicians across the world. This interest is demonstrated by the fact that, with the exception of Antarctica, researchers from every continent have contributed studies to this review. This global spread also means that data from children and parents across the globe are represented in this review. Not only is this potential relationship of global interest but research on parents' influence on their child's dental health has been conducted for more than a century[11].

The 43 studies included in this review reported a range of outcomes vis-à-vis the relationship between parental and child dental fear. With respect to the relationship between parental and child dental fear, a cursory glance at the review findings provides a relatively clear picture. Thirty-four (79%) of the 43 reviewed studies identified a significant relationship between parental and child dental fear. The existence of a significant

relationship is still confirmed if only those studies are considered, which used established measurement scales to assess both child and parental dental fear. Yet, with this proviso, 71% rather than four of five studies reported a relationship. The proportion of studies detecting a significant relationship is further marginally reduced if only studies deploying anxiety measures are considered (69%).

The detection of a relationship between parental and child dental fear appears to be somewhat influenced by the choice of measure. Studies not using established data collection tools (i.e., self-styled questionnaires) reported significant relationships between parental and child dental fear considerably more often than studies using established measures. Among the studies that used established tools, behavioural assessment techniques, which are used as a proxy to measure anxiety, tend to more often report significant relationships than direct anxiety measures. Studies using pictorial measures rarely reported a significant relationship between parent and child dental fear.

The fact that different types of measures produce different trends when investigating the link between parental and child dental fear raises methodological concerns. Among these concerns are questions about the internal and external validity of measures used, the conceptualization of dental fear, and the feasibility of assessing dental fear, particularly in children. From a validity perspective, unstandardized, and/or self-conceived measures to assess dental fear need to be considered with caution[44]. The same may apply to behavioural and observational measures of dental fear. Assuming low levels of validity in these two types of measures would help to explain some of the differences in outcomes compared to studies using established anxiety measures only[45]. Another approach towards exploring the different trends in established degrees of links between parental and child dental fear is to address the conceptualization of anxiety as a construct[46]. It may emerge that the validity of measures is not the primary issue at hand. It may emerge that behavioural and anxiety measures reflect different aspects of dental fear. Comparing child and parental dental fear adds to these difficulties in various ways. The age of a child has a bearing on the appropriateness of data collection methods and children's behaviour is contextual necessitating any assessment to be cognizant of the environments in which the child exists[47]. These concerns highlight the need for further research into the operationalization and measurement of anxiety in general and dental fear in particular.

The challenges of assessing dental fear are exacerbated when trying to establish associations between the levels of child and parental dental fear. Authors argued that the relationship between parental and child dental fear is dependent on the child's age[37]. This review confirms that the dental fear of children under the age of 8 is significantly related to parental dental fear. All 14 studies reviewed, which only included children younger up to age 7, reported a significant relationship between parental and child dental fear. Nine of these studies used established measurements scales, eight of which focused on the children's behaviour, and only one assessed child dental anxiety directly.

The relationship between parental and child dental fear in children 8 years or over, however, remains less clear. There are at least three reasons why this review was not able to shed more light on the relationship between parental child dental fear among older children and teenagers. Firstly, the large age ranges of children participating in many studies made it impossible to detect age-related effects; secondly, the age ranges used by the studies varied considerably; and thirdly, about half the studies including older children and teenagers reported a significant relationship between parental and child dental fear whereas the other half did not.

It has to be noted here that the categorization of age ranges applied in this review allows for a superficial investigation of potential age effects. Moreover, as a result of the necessity of allowing for broad age ranges, any conclusions based on age group comparisons have to be interpreted with caution.

The meta-analytical results converged with the detailed study-by-study assessment and gave additional support to the proposal that children of younger age have a more positive association of dental fear with their parent. Furthermore, the procedures available to meta-analysis enabled a check on the likelihood that negative studies were not being published. Mixed findings were found as the fail safe N-method demonstrated that at least ten times the number of negative studies would need to have been conducted and to be resting on investigators' shelves to overturn the positive result reported here; whereas Egger's regression asymmetry method indicated that the precision of the effect size was inconsistently related with the effect size magnitude which casts suspicion on the possibility of publication bias. The fact that Egger's regression coefficient was only just less than alpha of 0.05 might suggest that the risk of publication bias may not be great. Perhaps the lesson indicated by these additional analyses of potential bias is that the investigators in this field should be open to studying this link between parental and child dental anxiety and be encouraged to conduct additional, and more extensive studies to explore the detailed nature of the relationship.

Another area of interest in terms of exploring the relationship between parental and child dental anxiety is the situational context of the dental visit. Whether children are seen in specialist dental centres, hospitals, dental clinics, or elsewhere, depends on a variety of factors (i.e., including the nature of the oral health issue, the child's behaviour during dental visits, and accessibility of treatment options). It is of interest to practitioners and researchers whether certain settings influence the likelihood of both parents and children presenting with dental anxiety. Indeed, some environments in which the dental visit takes place appear to affect the association between parental and child dental fear. In studies conducted at dental clinics, the choice of measurement tool appears to be of particular importance in the search for a relationship between parental and child dental fear. If all relevant studies are considered, the majority reported a significant link. But, if only studies using established scales are included, six of seven did not detect a significant relationship between parental child dental fear. A significant relationship between parental and child dental fear does seem to exist in participants recruited in hospital settings, although only one study set in a hospital used an established anxiety scale. Incidentally, the latter study did not report a significant association. Studies recruiting patients in dental schools all reported a significant relationship between parental child dental fear, including one study deploying an established anxiety scale. The influence of specialist dental centres on this relationship remains inconclusive as exactly 50% of the studies using established scales detected a significant relationship.

The reasons for visiting the dentist appear not to influence the relationship between parental and child dental fear, regardless of whether the recruited children were seen by a specialists for behavioural problems, attended for a routine or invasive treatment, or were referred for established dental fear. Exceptions are studies in which children were recruited during their first visit to the dentist or during a routine treatment visit. The majority of these studies detected a significant relationship between parental and child dental fear.

Overall, this review confirms the existence of a significant relationship between parental and child dental fear. Moreover, despite the decades of research efforts invested in this field further research is needed. This review can provide three main recommendations for the design of future studies. Firstly, in order to detect valid and reliable research outcomes state-of-the-art management scales should be used to assess dental fear in parents and children. Secondly, ratings of children's behaviour are an important tool in general dentistry to gauge a child's level of cooperation[1]. Yet, the validity of using behavioural measures to assess dental fear needs to be confirmed. Thirdly, the age ranges of children included in studies need to be narrower and aligned with children's psychosocial development stages.

What this paper adds

- A narrative synthesis and meta-analysis of decades of research on the relationship between parental and child dental fear.
- An overview of the strengths and weaknesses of research on the relationship between parental and child dental fear.
- Evidence on the existing relationship between parental and child dental fear, particularly in younger children.

Why this paper is important to paediatric dentists

- A structured review of decades of research, which produced often conflicting outcomes about the relationship between parental and child mental health.
- A synthesis of evidence on this relationship from around the world and spanning decades.
- Further evidence that parents play an important role in the aetiology of child dental fear.

References

1 Klingberg G, Broberg AG. Dental fear/anxiety and dental behaviour management problems in children and adolescents: a review of prevalence and concomitant psychological factors. *Int J Paediatr Dent* 2007; **17**: 391–406.

2 Klingberg G, Berggren U, Carlsson SG, Norén JG. Child dental fear: cause-related factors and clinical effects. *Eur J Oral Sci* 1995; **103**: 405–412.

3 Bankole OO, Aderinokun GA, Denloye OO, Jeboda SO. Maternal and child's anxiety – effect on child's behaviour at dental appointments and treatments. *Afr J Med Sci* 2002; **31**: 349–352.

4 Shoben EJ, Borland LR. An empirical study of the etiology of dental fears. *J Clin Psych* 1954; **10**: 171–174.

5 Johnson R, Machen JB. Behaviour modification techniques and material anxiety. *J Dent Child* 1973; **40**: 272–276.

6 Klaassen M, Veerkamp J, Hoogstraten J. Predicting dental anxiety. The clinical value of anxiety questionnaires: an explorative study. *Eur J Paediatr Dent* 2003; **4**: 171–176.

7 Queensland Health. *Water Fluoridation*. Brisbane, Qld: Queensland Health, 2008. [WWW document.] URL http://www.health.qld.gov.au/fluoride/default.asp (assessed: 14 July 2008).

8 Wright GZ, Alpern GD, Leake JL. The modifiability of maternal anxiety as it relates to children's cooperative dental behavior. *J Dent Child* 1973; **40**: 265–271.

9 Latham HW. Control of children and the management of children's teeth. *Dent Cosmos* 1915; **57**: 1255–1260.

10 Woodcock IG. Psychology of child patients. *Dent Cosmos* 1931; **73**: 274–279.

11 Steen WM. Our relation to children. *Dent Rev* 1891; **5**: 534–537.

12 Strawn WI. Relation of the dentist and the child. *Dent Brief* 1911; **16**: 261–263.

13 Freeman R. A fearful child attends: a psychoanalytic explanation of children's responses to dental treatment. *Int J Paediatr Dent* 2007; **17**: 407–418.

14 Black B, Logan A. Links between communication patterns in mother–child, father–child and child–peer interactions and children's social status. *Chlid Dev* 1995; **66**: 255–271.

15 Dumas J, LaFreniere P, Seketich W. 'Balance of power': a transactional analysis of control in mother–child dyads involving socially competent, aggressive and anxious children. *J Abnorm Psychol* 1995; **104**: 104–117.

16 Veerkamp JS, Gruythuysen RJ, van AmerongenWE, Hoogstraten J. Dental treatment of fearful children using nitrous oxide. Part 2: The parent's point of view. *J Dent Child* 1992; **59**: 115–119.

17 Gazal G, Mackie IC. Distress related to dental extraction for children under general anaesthesia and their parents. *Eur J Paediatr Dent* 2007; **8**: 7–12.

18 Kain ZN, Mayes LC, O'Connor TZ, Cicchetti DV. Preoperative anxiety in children. Predictors and outcomes. *Arch Pediatr Adolesc Med* 1996; **150**: 1238–1245.

19 Bush JP, Melamed BG, Sheras PL, Greenbaum PE. Mother–child patterns of coping with anticipatory medical stress. *Health Psychol* 1986; **5**: 137–157.

20 Gershen JA. Maternal influence on the behavior patterns of children in the dental situation. *Dental Assist* 1977; **46**: 17–21.

21 Johnson R, Baldwin DC. Maternal anxiety and child behaviour. *J Dent Child* 1969; **36**: 87–92.

22 Winer GA. A review and analysis of children's fearful behavior in dental settings. *Chlid Dev* 1982; **53**: 1111–1133.

23 Tuutti H, Lahti S. Oral health status of children in relation to the dental anxiety of their parents. *J Pedod* 1987; **11**: 146–150.

24 Shaw O. Dental anxiety in children. *Br Dent J* 1975; **139**: 134–139.

25 ten Berge M, Veerkamp JS, Hoogstraten J, Prins PJ. Parental beliefs on the origins of child dental fear in the Netherlands. *J Dent Child* 2001; **68**: 51–54.

26 Murray JJ, Niven N. The child as a dental patient. *Curr Opin Dent* 1992; **2**: 59–65.

27 Rachman S. The conditioning theory of fear acquisition: a critical examination. *Behav Res Ther* 1977; **15**: 375–387.

28 ten Berge M, Veerkamp JS, Hoogstraten J, Prins PJ. Childhood dental fear in relation to parental child-rearing attitudes. *Psychol Rep* 2003; **92**: 43–50.

29 Arnrup K, Berggren U, Broberg AG, Bodin L. A short-term follow-up of treatment outcome in groups of uncooperative child dental patients. *Eur J Paediatr Dent* 2004; **5**: 216–224.

30 Sermet O. Emotional and medical factors in child dental anxiety. *J Child Psychol Psychiatr* 1974; **15**: 313–321.

31 Lautch H. Dental phobia. *Br J Psychiatry* 1971; **119**: 151–158.

32 Brown JP, Smith IT. Childhood fear and anxiety status in relation to dental treatment. *Aus Dent J* 1979; **24**: 256–259.
33 Murray P, Liddell A, Donohue J. A longitudinal study of the contribution of dental experience to dental anxiety in children between 9 and 12 years of age. *J Behav Med* 1989; **12**: 309–320.
34 Poulton R, Waldie KE, Thomson WM, Locker D. Determinants of early- vs late-onset dental fear in a longitudinal-epidemiological study. *Behav Res Ther* 2001; **39**: 777–785.
35 Holst A, Schröder U, Ek L, Hallonsten AL, Crossner CG. Prediction of behavior management problems in children. *Scand J Dent Res* 1988; **96**: 457–465.
36 Klingberg G, Berggren U. Dental problem behaviors in children of parents with severe dental fear. *Swed Dent J* 1992; **2**: 27–32.
37 Bailey PM, Talbot A, Taylor PP. A comparison of maternal anxiety levels with anxiety levels manifested in the child dental patient. *J Dent Child* 1973; **40**: 277–284.
38 Klingberg G, Berggren U, Norén JG. Dental fear in an urban Swedish child population: prevalence and concomitant factors. *Community Dent Health* 1994; **11**: 208–214.
39 Wright F, Lucas J, McMurray N. Dental anxiety in five to nine year old children. *J Pedod* 1980; **4**: 99–115.
40 Freeman R. Dental anxiety: a multifactorial aetiology. *Br Dent J* 1985; **159**: 406–408.
41 Brand AA. Some sources of children's fears in the dental situation. *J Dent Assoc South Afr* 1976; **31**: 5–8.
42 Locker D, Thomson WM, Poulton R. Psychological disorder, conditioning experiences, and the onset of dental anxiety in early adulthood. *J Dent Res* 2001; **80**: 1588–1592.
43 Taylor JA. A personality scale of manifest anxiety. *J Abnorm Psych* 1953; **48**: 285–290.
44 Haynes RB, Sackett DL, Guyatt GH, Tugwell P. *Clinical Epidemiology*. Philadelphia, PA: Lippincott Williams & Wilkins, 2006.
45 Greenhill L, Pine D, March J, Birmaher B, Riddle M. Assessment issues in treatment research of pediatric anxiety disorders: what is working, what is not working, what is missing, and what needs improvement. *Psychopharmacol Bull* 1998; **34**: 155–164.
46 March JS, Parker JD, Sullivan K, Stallings P, Conners CK. The multidimensional anxiety scale for children (MASC): factor structure, reliability, and validity. *J Am Acad Child Adolesc Psychiatry* 1997; **36**: 554–565.
47 Hoghugi M. *Assessing Child and Adolescent Disorders: A Practice Manual*. London: Sage, 1992.
48 Arnrup K, Broberg AG, Berggren U, Bodin L. Treatment outcome in subgroups of uncooperative child dental patients: an exploratory study. *Int J Paediatr Dent* 2003; **13**: 304–319.
49 Arnrup K, Berggren U, Broberg AG, Lundin SA, Hakeberg M. Attitudes to dental care among parents of uncooperative vs. cooperative child dental patients. *Eur J Oral Sci* 2002; **110**: 75–82.
50 Balmer R, O'Sullivan EA, Pollard MA, Curzon ME. Anxiety related to dental general anaesthesia: changes in anxiety in children and their parents. *Eur J Paediatr Dent* 2004; **5**: 9–14.
51 Cardoso CL, Loureiro SR, Nelson-Filho P. Pediatric dental treatment: manifestations of stress in patients, mothers and dental students. *Braz Oral Res* 2004; **18**: 150–155.
52 Colares V, Richman L. Factors associated with uncooperative behavior by Brazilian preschool children in the dental office. *J Dent Child* 2002; **69**: 87–91.
53 Corkey B, Freeman R. Predictors of dental anxiety in six-year-old children: findings from a pilot study. *J Dent Child* 1994; **61**: 267–271.
54 Folayan MO, Adekoya-Sofowora CA, D Otuyemi O, Ufomata D. Parental anxiety as a possible predisposing factor to child dental anxiety in patients seen in a suburban dental hospital in Nigeria. *Int J Paediatr Dent* 2002; **12**: 255–259.
55 Gustafsson A, Arnrup K, Broberg AG, Bodin L, Berggren U. Psychosocial concomitants to dental fear and behaviour management problems. *Int J Paediatr Dent* 2007; **17**: 449–459.
56 Hawley BP, McCorkle AD, Wittemann JK, Ostenberg PV. The first dental visit for children from low socioeconomic families. *ASDC J Dent Child* 1974; **41**: 376–381.
57 Johnson R, Baldwin DC Jr. Relationship of maternal anxiety to the behavior of young children undergoing dental extraction. *J Dent Res* 1968; **47**: 801–805.
58 Klaassen MA, Veerkamp JS, Hoogstraten J. Dental fear, communication, and behavioural management problems in children referred for dental problems. *Int J Paediatr Dent* 2007; **17**: 469–477.
59 Klingberg G. Dental fear and behavior management problems in children. A study of measurement, prevalence, concomitant factors, and clinical effects. *Swed Dental J – Suppl* 1995; **103**: 1–78.
60 Klorman R, Ratner J, Arata CLG, King JB, Sveen OB. Predicting the child's uncooperativeness in dental treatment from maternal trait, state, and dental anxiety. *J Dent Child* 1978; **45**: 62–67.
61 Klorman R, Michael R, Hilpert PL, Sveen OB. A further assessment of predictors of the child's behavior in dental treatment. *J Dent Res* 1979; **58**: 2338–2343.
62 Koenigsberg SR, Johnson R. Child behaviour during sequential dental visits. *J Am Dent Assoc* 1972; **85**: 128–132.
63 Koplik EK, Lamping DL, Reznikoff M. The relationship of mother–child coping styles and mothers' presence on children's response to dental stress. *J Psychol* 1992; **126**: 79–92.
64 Maiti S. Maternal anxiety and child behaviour on the first visit to the dental office. *J Indian Dent* 1983; **55**: 409–412.
65 Majstorovic M, Glavina D, Skrinjaric I. Child's dental anxiety: the role of previous medical

experience and social status. *Paediatr Croatica* 2001; **45**: 117–122.
66 Majstorovic M, Skrinjaric I, Glavina D, Szirovicza L. Factors predicting a child's dental fear. *Coll Antropol* 2001; **25**: 493–500.
67 Maragakis GM, Musselman RJ, Ho CC. Reaction of 5 and 6 year olds to dental injection after viewing the needle: pilot study. *J Clin Pediatr Dent* 2006; **31**: 28–31.
68 Mejare I, Ljungkvist B, Quensel E. Pre-school children with uncooperative behavior in the dental situation. Some characteristics and background factors. *Acta Odontol Scand* 1989; **47**: 337–345.
69 Milsom KM, Tickle M, Humphris GM, Blinkhorn AS. The relationship between anxiety and dental treatment experience in 5-year-old children. *Br Dent J* 2003; **194**: 503–506; discussion 495.
70 Otto U. The behaviour of children when visiting the dentist. *Swed Dent J* 1974; **67**: 207–222.
71 Peretz B, Nazarian Y, Bimstein E. Dental anxiety in a students' paediatric dental clinic: children, parents and students. *Int J Paediatr Dent* 2004; **14**: 192–198.
72 Rantavuori K, Zerman N, Ferro R, Lahti S. Relationship between children's first dental visit and their dental anxiety in the Veneto Region of Italy. *Acta Odontol Scand* 2002; **60**: 297–300.
73 Rantavuori K, Lahti S, Hausen H, Seppa L, Karkkainen S. Dental fear and oral health and family characteristics of Finnish children. *Acta Odontol Scand* 2004; **62**: 207–213.
74 Robins C, Robins WV, Rawson HE. Maternal anxiety and children's behavior during dental procedures. *J Missouri Dent Assoc* 1973; **53**: 47–55.
75 Townend E, Dimigen G, Fung D. A clinical study of child dental anxiety. *Behav Res Ther* 2000; **38**: 31–46.
76 Venham LL, Murray P, Gaulin-Kremer E. Child-rearing variables affecting the preschool child's response to dental stress. *J Dent Res* 1979; **58**: 2042–2045.
77 Wright G, Alpern G. Variables influencing children's cooperative behaviour at the first dental visit. *J Dent Child* 1971; **38**: 124–128.
78 Milgrom P, Mancl L, King B, Weinstein P. Origins of childhood dental fear. *Behav Res Ther* 1995; **33**: 313–319.