Social Science & Medicine 116 (2014) 49–55

Contents lists available at ScienceDirect

Social Science & Medicine

journal homepage: www.elsevier.com/locate/socscimed

The relationship between parenting, family interaction and childhood dental caries: A case-control study

M. de Jong-Lenters [a, b, *], D. Duijster [b, c], M.A. Bruist [d], J. Thijssen [e], C. de Ruiter [e]

[a] TNO, Wassenaarseweg 56, 2333 AL Leiden, The Netherlands
[b] Department of Social Dentistry and Behavioural Sciences, Academic Centre for Dentistry Amsterdam, University of Amsterdam and VU University, Gustav Mahlerlaan 3004, 1081 LA Amsterdam, The Netherlands
[c] Department of Preventive Dentistry, Academic Centre for Dentistry Amsterdam, University of Amsterdam and VU University, Gustav Mahlerlaan 3004, 1081 LA Amsterdam, The Netherlands
[d] Department of Social Psychology, University of Amsterdam, Weesperplein 4, 1018 XA, Amsterdam, The Netherlands
[e] Department of Clinical Psychological Science, Maastricht University, P.O. Box 616, 6200 MD, Maastricht, The Netherlands

ARTICLE INFO

Article history:
Received 1 April 2014
Received in revised form
12 June 2014
Accepted 20 June 2014
Available online 21 June 2014

Keywords:
Netherlands
Dental caries
Oral health
Child health
Parenting
Family relationships
Prevention
Observations

ABSTRACT

The aim of this case-control study was to explore the relationship between parenting practices, parent–child interaction and childhood dental caries, using a sample of 5–8-year old children from the Netherlands. Cases were defined as children with four or more decayed, missing or filled teeth and controls were caries free. Cases ($n = 28$) and controls ($n = 26$) were recruited from a referral centre for paediatric dental care and a general dental practice, respectively. Parenting practices and parent–child interactions of the child's primary caregiver were observed using Structured Interaction Tasks and subsequently rated on seven dimensions: positive involvement, encouragement, problem-solving, discipline, monitoring, coercion and interpersonal atmosphere. All Structured Interaction Tasks were videotaped, and coded by trained and calibrated observers blind to the dental condition. Differences in parenting dimensions between cases and controls were analysed using multivariate analysis of variance, independent samples *T*-tests, χ^2-tests and multiple logistic regression analyses. Controls had significantly higher scores on the dimensions positive involvement, encouragement, problem-solving and interpersonal atmosphere, compared to cases. Parents of controls were also less likely to show coercive behaviours. These associations remained statistically significant after adjustment for the mother's education level, tooth brushing frequency and the frequency of consuming sugary foods and drinks, except for coercion. There was no significant difference in discipline between cases and controls. In conclusion, this case-control study found a significant relationship between parenting practices, parent–child interaction quality and childhood dental caries. Our findings suggest that parenting practices may be an important factor to consider in caries preventive programs.

1. Introduction

Early childhood is a critical phase in which important foundations for lifelong health are laid (Blane, 1999). It is empirically established that the conditions in which children grow up leave an indelible imprint on the health of an individual throughout the lifespan (Kuh et al., 1997; Waldfogel, 2004). For example, relatively stable patterns of health-related behaviours are acquired at home during early life (e.g., fruit and vegetable intake, sugar-snacking, physical activity and oral hygiene), and these patterns are difficult to change in adulthood (Kelder et al., 1994). Parents play a pivotal role in the initiation and maintenance of these health-related behaviours. They shape their children's behaviours, attitudes and social norms through modelling, the use of specific parenting practices and more broadly through interpersonal interactions within the family (Rhee, 2008).

Parenting practices are the ways by which parents, intentionally and unintentionally, influence their child's development. Effective parenting practices include the parent's ability to encourage self-control and responsible behaviour in their child through parental direction, monitoring, and disciplinary efforts in the context of

* Corresponding author. TNO, Wassenaarseweg 56, 2333 AL Leiden, The Netherlands.
E-mail addresses: maddelon.dejong@tno.nl (M. de Jong-Lenters), D.Duijster@acta.nl (D. Duijster), meikebruist@gmail.com (M.A. Bruist), jill.thijssen@maastrichtuniversity.nl (J. Thijssen), corine.deruiter@maastrichtuniversity.nl (C. de Ruiter).

http://dx.doi.org/10.1016/j.socscimed.2014.06.031
0277-9536/

warm and affectionate family interactions (Darling and Steinberg, 1993; Sanders et al., 2000). A large body of evidence has demonstrated that effective parenting and supportive family interactions are associated with positive childhood outcomes, such as higher academic achievement, better psychosocial and emotional development, less disruptive child behaviours, fewer depressive symptoms and higher self-esteem (Dornbusch et al., 1987; Lamborn et al., 1991; Maccoby and Martin, 1983; Radziszewska et al., 1996; Steinberg et al., 1992). In terms of physical health, ineffective parenting (in particular parenting characterised by high levels of demand along with low levels of warmth and positive involvement) is related to higher rates of childhood obesity and an unhealthy diet, including lower fruit and vegetable consumption, higher caloric intake and lower frequency of eating breakfast (Arredondo et al., 2006; Kremers et al., 2003; Patrick et al., 2005; Rhee, 2008; Wake et al., 2007).

There is reason to believe that parenting practices and family interactions may also affect another common child health problem: dental caries. The role of parents is vital in establishing specific behaviours related to childhood dental caries, including children's oral hygiene and frequency of sugar consumption (Hooley et al., 2012). However, studies that have investigated the influence of parenting practices and, more broadly, family relationships on children's dental health are scarce. One study by Duijster et al. (2013) found that children with good family functioning and family relationships in terms of organisation, communication, responsiveness and social networks, had lower levels of dental decay and better oral hygiene compared to children with poor family relationships. Interestingly, in terms of parenting in particular, the studies that have been conducted in this area were unable to demonstrate an association between specific parenting styles and children's caries experience and adolescents' oral hygiene behaviours (Aleksejūnienė and Brukienė, 2012; Seow et al., 2009).

In the latter studies, self-report questionnaires were used to measure parenting practices, which may have resulted in the absence of the expected association between parenting and child dental health. Although these questionnaires were validated and psychometrically sound, there are some limitations to self-report methods (Hampson et al., 1989; Tutty, 1995). For example, parents' self-report could be biased by their own beliefs and perspectives, and therefore may not reflect actual behaviours. Moreover, there is a tendency of parents to answer questions in a socially desirable manner by over-reporting 'good' behaviours and under-reporting 'bad' behaviours (Thijssen and de Ruiter, 2014). Furthermore, most parenting questionnaires have been developed in a clinical context, designed to discriminate between problem and non-problem families. Yet, the majority of children with dental caries probably come from normative families whose children do not necessarily have significant clinical or behavioural problems (Duijster et al., 2013). Questions remain whether self-report methods are sensitive enough to distinguish between different parenting practices relevant to caries development within the normative range.

An alternative method of assessing parenting practices and family interaction that overcomes these limitations is parent–child observation. This method involves asking family members to perform a number of standardised tasks in which parenting and family interaction are subsequently rated by a trained observer, external to the family. Some researchers claim this method generates more objective and thus more valid data (Kerig and Lindahl, 2001). Therefore, the aim of this study was to explore the relationship between parenting practices, parent–child interaction and childhood dental caries, using observations in a case-control study design.

2. Materials and methods

Approval for this study was obtained from The Central Committee on Research Involving Human Subjects, The Netherlands (CCMO). Prior to the commencement of the study, written informed consent was sought from the parent of the child that was selected for the study.

2.1. Study sample

This case-control study was conducted in The Netherlands from February to August 2013. Cases were defined as children with four or more decayed, missing or filled deciduous and/or permanent teeth (dmft/DMFT $\geq$4). This value was chosen as it represents both the mean dmft and the median dmft of five-year-old children in the Netherlands with dental caries (Poorterman and Schuller, 2006). For each case, an age-matched ($\pm$4 months) and sex-matched control was recruited. Controls were children who were caries free in both their deciduous and permanent dentition (dmft/DMFT = 0). Both cases and controls were between 5 and 8 years old at the time of selection and they were of Dutch origin. Children were considered of Dutch origin when both their parents were born in The Netherlands. Children diagnosed with emotional and behavioural disorders (e.g., autism spectrum disorders and conduct problems), children with special needs and children with missing teeth due to dental trauma or teeth with enamel defects, were excluded from study selection. Only one child per family was included. Cases and controls were recruited from a referral centre for paediatric dental care and a general dental practice, respectively. First, an information letter about the study was sent to the home address of all selected children. Subsequently, parents of the children were invited to participate by telephone.

In order to detect a difference in parenting practices and parent–child interaction between cases and controls (if present), a power calculation indicated that a minimal sample of 42 children would be necessary. This calculation was based on the following parameters: 90% power, 5% level of significance and a standard deviation of 4.1 dmft based on caries levels in five-year-old children in the 2006 Dutch National Oral Health Survey (Poorterman and Schuller, 2006).

2.2. Data collection

2.2.1. Dental health status

Children's dmft/DMFT-scores were extracted from personal dental health records from the referral centre for paediatric dental care and the general dental practice. The diagnosis of dental caries was based on clinical examinations, supported by dental X-rays. Both practices employed two dental practitioners. Data were registered in a standardised way to ensure that the records were up-to-date and complete. The dmft/DMFT-score was computed by adding the number of decayed, missing and filled teeth. Missing teeth were only scored if records indicated that they were extracted due to caries. Missing teeth due to dental trauma, hypomineralization, agenesis or routine exfoliation were not included in the dmft-scores. Enamel caries lesions were also not included. Data from the latest dental visit were used to compute dmft/DMFT-scores. For all children, the latest dental visit had been no more than six months before the time of data collection for the purposes of this study.

2.2.2. Parenting practices and parent–child interaction

Parenting practices and parent–child interaction were observed using Structured Interaction Tasks (SIT) (DeGarmo and Forgatch, 2007; Forgatch and DeGarmo, 1999; Ogden and Hagen, 2008). This observational method derives strength from its basis in the

Social Interaction Learning model (Forgatch et al., 2004). On the one hand, this model describes effective parenting practices (involvement, encouragement, problem solving, monitoring and discipline) that positively impact on children's socio-emotional development and behaviours. On the other hand, it includes coercive parenting practices that can have negative consequences for the child's development.

The SIT contained seven structured tasks which were performed by the child and its primary caregiver in a quiet room at the referral centre for paediatric dental care. Tasks included: planning a fun activity for the weekend (3 min), problem solving on a topic selected by the parent (5 min), drawing a picture of their house (7 min), a snack break (5 min), problem solving on a topic selected by the child (5 min), teaching tasks (9 min), and a monitoring task in which the parent interviewed the child about a moment when the child was not in the parent's direct presence (5 min). The tasks were designed to elicit a variety of parenting practices. For example, the teaching tasks were designed to be a grade level beyond the child's current grade -provoking frustration in the child-, which provided the opportunity to observe the parent's response.

All observations were videotaped. They were evaluated using a coding system developed by Maastricht University in consort with researchers from Oregon Social Learning Center, based on the original Coder Impressions (Forgatch et al., 1992). The coding system contained specific items for each SIT task, as well as general items related to the overall interaction between parent and child during the full session. Items measured seven underlying dimensions of parenting practices and parent–child interaction: positive involvement (12 items), encouragement (20 items), problem-solving (27 items), discipline (26 items), monitoring (5 items), coercion (16 items) and interpersonal atmosphere (24 items).

- *Positive involvement* refers to the degree to which family interactions are characterised by warmth, empathy and positive affect. It also relates to whether parents show an active interest in their child's experiences.
- *Encouragement* reflects the extent to which parents stimulate their child's independence through positive endorsement, reinforcement and offering help when necessary.
- *Problem-solving* describes parents' ability to generate solutions that are feasible and acceptable to the child. It also reflects the extent to which parents and children are open to each other's viewpoints and are both involved in the decision making process.
- *Discipline* relates to parents' adequacy of setting appropriate limits for their child, and their efficiency in responding to their child's unacceptable behaviours in terms of timing, consistency, intensity and clear use of instructions/commands.
- *Monitoring* refers to parental supervision, such as whether parents keep close track of what is occupying the child on a day-to-day basis (e.g., friends, activities, interests).
- *Coercion* defines the degree to which parents have the tendency to criticise their children, be overly strict and demanding and use harsh and inconsistent disciplinary actions.
- *Interpersonal atmosphere* describes the extent to which parent–child interactions are pleasant, comfortable and free of conflict and frustration.

Items were scored on a five-point Likert-scale. A cumulative score for each dimension was computed, with higher scores reflecting more positive involvement and encouragement, more effective problem-solving ability and discipline practices, better monitoring, more coercive behaviour and a more positive interpersonal atmosphere. Cronbach α's for the seven dimensions were 0.77, 0.92, 0.95, 0.91, 0.38, 0.30 and 0.86, respectively. The low internal consistency for coercion was due to limited variance on a number of items related to this dimension, as parents rarely showed coercive behaviours. Therefore, coercion was categorised by dividing the distribution of scores into three groups (range = 26–38): 'not coercive' (scores 26–29), 'slightly coercive' (scores 30–33), 'quite coercive' (scores 34–38). The low internal consistency for monitoring was partially due to the low number of items composing this dimension. The reliability of this dimension was insufficient and therefore it was decided not to include the monitoring dimension in further analyses.

All observations were coded by one trained and calibrated observer who was blind to the dental condition (case or control). A random selection of 12 observations (22%) was double coded by a second blind observer for a reliability check. The percentage agreement between coders (difference in scores = 0, and difference in scores = 0 or 1) was 71.7% and 92.4%, respectively. The intra-class correlation was 0.91.

2.2.3. Sociodemographic characteristics and oral health behaviours

A self-administered parental questionnaire (18 items) was used to collect data on sociodemographic characteristics and children's oral health-related behaviours. Sociodemographic variables included parental income, the number of children in the household and the mother's highest completed level of education. The mother's education level was categorised into 'lower education' (0–12 years of education), 'medium education' (13–15 years of education) and 'higher education' (16 years or more years). The oral health behaviours studied were: tooth brushing frequency, age tooth brushing was started, re-brushing by a parent, supervised tooth brushing, frequency of consumption of sugary foods between meals and frequency of consumption of sugary drinks between meals. One question referred to the parent's self-reported oral health, which was responded to on a five-point Likert-scale from 'very poor' to 'excellent'.

2.3. Statistical analysis

Statistical analysis was carried out using SPSS (Version 20, IBM Corp.). Associations between parenting practices and parent–child interaction (in short: parenting dimensions) were examined using the Pearson correlation test. To analyse the relationship between parenting dimensions and childhood dental caries, various statistical methods were used. First, multivariate analysis of variance (MANOVA) was performed to assess the multivariate association of the dental condition (case or control) and all parenting dimensions. Second, mean scores of each parenting dimension, except for coercion, were compared between cases and controls using independent samples *T*-tests. For coercion, the χ^2-test was used to analyse the difference in distribution of coercive behaviours between cases and controls. Finally, a series of logistic regression analyses were conducted for parenting dimensions with the dental condition (case vs. control) as the dependent variable. First, crude odds ratio's (OR's) and 95% confidence intervals (95% CI) were estimated for bivariate associations between each parenting dimension and the dental condition. These associations were subsequently adjusted for a number of sociodemographic characteristics and oral health behaviours that were unevenly distributed between cases and controls (model 1). A *p*-value of <0.05 was regarded as significant.

3. Results

3.1. Description of the study sample

The sample consisted of 54 children (28 cases and 26 controls) and their primary caregivers (50 mothers, 4 fathers). For two cases

an age and sex-matched control could not be found. Cases had an average of 6.8 ± 1.8 decayed, missing or filled teeth (range = 4–12), while controls had no caries experience. The mean age of all children was 7.3 ± 1.0 years and boys and girls were equally represented in both groups (cases and controls). The distribution of sample characteristics for the two groups is presented in Table 1. The educational level of the mother was significantly lower in cases than in controls. In terms of oral health behaviours, cases reported more frequent consumption of sugary foods and drinks between meals, compared to controls. They were also less likely to brush their teeth twice a day, however, this difference did not reach statistical significance. Cases did not differ from controls in the age tooth brushing was started, the frequency of supervised brushing or re-brushing by a parent, number of children in the household, parental income and parent's self-reported oral health.

3.2. Analysis of parenting practices and parent–child interaction

3.2.1. Correlation matrix

Table 2 shows that all parenting dimensions, except for some dimensions with discipline, were moderately to strongly intercorrelated. In particular, high scores on encouragement were strongly associated with high scores on positive involvement and problem-solving, and with low scores on coercion ($r = 0.71$, $r = 0.70$ and $r = -0.68$, respectively).

3.2.2. Associations with childhood dental caries

Mean scores on the parenting dimensions between cases and controls are presented in Table 3 and the distribution of coercive behaviours between cases and controls is shown in Table 4. The MANOVA showed a significant multivariate effect for the dental condition (case or control) on parenting practices and parent–child interaction: $F(7,46) = 8.56$, $p < 0.001$. Controls had significantly higher scores on the dimensions positive involvement, encouragement, problem-solving and interpersonal atmosphere, compared to cases. Parents of controls were also less likely to show coercive behaviours compared to cases. There was no significant difference in discipline between cases and controls.

Similar bivariate associations were found when the relationship between parenting dimensions and the dental condition was analysed using logistic regression (Table 5). Crude OR's show that higher scores on the dimensions positive involvement, encouragement, problem-solving and interpersonal atmosphere were associated with a decreased likelihood of being a case compared to a control, while higher scores for coercion increased the chances of being a case compared to a control. After adjustment for the mother's education level, tooth brushing frequency and the frequency of sugary foods and drinks between meals, positive involvement (borderline significant), encouragement, problem-solving and interpersonal atmosphere remained significantly associated with the dental condition, while coercion did not (Table 5, models 1–6).

Table 1
Distribution of sociodemographic characteristics, oral health behaviours and parental oral health status between cases and controls.

Variables	Cases ($n = 28$)	Controls ($n = 26$)	p[a]
	n (%)	n (%)	
Sociodemographics			
Sex			
Girl	14 (50.0)	13 (50.0)	1.00
Boy	14 (50.0)	13 (50.0)	
Education level (mother)[b]			
Higher education	0 (0.0)	12 (46.2)	<0.001
Medium education	12 (50.0)	11 (42.3)	
Lower education	12 (50.0)	3 (11.5)	
Income[b]			
Above modal	6 (25.0)	11 (42.3)	0.38
Modal	13 (54.2)	12 (46.2)	
Below modal	5 (20.8)	3 (11.5)	
Number of children in the household[b]			
1 child	6 (25.0)	5 (19.2)	0.87
2 children	10 (41.7)	11 (42.3)	
3 or more children	8 (33.3)	10 (38.5)	
Oral health behaviours			
Tooth brushing frequency[b]			
Twice or more per day	19 (79.2)	25 (96.2)	0.07
Once or less per day	5 (20.8)	1 (3.8)	
Age tooth brushing was started[b]			
Less than one-year old	16 (66.7)	21 (80.8)	0.26
1 years old or older	8 (33.3)	5 (19.2)	
Re-brushing by a parent			
Often-always	14 (58.3)	14 (53.8)	0.49
Never-sometimes	10 (41.7)	12 (46.2)	
Supervised tooth brushing			
Often-always	21 (87.5)	24 (92.3)	0.46
Never-sometimes	3 (12.5)	2 (7.7)	
Frequency of sugary foods between meals[b]			
Twice or less per day	7 (29.2)	22 (84.6)	<0.001
Three times or more per day	17 (70.8)	4 (15.4)	
Frequency of sugary drinks between meals[b]			
Twice or less per day	10 (41.7)	19 (73.1)	0.03
Three times or more per day	14 (58.3)	7 (26.9)	
Parent's oral health status			
Parental self-rated oral health[b]			
Good to excellent	12 (50.0)	18 (69.2)	0.17
Very poor to fair	12 (50.0)	8 (30.8)	

[a] χ^2-test.
[b] Missing data for 4 children.

4. Discussion

This study found a significant relationship between parenting practices, parent–child interaction and childhood dental caries in a sample of 5–8-year old children from the Netherlands. Parenting on the dimensions positive involvement, encouragement, problem-solving, coercion and interpersonal atmosphere was more favourable in caries free children compared to children with four or more decayed, missing of filled teeth.

Notably, in this study, parenting on the dimension discipline did not significantly differ between children with and without caries. This could be attributed to the fact that discipline practices could only be scored when the child showed problem behaviour during the SIT observations. If the child did not show any difficult behaviour, the highest score for each of the discipline items was accorded. In this study, 33 children (61.1%) did not show any problem behaviours, therefore there was little variation in scores for discipline, impeding the possible demonstration of a significant difference between cases and controls.

Oral health behaviours are presumably an important mediating factor in the relationship between parenting practices, family

Table 2
Correlation matrix of dimensions of 'parenting practices and parent–child interaction'.

	1.	2.	3.	4.	5.	6.
1. Positive involvement	–					
2. Encouragement	0.71*	–				
3. Problem solving	0.50*	0.70*	–			
4. Discipline	0.12	0.34	0.41*	–		
5. Coercion[a]	−0.51*	−0.68*	−0.51*	0.16	–	
6. Interpersonal atmosphere	0.38*	0.50*	0.65*	0.43*	−0.48*	–

Pearson correlation, *$p < 0.01$.
[a] Categorised into three groups; 'not coercive', 'slightly coercive' and 'quite coercive'.

Table 3
Mean scores and standard deviations of dimensions of 'parenting practices and parent–child interaction' between cases and controls.

Dimensions	Cases ($n = 28$)		Controls ($n = 26$)		p^a
	Mean ± sd	Range	Mean ± sd	Range	
Positive involvement	50.4 ± 4.6	36–58	54.1 ± 3.0	49–60	<0.001
Encouragement	74.4 ± 9.1	56–92	87.3 ± 7.9	64–96	<0.001
Problem solving	89.2 ± 11.6	70–123	112.9 ± 15.0	63–129	<0.001
Discipline	123.3 ± 11.5	80–130	127.3 ± 6.4	101–130	0.13
Interpersonal atmosphere	98.2 ± 8.3	69–109	105.9 ± 3.0	95–111	<0.001

[a] Independent samples *T*-test.

Table 4
Distribution (n, %) of coercive behaviours between cases and controls.

Dimensions	Cases ($n = 28$)		Controls ($n = 26$)		p^a
	n	%	n	%	
Not coercive	10	35.7	16	61.5	<0.001
Slightly coercive	9	32.1	9	34.6	
Quite coercive	9	32.1	1	3.8	

[a] X^2-test.

interactions and children's caries experience. There are several plausible mechanisms by which parenting practices and family interactions could influence children's oral health behaviours and subsequently their oral health. For example, it has been shown that coercive parenting, characterised by inconsistent, ambiguous, and highly demanding discipline practices and irritable, angry affect, is associated with a higher degree of resistance and non-compliance in children (Kuczynski et al., 1987; Lytton, 1977). Patterson et al. (2010) termed these rigid coercive sequences, which have also been demonstrated empirically (Granic and Hollenstein, 2003; Jones et al., 1975). One could argue that these children are also less likely to comply with oral health behaviours imposed by the parents. Studies have also shown that this type of parenting has been related with an increased risk of childhood obesity and conduct problems (Kitzmann-Ulrich et al., 2010; Steinberg et al., 1992). Opposed to coercive parents, overly permissive parents who have little control over their child's behaviours, may be more likely to be indulgent towards their child's wishes (e.g., when they want sweets) and avoid arguments when their child does not want to co-operate (e.g., when they do not want to brush their teeth) (Skeie et al., 2006).

Our findings of low positive involvement, encouragement and problem solving in cases versus controls, suggest that parents of children with dental caries lack adequate positive parenting skills. On the other hand, a structured and supportive home environment, in which parents set appropriate and clear boundaries in the context of warm and affective interactions, could stimulate children to engage in healthy behaviours. For instance, it has been demonstrated that parents who reinforce proper behaviours with rewards or praising words are more likely to have children with healthy eating habits (Stark et al., 1986). Also, parental involvement in general may concur with monitoring children's dietary intake and supervising children's tooth brushing. However, it should be noted that the impact of parenting practices and family interactions on children's oral health may depend, in part, on characteristics of the child. For example, Spitz et al. (2006) have shown that children with difficult temperament had an increased risk of dental caries. This may create a vicious cycle, in which children's problem behaviours may, in turn, influence children's parenting practices (Patterson, 1982).

To the best of the authors' knowledge, this is the first study that was able to demonstrate an association between observed parenting practices and childhood dental caries. One of the strengths of this study was that observational methods were used, which were sensitive to detect subtle nuances in parenting practices within a normative range. Another advantage of observational methods is that they are free of reporting bias such as social desirability. The method used in this study captured the most relevant aspects of parenting practices according to the Social Interaction Learning model.

However, the findings of this study must be considered in the context of its limitations. With observational methods, there is a risk that the results are biased by the interpretation of the observer. In the present study, this risk was limited, as both coders were blind to the child's condition and inter-coder agreement was high. Another potential limitation is that observed interactions could have been influenced by the 'observer effect', in which the presence of the observer or a video camera may cause individuals to behave in an unnatural manner (Hampson et al., 1989). Therefore, observed

Table 5
The association of 'parenting practices and parent–child interaction' with childhood dental caries; the relative odds and 95% confidence intervals of being a 'case' compared to a 'control'.

	Dimensions	OR (95% CI)[b]	B[c]	SE[d]	Wald-test	p^a	Goodness of fit[e]
Crude	Positive involvement	0.72 (0.58–0.88)	−0.33	0.11	9.75	0.002	0.73
	Encouragement	0.84 (0.77–0.92)	−0.17	0.05	13.56	<0.001	0.29
	Problem solving	0.89 (0.85–0.94)	−0.11	0.03	16.43	<0.001	0.39
	Discipline	0.94 (0.86–1.02)	−0.06	0.04	2.09	0.15	0.18
	Coercion	2.81 (1.25–6.31)	1.03	0.41	6.21	0.01	0.23
	Interpersonal atmosphere	0.74 (0.62–0.88)	−0.31	0.09	11.26	0.001	0.59
Model 1[f]	Positive involvement	0.73 (0.53–1.01)	−0.32	0.17	3.56	0.06	0.62
Model 2[f]	Encouragement	0.86 (0.75–0.99)	−0.15	0.07	4.73	0.03	0.92
Model 3[f]	Problem solving	0.93 (0.87–0.99)	−0.08	0.03	5.41	0.02	0.38
Model 4[f]	Discipline	1.00 (0.90–1.12)	0.004	0.06	0.006	0.94	0.99
Model 5[f]	Coercion[g]	3.51 (0.73–16.84)	−0.42	0.18	5.13	0.02	0.57
Model 6[f]	Interpersonal atmosphere	0.66 (0.46–0.95)	1.26	0.80	2.46	0.12	0.85

[a] Logistic regression.
[b] OR (95% CI) = odds ratio (95% confidence interval).
[c] B = partial logistic regression coefficient.
[d] SE = standard error of the partial slope coefficient.
[e] Hosmer and Lemeshow goodness of fit test.
[f] Model 1–6: Each dimension of 'parenting practices and parent–child interaction' separately adjusted for the mother's education level, tooth brushing frequency, the frequency of sugary foods between meals and the frequency of sugary drinks between meals.
[g] Categorised into three groups; 'not coercive', 'slightly coercive' and 'quite coercive'.

behaviours may not reflect actual behaviours that are usually performed at home. Furthermore, only the interaction between the primary caregiver and the child was assessed. However, the primary caregiver was considered most important, as he/she spends the most time with the child.

Another potential limitation of case-control designs is the risk of selection bias. Cases were selected from a referral centre for paediatric dental care, while controls were recruited from a general dental practice. Therefore, cases and controls may not have been completely comparable. This potential bias was partly eliminated by matching cases and controls for sex and age and by adjusting for important confounding factors, including the mother's education level and oral health behaviours. The participant-rate of this study was relatively high (78.3%), and possible sampling bias could not be determined. However, the generalisability of this study is confined, since only children of Dutch origin were included. Therefore, findings of this study could not be applied to families with diverse ethnic backgrounds, as positive parenting practices and family interactions may be defined differently depending on culture and social norms. Additionally, no conclusions on causality and temporal sequence of variables can be deduced from this case-control study. This study explored the relationship between parenting practices, parent–child interaction and childhood dental caries, using data that was collected at a single point in time. However, childhood dental caries is a chronic disease, which develops through the interaction of various oral health behaviours over time. These are habitual behaviours that are often initiated and established in the child's early years. Therefore, parenting practices and family interactions are expected to be most influential on children's oral health behaviours at the time that these behaviours are introduced into the child's life. In this study, parenting practices and family interactions were measured when caries had already been developed, assuming that these are trait characteristics of the parent that are relatively stable over time. Prior research has shown that parenting practices are temporally stable (Clerkin et al., 2007; Shaffer et al., 2013). The evidence for temporal stability is quite strong, although there is also proof of statistically significant but smaller bi-directional effects between parenting and child behaviour (Lansford et al., 2011). Still, parenting practices as measured at the time of this study may not be entirely representative of parenting practices in a child's early life. Longitudinal studies are needed to explore the role of parenting practices and family interactions in the initiation and maintenance of children's oral health behaviours and their influence on the development of childhood dental caries over the years. Furthermore, it would be interesting to investigate the role of parenting practices in relation to socioeconomic inequalities in children's dental health. There is clear evidence of a strong relationship between socioeconomic status and childhood dental caries. It is plausible that these socioeconomic conditions indirectly influence children's oral health behaviours and subsequently their caries experience through an impact on parenting practices.

In conclusion, this case-control study found a strong relationship between parenting practices, parent–child interaction and childhood dental caries. High levels of coercion were associated with less parental involvement, such as lack of encouragement, positive affect and problem solving. This combination of suboptimal parenting behaviours may denote a form of neglect. In this sense, caries could be a warning sign for suboptimal parenting, which could compromise a child's general physical and psychological well-being. The study points to a need for further study into the possible causal association between ineffective parenting and dental caries. The findings of this study provide some direction for the development of caries preventive programs. There is growing recognition that interventions to prevent dental decay in children should be directed at changing the underlying determinants of childhood dental caries, such as parental dental self-efficacy (Arrow et al., 2013; Finlayson et al., 2007), Locus of Control (Lenčová et al., 2008) and sense of coherence (Nammontri et al., 2013). Results of this study suggest that parenting practices may be another important determinant to consider in caries preventive interventions. Future studies should ascertain whether programs that incorporate components to improve parenting practices and family interactions are effective in preventing dental caries in children. Furthermore, it would be interesting to investigate whether such health promotion initiatives have the potential to benefit both children's oral health and other health-related outcomes, including mental health.

Acknowledgements

The authors would like to thank Jessica de Mooij for helping with the data collection, Nadine Gijzen for guiding the SIT-training and for double coding the observations, prof G.H.W. Verrips for his useful input for this study and prof. A. de Jongh for facilitating the writing of this paper.

References

Aleksejūnienė, J., Brukienė, V., 2012. Parenting style, locus of control, and oral hygiene in adolescents. Med. Kaunas. 48, 102–108.
Arredondo, E.M., Elder, J.P., Ayala, G.X., Campbell, N., Baquero, B., Duerksen, S., 2006. Is parenting style related to children's healthy eating and physical activity in Latino families? Health Educ. Res. 21, 862–871.
Arrow, P., Raheb, J., Miller, M., 2013. Brief oral health promotion intervention among parents of young children to reduce early childhood dental decay. BMC Public Health 13, 245.
Blane, D., 1999. The life course, the social gradient, and health. In: Marmot, M., Wilkinson, R.G. (Eds.), Social Determinants of Health. Oxford University Press, Oxford, pp. 64–80.
Clerkin, S.M., Marks, D.J., Policaro, K.L., Halperin, J.M., 2007. Psychometric properties of the Alabama parenting questionnaire-preschool revision. J. Clin. Adolesc. Psychol. 36, 19–28.
Darling, N., Steinberg, L., 1993. Parenting style as context: an integrative model. Psychol. Bull. 113, 487–496.
DeGarmo, D.S., Forgatch, M.S., 2007. Efficacy of parent training for stepfathers: from playful spectator and polite stranger to effective stepfathering. Parent. Sci. Pract. 7, 331–355.
Dornbusch, S.M., Ritter, P.L., Leiderman, P.H., Roberts, D.F., Fraleigh, M.J., 1987. The relation of parenting style to adolescent school performance. Child. Dev. 58, 1244–1257.
Duijster, D., Verrips, G.H.W., van Loveren, C., 2013. The role of family functioning in childhood dental caries. Community Dent. Oral Epidemiol. http://dx.doi.org/10.1111/cdeo.12079.
Finlayson, T.L., Siefert, K., Ismail, A.I., Sohn, W., 2007. Maternal self-efficacy and 1–5-year-old children's brushing habits. Community Dent. Oral Epidemiol. 35, 272–281.
Forgatch, M.S., Knutson, N.M., Mayne, T., 1992. Coder Impressions of ODS Lab Tasks. Oregon Social Learning Center, Eugene.
Forgatch, M.S., DeGarmo, D.S., 1999. Parenting through change: an effective prevention program for single mothers. J. Consult. Clin. Psychol. 67, 711–724.
Forgatch, M.S., Bullock, B.M., Patterson, G.R., 2004. From theory to practice: increasing effective parenting through role-play. In: Steiner, H. (Ed.), Handbook of Mental Health Interventions in Children and Adolescents: an Integrated Developmental Approach. Jossey-Bass, New York, pp. 782–812.
Granic, I., Hollenstein, T., 2003. Dynamic systems methods for models for developmental psychopathology. Dev. Psychopathol. 15, 641–669.
Hampson, R.B., Beavers, W.R., Hulgus, Y.F., 1989. Insiders' and outsiders' views of family: the assessment of family competence and style. J. Fam. Psychol. 3, 118–136.
Hooley, M., Skouteris, H., Boganin, C., Satur, J., Kilpatrick, N., 2012. Parental influence and the development of dental caries in children aged 0–6 years: a systematic review of the literature. J. Dent. 40, 873–885.
Jones, R., Patterson, G.R., Reid, J.R., 1975. Naturalistic observation in clinical assessment. In: McReynolds, P. (Ed.), Advances in Psychological Assessment, vol. 3. Jossey-Bass, San Francisco, CA, pp. 42–95.
Kelder, S.H., Perry, C.L., Klepp, K.I., Lytle, L.L., 1994. Longitudinal tracking of adolescent smoking, physical activity and food choice behaviours. Am. J. Public Health 84, 1121–1126.
Kerig, P.K., Lindahl, K.M., 2001. Family Observational Coding Systems: Resources for Systemic Research. Lawrence Erlbaum Associates Publishers, Mahwah, US.

Kitzmann-Ulrich, H., Wilson, D.K., St George, S.M., Lawman, H., Segal, M., Fairchild, A., 2010. The integration of a family systems approach for understanding youth obesity, physical activity, and dietary programs. Clin. Child. Fam. Psychol. Rev. 13, 231–253.
Kremers, S.P., Brug, J., de Vries, H., Engels, R.C.M.E., 2003. Parenting style and adolescent fruit consumption. Appetite 41, 43–50.
Kuczynski, L., Kochanska, G., Radke-Yarrow, M., Girnius-Brown, O., 1987. A developmental interpretation of young children's noncompliance. Dev. Psychol. 23, 799–806.
Kuh, D., Power, C., Blane, D., Bartley, M., 1997. Social pathways between childhood and adult health. In: Kuh, D., Ben-Shlomo, Y. (Eds.), The Life Course Approach to Chronic Disease Epidemiology. Oxford University Press, Oxford, pp. 169–198.
Lamborn, S.D., Mounts, N.S., Steinberg, L., Dornbusch, S.M., 1991. Patterns of competence and adjustment among adolescents from authoritative, authoritarian, indulgent, and neglectful families. Child Dev. 62, 1049–1065.
Lansford, J.E., Criss, M.M., Laird, R.D., Shaw, D.S., Pettit, G.S., Bates, J.E., et al., 2011. Reciprocal relations between parents' physical discipline and children's externalizing behavior during middle childhood and adolescence. Dev. Psychopathol. 23, 225–238.
Lenčová, E., Pikhart, H., Broukal, Z., Tsakos, G., 2008. Relationship between parental locus of control and caries experience in preschool children – cross-sectional survey. BMC Public Health 8, 208.
Lytton, H., 1977. Correlates of compliance and the rudiments of conscience in two-year-old boys. Can. J. Behav. Sci. 9, 242–251.
Maccoby, E.E., Martin, J.A., 1983. Socialization in the context of the family: parent–child interaction. In: Hetherington, E.M. (Ed.), Handbook of Child Psychology: Socialization, Personality, and Social Development. Wiley, New York, pp. 1–101.
Nammontri, O., Robinson, P.G., Baker, S.R., 2013. Enhancing oral health via sense of coherence: a cluster-randomized trial. J. Dent. Res. 92, 26–31.
Ogden, T., Hagen, K.A., 2008. Treatment effectiveness of parent management training in Norway: a randomized controlled trial of children with conduct problems. J. Consult. Clin. Psychol. 76, 607–621.
Patrick, H., Nicklas, T.A., Hughes, S.O., Morales, M., 2005. The benefits of authoritative feeding style: caregiver feeding styles and children's food consumption patterns. Appetite 44, 243–249.
Patterson, G.R., 1982. Coercive Family Process. Castalia, Eugene: OR.
Patterson, G.R., Forgatch, M.S., DeGarmo, D.S., 2010. Cascading effects following intervention. Dev. Psychopathol. 22, 949–970.
Poorterman, J.H.G., Schuller, A.A., 2006. Tandheelkundige verzorging Jeugdige Ziekenfondsverzekerden (TJZ). Eindmeting 2005. Academisch Centrum Tandheelkunde Amsterdam, TNO Kwaliteit van Leven, Amsterdam/Leiden.
Radziszewska, B., Richardson, J.L., Dent, C.W., Flay, B.R., 1996. Parenting style and adolescent depressive symptoms, smoking, and academic achievement: ethnic, gender, and SES differences. J. Behav. Med. 19, 289–305.
Rhee, K., 2008. Childhood overweight and the relationship between parent behaviors, parenting style, and family functioning. Ann. Am. Acad. Polit. Soc. Sci. 615, 11–37.
Sanders, M.R., Gooley, S., Nicholson, J., 2000. Early Intervention in Conduct Problems in Children. In: Australia, The Australian Early Intervention Network for Mental Health in Young People, vol. 3.
Seow, W.K., Clifford, H., Battistutta, D., Morawska, A., Holcombe, T., 2009. Case-control study of early childhood caries in Australia. Caries Res. 43, 25–35.
Shaffer, A., Lidhiem, O., Kolko, D.J., Trentacosta, C.J., 2013. Bidirectional relations between parenting practices and child externalizing behavior: a cross-lagged panel analysis in the context of a psychosocial treatment and 3-year follow-up. J. Abnorm. Child. Psychol. 411, 199–210.
Skeie, M.S., Riordan, P.J., Klock, K.S., Espelid, I., 2006. Parental risk attitudes and caries-related behaviours among immigrant and western native children in Oslo. Community Dent. Oral Epidemiol. 34, 103–113.
Spitz, A.S., Weber-Gasparoni, K., Kanellis, M.J., Qian, F., 2006. Child temperament and risk factors for early childhood caries. J. Dent. Child. 73, 98–104.
Stark, L.J., Collins Jr., F.L., Osnes, P.G., Stokes, T.F., 1986. Using reinforcement and cueing to increase healthy snack food choices in preschoolers. J. Appl. Behav. Anal. 19, 367–379.
Steinberg, L., Lamborn, S.D., Dornbusch, S.M., Darling, N., 1992. Impact of parenting practices on adolescent achievement: authoritative parenting, school involvement, and encouragement to succeed. Child Dev. 63, 1266–1281.
Thijssen, J., de Ruiter, C., 2014. Initial validation of the Dutch translation of the caregiver wish list for parenting practices. J. Child Fam. Stud. 20, 541.
Tutty, L.M., 1995. Theoretical and practical issues in selecting a measure of family functioning. Res. Soc. Work Pract. 5, 80–106.
Wake, M., Nicholson, J.M., Hardy, P., Smith, K., 2007. Preschooler obesity and parenting styles of mothers and fathers: Australian national population study. Pediatrics 120, 1520–1527.
Waldfogel, J., 2004. Social Mobility, Life Chances, and the Early Years. CASE Paper 88. London School of Economics, London.