Just add positivity? Dental caries, obesity and problem behaviour in children: the role of parents and family relations

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Just add Positivity?
Just add Positivity?

Dental caries, obesity and problem behaviour in children: the role of parents and family relations

For the public defense of my thesis titled: Just add Positivity?

on Wednesday
14 September 2016
at 11:00 am
in the Aula of the University of Amsterdam,
Singel 411 in Amsterdam
(reachable from tram 1, 2 and 5 from CS Amsterdam)

Afterwards you are kindly invited to the reception at place:
Paranimfen:
Erica Polak
Martine van Gemert-Schriks
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Just add Positivity?

Dental caries, obesity and problem behaviour in children: the role of parents and family relations
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Dental caries, obesity and problem behaviour in children: the role of parents and family relations

Just add Positivity?

A C A D E M I S C H P R O E F S C H R I F T

ter verkrijging van de graad van doctor

aan de Universiteit van Amsterdam

op gezag van de Rector Magnificus

prof. dr. ir. K.I.J. Maex

ten overstaan van een door het College voor Promoties ingestelde commissie,
in het openbaar te verdedigen in de Aula der Universiteit

op woensdag 14 september 2016, te 11:00 uur

door

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Faculteit der Tandheelkunde
Ring the bells that still can ring
Forget your perfect offering
There is a crack in everything
That’s how the light gets in.

- Leonard Cohen
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JUST ADD POSITIVITY?

The cover of this thesis suggests a major breakthrough. What if we could just give children a medicine to eliminate all dental disease? Of course, there is no magic pill to stop caries. I actually think we don’t need one … Childhood dental caries is a preventable disease, after all, if parents maintain healthy behaviours. They are responsible for their child’s health. Could a positive change in parenting style or parenting skills be the golden recipe?

Working as a paediatric dentist for some time now, it is my experience that parents of children with multiple cavities approach their children differently and interact less positively with their children than parents of healthy children. Moreover, they often seem to find it more difficult to withstand their child’s wishes and demands, or even feel sorry for their child if they do so. Sometimes these children have more problems than dental caries alone, for instance behaviour problems or an unhealthy weight. Publications concerning the relationship between caries and family factors are scarce, but there is growing attention for social determinants influencing childhood dental caries. The conversations I had with parents and my experiences in daily practice led to the research questions and the studies described in this thesis. It will form the basis of further research.

Maddelon, June 2016
CHAPTER 1

Introduction
Growing up healthy?
During childhood, important foundations of health behaviours are laid, which influence children’s health in both positive and negative ways (1). The circumstances in which children grow up inevitably leave an imprint for life, for the less favourable health behaviours have proven to be difficult to change (2,3). Unfortunately, various preventable but common childhood conditions still affect children, the most frequent being childhood dental caries. Recently, a prevalence of 41% was reported for 5-year-olds in the Netherlands (4). Even in the developed countries, more than half of carious lesions remain untreated (5), which can cause eating and sleeping problems and it may affect child growth and school attendance (5).
Higher levels of dental caries are found among children from lower socioeconomic backgrounds and ethnic minority groups (6,7). In the Netherlands, the prevalence and severity of dental caries are highest among Dutch children from lower social classes and children of Moroccan and Turkish origin (8,9). These latter ethnic groups constitute 12 – 20% of the population in the larger cities in the Netherlands, and they are overrepresented in the lower socioeconomic strata (10). Numerous studies over the past three decades also suggest that socioeconomic status affects people’s risk of developing obesity, both in adults and children (11). In case children show behavioural problems the same relation is reported (12). High-risk populations apparently fail even harder to sufficiently benefit from conventional approaches in disease prevention.

The prevention of dental caries in children
Dental caries is a condition that largely results from lack of good oral hygiene, concomitant suboptimal delivery of fluoride and a high frequency intake of sugary foods and drinks (13). Risk factors are less than twice daily tooth brushing, visible plaque present on the teeth and a highly cariogenic diet, but they interact so that if there is a balance between good and bad habits the development of caries may be controlled (13). The traditional approach of programs to prevent (the further development of) childhood dental caries is delivering information to parents about healthy behaviours, unintentionally but implicitly blaming parents for unhealthy behaviour. It is however increasingly recognised that knowledge of favourable behaviours alone rarely leads to establishment and perseverance of behaviour changes in individuals (14). Apparently, behaviour change is not that simple for some parents. Parental knowledge is essential to understand the need
for change, but succeeding in changing unhealthy behaviours is almost impossible when practical tools for behaviour change are not provided (15). In prevention strategies, the broader context that determines behaviour patterns is not regarded. A growing body of research acknowledges that other factors than knowledge have to be considered, which also interact with each other: genetic and biological factors, the social environment, the physical environment, health behaviours, and dental and medical care (16-18). For instance, Howenstein et al described that parenting in which parents let a child make decisions, and try to keep the child happy, often with bribery, leads to increased caries levels (19). In addition, high caries levels are described caused by parents not being able to maintain healthy behaviours because of believing in genetic causes of preventable diseases, by not feeling in control or by having a low confidence in the ability to change unhealthy behaviours (20-22).

**Parenting and family functioning**

Since the 1950s multiple studies have defined and studied parenting and the consequences of parenting styles. Parenting style as defined in these studies consists of two dimensions: warmth versus hostility, and restrictiveness versus autonomy (23,24). Family functioning is a broader concept that describes the interactions between family members, such as communication, cohesion, roles and organization in the family, which influence the way both child and parent manage daily life (25,26). Could the development of interventions targeting at the improvement of parenting practices and family functioning be ‘the golden recipe’ in preventing and managing childhood dental caries, and even in treating or preventing other childhood conditions, for instance obesity? In order to develop these components of effective interventions, first a relationship between these family-related factors and oral health has to be shown.

The role of parents is vital in establishing behaviours related to childhood dental caries, including oral hygiene behaviour and frequency of sugar consumption (27). Studies that have investigated the influence of parenting practices and family relationships on children’s dental health are scarce. Ineffective or negative parenting and less favourable family functioning are related to an unhealthy diet, including lower fruit and vegetable consumption, higher caloric intake and lower frequency of eating breakfast; and to higher rates of childhood obesity (28-31). Overweight has an impact on general health and can induce chronic disease (32-34), which may become manifest also at an early age and not
Introduction

solely in later life (31). Furthermore, childhood obesity is a predictor of obesity in adulthood (35,36). Obtaining or maintaining a healthy weight depends on the balance between energy intake and physical activity. Just as in the prevention of childhood dental caries, it has proven to be challenging to achieve the behaviour change needed to positively influence this misbalance (37). Early prevention of both dental caries and obesity can play a significant role in growing up into a healthy individual.

Another negative outcome of unfavourable parenting is children’s externalising or internalising problem behaviour (38,39). This relation is reciprocal, with child characteristics giving rise to less favourable parenting practices and family functioning, which in turn may instigate and reinforce the child’s character traits or behaviours (40). This could be a complicating factor in maintaining healthy behaviours when it affects the way parents withstand their child’s wishes or demands. At the positive side, parental warmth and support are associated with relatively low levels of children’s externalising problems (41). Furthermore, a relationship between harsh discipline and aggression was described (42-44), as well as a negative influence on school performance (38). Early interventions are necessary to reduce the risk of disruptive behaviour in adolescence and adulthood (45,46).

Successful interventions on family or parent level

As result of the increasing interest in and the recognition of parenting and family factors as determinants of childhood conditions in general, interventions are developed in which these factors are addressed. In the prevention and treatment of obesity, for example, prevention programs that integrate a family component have demonstrated improvements in child health behaviours; however, a review by Kitzman-Ulrich et al, shows that the actual effects of these improvements in behaviours that specifically target obesity are unknown (47). Successful interventions addressing general parenting have been mapped in a review by Gerards et al. (48). Regarding child behaviour problems, parent management-training programmes have been developed and tested. A decrease of a child’s disruptive behaviour and improvement of parenting practices is seen if parents learn skills in a setting with their own child (49,50). In prevention programs for caries, however, these family factors have not been addressed.
CHAPTER 1

Common behaviours, common risk factors?
Scientists have tried to capture common risk factors that influence childhood conditions, in order to develop and improve effective interventions. A body of evidence has shown that a lower socioeconomic status is a risk-indicator for childhood dental caries (6,8,51,52). In the obesity epidemic, this is not different (11). Apparently, in families, there are life style factors that influence both diseases. In the case of dental caries and obesity in children, the frequency and total intake of (sugary) foods and drinks seems to be a common unfavourable behaviour. Understanding the mechanisms that obstruct the incorporation of healthy behaviour, or of behavioural change, would create a chance to target both diseases in one intervention. For instance, a recent study of Dusseldorp et al (2015) related reduced breakfast frequency with caries experience (53). This study argues that promoting structure and regularity, including having breakfast and reducing the number of eating and drinking moments, may be important to include in programs to prevent both dental caries and obesity in children (53).

Everyday practice
In the Netherlands, private dentists and dental hygienists provide dental health care. All dental care for children under 18 years of age is covered under parents’ health insurance premium. Most children are registered with a dentist, but this is not mandatory. When children show unyielding behaviour during dental visits, or if they are at high-risk for developing (more) caries, dentists have the possibility to refer them to a specialised paediatric practice. In these referral practices, children with disadvantaged socioeconomic status or ethnicity are overrepresented and high levels of dental caries are found. Cleyburch junior is one of these paediatric dental referral centres, where the high levels of caries were expected to help the examination of the topics under consideration, because less favourable parenting and more behaviour problems in the children could be a determinant of these levels of caries.

The aim and structure of this thesis
In order to identify possible family- or parent-targeted components of preventive interventions, this thesis aimed at exploring the role of parenting practices and family functioning in children’s oral health behaviours and childhood dental caries in a high-risk population. A second aim was to explore the relationships between obesity and child
Introduction

behaviour problems and dental caries. A further objective was to explore whether family functioning and parenting are associated with child behaviour problems. Influences of socioeconomic factors were considered. In fig 1 the conceptual framework of the studies in this thesis is schematically presented.

Figure 1. Conceptual framework of this thesis

To increase success of preventive programs for childhood dental caries, insight in parents’ opinion on preventive strategies is very useful. Chapter 2 describes a qualitative study in which parents were asked to share their views on barriers and facilitators in promoting oral health behaviours in children. A further objective was to explore their views on limitations and opportunities of professional support.

In chapter 3, a case-control study is described, in which the relationship between parenting practices, parent-child interactions and childhood dental caries was explored using observations of the parent interacting with their child in problem solving tasks. A cross-sectional study that examined the relationship between parental and family-related factors and childhood dental caries in a sample of 5- to 6-year-old children of Dutch, Moroccan and Turkish origin is presented in Chapter 4. The same observations were used to compare caries active cases and caries free controls. Furthermore, the relationship of parental- and family-related factors with social class and ethnicity was studied.

Assuming a common risk factor in both dental caries and overweight in childhood, it was aimed to study whether the two diseases indeed occur in the same individuals. Chapter 5 therefore describes a study that used anthropometric data obtained professionally to
investigate the association between Body Mass Index and dental caries experience in children aged 5 to 8 years receiving treatment in a referral centre for paediatric dental care in the Netherlands.

Family factors are also reported to have a reciprocal interaction with children’s problem behaviour (39). Furthermore, there is evidence to support that child behaviour problems and dental caries are related (54). The aim of the study described in chapter 6 was to evaluate the relationships between caries experience and children’s problem behaviour, family functioning and parenting style, which has not yet been described. Chapter 7 discusses the results of the studies. The implications of the results, strengths and limitations are described, and it contains recommendations for future research. Finally, chapter 8 summarises the results and conclusions of this thesis.
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Introduction

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CHAPTER 2

Establishing oral health promoting behaviours in children - parents’ views on barriers, facilitators and professional support: a qualitative study
Parents’ views on barriers, facilitators and professional support

ABSTRACT

The prevention of childhood dental caries relies on adherence to key behaviours, including twice daily tooth brushing with fluoride toothpaste and reducing the consumption of sugary foods and drinks. The aim of this qualitative study was to explore parents’ perceptions of barriers and facilitators that influence these oral health behaviours in children. A further objective was to explore parents’ views on limitations and opportunities for professional support to promote children’s oral health. Six focus group interviews were conducted, including a total of 39 parents of 7-year old children, who were recruited from paediatric dental centres in the Netherlands. Interviews were held with Dutch parents of low and high socioeconomic status and parents from Turkish and Moroccan origin. Focus group interviews were conducted on the basis of a pre-tested semi-structured interview guide and topic list. Content analysis was employed to analyse the data. Analysis of interview transcripts identified many influences on children’s oral health behaviours, operating at child, family and community levels. Perceived influences on children’s tooth brushing behaviour were primarily located within the direct family environment, including parental knowledge, perceived importance of and parental confidence in tooth brushing, locus of control, role modelling, parental monitoring and supervision, parenting strategies and tooth brushing routines and habituation. The consumption of sugary foods and drinks was influenced by both the direct family environment and factors external to the family, including the school, the social environment, commercials and television, supermarkets and affordability of foods. Parents raised several suggestions for professional oral health support, which included the provision of clear and consistent oral health information using a positive approach, dietary regulations at school and a multidisciplinary approach among dental professionals, child health centres and other institutions in providing parental support. In conclusion, this qualitative study provided detail regarding parental views on the influences on children oral health behaviours and their opinions on what further support is needed to promote children’s dental health. Parents’ suggestions for professional oral health support can guide the development or improvement of caries preventive interventions.
BACKGROUND

Dental caries is a common childhood disease with a range of biological and behavioural risk factors involved in its aetiology (1). Children are most likely to develop caries if they acquire Streptococcus Mutans at a young age, which can largely be compensated by other parameters, such as good oral hygiene and a non-cariogenic diet (2,3). Therefore, the prevention of childhood dental caries mainly relies on adherence to key behavioural messages, including twice daily tooth brushing from an early age with fluoride toothpaste and reducing the frequency of consuming sugary foods and drinks (4). However, it is increasingly recognized that knowledge of these messages alone does rarely lead to sustained behaviour change in individuals (5). Simple oral health behaviours are enmeshed in more complex daily habits, which are largely determined by a broad scope of psychosocial, economic and environmental factors (6). In this context, efforts to prevent childhood dental caries cannot narrowly focus on individuals and their biology and behaviours alone, but should consider the underlying determinants of children’s dental health as well.

This increased appreciation has led to articles conceptualizing and exploring the broader influences on the development of childhood dental caries. A comprehensive conceptual model by Fisher-Owens et al. (7) acknowledges a wide range of determinants of children’s oral health and oral health-related behaviours, such as parents’ health beliefs, practices and coping skills (8-10), family functioning (11) and composition (12,13), social support (11,14) and more distal factors, such as the living environment (15,16), culture (17), social capital (18) and the (dental) health care system (19). These determinants are suggested to operate at both child, family and community level, with interactions occurring across the various levels of influence.

Understanding the determinants of childhood dental caries can be augmented by qualitative research of exploring parental perspectives on the influences of childhood dental caries (20). Given the role of parents as principal regulators of children’s dietary intake and the important role of the family in shaping children’s oral hygiene habits, it is important to document their views. Also, parents could share their ideas on the guidance that is needed to improve these oral health behaviours. Both are important to consider when developing caries preventive interventions.
There are a few qualitative studies which sought to explore parental perspectives on children’s dental health promoting behaviours (17,21-28), yet these studies mainly focussed on influences on children’s tooth brushing behaviours alone or attitudes towards the significance of children’s dental health. Furthermore, no studies have been conducted to investigate parents’ views on current caries preventive interventions and opportunities for improvement. Therefore, the present study conducted focus group interviews with parents of 7-year-old children from the Netherlands, with the aim to explore their perceptions of factors (barriers and facilitators) that influence children’s oral health behaviours. Focus groups were chosen as a method, as opposed to individual interviews, because it encourages parents to provide open responses and it allows parents to build on each other’s ideas through facilitated discussion. The oral health behaviours studied were twice daily tooth brushing with fluoride toothpaste and reducing children’s consumption of sugary foods and drinks. A further objective was to explore parents’ views on limitations and opportunities for professional support to promote children’s oral health.

**METHODS**

**Ethical approval**
Approval for this study was obtained from The Medical Ethical Committee of the VU University of Amsterdam, the Netherlands (registration number 2012/144). Participating parents were informed via a postal letter that they were free to withdraw from the study at any time and that all data would be handled with full regard to confidentiality and anonymity. Parents were notified that they were recruited on the basis of sociodemographic factors and their child’s oral health status. These data had been collected in a study in which they had previously taken part (11). Prior to data collection, all participating parents provided written informed consent to participate in the study and to use the data for publication.

**Study population background**
In the Netherlands, healthcare is based on a single compulsory health insurance scheme. Dental health care is provided by private dentists and dental hygienists. All dental care for children under 18 years of age is automatically covered under parents’ health insurance premium. Most children are registered with a dentist, but this is not mandatory.
Key messages in Dutch oral health promoting guidelines are twice daily tooth brushing with fluoride toothpaste and restricting the consumption of foods and drinks to a maximum of 5 to 7 times a day.

Study design and sampling procedure
Qualitative focus group interviews were conducted between November 2012 and July 2013. Participants were parents of children who had previously taken part in a quantitative cross-sectional study in 2011-2012, which was set up to investigate family-related determinants of childhood dental caries (11). In this quantitative study, a stratified random sample of 630 6-year old children was recruited from paediatric dental centres located in various regions in the Netherlands. Data on sociodemographic characteristics were collected using parental questionnaires and children’s dental health status, expressed as the number of decayed, missing and filled teeth (dmft score), was extracted from personal dental records.

For the present study, a purposive sampling technique was used to select a subgroup of parents to participate in the focus group interviews. Selection was based on parents’ ethnic background, socioeconomic status (SES), geographical region and their child’s dental health status to ensure that a diverse range of views was adequately represented. Homogeneous focus groups of people from similar cultural and socioeconomic characteristics were created, because homogeneous groups are generally more comfortable and open with each other, whereas mixed ethnic or socioeconomic groups make it more difficult to achieve a high degree of group interaction (29). Separate focus group interviews were held with parents who were born in the Netherlands, parents who were first-generation immigrants from Turkey, and parents who were first-generation immigrants from Morocco. These two latter ethnic groups were targeted, because they constitute 12-20% of the population in the larger cities in the Netherlands (30), and the caries prevalence among children from these ethnic groups is relatively high (31). Focus groups with Dutch parents were stratified by SES. The mother’s highest completed level of education was used as an indicator for SES, which categorized parents into a low SES group (no education, elementary school, secondary school at lower level and further education at lower level) and a high SES group (secondary school at higher level, further education at higher level and University). The focus groups with Turkish and Moroccan parents were not stratified by SES, because the vast majority of first-generation immigrants
from Turkey and Morocco that participated in the quantitative study were from low SES as determined by their education level. Furthermore, within each focus group, parents of caries free children (dmft = 0), parents of children with moderate levels of dental caries (dmft ≥ 1 < 4) and parents of children with high levels of dental caries (dmft > 4) were purposively selected. Focus group interviews were held in four different geographical areas in which a paediatric dental centre was located, namely in Zoetermeer, Enschede, Den Haag and Utrecht. The areas vary greatly in terms of socioeconomic location and the proportion of immigrants living in the area.

All selected parents were informed about the study by telephone and requested to participate. Parents who agreed to participate received a confirmation letter at their home address, informing them about the aim, procedure and appointment details of the study. Only one parent per family was requested to take part. A monetary voucher of 25 euro’s was given as an incentive to participants.

Data collection
A semi-structured interview guide was developed to ensure consistency in data collection among focus group interviews, yet allowing the sessions to be flexible to optimize the natural flow of conversation in the groups. The interview guide included a series of open-ended questions to reduce the chance of priming and bias. The questions were designed to elicit discussion among parents about factors they perceived to influence children’s oral health behaviours (i.e. twice daily tooth brushing and reducing the consumption of sugary foods and drinks), and to stimulate discussion about what further (professional) support they think is needed to promote children’s oral health. Examples of questions were: ‘Could you describe your experiences with brushing your child’s teeth?’, and ‘What were things that made it either easy or difficult to brush your child’s teeth?’. A topic list, based on scientific literature and Fisher Owens’ theoretical model of children’s oral health determinants (7), was used to guide the interviews. Topics included potential influences on children’s oral health behaviours, such as child temperament, child preferences, routines, time, family composition and division of family roles, parenting, parental stress, parental depression, social support, peer pressure, health care, media and advertisement, schools and the availability and affordability of resources. Topics of the list were only introduced in the focus group interviews when they were not spontaneously brought up in the discussion. The questions were pilot-tested for clarity, comprehension and
suitability in one focus group interview with parents working at ACTA, department of ‘Social Dentistry’ and one with Turkish and Moroccan students. The interview guide is available upon request.

The focus group interviews were performed in a quiet room at a paediatric dental centre, and lasted between 75 and 120 minutes (mean time: 100 minutes), including a 15-minute break. All focus group interviews were conducted by a moderator (DD, MSc in Dental Public Health, PhD-student and trained in conducting qualitative research), who guided the discussion, and an assistant moderator/observer (MdJL, MSc in Paediatric Dentistry, PhD-student and working as a paediatric dentist), who took field notes and made sure that all participants contributed to the discussion. All focus group interviews were audio-recorded and transcribed verbatim. The audiotapes, transcripts and other supporting data were stored digitally in a password-protected database at the Academic Centre for Dentistry Amsterdam, which was only accessible for the authors (DD and MdJL).

Data analysis
Thematic analysis was employed to analyse and interpret the content of the data (32). First, open coding was done through reading the transcripts and assigning codes line by line, forming the initial coding scheme. Secondly, related codes were sorted and clustered to identify themes. Fisher-Owens’ theoretical model of children’s oral health determinants (7) was used to guide the thematic data analysis and to structure the identified themes into child level influences, family level influences and community level influences. MAXQDA (software for qualitative data analysis, 1989-2014, VERBI Software - Consult - Sozialforschung GmbH, Berlin, Germany) was used to manage the data analysis.

The open coding of all transcripts was performed by one author (DD). All authors fully read the transcripts. The initial coding scheme and the identified themes were evaluated and discussed in various group sessions with the remaining authors (MdJL, EV and CvL) until consensus was reached. For reporting purposes, quotes were translated from Dutch to English by a bilingual person (DD). The consolidated criteria for reporting qualitative research (COREQ) checklist was used to ensure quality in the reporting of this study (33).
RESULTS

Characteristics of focus groups and participants
Six focus group interviews were conducted, including two focus group interviews with Dutch parents of high SES, two focus group interviews with Dutch parents of low SES, one focus group interview with Turkish parents and one with Moroccan parents. A total number of 39 parents participated in the study (response rate 36%), ranging from 4 to 10 parents per focus group session. The response rate in the Turkish and Moroccan group was somewhat lower, due to language barrier and difficulties with transportation to the dental care centre. The mean age of the child of selected parents was 7.2 ± 0.5 years. The characteristics of participants are described in Table 1.

Structure of the results section
The results section contains two sections. First, the results on parents’ views on children’s oral health behaviours are described, which are broken down into two parts: ‘twice daily tooth brushing with fluoride toothpaste’, and ‘controlling the consumption of sugary foods and drinks’. The second section reports on parents’ views on limitations and opportunities for professional oral health support. The themes for each section are described in the context in which they were discussed in the focus group sessions, and they are illustrated with interview quotes of parents (sentences in italic).

1. Parental views on influences on children’s oral health behaviours

a. Twice daily tooth brushing with fluoride toothpaste

Analysis of the focus group interviews identified ten themes of influences on children’s tooth brushing behaviour. These are schematically presented in Fig. 1, in which influences are mapped to child, family and community levels.
Table 1. Characteristics of participants per focus group interview.

<table>
<thead>
<tr>
<th>Variables</th>
<th>D-HSES-1 (n = 10)</th>
<th>D-LSES-1 (n = 8)</th>
<th>D-HSES-2 (n = 4)</th>
<th>D-LSES-2 (n = 5)</th>
<th>T* (n = 6)</th>
<th>M (n = 6)</th>
<th>Total (n = 39)</th>
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<td></td>
<td>n</td>
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<td>n</td>
<td>n</td>
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<td>n (%)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Girl</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>18 (47.4)</td>
</tr>
<tr>
<td>Boy</td>
<td>3</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>20 (52.6)</td>
</tr>
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<td>Dental health status of the child</td>
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<td>Dmft = 0</td>
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<td>4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>18 (47.4)</td>
</tr>
<tr>
<td>Dmft ≥ 1 &lt; 4</td>
<td>4</td>
<td>3</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>13 (34.2)</td>
</tr>
<tr>
<td>Dmft &gt; 4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>7 (18.4)</td>
</tr>
<tr>
<td>Participating parent</td>
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<tr>
<td>Mother</td>
<td>9</td>
<td>8</td>
<td>4</td>
<td>5</td>
<td>2</td>
<td>3</td>
<td>31 (79.5)</td>
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<td>1</td>
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<td>-</td>
<td>-</td>
<td>4</td>
<td>3</td>
<td>8 (20.5)</td>
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<td>Education level of the mother</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3 (7.9)</td>
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<tr>
<td>Further education (higher level)</td>
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<td>-</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>8 (21.1)</td>
</tr>
<tr>
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<td>-</td>
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<td>-</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>7 (18.4)</td>
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<tr>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>4 (10.5)</td>
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<tr>
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<td>-</td>
<td>-</td>
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<td>-</td>
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<td>2 (5.3)</td>
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<td>4</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>32 (84.2)</td>
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<tr>
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<td>-</td>
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<td>2</td>
<td>1</td>
<td>6 (15.8)</td>
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<tr>
<td>Number of siblings per household</td>
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<td>3</td>
<td>2</td>
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<td>22 (57.9)</td>
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<tr>
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<td>3</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>16 (42.1)</td>
</tr>
</tbody>
</table>

D-HSES-1 and D-HSES-2: focus group interviews with Dutch parents of high SES, D-LSES-1 and D-LSES-2: focus group interviews with Dutch parents of low SES, T: focus group interview with Turkish parents, M: focus group interview with Moroccan parents.

* For one child, both the father and mother participated in the focus group session.
‘Social norm’
Parents perceived twice-daily tooth brushing as a generally accepted standard of behaviour (social norm). Social norms refer to the extent to which individuals think that others in their network or community practice a certain behaviour (e.g. tooth brushing). In addition, it requires individuals to believe that people in their network or community think it is important that they also practice the behaviour themselves.

“Perceived importance of tooth brushing” and “Locus of Control”
In general, parents acknowledged the value and importance of twice daily tooth brushing with fluoride toothpaste to maintain good oral health for their child. In most families parents managed to brush their children’s teeth twice a day, usually in the morning before or after breakfast and in the evening before bedtime. However, many of the parents whose children had caries experience did not believe that oral hygiene efforts could fully prevent their child from getting tooth decay, defined as an external locus of control. They often related childhood dental caries to causes outside the parent’s and child’s control, such as chance, genetics or health problems in childhood. A low-SES Dutch mother said: “It must be the genes of my husband, because my teeth are fine...” and a Moroccan father said: “When my son was four years old they had to extract six teeth. I think his teeth were bad because he’d been given lots of antibiotics for asthma when he was young”.

‘Child behaviour & compliance’, ‘Parental confidence in tooth brushing’ and ‘Parenting strategies’
Many parents expressed that they felt confident in their ability to successfully establish twice daily tooth brushing for their child, indicating they had a high dental self-efficacy. A high-SES Dutch mother said: “...It’s just perseverance. Her teeth are always brushed twice a day”. In the course of the interviews, however, many parents described situations in which they experienced difficulties with tooth brushing. A common barrier was associated with difficult child behaviour and non-compliance in response to tooth brushing. Some parents stated that it was sometimes a struggle to brush their child’s teeth, e.g. due to resistant behaviour, tantrums, pain during teething or tiredness of the child. A low-SES mother said: “For a time period I had this strong-willed toddler who was convinced he could do it all by himself. He just wouldn’t allow me to brush his teeth for him”. A few parents described that they sometimes rather avoided conflict in those situations, than to persist on tooth brushing. A Moroccan mother said: “When he’s uncooperative in the morning
I’m not always going to battle with him. Certainly not me, no.” Other parents reported various parenting strategies to cope with children’s non-compliant behaviour towards tooth brushing. Some parents tried to maximize compliance using positive reinforcement (e.g. giving compliments or providing rewards, such as a sticker or new tooth brush) or by turning tooth brushing into an easy/enjoyable activity (e.g. singing a song, using a tooth brushing poster with icons, setting an alarm, counting along). A high-SES Dutch mother said: “For a while it was a real struggle to brush her teeth, until we let go a little and tried to make it more positive by giving compliments”. Another high-SES Dutch parent reported that she used disciplinary restrictions, such as withholding privileges, to realize twice daily tooth brushing. A few parents used rigid disciplinary strategies by physically restraining the child to ensure that tooth brushing was properly performed. A low-SES Dutch mother said: “…I just held her in head lock for two minutes…”. Moreover, many parents agreed that it is essential to be consistent when disciplining their child. A high-SES Dutch mother said: “Eventually, you are the boss. I believe it’s very important not to give in to your child, because then it will always try to push boundaries”.

‘Tooth brushing routines and habituation’

In each focus group interview, many parents agreed that routines and structure in the family were very important to manage twice daily tooth brushing in children. A high-SES Dutch mother said: “Some children are always ten minutes late at school because their families don’t have routines and structure. These are often the same children that haven’t had breakfast and haven’t brushed their teeth”. Many parents reported that tooth brushing was embedded into a ritual of routinized daily activities, such as washing and getting dressed. Habituation helped to successfully implement the behaviour. A Turkish mother said: “I’ve never perceived tooth brushing to be difficult because it’s such an automatism. The children are just used to it”.

In each focus group interview, a few parents admitted that they sometimes skipped brushing their child’s teeth due to time constraints or a busy schedule. Tooth brushing in the morning was considered more challenging than in the evening. A low-SES Dutch mother said: “Mornings are often busy, especially when we both have to go to work. It needs planning. We’re in a hurry to brush their teeth and then the brushing is not always done very thoroughly” and another mother from the low-SES group said: “I don’t have time to brush their teeth in the morning. I mean… I leave at 7am and I have to dress two children, make breakfast for them, and so on. Of course I have a partner, but he’s like; Ah,
don’t worry…”. To facilitate tooth brushing in the morning, a few parents had placed an extra toothbrush downstairs, so that after breakfast children did not have to go upstairs to brush their teeth.

‘Role modelling’ and ‘Parental monitoring and supervision’

Many parents said they intended to monitor their child’s tooth brushing routines, either by brushing their child’s teeth for them, by re-brushing their child’s teeth or by supervising the child during brushing. A low-SES Dutch mother said: “First, he gets to brush by himself and then I re-brush his teeth. That’s something I really try to pursue.” A few parents perceived that brushing their own teeth in their child’s presence encouraged the child to brush too, by functioning as an example or role model for their child. A few parents mentioned not to supervise their children’s tooth brushing habits: A high-SES Dutch mother said: “I’m not around when they brush their teeth. I am already downstairs when they’re in the bathroom, so I have no clue how well they are brushing their teeth”. Many parents reported greater involvement in their children’s oral hygiene when children were young, which helped to control the behaviour. With growing age, children were considered more autonomous and more responsible for their own dental health, resulting in less parental involvement and monitoring. Another high-SES Dutch mother said: “When they are young you help them with everything, including tooth brushing. As they get older and more independent, they can brush their own teeth, and then you have to be very careful that those two minutes don’t become 1, 2, 3 … 10, done!”.

‘Parental knowledge of tooth brushing’

Some parents were insecure about details of knowledge concerning tooth brushing, which became apparent from questions they raised during the interviews (e.g. the best type of tooth brush, the recommended age to allow children to brush by themselves, etc.). Some parents had been given complicated advice, such as ‘not to brush within 30 minutes after eating or drinking’, or ‘not to brush before breakfast’ or ‘to be careful about the child swallowing toothpaste’, which made it difficult to adhere to advice.

b. Controlling the consumption of sugary foods and drinks

Analysis of the focus group interviews identified eleven themes of influences on children’s consumption of sugary foods and drinks. These are schematically presented in Fig. 2 and they are mapped to child, family and community levels.
Figure 1. Parental views on factors influencing twice-daily tooth brushing with fluoride toothpaste in children.
Parents’ views on barriers, facilitators and professional support

A Qualitative Study On Caries Prevention

Figure 1. Factors influencing twice daily tooth brushing with fluoride toothpaste in children.

Figure 2. Factors influencing children’s consumption of sugary foods and drinks.

Figure 2. Parental views on factors influencing children’s consumption of sugary foods and drinks.
CHAPTER 2

‘Parental knowledge of dietary recommendations’
Many parents recognized the importance of reducing children’s intake of sugary foods and drinks to prevent dental caries in children. Most of these parents had been given advice to limit the frequency of sugar consumption to a maximum of 5 to 7 times a day. However, there was quite some confusion among parents which foods and drinks are considered ‘unhealthy’ for their child’s teeth. A high-SES Dutch mother said: “Yes, but what are sugary foods? I mean… Is a multigrain biscuit also considered ‘sugary’?” Furthermore, a few parents had been given dietary advice by their dentist that was in conflict with dietary messages that are important for their child’s general health and development: another mother of the Dutch high-SES group said: “One of the things the dentist told me is that fruits can be bad for your child’s teeth. So you think you are doing it right by giving your child healthy foods, and then it turns out…” These unclear and conflicting messages were perceived as barriers to adhere to the advice.

Many parents intended to control their child’s intake of sugary foods and drinks, not only to maintain good oral health for their child, but also from a general health perspective. However, there was also a number of parents, especially in the Turkish and Moroccan focus group, who were not concerned about their child’s diet from an oral health perspective, because they did not believe that sugary foods and drinks were damaging for their child’s teeth. A Turkish father said: “It’s often attributed to sugars and sweets, but that’s just nonsense!”.

‘Child food preferences’
Parents cited that the difficulty of controlling children’s sugar consumption partially depended on child-related factors. Preference for certain foods and drinks (e.g. having a sweet tooth) and children disliking healthy foods or being ‘picky eaters’ were considered barriers to realising a healthy diet.

‘Parental confidence in controlling the consumption of sugary foods and drinks’ and ‘Parental emotions’
Some of the parents reported that they felt efficacious in controlling their child’s intake of sugary foods and drinks. They were confident about their ability to provide a healthy diet by giving their child healthy foods and drinks to school, by restricting the daily frequency of consuming sugars and by providing healthy alternatives when their child asked for
Parents’ views on barriers, facilitators and professional support

sweets. A low-SES Dutch mother said: “If they are really hungry I tell them to eat an apple or a cracker with cheese. At least that’s a little justified”. However, many parents admitted that they did not always feel competent to adhere to dietary advice given by their dentist. Some of the parents believed that the advice was infeasible. A common barrier was related to coping with children’s behaviours, wishes and conflict, for example, when children kept asking for sweets. A Turkish mother said: “...Of course it sometimes happens that I give in to my child when she keeps nagging for sweets. Obviously, We’re humans, right?”. Parental emotions also played a role. Some parents felt guilty to give their child healthy foods and drinks that they dislike. A mother from the low-SES group said: “I would feel very sorry for him when he opens his mug at school and he would see it has water in it...”.

‘Dietary routines and structure’ and ‘Parental control on a children’s diet at home’

Parents differed in opinion about the difficulty of reducing the frequency of sugar consumption at home. Mainly the parents with a high confidence (especially in the focus groups with Dutch parents of high SES) experienced little difficulty in controlling children’s intake of sugary foods and drinks when they are indoors. Perceived facilitators included family structure and parents’ ability to monitor their child’s dietary intake at home. Many of these parents said to have a regular and routinized daily eating pattern. A low-SES Dutch mother said: “It’s a standard routine. They have breakfast in the morning, they have one healthy snack and lunch at school, and after school they have one more snack or piece of fruit before dinner. That’s it...”. Having family meals together was believed to add structure to children’s dietary patterns. The same parents also reported to have clear rules and agreements at home about sugar-snacking. A Dutch mother from the high-SES group said: “It’s very easy. They know when they can have a snack or sweets. They are familiar with the rules and, I mean, there is just no debate about that” and another mother added: “They are not allowed to take snacks from the kitchen cupboard”. Many of these parents also agreed that parental monitoring helped to control their child’s sugar consumption at home, because they were able to supervise children in their direct presence.

In contrast, there were also many parents (more often in the focus groups with parents from lower SES and ethnic groups) who perceived barriers to limit their child’s consumption of sugary foods and drinks at home, in particularly in the weekends. These parents described less daily structure and less clarity and consistency of rules and agreements about sugar-
snacking. A low-SES Dutch mother said: “In the weekend … Oh well, than I also take something when I have an appetite for food” and a Turkish mother said: “He just gets candy or cookies when he asks for it and I think; Yes, now it’s ok”. Furthermore, many of them reported situations at home in which they felt unable to monitor their child’s diet, e.g. when they are not in their child’s direct presence or when they can’t pay attention because they are occupied with other activities at home. A high-SES Dutch mother said: “In the weekends, it often happens that they wake up earlier than we do, and then they’ve already had a cookie-breakfast”.

‘Social environment (family, friends, neighbours, etc.)’

Many parents agreed that they had little control over their child’s dietary intake when children were outdoors. Some of the parents reported that children were often indulged with sweets and snacks when visiting neighbours, grandparents or food shops, such as the bakery or butcher. A high-SES Dutch mother said: “Grandparents are the worst of course. It’s unbelievable how much food they get when they’re visiting. Always lots of crisps and sweets during the day… And often my mother also puts down a bowl of candy in the evening. She just likes to spoil them”. In case of an exception, this was often not seen as a problem. However, parents expressed concern when children frequently visited friends or family where they applied different norms and rules about sugar-snacking, or if someone who regularly looked after the children used different rules. A low-SES mother said: “My mother was often babysitting and I found it very hard to ask her to follow my rules and advice, because I didn’t want to offend her…”.

‘School environment and peer pressure’

Many of the parents who felt it was relatively easy to control children’s sugar intake at home reported many barriers to ensure a healthy diet at school. They perceived a lot of peer pressure from other parents who gave their child sweets or unhealthy snacks to school. A high-SES Dutch mother said: “I’ve seen what parents give their children to school; chocolate bars, almond cakes, it’s shocking!” and a Moroccan mother said: “It’s not mandatory to give your child a snack to school, but the 10 ‘o clock snack-break is obviously a very social thing. And of course it’s not very nice for him when he’s the only one who doesn’t have something yummy”. Yet, other parents, mainly those who reported barriers at home, expressed the belief that school helped to limit children’s sugar consumption due to routinized structure and dietary regulations at school. A Moroccan
father said: “On weekdays it’s much easier to reduce the number of eating and drinking moments, because at school they have fixed mealtimes. It’s just routine” and a Dutch mother from the low-SES group said: “At our school we have a newsletter in which parents are explicitly advised to give children fruit or a vegetable snack to school”. Birthday treats were seen as a barrier to ensure a healthy diet at school. Furthermore, a few parents expressed concern about children’s increasing autonomy with growing age. A high-SES Dutch mother said: “I don’t want to know what’s going to happen when they’re going to high school. I mean... the gulls know exactly at what time children have lunch break... Children throw their sandwiches into the trash bin and they use their pocket money to buy their own food at the school canteen...”.

‘Supermarket’, ‘Commercials & television’ and ‘Affordability of foods & drinks’
A few parents acknowledged the impact of commercials, television and supermarkets on children’s dietary wishes, however, many of them said this did not influence their purchasing behaviour, or only on exceptional occasions. A Turkish mother said: “… They’re certainly influenced by commercials. That’s where they get their ideas from, as well as from their classmates. They often come with suggestions ‘Mom, I’ve seen this, can you buy that next time?’ I sometimes do when it’s a holiday for example”.
A Dutch mother from the low SES-group said that prices influenced what foods and drinks she bought for her children, but not in a health adverse way: “I live on a very tight budget, so I really have to be cautious with how I spend my money. First I buy the things I need, such as fresh fruits, vegetables, bread and meat, and if I have money left I can buy extra’s, such as potato chips or chocolate eggs for Easter”.

2. Parental views on limitations and opportunities for professional oral health support

Parents were encouraged to give their opinion about current oral health interventions in general and they were asked what further support they think is needed to promote children’s oral health. Responsibilities and opportunities for oral health support were identified at four professional and institutional settings: dental professionals, child health centres, school and Kindergarten and other institutions, including social welfare and health insurance companies. Table 2 presents an overview of perceived limitations and suggested support per health profession/institution.
### Table 2. Parental views on limitations of and opportunities for professional support to promote children’s oral health

<table>
<thead>
<tr>
<th>Setting</th>
<th>Perceived limitations</th>
<th>Opportunities</th>
</tr>
</thead>
</table>
| Dental professionals     | Little priority for prevention and advice  
Limited involvement of parents  
Dissatisfaction with content of dental health education:  
  - Insufficient and very general information  
  - Complicated and conflicting messages  
Dissatisfaction with delivery of dental health education:  
  - Tone | Encouraging dental visits at an early age  
Delivering dental health education in group discussions  
Improving the content of dental health education:  
  - Simple, clear and consistent messages  
  - Tailored advice  
Improving the delivery of dental health education:  
  - Increasing attention and expression of understanding |
| Child health centres     | Little priority for oral health promotion  
Dissatisfaction with content of dental health education:  
  - Insufficient and very general information  
  - Complicated and conflicting messages (oral health and general health) | Referring to a (paediatric) dentist at an early age  
Integrating dental health education into general consultation visits (e.g. by assistant in waiting room)  
Providing information leaflets or showing video’s in waiting room |
| Schools                  | Age of children: late advice and prevention  
School dental health education: no long term effect on behaviour change | Delivering dental health education at schools  
Organizing theme projects at schools  
Implementing dietary regulations at schools  
Promoting fruit days at schools |
| Kindergarten             |                                                                                       | Organizing tooth brushing group activities: learning by doing  
Delivering dental health education to parents in group discussions at the day care centre |
| Social welfare           |                                                                                       | Collaborating between dental professionals and social welfare; providing parenting support |
| Health insurance companies | Commercial interests  
Privacy issues | Providing information leaflets and oral hygiene aids  
Providing lists of dental practices in the area |
Parents’ views on barriers, facilitators and professional support

‘Dental professionals’ and ‘Child health centres’

The provision of oral health support was mainly considered the responsibility of dental professionals, since it’s their area of expertise. Parents also said that the role of child health centres in caries prevention could not be ignored, as they reach a large proportion of the population, because families regularly visit the centres for child health and growth monitoring from an early age. Suggested tasks for child health centres included the provision of dental advice to novice parents and to ensure timely visits to a dental practice. Many parents reported that (dental) health care professionals spend little time on informing parents about caries prevention, and they felt that attention and subsidies for public oral health promotion has decreased over the years. Many parents expressed the desire to receive proper oral health information, starting early in a child’s life. Common requests were to receive clear and tailored advice and practical tips to help the implementation of dentally healthy behaviours for their child (e.g. using stickers as a daily incentive or an alarm to facilitate brushing, placing a tooth brush downstairs, receiving tips on non-cariogenic snacks, etc.). They also stressed that they wanted to feel heard and supported by the person providing the health information, rather than feeling blamed. A high-SES Dutch mother said: “It’s so frustrating when you get an accusing comment, such as ‘Are you really re-brushing his teeth?’ Right away! It would be much more helpful if they say ‘Well, this is already going ok, but this could need some attention’. A positive approach, you know…” Some parents preferred to receive health information in group sessions, as they reported positive experiences. Another high-SES Dutch mother said: “I really enjoyed the health information sessions that they organized at the dental centre. I really learned a lot and I’m still benefitting from them”.

‘Schools’ and ‘Kindergarten’

Parents also discussed opportunities to improve children’s oral health behaviours via schools. Some parents suggested that oral health education at schools or theme projects about oral health may be useful to raise awareness about oral health in children. However, there were also some parents who questioned the long-term benefit of school health education, especially when parents were not involved. A low-SES Dutch mother said: “...No, that’s only temporary. You can’t expect children to start brushing their teeth until they’re 6, 7 or 8 years old after only one class. That’s really up to the parent to get that done”. Other recommendations at schools involved the introduction of fruit days and the implementation of dietary regulations, e.g. prohibiting sugary snacks during break time.
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A few parents suggested organizing tooth brushing group activities at Kindergarten. Kindergarten was also seen as an opportune setting to target parents for early dental advice in group sessions.

‘Social welfare’
A few parents discussed the option of collaborating with institutions, such as social welfare or youth care services, to provide parental support for families who experience multiple difficulties with raising their child: a high-SES Dutch mother said: “If a parent doesn’t succeed to get his or her child’s teeth brushed then there might be more problems concerning parenting in general. Perhaps social welfare could provide help in these situations, because this is beyond the ability of the dentist”.

‘Health insurance companies’
The potential role of health insurance companies in promoting children’s oral health behaviours was also discussed. Some parents raised concerns due to privacy issues and possible conflicting commercial interests. However, other parents said they appreciated to receive information leaflets with age-focused dental advice, e.g. complemented with oral hygiene aids. Also, a list of (paediatric) dental practices in the area was welcome.

DISCUSSION

This qualitative study provided an elaborate description of the influences on children’s oral health behaviours from the perspective of parents of 7-year old children from the Netherlands. Two models were introduced which include barriers of and facilitators to the adherence of twice daily tooth brushing with fluoride toothpaste and controlling the consumption of sugary foods and drinks. Furthermore, parents were asked to give their opinion about limitations and opportunities for professional support to promote children’s oral health.

This was one of the first studies that used a comprehensive qualitative approach to explore both parents’ perceptions on the determinants of children’s key oral health behaviours, as well as their views and ideas for professional oral health support. Previous qualitative studies in the dental literature solely focussed on tooth brushing behaviour
Parents’ views on barriers, facilitators and professional support

(21-23) or beliefs, attitudes and practices regarding children’s oral health in general (24), or they referred to specific population groups (e.g. cultural groups and children treated under general anaesthesia) (17,25-28). A strength of this study is that the qualitative data allows for in depth exploration of the indirect processes that are involved in the adoption of behaviours, while quantitative data is often restricted to exploring direct associations between predetermined and measurable variables.

However, findings of the current study should be considered in the light of some limitations. First, the generalizability of findings is limited by the qualitative nature of the study. Not all views may have been adequately represented due to a high non-response rate and selection bias, because parents of children who visit a regular dental practice and Turkish and Moroccan parents who do not speak the Dutch language were not included. However, in the six focus group interviews in this study thematic saturation was reached (34), meaning that additional participants would likely not have added new information enriching the depth or scope of the data. Secondly, parental responses may have been influenced by the opinions and perceptions of more vocal parents, although the assistant-moderator obviated this to a certain extent. In addition, the choice of location at the dental centre may have increased the risk of parents responding in a socially desirable manner.

Perceived influences on children’s tooth brushing behaviour were primarily located within the direct family environment. The role of parents and the family as mediators/ moderators of children’s oral health behaviours is also increasingly acknowledged in the dental literature (35). In terms of children’s consumption of sugary foods and drinks, also many extra-familial factors were felt to be of influence, including the school, the social environment, commercials and television, supermarkets and affordability of foods. This concurs with findings from the obesity literature on factors influencing children’s dietary behaviours in general (36). Although generally the same themes of influences were discussed in each focus group interview, parents in the Turkish, Moroccan and low SES focus groups more often perceived genetics to play a role in caries aetiology and they often identified barriers within the direct family environment, while parents from high SES focus groups more commonly reported barriers at school or the social environment.

However, the qualitative design of this study does not allow quantification of differences between ethnic and social groups, but the findings indicate that this is an important area that needs more examination in quantitative research.
The focus group interviews also revealed information on the limitations that parents experienced with current oral health interventions and their opinions about further support that is needed to help parents in establishing good oral health for their children. Parents discussed limitations and opportunities at multiple professional disciplines, namely dental professionals, child health centres, schools and Kindergarten, and other health institutions. Their suggestions for improvement concerned the desire to receive clear and tailored oral health information, starting from a child’s early age. Perceived obstacles referred to the complexity of current advice and the wide diversity in recommendations, which were sometimes also in conflict with recommendations received elsewhere. A recent review also highlighted a wide difference in recommended tooth brushing methods by dental associations, professionals, companies and texts (37). This is a serious concern to all (dental) health professionals. This highlights the urgent need for achieving consensus on clear, simple and evidence-based oral health recommendations, both within the dental profession and between all disciplines that could play a role in children’s oral health, e.g. by broad implementation of guidelines. Another complaint of parents was that oral health advice was often delivered using a victim-blaming tone. Parents indicated to be more susceptible for advice if they felt positive involvement and understanding from health professionals. However, while dental health information can be a prerequisite to engage in dentally healthy behaviours, there is limited evidence for the effectiveness of a purely educative approach in achieving long-term behaviour change (5,38). The current study demonstrated that many parents in the focus groups possessed sufficient oral health knowledge and motivation, but they still reported many barriers to adhere to the advice. This suggests that where parents accept preventive health messages, many need support in implementing them. However, the suggestions that parents raised for professional oral health support were minimally related to the barriers they experienced within their own family. Thus, there was a clear discrepancy between the perceived ‘problems’ and the suggested ‘solutions’. Therefore, for future qualitative research, it would be interesting to ask parents directly how they think that each reported barrier could be addressed in interventions. Many reported barriers in this study seemed to revolve around the family environment. Therefore, a family-based approach may be effective in dental caries prevention, which focuses on active parent involvement in children’s disease prevention, targeting multiple family members rather than that of the child alone (39). Those interventions may include
components to improve parents’ dental self-efficacy and beliefs, and training of parenting skills (e.g. positive reinforcement, child management) and habit formation (e.g. establishing daily routines). As parental support cannot only rest with dental health professionals, a multidisciplinary approach seems necessary. This view was shared by general dental practitioners from the United Kingdom, who felt isolated in their efforts to promote the oral health of high-risk children and reported the need to broaden the involvement of partners from primary care settings (40). Integrated care requires short links and clear communication lines between dental professionals, child health centres, schoolteachers and social welfare. This simultaneously provides the opportunity to introduce a referral system between disciplines to ensure timely and adequate (oral) health support.

In conclusion, this qualitative study provided detail regarding parental views on the influences on children oral health behaviours and their opinions on what further support is needed to promote children’s dental health. Their suggestions for professional oral health support can guide the development or improvement of caries preventive interventions. Important suggestions included the provision of clear oral health education using a positive approach, early referral to a dental practice, dietary regulations at school and a multidisciplinary approach in providing parental support, in which dental professionals, child health centres and other institutions work closely together to promote children’s oral health.

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REFERENCES


Parents’ views on barriers, facilitators and professional support


Parents’ views on barriers, facilitators and professional support
CHAPTER 3

The relationship between parenting, family interaction and childhood dental caries: a case-control study
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 to 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, $\chi^2$-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.
CHAPTER 3

INTRODUCTION

Early childhood is a critical phase in which important foundations for lifelong health are laid (1). 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 (2,3). 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 (4,5). 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 (5).

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 warm and affectionate family interactions (6,7). 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 (8-12). In terms of physical health, ineffective parenting (in particular parenting characterized 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 (5,13-16).

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 (17). 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. (18) found that children with good family functioning and family relationships in terms of organization, 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 (19,20).

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 (21,22). 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 (23). 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 (18). 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 standardized tasks in which a trained observer subsequently rates parenting and family interaction, external to the family. Some researchers claim this method generates more objective and thus more valid data (24). 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.

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.
CHAPTER 3

Parenting, family interaction and childhood dental caries

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 ≥ 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 (25). For each case, an age-matched (+/- 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 5-year-old children in the 2006 Dutch National Oral Health Survey (25).

Data collection

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 standardized 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/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.

**Parenting practices and parent-child interaction**

Parenting practices and parent-child interaction were observed using Structured Interaction Tasks (SIT) (26-28). This observational method derives strength from its basis in the Social Interaction Learning model (29). 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 (30). 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 characterized 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 criticize 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 5-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 categorized 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.

**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 categorized 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 5-point Likert-scale from ‘very poor’ to ‘excellent’.

**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 $\chi^2$-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 socio-demographic 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.
RESULTS

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.

Analysis of parenting practices and parent-child interaction
Correlation matrix
Table 2 shows that all parenting dimensions, except for some dimensions with discipline, were moderately to strongly inter-correlated. 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).
Table 1. Distribution of sociodemographic characteristics, oral health behaviours and parental oral health status between cases and controls.

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

*p*χ²-test
*a* missing data for 4 children
Table 2. Correlation matrix of dimensions of ‘parenting practices and parent-child interaction’.

<table>
<thead>
<tr>
<th></th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
<th>6.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Positive involvement</td>
<td></td>
<td>0.71*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Encouragement</td>
<td>0.71*</td>
<td></td>
<td>0.50*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Problem solving</td>
<td>0.50*</td>
<td>0.70*</td>
<td></td>
<td>0.41*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Discipline</td>
<td>0.12</td>
<td>0.34</td>
<td>0.41*</td>
<td></td>
<td>0.16</td>
<td></td>
</tr>
<tr>
<td>5. Coercion*</td>
<td>-0.51*</td>
<td>-0.68*</td>
<td>-0.51*</td>
<td></td>
<td>0.16</td>
<td></td>
</tr>
<tr>
<td>6. Interpersonal atmosphere</td>
<td>0.38*</td>
<td>0.50*</td>
<td>0.65*</td>
<td>0.43*</td>
<td>-0.48*</td>
<td></td>
</tr>
</tbody>
</table>

Pearson correlation, *p < 0.01

* Categorized into three groups: ‘not coercive’, ‘slightly coercive’ and ‘quite coercive’.

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.

Table 3. Mean scores and standard deviations of dimensions of ‘parenting practices and parent-child interaction’ between cases and controls.

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Cases ($n = 28$)</th>
<th>Controls ($n = 26$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean ± SD</td>
<td>range</td>
</tr>
<tr>
<td>Positive involvement</td>
<td>50.4 ± 4.6</td>
<td>36-58</td>
</tr>
<tr>
<td>Encouragement</td>
<td>74.4 ± 9.1</td>
<td>56-92</td>
</tr>
<tr>
<td>Problem solving</td>
<td>89.2 ± 11.6</td>
<td>70-123</td>
</tr>
<tr>
<td>Discipline</td>
<td>123.3 ± 11.5</td>
<td>80-130</td>
</tr>
<tr>
<td>Interpersonal atmosphere</td>
<td>98.2 ± 8.3</td>
<td>69-109</td>
</tr>
</tbody>
</table>

*p* Independent samples $T$-test
Table 4. Distribution (n, %) of coercive behaviours between cases and controls.

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Cases (n = 28)</th>
<th>Controls (n = 26)</th>
<th>p*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Not coercive</td>
<td>10</td>
<td>35.7</td>
<td>16</td>
</tr>
<tr>
<td>Slightly coercive</td>
<td>9</td>
<td>32.1</td>
<td>9</td>
</tr>
<tr>
<td>Quite coercive</td>
<td>9</td>
<td>32.1</td>
<td>1</td>
</tr>
</tbody>
</table>

*χ²-test

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 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’.

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

* Logistic regression  
* OR (95% CI) = odds ratio (95% confidence interval)  
* B = partial logistic regression coefficient  
* SE = standard error of the partial slope coefficient  
* Hosmer and Lemeshow goodness of fit test.  
* 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.  
* Categorized into three groups; ‘not coercive’, ‘slightly coercive’ and ‘quite coercive’.  

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CHAPTER 3
DISCUSSION

This study found a significant relationship between parenting practices, parent-child interaction and childhood dental caries in a sample of 5 to 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 4 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 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, characterized 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 (31,32). Patterson et al. (33) termed these rigid coercive sequences, which have also been demonstrated empirically (34,35). 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 (12,36). 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) (37).

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 (38). 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. (39) 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 (40).

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 (21). Therefore, observed 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 generalizability 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 (41,42). 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 (43). 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 (44,45), locus of control (46) and sense of coherence (47). 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

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CHAPTER 4

Parental and family-related influences on dental caries in children of Dutch, Moroccan and Turkish origin
The aim of this cross-sectional study was to investigate the relationship between parental and family-related factors and childhood dental caries in a sample of 5- to 6-year-old children of Dutch, Moroccan and Turkish origin. Furthermore, the relationship of parental and family-related factors with social class and ethnicity was examined. The study sample included 92 parent-child dyads (46 cases and 46 controls), which were recruited from a large paediatric dental centre in the Hague, the Netherlands. Cases were children with 4 or more decayed, missing or filled teeth and controls were caries free. Validated questionnaires were used to collect data on sociodemographic characteristics, oral health behaviours, parents’ dental self-efficacy and locus of control (LoC), parenting practices and family functioning. Parenting practices were also assessed using structured video observations of parent-child interactions. Parents of controls had a more internal LoC and they were more likely to show positive (observed) parenting in terms of positive involvement, encouragement and problem solving, compared to cases ($p < 0.05$). Lower social class was significantly associated with a lower dental self-efficacy, a more external LoC and poorer parenting practices. Furthermore, LoC was more external in Moroccan and Turkish parents, compared to Dutch parents. In conclusion, parents’ internal LoC and observed positive parenting practices on the dimensions positive involvement, encouragement and problem solving were important indicators of dental health in children of Dutch, Moroccan origin and Turkish. Findings suggest that these parental factors are potential mediators of socioeconomic inequalities in children’s dental health.
Although significant improvements in children’s oral health have occurred in many Western countries over the last 30 years, oral health inequalities have emerged as a major public health challenge (1,2). Higher levels of dental caries are found among children from lower socioeconomic backgrounds and certain ethnic minority groups (3,4). In the Netherlands, the prevalence and severity of dental caries is highest among Dutch children from lower social classes and children of Moroccan and Turkish origin (5,6). These latter ethnic groups constitute 12-20% of the population in the larger cities in the Netherlands and they are overrepresented in the lower socioeconomic strata (7).

High-risk populations apparently fail to sufficiently benefit from conventional approaches in caries prevention. These approaches often focus on achieving individual behaviour change through dental health education and awareness raising programmes. The assumption of these approaches is that children and/or parents will alter their behaviour once they acquire the relevant knowledge and motivation (8). However, systematic reviews have reported on the limited effectiveness of educational interventions to produce sustained improvements in oral health outcomes, particularly in those from lower socioeconomic position and ethnic minority groups (9,10). Therefore, a paradigm shift in caries prevention is needed towards innovative strategies that address the underlying determinants of childhood dental caries. The development of such strategies requires understanding of the full range of oral health determinants and the mechanisms by which socioeconomic conditions and ethnicity affect children’s dental health.

One factor that plays an important role in the development of childhood dental caries is the family (11). The family provides the child’s proximate home environment that promotes certain oral health-related behaviours, expectations, beliefs and social norms. Parental attributes, parenting practices and overall family functioning all capture components of the family system; yet, they are distinct constructs that may differentially influence children’s caries experience. Parental attributes are characteristics of the parents that may influence the quality of the home environment. Examples of parental attributes that were associated with higher levels of childhood dental caries include parental stress (12,13), low sense of coherence (14,15), maternal depression (16), low dental self-efficacy (17-19) and an external dental health-related locus of control (LoC) (17,20). Parenting practices refer to parental behaviours specifically directed towards raising the child. A recent
study reported a significant relationship between parenting practices and children’s oral health outcomes (21), while two other studies did not (16,22). Broader family functioning measures relate to the evaluation of interactions between family members at a systemic level, such as parent-child, parent-parent and sibling-sibling relationships, and how these relationships interact to influence overall family functioning (23). Two studies reported that good family functioning, i.e. in terms of responsiveness, involvement, communication and organization/structure, was significantly associated with lower levels of dental decay, better oral hygiene and less frequent consumption of sugary foods in children (24,25).

In summary, the literature acknowledges a range of parental and family factors as possible mediators of caries development in children, yet the evidence relies on few empirical studies. Furthermore, it remains unclear whether these factors could explain socioeconomic and ethnic inequalities in the prevalence of childhood dental caries. Therefore, the aim of this study was to explore the relationship between parental and family-related factors (parents’ dental self-efficacy and LoC, parenting practices and family functioning) and childhood dental caries in a sample of 5- to 6-year-old children of Dutch, Moroccan and Turkish origin. A further objective was to explore the relationship of parental and family-related factors with social class and ethnicity. The hypothesis of this study was that parents of caries free children (controls) had a higher dental self-efficacy, a more internal LoC and more positive parenting practices and family functioning, compared to children with dental caries (cases). Furthermore, it was hypothesized that these parental and family-related factors were more favourable in parents from higher social classes and those of Dutch origin, compared to parents from lower social classes and those of Moroccan or Turkish origin, respectively.

**MATERIALS AND METHODS**

Ethical approval for this study was obtained from The Central Committee on Research Involving Human Subjects, the Netherlands (CCMO). Prior to data collection, all participating parents provided written informed consent.
Study sample
Data for this study were collected between September 2013 and March 2014. Participants were recruited from a large paediatric dental care centre in the Hague, the Netherlands. The centre works in partnership with elementary schools and has several clinics in different geographical regions in the city that vary greatly in terms of socioeconomic level and immigrant population.

All 5- and 6-year-old children that were of Dutch, Moroccan and Turkish origin were selected. Children were considered of Dutch origin if both their parents were born in the Netherlands. Children were classified as Moroccan or Turkish if (i) both their parents were first-generation immigrants, or (ii) if one parent was a first-generation immigrant and one parent was a second-generation immigrant. Subsequently, children were selected and allocated according to their dental condition into two groups: cases and controls. Cases were defined as children with 4 or more decayed, missing or filled deciduous teeth (dmft ≥ 4) and controls had no decayed, missing or filled teeth in both their deciduous and permanent dentition (dmft/DMFT = 0, referred to as ‘caries free’). A dmft value of 4 was chosen to define cases, because it corresponds with the mean and median dmft of 5-year-old children with dental caries in the 2006 Dutch National Oral Health Survey (26). Children diagnosed with emotional and behavioural disorders (e.g., autism spectrum disorders), children with special needs and children with tooth enamel defects were excluded from study selection. Only one child per family was included. The sample size was determined on the basis of a previously conducted study by de Jong-Lenters et al. (21), for which a power calculation indicated that a minimum sample size of 42 children would be necessary to detect differences in parenting variables between cases and controls (if present). However, the sample size of this study was increased further to ensure enough participants in the socioeconomic and ethnic subgroups to be compared.

An information letter about the study was sent to the home address of all eligible children (n = 271; 165 cases and 106 controls). The parents of the children were subsequently contacted by telephone and kindly requested to participate. A total of 92 parent-child dyads participated in the study, including 46 cases and 46 controls (response rate = 34 %). The response rate varied from 13 % in Turkish cases to 57 % in Dutch controls. Common reasons for non-participation in the ethnic minority groups were the language barrier and difficulties with transportation to the dental care centre, while the Dutch group reported no interest and/or no time as main reasons for non-participation. Participation
involved a 90-minute visit of the child and a parent to the paediatric dental care centre. Incentives for the study included a monetary voucher for the parent (20 euro's) and a small gift and oral hygiene kit for the child.

Data collection

Dental health data

Children’s dmft scores were obtained from personal dental health records from the paediatric dental centre. The diagnosis of dental caries was based on clinical examinations (supported by dental x-rays), which were performed by dentists working at the centre. The centre registers data in a systematic manner to ensure that records are up-to-date and complete. The dental status of children’s primary dentition was extracted using data from the last dental visit, which had been no more than 6 months before the time of data collection for this study. The dmft score was calculated by adding the number of decayed, missing (due to caries), and filled teeth. Missing teeth as a result of dental trauma, hypomineralization, agenesis or routine exfoliation were not included in the dmft scores. Enamel caries lesions were also not included. Data extraction was performed by one researcher (DD), who holds a Bachelor of Science degree in Dentistry.

Sociodemographic and behavioural data

A parental self-report questionnaire was used to collect data on sociodemographic characteristics and oral health behaviours. Sociodemographic variables included the mother’s highest completed level of education, family income and family structure. The mother’s education level was used as an indicator for social class and was categorized into (i) lower education (no education, elementary school and secondary school at lower level), (ii) medium education (secondary school at higher level and further education at lower level) and (iii) higher education (further education at higher level and university). The oral health behaviours measured were tooth brushing frequency, the age tooth brushing was started, parental involvement with tooth brushing and the frequency of consuming sugary foods and drinks between meals.

Parental and family-related variables

Table 1 presents an overview of parental and family-related variables measured in this study. For each variable a definition is described.
Parental oral health-related attributes

Parents’ dental self-efficacy and dental health LoC were measured using a validated questionnaire developed by Pine et al. (27). This questionnaire assesses parental beliefs and attitudes associated with children's oral health behaviours, including sugar snacking and tooth brushing with fluoride toothpaste.

Parenting practices

Different approaches to measuring parenting practices have been devised, which include self-report questionnaires (‘insider’s view’) and observational methods that rely on ratings from an observer external to the family (‘outsider’s view’). Since there is little congruence in parenting assessment between these two methodologies (28), both observational and self-report methods were used to measure parenting practices in this study.

The self-report Alabama Parenting Questionnaire (APQ) was used to measure parenting practices on three dimensions: involvement, positive parenting and inconsistent discipline (29). The APQ was designed to tap the most important aspects of parenting practices related to disruptive behaviour problems in children. The measure demonstrated adequate levels of reliability and construct validity (29).

Parenting practices were also observed using Structured Interaction Tasks (SIT) (30-32). This observational method measures relevant aspects of parenting practices known to impact on children’s socio-emotional development and behaviours. The SIT contains seven structured tasks, which are performed by the child and the parent in a quiet room at the paediatric dental care centre. Tasks include: 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 home (7 min), snack break (5 min), problem solving on a topic selected by the child (5 min), teaching/learning tasks (9 min), and a monitoring task in which the parent interviews the child about a moment when the child was not in the parent’s direct presence (5 min). All parent-child interactions were videotaped. The video material was rated using an objective coding system, based on the Coder Impressions (33). The coding system contains specific items for each SIT task, as well as general items related to the overall quality of the interaction between parent and child during the entire session. Items measure 6 underlying dimensions of parenting practices: positive involvement, encouragement, problem solving, discipline, coercion and interpersonal atmosphere. All observations were coded by one trained and calibrated observer who was blind to the
dental condition. A random selection of 12 observations (13 %) 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 72.5 % and 94.4 %, respectively. The intra-class correlation was 0.88.

**Family functioning**

Family organization and social network were assessed by the Gezinsvragenlijst (GVL, translation ‘Family Questionnaire’), a validated measure to assess family functioning and the quality of family relationships (24,34). Psychometric evaluation supported the reliability and the validity of the GVL (34).

The questionnaire items by Pine et al. and the APQ-items were translated into Dutch and back translated. The self-report questionnaires were interview-administered if a parent was illiterate. All items of the questionnaire by Pine et al., the APQ, the SIT and the GVL were measured on a 5-point Likert scale. A cumulative score for each dimension was computed. The number of items per dimension, the range of the scores, the direction of scores and the internal consistency for each variable in the present sample are presented in Table 1.

**Statistical analysis**

Statistical analysis was carried out using SPSS (Version 20, IBM Corp.). Independent samples T-tests were performed to compare mean scores of parental and family-related variables between cases and controls. Furthermore, logistic regression analysis was conducted for the association of parental and family-related variables with the dental condition as the dependent variable (control vs. case). To test whether social class and ethnicity modified the effects of parental and family-related variables on the dental condition, interaction terms with social class and ethnicity were introduced into the regression models. Presence of interactions was subsequently examined using the likelihood ratio test. Differences in parental and family-related variables between socioeconomic groups and Dutch, Moroccan and Turkish groups were compared using analysis of variance (ANOVA). A p-value of < 0.05 was considered significant.
Table 1. Definition, number of items (score range), direction of scores and internal consistency for parental and family-related variables.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Definition</th>
<th>No. of items (score range)</th>
<th>Direction*</th>
<th>Cronbach’s α</th>
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<tr>
<td>Oral health-related attributes</td>
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<tr>
<td>Dental self-efficacy</td>
<td>Parents’ confidence in their ability to engage in healthy oral health practices for their child.</td>
<td>9 (9-45)</td>
<td>+</td>
<td>0.67</td>
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<tr>
<td>Locus of control</td>
<td>Parents’ belief towards their ability to control the dental health of their child: health-external persons interpret health as dependent on outside forces (e.g. luck, responsibility of the dentist or genetics), whereas health-internal persons believe that health is determined by one’s own behaviour.</td>
<td>9 (9-45)</td>
<td>+</td>
<td>0.83</td>
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<tr>
<td>Parenting practices (APQ)</td>
<td></td>
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<tr>
<td>Involvement</td>
<td>Parents’ interest in the child’s activities and positive interactions with the child.</td>
<td>10 (10-50)</td>
<td>+</td>
<td>0.65</td>
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<tr>
<td>Positive parenting</td>
<td>The frequency of praise and positive reinforcement for prosocial child behaviour.</td>
<td>6 (6-30)</td>
<td>+</td>
<td>0.69</td>
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<tr>
<td>Inconsistent discipline</td>
<td>Parents’ irregular and unpredictable use of discipline practices and child punishment.</td>
<td>6 (6-30)</td>
<td>-</td>
<td>0.52</td>
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<tr>
<td>Parenting practices (SIT)</td>
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<tr>
<td>Positive involvement</td>
<td>The degree to which family interactions are characterized by warmth, empathy and positive affect and whether parents show an active interest in their child’s experiences.</td>
<td>12 (12-60)</td>
<td>+</td>
<td>0.77</td>
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<td>Encouragement</td>
<td>The extent to which parents stimulate their child’s independence through positive endorsement, reinforcement and offering help when necessary.</td>
<td>20 (20-100)</td>
<td>+</td>
<td>0.87</td>
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<tr>
<td>Problem solving</td>
<td>Parents’ ability to generate solutions that are feasible for the child, and the extent to which the parent and child are both involved in the decision making process and are open to each other’s viewpoints.</td>
<td>27 (27-135)</td>
<td>+</td>
<td>0.91</td>
</tr>
<tr>
<td>Discipline</td>
<td>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.</td>
<td>26 (26-130)</td>
<td>+</td>
<td>0.80</td>
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<tr>
<td>Coercion</td>
<td>The degree to which parents have the tendency to criticize their children, be overly strict and demanding and use harsh and inconsistent disciplinary actions.</td>
<td>16 (16-80)</td>
<td>-</td>
<td>0.61</td>
</tr>
<tr>
<td>Interpersonal atmosphere</td>
<td>The extent to which parent-child interactions are pleasant, comfortable and free of conflict and frustration.</td>
<td>24 (24-95)</td>
<td>+</td>
<td>0.70</td>
</tr>
<tr>
<td>Family functioning</td>
<td></td>
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<tr>
<td>Organization</td>
<td>The degree of structure, routines, and assignment of roles in the family, as well as the family’s ability to resolve problems.</td>
<td>9 (9-45)</td>
<td>+</td>
<td>0.64</td>
</tr>
<tr>
<td>Social network</td>
<td>The extent to which the family can rely on support from people in their social environment.</td>
<td>9 (9-45)</td>
<td>+</td>
<td>0.84</td>
</tr>
</tbody>
</table>

* '+' = higher scores reflect positive outcomes, '-' = higher scores reflect negative outcomes.
### Results

#### Description of the sample

The study sample included 92 parent-child dyads (46 cases and 46 controls), consisting of 35 Dutch children (14 cases and 21 controls), 31 Moroccan children (18 cases and 13 controls) and 26 Turkish children (14 cases and 12 controls). Seventy-four percent of the participating parents were biological mothers and 26 % were biological fathers. The mean age of the children was 6.1 ± 0.5 years (range = 5.3 - 6.9). Cases had an average dmft of 6.5 ± 2.3 (range = 4 - 12), while controls had a mean dmft/DMFT of 0.0 ± 0.0. Sample characteristics are summarized in Table 2. Girls were significantly overrepresented in cases (69.6 %) compared to controls (47.8 %). Cases and controls did not differ significantly in mother’s education level, family income, birth order of the child and relationship status of the parents. In terms of oral health behaviours, cases reported more frequent consumption of sugary foods between meals compared to controls (although this was only a trend, p = 0.06), but this was not the case for consumption of sugary drinks. There were no statistical differences in tooth brushing frequency; age tooth brushing was started and parental involvement with tooth brushing between cases and controls.

#### Correlations between parental and family-related factors

A correlation matrix of all parental and family-related factors is presented in Table 3. A higher dental self-efficacy was significantly associated with a more internal LoC (Pearson’s $r = 0.41$). Dental self-efficacy and LoC were also moderately correlated with several (observed) parenting dimensions, including positive involvement, encouragement and problem solving. The majority of the SIT dimensions were moderately to strongly intercorrelated. In particular, strong associations were found for encouragement with problem solving and coercion (r = 0.59 and r = -0.59, respectively), and for problem solving with interpersonal atmosphere (r = 0.60).

As expected, there was limited congruence between parenting practices measured with the APQ (self-report method) and parenting practices measured with the SIT (observational method). Correlations were $r = 0.24$ (significant at $p = 0.03$) for APQ-involvement and SIT-positive involvement, $r = 0.06$ (not significant) for APQ-positive parenting and SIT-encouragement and $r = -0.31$ (significant at $p = 0.003$) for APQ-inconsistent discipline and SIT-discipline.

<table>
<thead>
<tr>
<th>Variables Definition</th>
<th>No. of items (score range)</th>
<th>Direction*</th>
<th>Cronbach’s α</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Oral health-related attributes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dental self-efficacy Parents’ confidence in their ability to engage in healthy oral health practices for their child.</td>
<td>9 (9-45)</td>
<td>+0.83</td>
<td></td>
</tr>
<tr>
<td>Locus of control Parents’ belief towards their ability to control the dental health of their child: health-external persons interpret health as dependent on outside forces (e.g. luck, responsibility of the dentist or genetics), whereas health-internal persons believe that health is determined by one’s own behaviour.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Parenting practices (APQ)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Involvement Parents’ interest in the child’s activities and positive interactions with the child.</td>
<td>10 (10-50)</td>
<td>+0.65</td>
<td></td>
</tr>
<tr>
<td>Positive parenting The frequency of praise and positive reinforcement for prosocial child behaviour.</td>
<td>6 (6-30)</td>
<td>+0.69</td>
<td></td>
</tr>
<tr>
<td>Inconsistent discipline Parents’ irregular and unpredictable use of discipline practices and child punishment.</td>
<td>6 (6-30)</td>
<td>-0.52</td>
<td></td>
</tr>
<tr>
<td><strong>Parenting practices (SIT)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive involvement The degree to which family interactions are characterized by warmth, empathy and positive affect and whether parents show an active interest in their child’s experiences.</td>
<td>12 (12-60)</td>
<td>+0.77</td>
<td></td>
</tr>
<tr>
<td>Encouragement The extent to which parents stimulate their child’s independence through positive endorsement, reinforcement and offering help when necessary.</td>
<td>20 (20-100)</td>
<td>+0.87</td>
<td></td>
</tr>
<tr>
<td>Problem solving Parents’ ability to generate solutions that are feasible for the child, and the extent to which the parent and child are both involved in the decision making process and are open to each other’s viewpoints.</td>
<td>26 (26-130)</td>
<td>+0.80</td>
<td></td>
</tr>
<tr>
<td>Discipline 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.</td>
<td>16 (16-80)</td>
<td>-0.61</td>
<td></td>
</tr>
<tr>
<td>Coercion The degree to which parents have the tendency to criticize their children, be overly strict and demanding and use harsh and inconsistent disciplinary actions.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Family functioning</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organization The degree of structure, routines, and assignment of roles in the family, as well as the family’s ability to resolve problems.</td>
<td>9 (9-45)</td>
<td>+0.64</td>
<td></td>
</tr>
<tr>
<td>Social network The extent to which the family can rely on support from people in their social environment.</td>
<td>9 (9-45)</td>
<td>+0.84</td>
<td></td>
</tr>
</tbody>
</table>

* '+' = higher scores reflect positive outcomes, '-' = higher scores reflect negative outcomes.
### Chapter 4

Parental and family-related influences on dental caries

#### Table 2. Distribution of socio-demographic characteristics and oral health behaviours between cases and controls.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Controls (n = 46)</th>
<th>Cases (n = 46)</th>
<th>p*</th>
</tr>
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<tbody>
<tr>
<td><strong>Sociodemographics</strong></td>
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</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Dutch</td>
<td>21 (45.7)</td>
<td>14 (30.4)</td>
<td>0.31</td>
</tr>
<tr>
<td>Moroccan</td>
<td>13 (28.3)</td>
<td>18 (39.1)</td>
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</tr>
<tr>
<td>Turkish</td>
<td>12 (26.1)</td>
<td>14 (30.4)</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
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<tr>
<td>Boy</td>
<td>24 (52.2)</td>
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<td>Girl</td>
<td>22 (47.8)</td>
<td>32 (69.6)</td>
<td></td>
</tr>
<tr>
<td>Education level (mother)</td>
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<tr>
<td>Lower education</td>
<td>16 (35.6)</td>
<td>23 (50.0)</td>
<td>0.20</td>
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<tr>
<td>Medium education</td>
<td>13 (28.9)</td>
<td>14 (30.4)</td>
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</tr>
<tr>
<td>Higher education</td>
<td>16 (35.6)</td>
<td>9 (19.6)</td>
<td></td>
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<tr>
<td>Family income</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Below modal</td>
<td>16 (36.4)</td>
<td>24 (52.2)</td>
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<tr>
<td>Modal</td>
<td>17 (38.6)</td>
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<tr>
<td>Above modal</td>
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<tr>
<td>Birth order</td>
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<tr>
<td>3rd child or more</td>
<td>9 (20.5)</td>
<td>12 (27.3)</td>
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<tr>
<td>2nd child</td>
<td>19 (43.2)</td>
<td>20 (45.5)</td>
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<tr>
<td>1st child</td>
<td>16 (36.4)</td>
<td>12 (27.3)</td>
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<td>Relationship status</td>
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<td>Single</td>
<td>8 (17.8)</td>
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<td>With partner</td>
<td>37 (87.2)</td>
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<td><strong>Oral health behaviours</strong></td>
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<td>Tooth brushing frequency</td>
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<tr>
<td>(Often) less than twice a day</td>
<td>17 (37.8)</td>
<td>20 (45.5)</td>
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<tr>
<td>Always twice a day or more</td>
<td>28 (62.2)</td>
<td>24 (54.5)</td>
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</tr>
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<td>Age tooth brushing was started</td>
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<td>Two years old or older</td>
<td>5 (11.1)</td>
<td>6 (14.3)</td>
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<td>Between one and two years old</td>
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<td>14 (33.3)</td>
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<tr>
<td>Less than one year old</td>
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<td>22 (52.4)</td>
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<td>Parental involvement with tooth brushing</td>
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<td>Never – sometimes</td>
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<td>Often – always</td>
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<td>Frequency of sugary foods between meals</td>
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<td>Three times or more per day</td>
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<td>23 (52.3)</td>
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<td>21 (47.7)</td>
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<tr>
<td>Frequency of sugary drinks between meals</td>
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<td>Three times or more per day</td>
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<tr>
<td>Twice or less per day</td>
<td>30 (66.7)</td>
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* χ²-test
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<th>APQ-2</th>
<th>APQ-3</th>
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<th>SIT-2</th>
<th>SIT-3</th>
<th>SIT-4</th>
<th>SIT-5</th>
<th>SIT-6</th>
<th>GVL-1</th>
<th>GVL-2</th>
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<td>-</td>
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<td>-0.20</td>
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<td>0.33*</td>
<td>0.24*</td>
<td>0.13</td>
<td>-0.15</td>
<td>-</td>
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<td>SIT-2</td>
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<td>0.44*</td>
<td>0.16</td>
<td>0.06</td>
<td>-0.19</td>
<td>0.48*</td>
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<tr>
<td>SIT-3</td>
<td>0.32*</td>
<td>0.58*</td>
<td>0.23*</td>
<td>0.10</td>
<td>-0.07</td>
<td>0.345*</td>
<td>0.59*</td>
<td>-</td>
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<tr>
<td>SIT-4</td>
<td>0.18</td>
<td>0.12</td>
<td>0.14</td>
<td>0.21*</td>
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<td>0.16</td>
<td>0.26*</td>
<td>0.47*</td>
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<td>-0.13</td>
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<td>-0.21</td>
<td>-0.59*</td>
<td>-0.21*</td>
<td>-0.40*</td>
<td>-</td>
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<td>SIT-7</td>
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<td>0.20</td>
<td>0.16</td>
<td>-0.09</td>
<td>0.23*</td>
<td>0.31*</td>
<td>0.60*</td>
<td>0.36*</td>
<td>-0.07</td>
<td>-</td>
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<tr>
<td>GVL-1</td>
<td>0.31*</td>
<td>0.16</td>
<td>0.37*</td>
<td>0.26*</td>
<td>-0.08</td>
<td>0.09</td>
<td>0.11</td>
<td>0.16</td>
<td>0.07</td>
<td>0.05</td>
<td>0.04</td>
<td>-</td>
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<tr>
<td>GVL-2</td>
<td>0.29*</td>
<td>0.11</td>
<td>0.30*</td>
<td>0.18</td>
<td>-0.17</td>
<td>0.12</td>
<td>0.21*</td>
<td>0.17</td>
<td>0.11</td>
<td>-0.05</td>
<td>0.07</td>
<td>0.38*</td>
<td>-</td>
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</tbody>
</table>

Pearson correlation, *p < 0.05
Differences in parental and family-related factors between cases and controls

Parents’ LoC was significantly more internal in controls than in cases, but parents’ dental self-efficacy did not differ significantly between cases and controls (Table 4). In terms of parenting practices, the SIT dimensions positive involvement, encouragement and problem solving were significantly higher in controls than in cases. Yet, there were no significant differences between cases and controls on any of the APQ dimensions and on the SIT dimensions discipline, coercion and interpersonal atmosphere. Furthermore, cases did not differ significantly from controls in the quality of family organization and social network.

Table 4. Mean scores and standard deviations of parental oral health-related attributes, parenting practices and family functioning between cases and controls.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Controls (n = 46)</th>
<th>Cases (n = 46)</th>
<th>p*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean ± SD</td>
<td>range</td>
<td>mean ± SD</td>
</tr>
<tr>
<td>Oral health-related attributes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dental self-efficacy</td>
<td>35.2±5.8</td>
<td>22-45</td>
<td>34.4±4.8</td>
</tr>
<tr>
<td>Dental health locus of control</td>
<td>31.7±6.8</td>
<td>12-44</td>
<td>27.3±7.6</td>
</tr>
<tr>
<td>Parenting practices (APQ)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Involvement</td>
<td>41.5±4.8</td>
<td>27-50</td>
<td>40.7±4.0</td>
</tr>
<tr>
<td>Positive parenting</td>
<td>26.1±2.4</td>
<td>21-30</td>
<td>26.4±2.8</td>
</tr>
<tr>
<td>Inconsistent discipline</td>
<td>16.0±3.0</td>
<td>10-22</td>
<td>14.9±3.4</td>
</tr>
<tr>
<td>Parenting practices (SIT)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Positive involvement</td>
<td>51.5±4.5</td>
<td>41-59</td>
<td>49.2±4.8</td>
</tr>
<tr>
<td>Encouragement</td>
<td>78.7±8.0</td>
<td>62-92</td>
<td>73.7±8.7</td>
</tr>
<tr>
<td>Problem solving</td>
<td>102.3±12.6</td>
<td>73-128</td>
<td>92.9±13.7</td>
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<tr>
<td>Discipline</td>
<td>122.0±4.9</td>
<td>104-125</td>
<td>121.3±6.9</td>
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<td>Coercion</td>
<td>20.6±4.1</td>
<td>16-34</td>
<td>21.8±4.8</td>
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<tr>
<td>Interpersonal atmosphere</td>
<td>109.9±5.5</td>
<td>94-120</td>
<td>108.7±5.8</td>
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<tr>
<td>Family functioning</td>
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<tr>
<td>Organization</td>
<td>40.0±3.2</td>
<td>34-45</td>
<td>39.4±4.3</td>
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<tr>
<td>Social network</td>
<td>38.2±5.9</td>
<td>20-45</td>
<td>37.1±7.0</td>
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</tbody>
</table>

* Independent samples T-test
Similar associations were found when the association of parental and family-related dimensions with the dental condition was examined using logistic regression (results not shown). Sex-adjusted Odds Ratio’s and 95% confidence intervals were 0.92 (0.86 – 0.98), 0.91 (0.82 – 0.99), 0.93 (0.88 – 0.98) and 0.95 (0.92 – 0.98) for LoC and the SIT dimensions positive involvement, encouragement and problem-solving, respectively, indicating that higher scores on these dimensions were associated with a decreased likelihood of being a case compared to a control. There was no evidence for an interaction with social class or ethnicity: the effect of parental and family-related factors on children’s dental condition did not differ significantly across socioeconomic and ethnic strata.

The relationship of parental and family-related factors with social class and ethnicity

Social class was significantly associated with parental oral health-related attributes and all SIT dimensions, except discipline (Table 6). Parents of children from higher social classes had a higher dental self-efficacy and a more internal LoC. They also showed higher levels of positive involvement and encouragement, better problem solving and a better interpersonal atmosphere during interactions with their child, and they were less likely to show coercive behaviours. The association between social class and the APQ dimension involvement was borderline significant. No significant associations were found for social class with the APQ dimensions positive parenting and discipline, nor with family functioning.

Dutch parents had a more internal LoC (32.7 ± 5.8) compared to Moroccan parents (29.0 ± 7.4, \( p = 0.004 \)) and compared to Turkish parents (25.5 ± 7.9, \( p < 0.001 \)). All other parental and family-related factors were not significantly different between Dutch, Moroccan and Turkish parents (results not shown).
Table 5. Mean scores and standard deviations of parental oral health-related attributes, parenting practices and family functioning between children with lower, medium and higher educated mothers.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Low (n = 39)</th>
<th>Medium (n = 27)</th>
<th>High (n = 25)</th>
<th>p*</th>
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<tbody>
<tr>
<td><strong>Oral health-related attributes</strong></td>
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</tr>
<tr>
<td>Dental self-efficacy</td>
<td>33.5±5.5</td>
<td>34.6±5.8</td>
<td>36.9±5.2</td>
<td>0.04</td>
</tr>
<tr>
<td>Dental health locus of control</td>
<td>24.8±7.7</td>
<td>32.0±4.8</td>
<td>34.2±5.1</td>
<td>&lt;0.001</td>
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<td><strong>Parenting practices (APQ)</strong></td>
<td></td>
<td></td>
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<tr>
<td>Involvement</td>
<td>39.9±3.7</td>
<td>41.6±5.2</td>
<td>42.4±4.2</td>
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<td>Positive parenting</td>
<td>26.1±2.7</td>
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<td>0.27</td>
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<td>15.5±3.7</td>
<td>14.9±2.8</td>
<td>0.63</td>
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<td><strong>Parenting practices (SIT)</strong></td>
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</tr>
<tr>
<td>Positive involvement</td>
<td>48.7±4.8</td>
<td>50.4±4.2</td>
<td>52.6±4.6</td>
<td>0.006</td>
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<tr>
<td>Encouragement</td>
<td>71.2±8.3</td>
<td>78.0±6.9</td>
<td>81.3±7.4</td>
<td>&lt;0.001</td>
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<td>Problem solving</td>
<td>90.3±13.0</td>
<td>100.2±11.5</td>
<td>104.9±13.1</td>
<td>&lt;0.001</td>
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<td>Discipline</td>
<td>120.6±7.1</td>
<td>122.7±4.5</td>
<td>122.1±5.5</td>
<td>0.36</td>
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<tr>
<td>Coercion</td>
<td>23.0±4.9</td>
<td>20.1±3.6</td>
<td>19.8±3.9</td>
<td>0.006</td>
</tr>
<tr>
<td>Interpersonal atmosphere</td>
<td>107.0±7.2</td>
<td>110.6±3.5</td>
<td>111.3±3.5</td>
<td>0.004</td>
</tr>
<tr>
<td><strong>Family functioning</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organization</td>
<td>38.9±4.3</td>
<td>40.3±3.7</td>
<td>40.1±3.0</td>
<td>0.28</td>
</tr>
<tr>
<td>Social network</td>
<td>36.7±7.3</td>
<td>38.5±5.6</td>
<td>38.4±5.9</td>
<td>0.43</td>
</tr>
</tbody>
</table>

*p* One-way ANOVA

DISCUSSION

This cross-sectional study found that parents’ dental health LoC and observed parenting practices were significantly associated with childhood dental caries in a sample of 5-to 6-year-old children of Dutch, Moroccan and Turkish origin. Parents of caries free children had a more internal LoC regarding dental health and they were more likely to show positive parenting practices in terms of positive involvement, encouragement and problem solving, compared to parents of children with four or more decayed, missing or filled teeth.

Interestingly, several observed parenting practices (measured with the SIT) were significantly associated with childhood dental caries, while similar parenting practices measured through self-report (with the APQ) were not. In line with this, the observational
ratings did not correlate strongly with self-report ratings of parenting practices. Findings from other dental health studies are equivocal: one study reported strong differences in observed parenting practices between children with and without dental caries (21), while two studies using self-report methods (the Parenting Scale and the Authoritative Parenting Index) did not find an association between parenting and children's oral health outcomes (16,22). Thus, the question is raised: which findings are more valid? The abovementioned studies, including the present study, used well-validated self-report family measures with good psychometric properties. Still, there is considerable discussion regarding the advantages and disadvantages of using self-report methods vs. observational methods for parenting assessment (28,35). Self-report methods rely on parents' own beliefs and perceptions of their parenting behaviour. However, it is generally accepted that these can be quite distinct from actual behaviours (36). Furthermore, there may be a tendency of parents to answer questions about their parenting in a socially desirable manner. Structured observational methods do not possess these limitations and have the advantage that all participants receive the exact same standardized instruction. However, with observational ratings there is a risk that results may be biased by the interpretation of the observer, yet this was limited in the present study, because coders were blind to the child's dental condition and inter-coder agreement was high.

Another issue with self-report parenting assessment is that most parenting measures have been developed for use in a clinical context, designed to distinguish between 'problem families' and 'non-problem families'. Yet, in oral health research, the majority of the participating families are normative families that do not necessarily have clinical problems. Therefore, the self-report methods used in oral health studies may not have been sensitive enough to discriminate among parenting practices within the normative range. The current study demonstrated a significant and meaningful relationship between observed parenting practices and childhood dental caries. This suggests that observational ratings are able to detect subtle nuances in parenting practices that are relevant to caries development. Thus, it seems that research into parenting behaviours in relation to oral health outcomes may better rely on objective observational methods, rather than self-report ratings.

Oral health behaviours likely play an important mediating role in the relationship between parental factors and children's caries experience. The role of parents is central in shaping children's behaviours, attitudes and social norms regarding oral health (11). Their
perceptions of LoC, or judgment about their ability to control their child’s dental health, can be an important argument for why they engage in oral health promoting behaviours for their children. Parenting practices provide the context in which parents’ intended oral health promoting behaviours are delivered and interpreted by the child. For example, positive parenting practices may directly enhance children’s uptake of healthy habits through modelling and reinforcing proper behaviours (e.g., with rewards or praising words) (37), and through monitoring and controlling children’s dietary intake and oral hygiene habits. Furthermore, it has been shown that behavioural directions are most accepted by the child when the parent displays moderate levels of strictness and when the child experiences greater involvement or warmth from the parent (38,39). On the other hand, ineffective parenting (characterized by highly demanding disciplining practices, and low levels of positive interaction) has been associated with a higher degree of resistance and non-compliance in children (40,41), which may have similar effects on children’s compliance with oral health behaviours. Ineffective parenting has also been related to an unhealthy diet and childhood obesity, including higher caloric intake, lower fruit and vegetable consumption and lower frequency of eating breakfast (39,42-45). Our findings of lower levels of positive involvement, encouragement and problem solving in children with dental caries, compared to caries free children, suggest that ineffective parenting also affects children’s dental health.

There is clear evidence for a socioeconomic gradient in childhood dental caries, yet the underlying mechanisms that account for the strong relationship between social class and children’s caries experience are not fully understood. It is plausible that parenting and family factors are partially responsible for socioeconomic inequalities in children’s dental health, as parenting and family factors are known to be socially patterned (46,47). The current study confirmed an association between parental and family-related factors and socioeconomic status: being from a lower social class increased the likelihood of having parents with less favourable oral health-related attributes and parenting practices. These, in turn, were associated with an increased risk of dental caries in children, which supports the potential mediating role of parents’ oral health-related attributes and parenting practices in the relationship between socioeconomic conditions and childhood dental caries. The mediating role of family factors has been conceptualized in a theoretical model by Fisher-Owens et al. (48) and empirically tested in a structural path model (49). This model implies that social conditions indirectly influence children’s oral health behaviours.
and subsequently children’s caries experience through an impact on inter-related parental and family factors. Parents’ LoC was significantly more external in parents of Moroccan and Turkish backgrounds, compared to Dutch backgrounds, which could contribute to the explanation of ethnic variation in children’s caries experience. However, whether this factor plays a mediating role in ethnic inequalities in children’s dental health, in addition to other explanatory variables, including socioeconomic position, should be further investigated in a sufficiently large sample using structural equation modelling.

One of the evident strengths of this study was the use of reliable and valid instruments to measure parental and family-related factors. The instruments had good psychometric properties and they derive strength from their basis in theoretical models. A novel approach was that both observational and self-report methods were used, providing multiple perspectives of the family. Furthermore, this study included a unique study sample with a large proportion of children from lower social class and from Moroccan and Turkish origin, which are difficult groups to recruit for research purposes. However, some potential limitations should be taken into account. Limitations include the relatively small sample size of the subgroups and the limited generalizability. Children from a general dental practice and children whose parents don’t speak the Dutch language were not included and the non-response rate was relatively high. Nevertheless, the current study sample was appropriate for testing the hypotheses, and the number of included participants was sufficient to detect statistically significant differences with an effect size $d = 0.45$, a power of 0.80 and a significance level of $\alpha = 0.05$. Notably, there were no significant differences in self-reported oral hygiene behaviours and social class between caries free children and children with dental decay. However, exposure to fluoride was not assessed, and this is a factor that may provide an alternative explanation for the differences in dental decay. The absence of an expected difference in social class could be attributed to selection bias and the fact that children with and without dental caries were recruited from the same patient population of the paediatric dental care centre. In addition, no conclusions on temporal and causal associations of variables can be deduced from this cross-sectional study. Despite evidence for temporal stability of parenting and family functioning (50,51), life events and transitions that occur in the family may affect parental and family-related factors over time. Prospective, longitudinal studies are therefore needed to investigate the role of parental and family-related factors in the initiation of children’s oral health behaviours and the development of childhood dental caries over the years. Such an
approach will also allow in depth-examination of the mediating or moderating effects of these family factors on socioeconomic inequalities in childhood dental caries.

In conclusion, parents’ internal belief of their ability to control their child’s dental health, and observed positive parenting practices on the dimensions of positive involvement, encouragement and problem solving were important indicators of dental health in children of Dutch, Moroccan and Turkish origin. Findings of this study indicate that these parental factors are potential mediators of socioeconomic inequalities in children’s dental health. The important influence of parents on childhood dental caries supports the design of health promotion strategies that intervene at this level to further reduce caries levels in children, especially in those at higher risk.

ACKNOWLEDGEMENTS

This study was financially supported by Menzis Health Insurer, the Netherlands. The authors thank Sanne Bax and Sinica Cheung for helping with data collection, Nadine Gijzen for guiding the SIT-training and for double coding the observations, and all parents and children who participated in the study. We also gratefully acknowledge the support from the Jeugdtandzorg Den Haag, especially Hans Berendsen, Helga Wissenburg and Sylvia Gossen.
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CHAPTER 4


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Parental and family-related influences on dental caries


CHAPTER 5

Body mass index and dental caries in children aged 5 to 8 years attending a dental paediatric referral practice in the Netherlands
CHAPTER 5

BMC research notes
ABSTRACT

Obesity and dental caries are widely recognised problems that affect general health. The prevention of both dental caries and obesity has proven very difficult: children and their parents may need professional support to achieve behaviour change. To find out whether both dental caries and overweight in childhood can be targeted using a common risk factor approach, it is necessary to establish whether the two diseases are indeed linked. The aim of the present study was therefore to use anthropometric data obtained professionally to investigate the association between Body Mass Index and dental caries experience in children aged 5 to 8 years receiving treatment in a referral centre for paediatric dental care in the Netherlands. Children’s dmft and dmfs scores were calculated using dental records and sociodemographic data were also extracted from these records. Dentists were trained to measure standing height and weight in a standardised way. Body Mass Index was calculated by dividing kilogrammes by height squared (kg/m²). Extended International (International Obesity Task Force) body mass index cut-offs were used to define ‘no overweight’ and ‘overweight’ (with the latter category including obesity). No statistically significant differences were found between the mean dmft or dmfs scores of the two groups (overweight and non-overweight), even after correction for the effect of the potential confounders sex, socioeconomic status and ethnicity. The percentage of caries active children in the non-overweight group was almost the same as in the overweight group. No statistically significant differences were found. We hypothesised to find a positive association between body mass index and dental caries experience in children aged 5 to 8 years attending our practice. However, this study did not find a relationship of this kind. A common risk factor approach for the prevention of caries and overweight is therefore not supported by our study.
BACKGROUND

Obesity is a widely recognised problem (1-3). In the Netherlands, the trend for obesity in the past 30 years has been upwards, with the population of the large cities being most affected (4,5). In recent years, however, the rise seems to be flattening out in city areas (6,7). Even so, overweight remains a major health concern since it has a major impact on general health and can induce chronic disease (8-10). Moreover, these health effects become manifest not only in later life but also at an early age (11). It has proven challenging to achieve the behaviour change needed to maintain or achieve a healthy weight (12). This issue is therefore a major concern, particularly in children, since it has been suggested in the literature that childhood obesity is a predictor of obesity in later life (13,14).

Dental caries still affects many schoolchildren, despite all the efforts made in prevention programmes. Recently, a prevalence of 41% was reported for 5-year-olds in the Netherlands (15). It is a disease that, even in the context of the preventive effect of using fluoride toothpaste, largely results from difficulties in managing a healthy lifestyle: the inadequate removal of dental plaque and the frequent intake of sugary foods and drinks (16).

The prevention of both dental caries and obesity has proven to be very difficult: children and their parents may need professional support to achieve behaviour change (17). To find out whether both dental caries and overweight in childhood can be targeted with a common risk factor approach, it is necessary to determine whether the two diseases are indeed associated. Several studies have been conducted linking children’s dental caries experience to Body Mass Index (BMI), but the results are contradictory. In a recent systematic review, Hayden also concluded that the literature is inconclusive and that further analysis of this association and its confounding variables is needed (18). On the one hand, studies by Gerdin et al., Willershausen et al., Powell et al. and Yao et al. found that obesity or an unhealthily high BMI were linked to a higher number of caries lesions (19-22). On the other, Sheller et al. found no association between BMI and dmft (decayed-missing-filled teeth) or the number of pulp-involved teeth (23), whereas Benzian et al. and Bafti et al. actually found an inverse relationship, reporting an association between underweight and a higher mean dmft, although it should be pointed out that these studies were not carried out in Western countries (24,25).
In the Netherlands, dentistry consists of primary and secondary dental care. If the General Dental Practitioner (GDP) feels unable to deliver the care needed, referral to specialists in various areas is possible. These include dental surgery, endodontics or paediatric dentistry. One fairly large paediatric referral practice is ‘Cleyburgh junior’, which is attended by children as young as 1 or 2 years old, as well as by adolescents. In addition to delivering traditional treatment, this centre aims to teach children and their parents how to care for their own teeth and gums and, where appropriate, to cope with the problems they encounter in the dental surgery, all in line with their individual needs, capacities and skills. After treatment at the centre finishes, the children are referred back to the GDP.

Dental caries was found in 84% of the children attending the centre. The mean dmft was 4.6 (SD ± 3.4) (26). Furthermore, our dentists’ impression is that most of the families referred find that there are obstacles that work against their efforts to implement healthy behaviours in their daily routines. Studies have indicated that parental beliefs, parenting and family interaction are associated with dental caries (27,28). Parents are responsible for establishing and maintaining their children’s routines, such as fruit and vegetable intake, sugar snacking, physical activity and oral hygiene. Children’s behaviours, attitudes and social norms are moulded by modelling, specific parenting skills and, more extensively, by interactions between all family members (29). It is important to establish healthy behaviours from early childhood onwards since unhealthy behaviours acquired early in life are difficult to change in adulthood (30). Moreover, studies have demonstrated that a range of health-related behaviours such as dietary behaviours, physical activity and oral hygiene behaviours are clustered in individuals (31). Our practice, with its high caries rates, provides an excellent opportunity to explore the association between caries and obesity. We first conducted a pilot study to explore the association between BMI and caries in a group of children aged 5 to 8 years (n = 247). The results showed the expected association: more caries lesions were found in overweight children (32). However, the limitations of this pilot study were that anthropometric data were self-reported by parents, that the response rate was fairly low (56%) and that potential confounders were not included in the analyses. Furthermore, because the lifestyle and family factors mentioned here have also proven to be important determinants of the development of overweight and obesity (33), we hypothesised that children in our practice were more prone to being overweight. The present study was therefore established to investigate, on the basis of anthropometric data obtained by professionals, the association between BMI and dental caries.
caries experience in children aged 5 to 8 years who were treated in our referral centre for paediatric dental care.

**METHODS**

Approval for this study was obtained from The Central Committee on Research Involving Human Subjects in the Netherlands (VU MEtc, nr 2012/393). Prior to every measurement, the parents of the selected child were asked for written informed consent.

**Study Sample**

The data for this study were collected in a referral centre for paediatric dental care in Noordwijk (the Netherlands). The general statistics for the practice indicate that children are referred for various diagnoses, including Early Childhood Caries in very young children (22 %), congenital dental disorders (18 %), psychological problems (18 %), behaviour management problems (15 %), fear (14 %) and developmental problems (6 %). The ages of the children referred vary widely. For the purposes of this study, we selected all the children aged 5 to 8 who came for a regular check-up at our centre between January 2013 and July 2013. Every child was included only once: if they had more than one visit during the data-collection period, children were not included again. Children with diagnosed disorders in the emotional or behavioural field, children with special needs and newly referred children were excluded.

**Data Collection**

Before the regular check-up, we asked all children who met the selection criteria to participate in the study. Parents were informed about the purpose of the study and were asked to sign a written consent form, which also stated that they gave permission to use data from their child’s clinical health records for the purposes of this study. The treatment of the children was not affected in any way by a refusal to participate.

**Caries experience**

It is standard practice in the referral centre to update all personal dental health records in a standardised way every time patients visit the practice. Reasons for restoration or
The diagnosis of dental caries is based on periodical clinical examinations supported by dental X-rays, mostly bitewings, whenever possible. Children’s dmft and dmfs (decayed-missing-filled surfaces) scores were calculated on the basis of these dental records. Patients’ dmft and dmfs scores are widely used outcome measures for the extent of caries experience in the primary dentition: it is the sum of decayed (d), missing (m) and filled (f) teeth (t) or surfaces (s). Missing teeth were not scored if they were absent due to dental trauma, hypomineralisation, agenesis or routine exfoliation; they were only scored if records indicated that they were extracted due to caries. In this case, only three surfaces per extracted element were recorded. We used the dental health data on the day of the measurement to compute dmft/s scores. In addition, caries activity was defined as a score of 0 (caries free) or one or more surfaces/elements affected (caries active). Secondary teeth were not scored.

**BMI**

Dentists in our practice were trained to perform the anthropometric measurements in a standardised way. They were conducted in the paediatric dentist’s treatment room. Children’s standing height was measured to the nearest full centimetre using a stadiometer (Seca); their weight was rounded off to the nearest 0.1 kilogramme using a calibrated scale (Seca, Model 877). During these measurements, the children wore light clothing but no shoes. Body Mass Index was calculated by dividing kilogrammes by height squared (kg/m²). We subsequently used extended International (IOTF) body mass index cut-offs to define ‘no overweight’ and ‘overweight’ (with the latter category including obesity) (34).

**Socio-demographic characteristics**

Our practice uses a protocol that involves the recording of the child’s age, sex and ethnicity, and the mother’s highest level of completed education. Ethnicity is defined on the basis of the mother’s country of birth: the Netherlands or elsewhere. There are three categories for the highest educational level of the mother: i) no education or elementary school, ii) lower secondary education and iii) higher education or university. These categories defined the variable ‘education level of the mother’.
Statistical analysis
The outcome variables were dmft scores, dmfs scores, caries activity and BMI. We used linear regression analysis to determine whether or not there was a link between dmfs/dmft and overweight, with overweight being used as the predictor. Logistic regression analysis was used to determine whether or not there was a link between overweight and caries activity. The results were then corrected for the influence of potential confounders, in this case sex, ethnicity and education level of the mother. A $p$-value < 0.05 was regarded as statistically significant.

RESULTS

Study sample
The study sample consisted of 230 children (response rate 98 %). The mean age of the sample was 7.0 (SD ± 1.2), and 56.5 % were girls. The mean dmft was 4.2 ± 3.4; 19.6 % of the children were caries-free and 18.3 % were classified as overweight. Table 1 presents the findings and general characteristics of the sample studied. No statistically significant difference in the mean dmft or dmfs scores was found between the two groups (overweight and no overweight), even after correction for the influence of the potential confounders sex, SES and ethnicity (Table 2). The percentage of caries active children in the non-overweight group was almost the same as in the overweight group. No statistically significant differences were found.
Body Mass Index and dental caries

Table 1. Outcomes and general characteristics of the studied sample (n = 230)

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>7.0 ± 1.2</td>
</tr>
<tr>
<td>Dmft</td>
<td>4.2 ± 3.4</td>
</tr>
<tr>
<td>Dmfs</td>
<td>10.3 ± 9.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dental caries</td>
</tr>
<tr>
<td>Caries-free</td>
</tr>
<tr>
<td>Caries-active</td>
</tr>
<tr>
<td>Overweight</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>Sex</td>
</tr>
<tr>
<td>Girl</td>
</tr>
<tr>
<td>Boy</td>
</tr>
<tr>
<td>Education level (mother)§</td>
</tr>
<tr>
<td>High</td>
</tr>
<tr>
<td>Medium</td>
</tr>
<tr>
<td>Low</td>
</tr>
<tr>
<td>Ethnicity#</td>
</tr>
<tr>
<td>Native</td>
</tr>
<tr>
<td>Immigrant</td>
</tr>
</tbody>
</table>

n including obesity
§ missing data for 14 children
# missing data for 1 child

Table 2. Differences in level of caries between the overweight and no overweight group

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Overweight^ Yes</th>
<th>Overweight^ No</th>
<th>B (95% CI)</th>
<th>Adj. B^ $ (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>dmft</td>
<td>4.2 ± 3.4</td>
<td>4.2 ± 3.4</td>
<td>0.04 (-1.1, 1.2)</td>
<td>-0.38 (-4.5, 0.7)</td>
</tr>
<tr>
<td>dmfs</td>
<td>10.2 ± 9.4</td>
<td>10.9 ± 9.1</td>
<td>0.68 (-2.5, 3.8)</td>
<td>-0.46 (-3.5, 2.6)</td>
</tr>
<tr>
<td>Caries activity</td>
<td>80.3 (151)</td>
<td>81.1 (34)</td>
<td>1.04 (0.5, 2.4)</td>
<td>0.72 (0.3, 1.8)</td>
</tr>
</tbody>
</table>

* p<0.05
^ Caries-active (yes) or caries-free (no)
^ Overweight includes obesity
$ adjusted for sex, ethnicity and age
DISCUSSION

We hypothesised to find a positive association between BMI and dental caries experience in the children aged 5 to 8 years attending our practice. However, our study did not find a relationship of this kind. Given this result, we conclude that being caries active is not a predictor for being overweight, nor the other way around. Based on this study alone, one could say that the dental practice cannot play a role in preventing obesity, even as a way of screening children for overweight, at least not based on dental health records. Nevertheless, the literature does recommend a common risk factor approach to preventing caries and obesity since eating and drinking habits seem to be an overlapping element (35,36). However, despite the fact that different health-related behaviours have been found to cluster in individuals, different approaches are reported to be necessary for each required behaviour change. We know from the literature that these required behaviour changes have to be identified in detail and interventions are more effective if change objectives are subsequently specified per health related behaviour (31,37,38). The literature also tells us that conventional prevention methods - often focusing only on delivering knowledge about health behaviours - are largely ineffective (39). Obviously, more tailored interventions are required. This fact has been worked out in the theory of motivational interviewing, which has potential to improving oral health behaviours, especially compared to conventional education (40). In this theory the patient is led through four stages, in which barriers and facilitators experienced by the patient or the patients parents define a very personal preventive plan; based on intrinsic motivation. Meanwhile, the health professional is guiding the patient in implementing this plan, even in more difficult times (41). Fisher Owens developed a model that suggested a wide range of underlying determinants of dental caries at the child, family and community levels (42). We therefore believe that a paradigm shift is needed to acknowledge psychosocial factors as determinants of health. In the prevention and treatment of obesity, for example, successful interventions addressing general parenting have indeed been developed and mapped in a review by Gerards et al (43).

Furthermore, as mentioned above, the apparent multifactorial character of both overweight and caries means that it is important to consider different causes. Some causes - sound oral hygiene for example - affect only one disease. Other common causes are more complex: the frequency of the intake of sugary foods and drinks could be a cause of caries but the exact quantity per portion is less relevant for caries than it is for overweight.
Parents in our practice say that some children are ‘bad eaters’: they mean that they have to encourage these children more and the result is a higher frequency of the intake of sugary foods or drinks, with small amounts being eaten or drunk on each occasion.

One of the strengths of this study was the very high prevalence of caries experience in our sample (80.4 %). The overall prevalence in 5-year-olds in the Netherlands is 41 % (15). In theory, the high prevalence in our practice should have facilitated the confirmation of the hypothesis. However, a limitation was that all parents are referred to our practice by a GDP. Some more concerned parents asked for a referral letter themselves and, since these were probably mostly parents of caries free children, this may have affected the profile of the caries free group, making the comparison of the caries-free and caries-active groups less reliable. The prevalence of overweight children in our practice was also higher: 18.3 % as opposed to 13 - 15 % in the Dutch population (4). This fact could be seen as support for the hypothesis that BMI will be higher in children with caries. The present study used a more refined method than the pilot study that was also conducted by the authors. Anthropometric measurements were taken professionally and the effect of potential confounders was taken into account. There was almost no selection bias since all the children attending the practice were asked to enter the study and only 2 % declined. Furthermore, highly reliable dental health records with caries diagnosis based on X-rays made the design very strong. Far more proximal lesions are detected with X-rays (44). In 87 % of our children, bitewings were used and they were not used only when restraint of the child would have been required otherwise. In this minority, overview radiographs were taken if possible. In a small number of cases, no radiographs were made because there was no indication.

As mentioned earlier, the findings of this study must be seen in the context of its limitations. The sample is not representative of the general population, as can be seen in the high caries rate. Another potential limitation is that overweight and obesity may become apparent at an older age. Furthermore, bitewings were not used for all children to determine caries experience and, in some cases, treatment of caries at the GDP (before referral) may have been missed. The latter two factors may have resulted in a lower mean dmft.

Studies by Gerdin et al. and Willershausen et al. did provide support for the positive association hypothesised here. However, both studies looked only at children aged 10 years old and measurements were taken at multiple moments in time (19,20). As mentioned above, it is therefore reasonable to speculate that overweight is usually revealed...
at a higher age. Powell et al. also found a positive association when looking at younger children but his sample consisted only of children treated under general anaesthesia (21). By contrast, a number of studies have shown that more caries experience was associated with being underweight. These studies found a very high caries rate: the authors saw this high caries prevalence and the low restoration rate as an indicator of pulp involvement and therefore a failure to thrive in general (24,25).

The main reason for conducting this study, backed up by the observation that parents play an essential role in maintaining healthy behaviours in children, was the hypothesis that both obesity and dental caries can be targeted by a common risk factor approach. In our practice, parents encountered obstacles to the implementation of these behaviours, confirming suggestions found elsewhere in the literature relating to both obesity and caries (45,46). Improvements in dental health and behaviours must begin, however, with dental professionals wanting parents and children to succeed in prevention and recognition of the need to work together with all health professionals. Moreover, dental professionals will have to acknowledge the need to go beyond health education based on knowledge only (one-way traffic) and to start exploring what happens in the home in order to enhance the probability of active behaviour change.

Although it was hypothesised to find a positive association between BMI and dental caries experience in children aged 5 to 8 years attending our practice, our study did not find evidence of that relationship. A common risk factor approach to the prevention of caries and overweight was not therefore supported by our study.

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CHAPTER 6

Dental caries and behaviour problems in a high-risk child population and their association with parenting and family functioning
CHAPTER 6

Maddelon de Jong-Lenters
Denise Duijster
Annemarie Schuller
Cor van Loveren
Erik Verrips

Submitted
ABSTRACT

The aim of this study was to explore the relationship between child behaviour problems and dental caries. Further objectives were to assess whether child behaviour problems and dental caries have a common association with oral health behaviours, parenting and family functioning. Cross-sectional data were collected in a paediatric dental practice in the Netherlands. Children’s dmft scores were obtained from children’s dental records. Child behaviour problems, oral health behaviours, parenting and family functioning were measured using validated self-report questionnaires. The study sample consisted of 251 5 to 8-year-old children. Children with conduct problems had a significantly higher mean dmft ($p = 0.05$). The mean dmft was also higher in hyperactive children, but this did not reach statistical significance ($p = 0.08$). Parenting was associated with both dental caries and child behaviour problems: children of strict parents had significantly higher mean dmft ($p = 0.02$), while children of parents who reported low levels of nurturance were significantly more likely to show conduct problems ($p = 0.04$). Poor family functioning in terms of responsiveness, communication and organization was also associated with conduct problems and hyperactivity, but not with dmft. No significant associations with oral health behaviours were found. This study found a significant relationship between child behaviour problems and dental caries, which may be explained by an underlying influence of parenting styles. Findings of this study suggest that child behaviour problems and parenting play a role in children’s oral health and should be considered in caries preventive interventions.
INTRODUCTION

Dental caries and behaviour problems are two common childhood conditions (1,2). This is most remarkable for dental caries given all the efforts made and all treatments available to prevent the disease. Even in developed countries, more than half of all carious lesions remain untreated (2), potentially resulting in eating and sleeping problems, and affecting child growth and school attendance. It is a disease that largely results from difficulties with maintaining good oral health behaviours, including the adequate removal of dental plaque – and the concomitant optimal fluoride use – and limiting the frequency of sugar consumption (3). Behaviour problems have been increasingly diagnosed in children (4,5). They can be broken down into child behaviours that have a negative effect on the child’s environment (externalising) and behaviours that have a negative effect on the child itself (internalising) (6). Examples of externalising behaviour problems are Attention Deficit Hyperactivity Disorder (ADHD), impulsiveness and general conduct problems. Internalising behaviour problems include emotional problems, such as fear and depression (7).

There is evidence suggesting that child behaviour problems and dental caries are related. Williamson et al. found that internalising and externalising behaviour problems were significantly more prevalent in caries active children than in caries free children (8). Higher levels of dental caries have been reported in children with ADHD (9,10), although other studies have claimed that levels of caries are actually lower in this group of children (11,12).

There are several plausible explanations for the relationship being positive. A possible direct explanation is that good oral hygiene and limiting the intake of sugary snacks is more challenging in children with problem behaviour such as general conduct problems and ADHD (11). Indirectly, the family environment could play an important role in the successful organisation of everyday life and particularly the adoption of healthy behaviours (13,14). For example, emotional family interactions, such as expression of affect and responsiveness, parents’ discipline practices and family routines provide the context in which parents’ intended health behaviours are delivered to and interpreted by the child. These are examples that refer to two aspects of the family environment: parenting and family functioning. Multiple studies since the 1950s have described parenting as a versatile and complex behavioural pattern consisting of two dichotomies: warmth versus hostility, and restrictiveness versus autonomy (15,16). Family functioning is a broader concept that
describes how the interactions between all family members – communication, cohesion, roles and organisation in the family, for example – affect the way both children and parents manage daily life (17). Previous studies have shown that parenting practices and family functioning have been associated with positive outcomes such as the adoption of healthy behaviours (13,14) or negative outcomes such as externalising and internalising problem behaviour in children (18). The association is reciprocal, with child characteristics giving rise to less favourable parenting and family functioning that may, in turn, instigate and reinforce children’s character traits or behaviours (19).

There are no studies to date on the relationship between child behaviour problems and dental caries, and the underlying role of parenting, family functioning and oral health behaviours. The aim of this study was therefore 1) to assess the relationship between behaviour problems and dental caries in children. Further objectives were 2) to assess the relationship between oral health behaviours and a) dental caries and b) child behaviour problems, and 3) to assess the relationship between parenting and family functioning and a) childhood dental caries and b) child behaviour problems. Figure 1 presents these aims schematically, the numbers used in the figure correspond with the numbering as used above.
CHAPTER 6

Dental caries, behaviour problems and family factors

Figure 1. Conceptual framework and objectives of the study, numbered in correspondence with the aims as mentioned in the text.

METHODS

Approval for this study was obtained from the Ethics Committee for patient-related research of the VU University (VU MEtc, nr 2012/393). All parents signed written consent forms before children were included.

Participants
The data for this study were collected in a referral centre for paediatric dental care in Noordwijk (the Netherlands). Children are referred for various diagnoses, including Early Childhood Caries in very young children, congenital dental disorders, psychological problems, behaviour management problems, dental fear and developmental problems. A
small percentage of the children have special needs associated with mental or physical disability. The ages of the children referred to the centre vary widely. For the purposes of this study, all children born between July 1st 2005 and July 1st 2007 were selected from the referral centre’s patient population. Children with special needs were excluded. An invitation letter with information about the study, an informed consent form and a questionnaire were sent to the children’s parents. To increase the response rate, a prepaid return envelope was attached and participants received a monetary incentive (10 euros). Non-respondents were first sent a reminder by mail with another copy of the questionnaire after 4 weeks, followed by a reminder by telephone after an additional 4 to 6 weeks.

**Clinical dental measurements**
Standard procedure at the referral centre includes the updating of all personal dental health records using a protocol every time patients attend the practice. Reasons for restoration or extraction are recorded. The diagnosis of dental caries is based on clinical examinations supported by dental X-rays, mostly bitewings, on condition that the patient cooperates. Children’s dmft scores (sum of decayed (d), missing (m) and filled (f) deciduous teeth) were obtained from these dental records. Missing teeth were not scored if they were absent due to dental trauma, hypomineralisation, agenesis or normal exfoliation; they were only scored if records indicated that they were extracted due to caries. Dental health status on the day the questionnaires were returned was used to compute dmft scores. Permanent dentition was not scored.

**Sociobehavioural measures**

**Sociodemographic data**
A self-administered parental questionnaire was used to collect information about sociodemographic variables such as the child’s date of birth, gender, ethnicity and the mother’s highest completed level of education. Ethnicity was defined on the basis of the mother’s country of birth: the Netherlands or any other country. There were three categories of educational level: i) lower education (no education, elementary school and lower general education), ii) intermediate education (higher general education and lower vocational education) and iii) higher education (higher vocational education or university).
**Oral health behaviours**

Oral health behaviours were measured using the following items: age at which brushing started (less than 1 year old, 1 - 2 years old, more than 2 years old), frequency of brushing per day (1 time or less, 2 times or more), frequency of daily intake of sugary foods per day (2 times or less, 3 times or more) and frequency of consumption of sugary drinks per day (2 times or less, 3 times or more).

**Child behaviour problems**

Problem behaviours in children were scored with the ‘hyperactivity-inattention’ and ‘conduct problems’ domains using the Strengths and Difficulties Questionnaire (SDQ) (Table 1). This is a concise questionnaire that has proven its value over time to measure psychosocial adjustment in children and adolescents (20). The parental version for children aged 4 - 17 was used in this study. The clinical domains conduct problems and hyperactivity-inattention were used because it is assumed that they are linked to family and behaviour factors. Both subscales consist of 5 items with answers on a 3-point Likert scale (0 being ‘not true’, 1 ‘somewhat true’ and 2 being ‘certainly true’). An example of an item used to measure conduct problems is ‘My child often lies or cheats’; an example of an item measuring hyperactivity-inattention scale is ‘My child is easily distracted, concentration wanders’. The SDQ scores for both subscales were broken down into average, raised and high scores using normative cut-off points from the original Dutch SDQ (21). Given the low number of children allocated to the high and raised categories, these were combined to one category: raised/high.

**Family functioning**

The Gezinsvragenlijst (GVL, translation Family Questionnaire) is a validated instrument used to measure the quality of family and parenting circumstances in children aged 4 - 18 years (17) (Table 1). The GVL measures, among other domains, ‘responsiveness’, ‘communication’ and ‘organisation’. It is thought that these domains may have an influence on children’s oral health behaviours and on dental caries and child behaviour problems. The three subscales consist of 9 items each with answers on a 5-point Likert scale ranging from ‘strongly agree’ to ‘strongly disagree’. An example of an item measuring responsiveness is ‘We give our child a lot of compliments’; an example of an item covering communication scale is ‘We find it hard to understand our child’; one item
used to measure organisation is ‘We strive for order and regularity in our household’. All 9 answers in each subscale were summed, resulting in subscale scores ranging from 9 to 45. Higher scores indicate poorer functioning. Each subscale classifies family functioning as normal, subclinical and clinical using normative cut-off scores provided by the authors of the instrument (17). When one item was missing, the mean of the remaining 8 items of that subscale was calculated and added to the total score of that subscale.

**Parenting style**
The Child Rearing Practices Report (CRPR) (Table 1) was used to assess the norms, values, attitudes, behaviours and intent of either maternal or paternal parenting. This instrument has proven reliability and construct validity over time (22). Of the 40 items in total, 22 measure the strictness of parents (for example: ‘I do not accept my child getting angry at me’). The other 18 items assess nurturance (example being ‘I think you should comfort a child when it is upset’). As no normative scores have been published for the CRPR, the total scores obtained with the two subscales of the CRPR were classified as low or high on the basis of the median of the two scale scores in the current study. If there were 1 or 2 missing items in one subscale, the mean subscale score was imputed.

Table 1 presents an overview of all the domains measured in this study, including a definition of each domain, the number of items per subscale and internal consistency.

**Statistical Analysis**
SPSS (Version 20, IBM Corp.) was used for statistical analysis. Bivariate associations between sociodemographic characteristics, oral health behaviours, child behaviour problems, family functioning dimensions, parenting and dmft were assessed using the Mann-Whitney U test and the Kruskal-Wallis test. Bivariate associations between the SDQ subscales conduct problems and hyperactivity-inattention and the subscales used for family functioning and parenting were analysed using chi-square testing. A $p$-value of $p < 0.05$ was considered statistically significant.
## Table 1. Definition, number of items and internal consistency for social-behavioural constructs

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Definition</th>
<th>No. of items</th>
<th>Cronbach's α</th>
</tr>
</thead>
<tbody>
<tr>
<td><em><em>Child behaviour problems (SDQ</em>)</em>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conduct problems</td>
<td>The extent to which a child fights, lies or loses his/her temper.</td>
<td>5</td>
<td>0.39</td>
</tr>
<tr>
<td>Hyperactivity-inattention</td>
<td>A child's degree of impulsiveness, concentration and restlessness.</td>
<td>5</td>
<td>0.76</td>
</tr>
<tr>
<td><em><em>Family functioning (GVL</em>)</em>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Responsiveness</td>
<td>To what extend parents respond to the needs of their child in different personal and cognitive fields.</td>
<td>9</td>
<td>0.75</td>
</tr>
<tr>
<td>Communication</td>
<td>Parent-child interaction: the degree they listen to each other and respond to each other's needs in harmonious and less harmonious situations.</td>
<td>9</td>
<td>0.76</td>
</tr>
<tr>
<td>Organisation</td>
<td>The degree of structure, routines and assignment of roles in the family, as well as the family's ability to resolve problems.</td>
<td>9</td>
<td>0.75</td>
</tr>
<tr>
<td><em><em>Parenting (CRPR</em>)</em>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Restrictiveness</td>
<td>Parents' tendency to confine behaviour within certain specified limits.</td>
<td>22</td>
<td>0.84</td>
</tr>
<tr>
<td>Nurturance</td>
<td>Interaction between parent and child in which parent responds to the child's needs.</td>
<td>28</td>
<td>0.81</td>
</tr>
</tbody>
</table>

1. SDQ, Strengths and Difficulties Questionnaire (21)
2. GVL, Gezinsvragenlijst (Family Questionnaire) (17)
3. CRPR, Child Rearing Practices Report (22)
RESULTS

Description of the study sample and the relationships with oral health behaviours (Figure 1, objective 2a and 2b)

Of the 450 families approached, 251 (56 %) returned the questionnaire. The study sample consisted of 251 children; just over half were girls (51 %). The mean age of the children was 6.6 years ± 0.8 (mean ± SD) on the date of completing the questionnaire, and the mean dmft was 4.6 ± 3.2 (range 0 - 12). Only 16 % of the children in the sample were caries free. The dmft scores were significantly lower in children of mothers with a higher level of education, as well as in children with native mothers, in a comparison with children of mothers with lower levels of education and immigrant mothers, respectively. A description of the sample can be found in Table 2.

The reported age that tooth brushing was started, the frequency of tooth brushing, the intake of sugary foods and the intake of sugary drinks were not significantly associated with mean dmft (Table 2), nor with conduct problems or hyperactivity-inattention (results not shown).

The relationship between child behaviour problems and dental caries (Figure 1, objective 1)

Table 3 shows the relationship between child behaviour problems and childhood dental caries. Children with ‘raised/high’ conduct problems had a significantly higher mean dmft than the children with average conduct problems ($p = 0.05$). The children with ‘raised/high’ hyperactivity-inattention also had higher mean dmft scores, but this difference was not statistically significant in comparison to the children with ‘average’ hyperactivity-inattention scores ($p = 0.08$).
Table 2. Number (n) and percentage (%) of participants by gender, educational level, ethnicity, oral health behaviours, mean dmft score and 95% confidence interval (95% CI) and p-value of statistical test

<table>
<thead>
<tr>
<th>Variables</th>
<th>n (%)</th>
<th>Mean dmft (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Girl</td>
<td>127 (50.6)</td>
<td>4.1 (3.6; 4.7)</td>
<td>0.06</td>
</tr>
<tr>
<td>Boy</td>
<td>124 (49.4)</td>
<td>5.0 (4.4; 5.7)</td>
<td></td>
</tr>
<tr>
<td>Educational level (mother)</td>
<td></td>
<td></td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Lower education</td>
<td>62 (24.7)</td>
<td>6.0 (5.2; 6.7)</td>
<td></td>
</tr>
<tr>
<td>Intermediate education</td>
<td>119 (47.4)</td>
<td>4.5 (3.9; 5.1)</td>
<td></td>
</tr>
<tr>
<td>Higher education</td>
<td>70 (27.9)</td>
<td>3.4 (2.7; 4.2)</td>
<td></td>
</tr>
<tr>
<td>Ethnicity (mother)</td>
<td></td>
<td></td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Native</td>
<td>208 (82.9)</td>
<td>4.2 (3.8; 4.7)</td>
<td></td>
</tr>
<tr>
<td>Immigrant</td>
<td>43 (17.1)</td>
<td>6.1 (5.2; 4.1)</td>
<td></td>
</tr>
<tr>
<td>Age tooth brushing started</td>
<td></td>
<td></td>
<td>0.14</td>
</tr>
<tr>
<td>&lt; 1yr</td>
<td>138 (56.3)</td>
<td>4.2 (3.7; 4.8)</td>
<td></td>
</tr>
<tr>
<td>1 - 2 yrs</td>
<td>89 (36.3)</td>
<td>4.8 (4.1; 5.4)</td>
<td></td>
</tr>
<tr>
<td>2+ yrs</td>
<td>18 (7.4)</td>
<td>5.6 (4.0; 7.3)</td>
<td></td>
</tr>
<tr>
<td>Frequency of tooth brushing</td>
<td></td>
<td></td>
<td>0.74</td>
</tr>
<tr>
<td>1 time or less a day</td>
<td>63 (25.3)</td>
<td>4.5 (3.7; 5.2)</td>
<td></td>
</tr>
<tr>
<td>2 times a day or more</td>
<td>186 (74.7)</td>
<td>4.6 (4.1; 5.1)</td>
<td></td>
</tr>
<tr>
<td>Frequency of sugary foods</td>
<td></td>
<td></td>
<td>0.19</td>
</tr>
<tr>
<td>2 times a day or less</td>
<td>162 (64.5)</td>
<td>4.4 (3.9; 4.9)</td>
<td></td>
</tr>
<tr>
<td>3 times a day or more</td>
<td>89 (35.5)</td>
<td>4.9 (4.2; 5.5)</td>
<td></td>
</tr>
<tr>
<td>Frequency of sugary drinks</td>
<td></td>
<td></td>
<td>0.29</td>
</tr>
<tr>
<td>2 times a day or less</td>
<td>126 (50.4)</td>
<td>4.4 (3.8; 5.0)</td>
<td></td>
</tr>
<tr>
<td>3 times a day or more</td>
<td>124 (49.6)</td>
<td>4.7 (4.2; 5.3)</td>
<td></td>
</tr>
</tbody>
</table>

1. Mann-Whitney U test
2. Kruskal-Wallis test

Table 3. The relationship between child behaviour problems and mean dmft

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Mean dmft (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDQ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conduct problems</td>
<td></td>
<td>0.05</td>
</tr>
<tr>
<td>Average (n = 156)</td>
<td>4.2 (3.7; 4.7)</td>
<td></td>
</tr>
<tr>
<td>Raised / high (n = 92)</td>
<td>5.1 (4.4; 5.7)</td>
<td></td>
</tr>
<tr>
<td>Hyperactivity-inattention</td>
<td></td>
<td>0.08</td>
</tr>
<tr>
<td>Average (n = 200)</td>
<td>4.4 (3.9; 4.8)</td>
<td></td>
</tr>
<tr>
<td>Raised / high (n = 46)</td>
<td>5.3 (4.3; 6.3)</td>
<td></td>
</tr>
</tbody>
</table>

1. Mann-Whitney U test
The relationship between parenting, family functioning and dental caries (Figure 1, objective 3a)

Children of parents with strict parenting behaviours had significantly higher mean dmft scores ($p = 0.02$). There were no statistically significant associations with mean dmft and parenting in terms of nurturance, or with family functioning in terms of responsiveness, communication or organisation (Table 4).

Table 4. The relationship between mean dmft, and family functioning and parenting

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Mean dmft (95% CI)</th>
<th>$p$-value$^1$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GVL$^1$</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Responsiveness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal ($n = 229$)</td>
<td>4.6 (4.1; 5.0)</td>
<td>0.17</td>
</tr>
<tr>
<td>Subclinical ($n = 19$)</td>
<td>4.2 (2.8; 5.6)</td>
<td></td>
</tr>
<tr>
<td>Clinical ($n = 3$)</td>
<td>7.7 (3.9; 11.5)</td>
<td></td>
</tr>
<tr>
<td>Communication</td>
<td></td>
<td>0.15</td>
</tr>
<tr>
<td>Normal ($n = 203$)</td>
<td>4.4 (4.0; 4.9)</td>
<td></td>
</tr>
<tr>
<td>Subclinical ($n = 32$)</td>
<td>4.8 (3.7; 5.8)</td>
<td></td>
</tr>
<tr>
<td>Clinical ($n = 11$)</td>
<td>6.4 (4.8; 7.9)</td>
<td></td>
</tr>
<tr>
<td>Organisation</td>
<td></td>
<td>0.09</td>
</tr>
<tr>
<td>Normal ($n = 205$)</td>
<td>4.6 (4.1; 5.0)</td>
<td></td>
</tr>
<tr>
<td>Subclinical ($n = 32$)</td>
<td>4.0 (2.8; 5.1)</td>
<td></td>
</tr>
<tr>
<td>Clinical ($n = 12$)</td>
<td>6.6 (4.6; 8.6)</td>
<td></td>
</tr>
<tr>
<td><strong>CRPR$^2$</strong></td>
<td></td>
<td>0.02</td>
</tr>
<tr>
<td>Restrictiveness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low ($n = 116$)</td>
<td>4.0 (3.4; 4.6)</td>
<td></td>
</tr>
<tr>
<td>High ($n = 113$)</td>
<td>5.0 (4.4; 5.5)</td>
<td></td>
</tr>
<tr>
<td>Nurturance</td>
<td></td>
<td>0.87</td>
</tr>
<tr>
<td>Low ($n = 128$)</td>
<td>4.5 (4.0; 5.0)</td>
<td></td>
</tr>
<tr>
<td>High ($n = 119$)</td>
<td>4.6 (4.0; 5.2)</td>
<td></td>
</tr>
</tbody>
</table>

$^1$ Kruskal-Wallis test

$^2$ Mann-Whitney U test
Table 5. Number (n) and percentage (%) of participants per subscale for child problem behaviour and p-value of statistical test by subscales for family functioning and parenting

<table>
<thead>
<tr>
<th>Subscale</th>
<th>SDQ – Conduct problems</th>
<th>SDQ- Hyperactivity-inattention</th>
<th>p-value 1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average n (%)</td>
<td>Raised/High n (%)</td>
<td>p-value 1</td>
</tr>
<tr>
<td>GVL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Responsiveness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal (n = 229)</td>
<td>146 (64.3)</td>
<td>81 (35.7)</td>
<td>0.03</td>
</tr>
<tr>
<td>Subclinical (n = 19)</td>
<td>9 (50.0)</td>
<td>9 (50.0)</td>
<td></td>
</tr>
<tr>
<td>Clinical (n = 3)</td>
<td>1 (33.3)</td>
<td>2 (66.7)</td>
<td></td>
</tr>
<tr>
<td>Communication</td>
<td></td>
<td></td>
<td>0.01</td>
</tr>
<tr>
<td>Normal (n = 203)</td>
<td>137 (67.5)</td>
<td>66 (32.5)</td>
<td></td>
</tr>
<tr>
<td>Subclinical (n = 32)</td>
<td>11 (35.5)</td>
<td>20 (64.5)</td>
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<tr>
<td>Clinical (n = 11)</td>
<td>4 (44.4)</td>
<td>5 (55.6)</td>
<td></td>
</tr>
<tr>
<td>Organisation</td>
<td></td>
<td></td>
<td>0.02</td>
</tr>
<tr>
<td>Normal (n = 205)</td>
<td>134 (66.0)</td>
<td>69 (34.0)</td>
<td></td>
</tr>
<tr>
<td>Subclinical (n = 32)</td>
<td>15 (48.4)</td>
<td>16 (51.6)</td>
<td></td>
</tr>
<tr>
<td>Clinical (n = 12)</td>
<td>5 (41.7)</td>
<td>7 (58.3)</td>
<td></td>
</tr>
<tr>
<td>CRPR</td>
<td></td>
<td></td>
<td>0.18</td>
</tr>
<tr>
<td>Restrictiveness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low (n = 116)</td>
<td>79 (68.1)</td>
<td>37 (31.9)</td>
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<tr>
<td>High (n = 113)</td>
<td>66 (59.5)</td>
<td>45 (40.5)</td>
<td></td>
</tr>
<tr>
<td>Nurturance</td>
<td></td>
<td></td>
<td>0.04</td>
</tr>
<tr>
<td>Low (n = 128)</td>
<td>73 (57.0)</td>
<td>55 (43.0)</td>
<td></td>
</tr>
<tr>
<td>High (n = 119)</td>
<td>83 (69.7)</td>
<td>36 (30.3)</td>
<td></td>
</tr>
</tbody>
</table>

1 $\chi^2$ test
The relationship between parenting, family functioning and child behaviour problems
(Figure 1, objective 3b)
Table 5 provides an overview of the domains conduct problems and hyperactivity-
inattention, and how they are related to the different family functioning and parenting
domains. Poor family functioning in terms of responsiveness, communication and
organisation was significantly associated with a higher percentage of children with a
raised/high level of conduct problems and hyperactivity-inattention.
Children of parents who reported low levels of nurturance were significantly more likely
to have ‘high/raised’ conduct problems ($p = 0.04$). Strict parenting was more common in
children with ‘raised/high’ hyperactivity-inattention, but this was only borderline significant
($p = 0.06$).

DISCUSSION

This study assessed the relationship between child behaviour problems and dental caries,
and whether child behaviour problems and dental caries have a common association with
oral health behaviours, parenting and family functioning. The findings of this study are
schematically presented in Figure 2: solid lines indicate statistically significant associations;
dashed lines indicate borderline significant associations ($0.05 < p \leq 0.08$).
This study found that children with conduct problems had significantly more dental
caries experience. Hyperactive children also had higher levels of dental caries, which
approximated statistical significance ($p = 0.08$). These relationships may directly operate
via oral health behaviours. For example, parents may find it more difficult to maintain
healthy behaviours if the child shows resistance towards the rules and structures provided
by their parents. Communication may also be more challenging in children with behaviour
problems, which could be reflected in the way parents deal with their children’s wishes
or demands with regards to - for example - sugary snacks (23). However, the potential
mediating role of oral health behaviours in the ‘problem behaviour - dental caries’
relationship could not be demonstrated in this study, as oral health behaviours were not
associated with dmft, nor with child behaviour problems.
CHAPTER 6
Dental caries, behaviour problems and family factors

Figure 2. Associations between dmft and the measured behaviour and family-related domains.
The absence of the expected associations with oral health behaviours could be attributed to limitations in measurement. The reported oral health behaviours in this study may not have been an accurate reflection of actual behaviours, because parents could have given socially desirable responses and behaviours were measured at a single point in time, while they can change over the years. Particularly in this sample, children received dental care in a specialised paediatric centre and therefore they most likely received oral hygiene instructions and guidance. As a result, oral health behaviours at the time of measurement may have improved since the time that dental caries had developed, or parents may have overestimated their behaviours.

An indirect factor that could explain the relationship between child behaviour problems and dental caries is the family environment, for instance by parenting and family functioning exerting an influence on child behaviours in general. The results of this study provided some support for the plausibly underlying role of the family. Parenting was associated with both dental caries and child behaviour problems: children of strict parents had significantly higher levels of dental caries and they also had a higher likelihood of being hyperactive (borderline significant), while children of parents who reported low levels of nurturance were significantly more likely to show conduct problems. Poor family functioning was also associated with child behaviour problems, but not with dental caries.

The finding of strict parenting being a risk factor for dental caries and behaviour problems is counter-intuitive, since strictness may be expected to further the establishment of routines, daily structures and living up to rules. However, similar results have been found in the literature. Strict, harsh and coercive parenting is, for example, associated with a higher level of resistance and general non-compliance in children (24,25). Overly strict and harsh parenting is considered to be negative parenting: associations have also been reported with problem behaviour, childhood obesity and an unhealthy diet (26).

The question that arises is whether negative parenting also makes children less likely to comply with oral health behaviours imposed by the parents (27-30). In contrast, positive parenting - described as high levels of nurturance in combination with moderate levels of restrictiveness - has been related to several positive child health outcomes, including fewer conduct problems (18) and less dental caries (31). More recent studies have shown that children of parents who demonstrate high levels of involvement and positive encouragement were more likely to be caries free (32,33).
CHAPTER 6

Dental caries, behaviour problems and family factors

Poor family functioning, high levels of restrictiveness and low levels of nurturance were all related to child behavioural problems. These interactions are reciprocal and may create a vicious cycle in which difficult-to-manage children elicit more negative and ineffective parental treatment. Less favourable parenting and family functioning may, in turn, contribute to the development of even higher levels of child problem behaviours (19,34,35). This bidirectional relationship may have a synergistic effect on the risk of developing dental caries, since both are risk factors in the development of the disease and are likely to intensify each other.

Strengths and limitations

One strength of the study was that all employed questionnaires were widely used, reliable and valid instruments (17,21,22). Another strength was the way children’s caries experience was classified. The dmft score was based on dental health records with caries diagnosis supported by X-ray images. More proximal lesions can be detected with X-rays than with clinical inspection only (36). Bitewings were used in almost all cases, except when children did not wish to cooperate. Eighty-four per cent of the children in the sample had cavitated dental lesions. The high levels of caries in the group of children referred were expected to help the exploration of the research question under consideration, because less favourable parenting and behaviour problems could be a determinant of the high caries levels in children. On the other hand, the levels of problem behaviour in the referred children in the practice may have biased the sample: referral is often triggered by treatment failures. Therefore, the high level of caries active children could have interfered with differentiation in the caries active group in all the constructs measured. In addition, the modest sample size \( n = 251 \) and the relatively high non-response rate (44 %) have resulted in very low numbers of children with poor family functioning. This may have obscured the demonstration of an association between family functioning and dental caries.

This cross-sectional study permits no conclusions about causality and long-term results relating to caries activity, since childhood dental caries is a multifactorial disease that continues to develop due to the interplay of different variables. Despite evidence suggesting that parenting and family functioning are stable factors (37,38), they are subject to all sorts of life events and developments that may affect them over time. Prospective, longitudinal studies are therefore needed to investigate the role of parental,
behaviour and family-related factors in the initiation of problematic oral health behaviours in children and the development of childhood dental caries over the years.

**Implications and conclusions**

The findings of this study suggest that parent and family factors, such as poor family functioning and strict and harsh parenting, should receive more attention when developing tailored caries preventive approaches, particularly when children have behaviour problems. The reciprocal association between family factors and child behaviour problems should be considered, because it may be a complicating factor in establishing dentally healthy behaviours. Given the ineffectiveness of health education by teaching knowledge alone, the needs of the patient and the family as a whole should be considered. More research is needed to evaluate preventive interventions that target these factors. Education for dental students is lacking in this field, so in case of positive results in prospective interventions, a paradigm shift will be required to educate a new generation and to introduce the consideration of these factors into daily practice.

**Acknowledgements**

The authors would like to thank Nanda Greving-Visser and the rest of the team of Cleyburch junior for helping with the data collection, Erica Polak for her useful suggestions, and all patients and their parents for participating in this study.
REFERENCES


CHAPTER 7

Discussion
Despite the fact that childhood dental caries and childhood obesity are preventable diseases, they are both still very prevalent (1-3). Risk factors for developing dental caries are less than twice daily tooth brushing, visible plaque present on the teeth and a highly cariogenic diet (4). Obesity is caused by too high an energy intake or too low energy expenditure, or a combination of both. Excessive intake of sugary foods and drinks and increased sedentary behaviour, such as less physical activity and more ‘screen time’, are risk factors causing the misbalance (5). Young children cannot be held responsible for maintaining key health behaviours necessary to prevent these childhood conditions. Parents will have to help them to change unhealthy behaviours. In order to adopt a healthy lifestyle, parental knowledge on which exact behaviour to change is necessary (6), but knowledge alone rarely leads to a sustained behaviour change (7). In young children, key oral health behaviours mainly take place in the family environment, when tooth brushing and the intake of sugary foods and drinks happen with the parents present. Despite this evident influence of parents, family factors are rarely considered in context of oral health behaviour patterns (8). Succeeding in maintaining key oral health behaviours depends on attitudes of parents, parenting practices and parent-child interactions (9-11). The development of interventions targeting these parent and family factors could be essential in prevention of dental caries. For this, detailed knowledge of parent- and family-related barriers for behaviour change is indispensable.

To identify possible components of prospective interventions, this thesis firstly aimed at exploring the role of parenting and family functioning in children’s oral health behaviours and childhood dental caries. A second aim was to explore the relationships between obesity and dental caries, in order to assess if both diseases could be targeted by the same behaviour change. A further objective was to explore whether family functioning, parenting and childhood dental caries are associated with child behaviour problems, for these could be a potential confounder in the relationship between family factors and dental caries.

**Triangulation of research methods**

In the various studies in this thesis self-report questionnaires, focus group interviews and observational methods were used. This triangulation in research methods emphasised the influence of parenting practices and parent-child interaction on childhood dental caries. The questionnaires used were well-validated self-report family assessments.
with good psychometric properties. Still, there is considerable discussion regarding the advantages and disadvantages of using self-report methods versus observational methods for parenting assessment (12,13). Self-report methods rely on parents’ own beliefs and perceptions of their parenting behaviours. However, it is generally accepted that these can be quite distinct from actual behaviours (14). Furthermore, there may be a tendency of parents to answer questions about their parenting in a socially desirable manner. Structured observational methods do not possess these limitations and have the advantage that all participants receive the exact same standardized instruction. However, with observational ratings, there is a risk that results may be biased by the interpretation of the observer. This was limited in this thesis, because coders were blind to the child’s dental condition and intercoder agreement was high. In the observational studies (chapter 3 and 4) a case-control design was used, comparing caries free children to children with caries experience. A potential limitation of case-control designs is the risk of selection bias. Parents of children with caries experience might have been reluctant to join the study as a result of feelings of guilt or fear of exposure of their less ideal parenting practices. The large proportion of children from lower social class and from Moroccan and Turkish origin that was needed to compose the studied population in chapter 4 was difficult to recruit. In addition, parents of caries free children may have not prioritised to join, for they did not experience any problems.

Various constructs of parenting, family functioning and child behaviour problems were measured, which are presented and defined in Table 1. Positive and effective parenting is considered parenting with low levels of coercion and inconsistent discipline, moderate levels of strictness and high levels of nurturance or positive involvement, encouragement and problem solving ability. Negative and ineffective parenting is considered parenting with higher levels of coercion and inconsistent discipline, higher levels of strictness and lower levels of nurturance or positive involvement, encouragement and of problem solving ability. Responsiveness and communication (family functioning) are - when combined - similar to nurturance. Organisation (family functioning) is defined as the degree of structure, routines and assignment of roles in the family; this domain also includes problem solving.
The findings of the studies in this thesis are schematically presented in Figure 1. Each rectangular shape represents a construct measured by one or more variables. The solid lines represent statistically significant associations, as empirically demonstrated in this thesis. Dotted lines represent associations that were not found to be statistically significant in this thesis. Curved lines represent statistically significant associations without postulated causality. Associations between shapes without connected lines were not studied in this thesis. The numbers used in the figure correspond with the numbering used in the title of each paragraph below.

Figure 1. Overview of studied associations

Each rectangular shape represents a construct measured by one or more variables. A solid line represents a statistically significant association, as empirically demonstrated in this thesis. A dotted line represents an association that was not found to be statistically significant in this thesis. Curved lines represent a statistically significant association without postulated causality. Possible associations between shapes without connected lines were not studied in this thesis.
### Table 1. Overview of the measured constructs and their definition

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Definition</th>
</tr>
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<tbody>
<tr>
<td><strong>Oral health-related attributes</strong></td>
<td></td>
</tr>
<tr>
<td>Dental self-efficacy</td>
<td>Parents' confidence in their ability to engage in healthy oral health practices for their child.</td>
</tr>
<tr>
<td>Locus of control</td>
<td>Parents' belief towards their ability to control the dental health of their child: health-external persons interpret health as dependent on outside forces (e.g. luck, responsibility of the dentist or genetics), whereas health-internal persons believe that health is determined by one's own behaviour.</td>
</tr>
<tr>
<td><strong>Child behaviour problems</strong></td>
<td></td>
</tr>
<tr>
<td>Conduct problems</td>
<td>The extent, to which a child fights, lies or loses his/her temper.</td>
</tr>
<tr>
<td>Hyperactivity/Inattention</td>
<td>A child's degree of impulsiveness, concentration and restlessness.</td>
</tr>
<tr>
<td><strong>Parenting</strong></td>
<td></td>
</tr>
<tr>
<td>Restrictiveness</td>
<td>Parents' tendency to confine behaviour within certain specified limits.</td>
</tr>
<tr>
<td>Nurturance</td>
<td>Interaction between parent and child in which parent responds to the child's needs.</td>
</tr>
<tr>
<td><strong>Parenting practices (self-report)</strong></td>
<td></td>
</tr>
<tr>
<td>Involvement</td>
<td>Parents' interest in the child's activities and positive interactions with the child.</td>
</tr>
<tr>
<td>Positive parenting</td>
<td>The frequency of praise and positive reinforcement for prosocial child behaviour.</td>
</tr>
<tr>
<td>Inconsistent discipline</td>
<td>Parents' irregular and unpredictable use of discipline practices and child punishment.</td>
</tr>
<tr>
<td><strong>Parenting practices (observed)</strong></td>
<td></td>
</tr>
<tr>
<td>Positive involvement</td>
<td>The degree to which family interactions are characterized by warmth, empathy and positive affect and whether parents show an active interest in their child's experiences.</td>
</tr>
<tr>
<td>Encouragement</td>
<td>The extent to which parents stimulate their child's independence through positive endorsement, reinforcement and offering help when necessary.</td>
</tr>
<tr>
<td>Problem solving</td>
<td>Parents' ability to generate solutions that are feasible for the child, and the extent to which the parent and child are both involved in the decision making process and are open to each other's viewpoints.</td>
</tr>
<tr>
<td>Discipline</td>
<td>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.</td>
</tr>
<tr>
<td>Coercion</td>
<td>The degree to which parents have the tendency to criticize their children, be overly strict and demanding and use harsh and inconsistent disciplinary actions.</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Interpersonal atmosphere</td>
<td>The extent to which parent-child interactions are pleasant, comfortable and free of conflict and frustration.</td>
</tr>
<tr>
<td>Family functioning</td>
<td></td>
</tr>
<tr>
<td>Responsiveness</td>
<td>To what extent parents respond to the needs of their child in different personal and cognitive fields.</td>
</tr>
<tr>
<td>Communication</td>
<td>Parent-child interaction: the degree they listen to each other and respond to each other's needs in harmonious and less harmonious situations.</td>
</tr>
<tr>
<td>Organisation</td>
<td>The degree of structure, routines and assignment of roles in the family, as well as the family's ability to resolve problems.</td>
</tr>
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</table>
Parents’ perceptions of barriers and facilitators that influence key oral health behaviours and their views on limitations and opportunities for professional support to promote children’s oral health (not in figure)

The study in chapter 2 was one of the first studies that used a comprehensive qualitative approach to explore both parents’ perceptions on the determinants of children’s key oral health behaviours, as well as their views and ideas for professional oral health support. Previous qualitative studies in the dental literature solely focussed on tooth brushing behaviour (15-17) or beliefs, attitudes and practices regarding children’s oral health in general (18), or they referred to specific population groups (e.g. cultural groups and children treated under general anaesthesia) (19-23).

Chapter 2 describes a focus group study that examined parent-reported barriers and facilitators that influence the adoption of key oral health behaviours in children. The behaviours focussed on were twice daily tooth brushing with fluoride toothpaste and the reduction of the consumption of sugary foods and drinks. With regards to tooth brushing, parents experienced that almost all barriers occurred in the home environment. Besides the factors on child level (child behaviour and compliance), parent and family factors as locus of control, self-efficacy, routines and habituation and parenting strategies were reported. In controlling the consumption of sugary foods and drink routines and parental control were also mentioned as factors on parent and family level, but community level influences as social environment and peer pressure were reported as well. In general, most factors that were experienced by parents as barriers or facilitators for oral health behaviours were parent-related. But parents also reported that the child’s character had positive or negative influence on perseverance of both tooth brushing quality and limiting the consumption of sugary snacks.

Parents were also asked to share their views on limitations and opportunities for professional support to promote children’s oral health. Limitations of health education were perceived in dental health settings: in their opinion parents were not sufficiently involved in prevention by dental professionals and the information provided was very general. They reported receiving complicated and even conflicting messages with the ones received from other health professionals. The tone used by dental professionals and their apparent lack of understanding of the challenges parents encounter in sustaining healthy behaviours, was another important perceived limitation.
Parents would like to receive dental health education during general consultation visits. They also perceived it to be useful to deliver a consistent message on key oral health behaviours at child health centres and schools and to receive information through dedicated group activities at schools and kindergarten. This view was shared with general dental practitioners from the United Kingdom, who felt isolated in their efforts to promote the oral health of children in high-risk of caries and reported the need to broaden the involvement of partners from primary care settings (24).

The relationship between socioeconomic status and ethnicity with locus of control, self-efficacy and dental caries (Figure 1, associations 1 - 7)

Findings in this thesis show that socioeconomic status and ethnicity were associated with childhood dental caries. This finding is in line with the fact that in the Netherlands, the prevalence and severity of dental caries are highest among Dutch children from lower social classes and children of Moroccan and Turkish origin (25,26). Watt et al (1999) even reported that - although oral health has overall dramatically improved in the last 20 years - oral health inequalities have widened (27). The underlying mechanisms that account for this strong relationship between social class and children’s caries experience is not fully understood. It is plausible that that parenting and family factors are partially responsible for socioeconomic inequalities in children’s dental health, as parenting and family factors are known to be socially patterned (28,29). Results of this thesis showed that socioeconomic status was significantly associated with locus of control and self-efficacy. Parents of higher social class had a higher dental self-efficacy and a more internal locus of control. Dutch parents had a more internal locus of control compared to Moroccan parents and Turkish parents. The other parental and family-related factors were not significantly different between Dutch, Moroccan and Turkish parents.

This thesis confirmed an association between parental and family-related factors and socioeconomic status; being from a lower social class increased the likelihood of parents having less favourable oral health-related attributes and parenting practices. These, in turn, were associated with an increased risk of dental caries in children, which supports the potential mediating role of parents’ oral health-related attributes and parenting practices in the relationship between socioeconomic status and childhood dental caries. Future research is necessary to further investigate this mechanism.
The relationships between locus of control and self-efficacy with dental caries (Figure 1, associations 8 and 9)

In the focus group study (chapter 2) the majority of the parents whose children had caries experience did not believe that oral hygiene efforts could fully prevent their child from getting tooth decay accepting an external locus of control. They often related childhood dental caries to causes outside of the parent’s or child’s control, such as chance, genetics or health problems in childhood. Results of chapter 4 showed that parents’ locus of control was significantly more internal in caries free children than in children with caries experience, but parents’ dental self-efficacy did not differ between these two groups. This finding is important to consider in dental health education, for it is conceivable that parents will not change unfavourable behaviours if they believe that the behaviour change will not compensate the external cause.

The relationships between parenting, family functioning, child behaviour problems and dental caries (Figure 1, associations 10 - 14)

Results of the observational studies showed a distinct and significant difference in family factors between children with caries and caries free children. Positive parenting practices in terms of positive involvement, encouragement and problem solving were significantly more found in parents of caries free children, compared to parents of children with a significant amount of caries (dmft ≥ 4). In the first observational study (chapter 3) results showed that more coercion was used in families of children with caries experience. In chapter 6, stricter parenting was associated with higher levels of dental caries. Using coercion is considered negative and ineffective (30). In the study described in chapter 4 the finding that parents from caries free children used less coercion was not confirmed, perhaps due to the slight different study population, because in the second observational study (chapter 4) children with caries experience as well as caries free children were both selected from the paediatric centre. In contrast, in the first observational study (chapter 3) caries free children were selected from a general dental practice, while the children with caries experience were recruited in a paediatric centre. There could have been less divergent parenting in the population from the general practice.

The suggestion of strict parenting being a risk factor for dental caries and behaviour problems is counter-intuitive, since strictness may be expected to further the establishment of routines, daily structures and living up to rules. It has, however, also
been found that strict, harsh and coercive parenting is associated with a higher level of resistance and general non-compliance of children (31,32). Overly strict and harsh parenting is considered to be negative parenting: associations have also been reported with problem behaviour, childhood obesity and an unhealthy diet (33-37). The question that arises is whether negative and ineffective parenting also makes children less likely to comply with oral health behaviours imposed by the parents. In contrast, high levels of nurturance in combination with moderate levels of restrictiveness – considered positive and effective parenting - have been related to several positive child health outcomes, including fewer conduct problems (38) and less dental caries (39). Recent studies have shown that children of parents who demonstrate high levels of positive involvement and encouragement were more likely to be caries free (40,41).

The studies in this thesis found no associations with family functioning in terms of responsiveness, communication or organisation and childhood dental caries. The modest sample size and the relatively high non-response rate resulted in very low numbers of children with poor family functioning. This may have obscured the association between family functioning and dental caries. Duijster et al (2014) studied a larger population and did find a relationship between all three family functioning domains in that study and childhood dental caries (42). Teaching parents skills on organisation of the daily tasks and maintaining of healthy behaviours could be very helpful, for instance to teach parents to create a predictable routine and choose clear and achievable goals in behaviour change. Poorer family functioning, higher levels of restrictiveness and lower levels of nurturance were all related to child behavioural problems (chapter 6). These interactions are reciprocal and may create a vicious cycle, in which difficult-to-manage youngsters elicit more negative and ineffective parental treatment. Less favourable parenting and family functioning may, in turn, contribute to the development of even higher levels of child problem behaviours (30,43,44). This bidirectional relationship may have a synergistic effect on the risk of developing dental caries, since both are risk factors in the development of the disease and are likely to intensify each other. It should therefore be noted that parenting during challenging situations and the way family members interact, in part, are influenced by characteristics and behaviours of the child.
The relationship between oral health behaviours, child behaviour problems and childhood dental caries (Figure 1, associations 15 and 16)

The relationships between family factors and childhood dental caries found in this study may directly operate via oral health behaviours. For example, parents may find it more difficult to maintain healthy behaviours if the child shows resistance towards the rules and structures provided by their parents. Communication may also be more challenging in children with behaviour problems, which could be reflected in the way parents deal with their children’s wishes or demands with regards to - for example - sugary snacks (45). However, the potential mediating role of oral health behaviours in the ‘problem behaviour - dental caries’ relationship could not be demonstrated in this study, as oral health behaviours were not associated with dmft, nor with child behaviour problems.

The absence of the expected associations with oral health behaviours could be attributed to limitations of the measurements. The reported oral health behaviours in this study may not have been an accurate reflection of actual behaviours, because parents could have given socially desirable responses; and behaviours, which can change over the years, were measured at a single point in time. Particularly in this sample, the children that received dental care in a specialised paediatric centre and therefore most likely received oral hygiene instructions and guidance may have improved their oral health behaviours at the time of measurement since the time that dental caries had developed. Also, the parents may have overestimated their behaviours.

An indirect factor that could explain the relationship between child behaviour problems and dental caries is the family environment, for instance by parenting and family functioning. The results of this study partially confirm the plausible underlying role of the family. Parenting was associated with both dental caries and child behaviour problems: children of strict parents had significantly higher levels of dental caries and they also had a higher likelihood of being hyperactive (borderline significant), while children of parents who reported low levels of nurturance were significantly more likely to show conduct problems. Poor family functioning was associated with child behaviour problems, but not with dental caries.

The relationship between childhood dental caries and obesity (Figure 1, association 16)

Another aim of this thesis was to explore the association between dental caries and obesity in children, in order to assess if both diseases could be targeted by the same
behaviour change. In chapter 5 in this thesis, no association was found between dental caries and obesity. The multifactorial character of both overweight/obesity and dental caries means that it is important to consider the various respective causes. Some causes - sound oral hygiene for example - affect only one disease. Other intuitively common causes are more complex: the frequency of the intake of sugary foods and drinks could be a cause of caries but the quantity per portion is less relevant for caries than it may be for overweight. Some parents in the referral practice indicated that their children were ‘bad eaters’: they said that they have to encourage these children more often resulting in a higher frequency of the intake of sugary foods or drinks, with small amounts being eaten or drunk on each occasion, with limited time in between. This dietary pattern may increase the risk of caries but does not necessarily increase the risk of obesity.

The common risk factor
In literature on the causes of obesity ineffective parenting has been related to unhealthy diet, including higher caloric intake, lower fruit and vegetable consumption and lower frequency of eating breakfast (35-37,46,47). In child problem behaviour, a reciprocal relation with negative parenting has been extensively reported over the years (38,43,48). Other outcomes of negative and ineffective parenting are low self-esteem (49), lower academic results (50) and aggressive and delinquent behaviour (51). There is a growing body of literature that suggests that targeting on family factors could be useful in prevention of dental caries (8,42,52). Parent- and family-related strategies have been successfully implemented in obesity interventions (53), but the magnitude of the effect of these interventions was on average small to moderate. If more successful in effect size, prospective oral health interventions - with components to target positive and effective parenting - could positively influence all the described negative outcomes.

Parent targeted interventions
In line with the results of the studies of this thesis, developing a parent-targeted intervention, which focuses on teaching skills to parents and providing practical tools in maintaining daily routines, could be very useful. First, it has to be identified which behaviours parents need to change (6,54). Being able to screen patients on risk factors for dental caries that are already known (e.g. visible plaque, low frequency of (re-) brushing with fluoride toothpaste and high frequency of sugary foods and drinks, low
socioeconomic status, foreign ethnicity of the mother) and the ones identified in this thesis (e.g. low positive involvement and encouragement, low levels of problem solving and high levels of coercion), is the first step in developing and intervention. Difficulties in parenting practices, parent-reported child problem behaviour and an unhealthily high BMI are important risk indicators to consider for developing childhood dental caries and they call for a tailored approach. In Table 2 components of prospective tailored interventions are suggested. Those components may include details to improve parents’ dental self-efficacy and beliefs (locus of control). One has to realise that these attitudes and beliefs are difficult to change. Therefore, it is important to discuss the opportunity of parents to influence the health of a child, despite of their beliefs.

Training parents in tooth brushing skills and providing them with practical tools to increase the effectiveness of parental tooth brushing and re-brushing has to be part of the intervention. In order to help parents introduce and maintain healthy behaviours of their child, teaching the parents skills like positive involvement, encouragement and problem solving has to be included in the program. Implementing these skills in daily practice is the next step in developing an intervention. This can be realised by improving parent-child interaction in a setting with both parent and child present, for instance by letting them carry out tooth brushing like they would do at home. Rewards and praising words have to be used by parents if desired behaviour of the child is seen and undivided positive attention is given to the child (positive involvement and encouragement). Another example could be a discussion with each other - led by a health professional - on feeding wishes of children, in this way teaching parents the skill problem solving. Parents receive immediate feedback. Without parents literally knowing, this could lead to less parenting behaviours that are defined as negative and ineffective parenting (e.g. harsh parenting and coercion). This has been done successfully in Parent Child Interaction Therapy (PCIT). In this therapy parents are supervised in the interaction with their child. This is done in an extensive way, but over a short period of time, hereby successfully targeting child behaviour problems (55,56). Therefore, interventions equal to PCIT could be helpful in managing healthy behaviours in children. This could even facilitate parents in effectuating positive parenting practices, for improvement in these practices could break through the vicious cycle of negative parenting with child behaviour problems. Of course, the implementation of these skills in the home environment is the final step; therefore intentions have to be evaluated in recall visits with both parent and child present and especially by entering into dialogue with the parents.
FUTURE RESEARCH

In future studies, more reliable measurements of oral health behaviours could be used to test the possible mechanisms that account for the association between parenting and childhood dental caries. In a recent study of Collett et al (2016), for instance, parent-child interaction was studied during tooth brushing (57). The oral health behaviour under consideration was not parent-reported, but observed by the researchers. This is a more reliable measurement than self-report via questionnaires. Longer duration of parent-led tooth brushing was related to better oral health in terms of caries and gingivitis. Future studies could be developed to test if teaching parents positive skills could be an effective tool to influence oral health behaviours. The influence of existing behaviour problems in children could be considered in a separate study in which a population of children with higher levels of problem behaviour is included.

A parent-targeted intervention study in dental practice has to be set up, in which parents are taught (positive parenting) skills and are provided with practical tools. These have to be targeted at changing the key parenting practices found to be related to favourable oral health: parents have to be taught to use more encouragement, positive involvement and problem solving ability and to create less coercion in parent-child interactions. Suggested components of prospective tailored interventions focusing on these key parenting practices are schematically presented in Table 2.

Furthermore, in future studies all constructs and behaviours that were measured by self-report have to measured in an objectivised way. Especially oral health behaviours are difficult to measure using parent-report questionnaires. Another example of the possible underestimating influence of self-report measures is the possibility that parents, who have the tendency to report strict or even harsh parenting practices trying to confine the child, eventually do give in to their child. Hereby they unintentionally reinforce the child’s negative behaviour. This behaviour could be an extra challenge in the maintaining of healthy behaviours. Parents thereby unintentionally influence the child’s oral health in a negative way. Prospective, longitudinal studies are needed to investigate the role of parental, behaviour and family-related factors in the initiation of problematic oral health behaviours in children and the development of childhood dental caries over the years.
Table 2. Suggested components of prospective tailored interventions

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Construct</th>
<th>Description of skills to teach to parents</th>
</tr>
</thead>
<tbody>
<tr>
<td>In general</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encouragement</td>
<td></td>
<td>Name desired behaviour and compliment child immediately after behaviour is shown (e.g. well done!)</td>
</tr>
<tr>
<td>Encouragement, less coercion</td>
<td></td>
<td>Ignore undesired behaviour, do not punish for it</td>
</tr>
<tr>
<td>Encouragement, less coercion</td>
<td></td>
<td>Use the word ‘no’ as little as possible</td>
</tr>
<tr>
<td>Twice daily tooth brushing with fluoride tooth paste</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encouragement, Problem solving</td>
<td></td>
<td>Let the child choose between two or three suitable brushes and various tooth pastes</td>
</tr>
<tr>
<td>Encouragement, less coercion</td>
<td></td>
<td>Small rewards if wanted behaviour is shown (e.g. compliments, stickers, points system)</td>
</tr>
<tr>
<td>Problem solving</td>
<td></td>
<td>Place extra tooth brush in kitchen, to facilitate morning tooth brushing</td>
</tr>
<tr>
<td>Positive involvement</td>
<td></td>
<td>Re-brushing in a positive setting, with compliments for compliance, in a structured position (e.g. with music or singing a song)</td>
</tr>
<tr>
<td>Positive involvement</td>
<td></td>
<td>Talking about what was for dinner (pretend that it is still in between teeth and has to be brushed away)</td>
</tr>
<tr>
<td>Controlling frequency of sugary foods and drinks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive involvement</td>
<td></td>
<td>Eat and drink sitting down at the table, on set times</td>
</tr>
<tr>
<td>Problem solving</td>
<td></td>
<td>If drinks and sweets are not finished in 10 minutes, save it for another set moment, or throw it away</td>
</tr>
<tr>
<td>Encouragement, less coercion</td>
<td></td>
<td>If child asks for sweets or drinks, say ‘yes, on the set time’; Avoid saying ‘no’</td>
</tr>
</tbody>
</table>
Notice for the dental health professional

- Grant undivided attention
- Show understanding (e.g., 'of course, you need your sleep also'; 'I know it's hard sometimes')
- Keep it simple
- Give parents the idea that they are inventing their own solution
- Try to restrain from ‘wagging the finger’

¶ Based on parent-reported views on professional support (chapter 2)
CONCLUSION AND IMPLICATIONS

In focus group interviews, parents reported barriers and facilitators in maintaining/adapting healthy behaviours. Parents reported to be in need for less complicated and especially less conflicting messages, delivered by health professionals in a positive way, with them showing understanding of the daily challenges they encounter. In this thesis ineffective and negative parenting was found to be associated with more childhood dental caries. More positive parenting practices as positive involvement; encouragement and problem solving were seen in parents with caries free children. Children with behaviour problems had more dental caries. Furthermore, the reciprocal relation between family factors and child behaviour problems was confirmed, which provides evidence for the triangle between family factors, child behaviour problems and caries.

Parents need well-described tools to enable them to learn practical (parenting) skills that will help them to change their daily routines and the way they tackle daily challenges in maintaining key oral health behaviours. Future research should therefore be focused on planning and testing parent-targeted interventions in which parents are guided to obtain (parenting) skills and practical tools. Table 2 gives an overview of possible components of prospective interventions. This could lead to a less strict, less coercive and thus more positive approach, from which children could benefit in behaviour change which could lead to various positive outcomes as less dental caries, a healthy weight and even the limitation of behaviour problems. Education for dental students is lacking in this field, so in case of positive results in prospective interventions, a paradigm shift will be required to educate a new generation and to introduce the consideration of these factors into daily practice.
REFERENCES


CHAPTER 8

Summary / Samenvatting
SUMMARY

In order to identify possible family- or parent-targeted components of preventive interventions, this thesis aimed at exploring the role of parenting practices and family functioning in children’s oral health behaviours and childhood dental caries in a high-risk population. A second aim was to explore the relationships between obesity and child behaviour problems and dental caries. A further objective was to explore whether family functioning and parenting are associated with child behaviour problems.

Chapter 2 describes a qualitative study, in which six focus group interviews were conducted, including a total of 39 parents of 7-year old children, who were recruited from paediatric dental centres in the Netherlands. The aim of this qualitative study was to explore parents’ perceptions of barriers and facilitators that influence key oral health behaviours in children. With regards to tooth brushing, parents experienced that almost all barriers occurred in the home environment. Besides the factors on child level (child behaviour and compliance), parent and family factors as locus of control, self-efficacy, routines and habituation and parenting strategies were reported. In controlling the consumption of sugary foods and drink routines and parental control were also mentioned as factors on parent and family level, but community level influences as social environment and peer pressure were reported as well. In general, most factors that were experienced by parents as barriers or facilitators for oral health behaviours were parent-related, but parents also reported that the child’s character had positive or negative influence on both tooth brushing quality and limiting the consumption of sugary snacks.

A further objective was to explore parents’ views on limitations and opportunities for professional support to promote children’s oral health. Limitations of health education were perceived in dental health settings: in their opinion parents were not sufficiently involved in prevention by dental professionals and the information provided was general, but complicated and sometimes even conflicting with that received from other health professionals. The tone used by dental professionals and their apparent lack of understanding of the challenges parents encounter in sustaining healthy behaviours, was another important perceived limitation. Parents would like to receive dental health education during general consultation visits. They also perceived it to be useful to deliver
a consistent message on key oral health behaviours at child health centres and schools and to receive information through dedicated group activities at schools and kindergarten.

Chapter 3 aimed on exploring the relationship between parenting practices, parent-child interaction and childhood dental caries, using a sample of 5- to 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 (SITs) and subsequently rated on seven dimensions: positive involvement, encouragement, problem solving, discipline, monitoring, coercion and interpersonal atmosphere. In chapter 4 the same study design was used to explore these associations in a sample of 5- to 6-year old children of Dutch, Moroccan and Turkish origin. Furthermore, in this chapter, the relationship of parental and family-related factors with social class and ethnicity was examined. The study sample included 92 parent-child dyads (46 cases and 46 controls), which were recruited from a large paediatric dental centre in The Hague, the Netherlands.

Results of the observational studies in chapters 3 and 4 showed a distinct and significant difference in family factors between children with caries and caries free children. Positive parenting practices in terms of positive involvement, encouragement and problem solving were significantly more found in parents of caries free children, compared to parents of children with a significant amount of caries (dmft ≥ 4). In the first observational study (chapter 3) results showed that more coercion was used in families of children with caries experience.

In chapter 4, outside the video observations, validated questionnaires were used to collect data on sociodemographic characteristics, oral health behaviours, parents’ dental self-efficacy and locus of control, parenting practices and family functioning. Parents of controls had a more internal locus of control. Lower social class was significantly associated with a lower dental self-efficacy, a more external locus of control and poorer parenting practices. Furthermore, locus of control was more external in Moroccan and Turkish parents, compared to Dutch. Findings suggest that the mentioned parental factors are potential mediators of socioeconomic inequalities in children’s dental health.
Chapter 5 aimed at using anthropometric data to investigate the association between Body Mass Index (BMI) and dental caries experience in 230 children aged 5 to 8 years receiving treatment in a referral centre for paediatric dental care in the Netherlands. Children’s dmft and dmfs scores were calculated using dental records and sociodemographic data were also extracted from these records. Dentists were trained to measure standing height and weight in a standardised way. BMI was calculated by dividing kilogrammes by height squared (kg/m²). Extended International (International Obesity Task Force) body mass index cut-offs were used to define ‘no overweight’ and ‘overweight’ (with the latter category including obesity). It was hypothesised to find a positive association between BMI and dental caries experience in children aged 5 to 8 years attending the practice. However, this study did not find a relationship of this kind. A common risk factor approach for the prevention of caries and overweight is therefore not supported by this thesis.

Chapter 6 contains the results of a study that aimed to explore the relationship between child behaviour problems and dental caries. Further objectives were to assess whether child behaviour problems and dental caries have a common association with oral health behaviours, parenting and family functioning. Cross-sectional data were collected in a paediatric dental practice in the Netherlands. Children’s dmft scores were obtained from children’s dental records. Child behaviour problems, oral health behaviours, parenting and family functioning were measured using validated self-report questionnaires. The study sample consisted of 251 5 to 8 year old children. Children with conduct problems had a significantly higher mean dmft. The mean dmft was also higher in hyperactive children, but this did not reach statistical significance. Parenting was associated with both dental caries and child behaviour problems: children of strict parents had significantly higher mean dmft, while children of parents who reported low levels of nurturance were significantly more likely to show conduct problems. Poor family functioning in terms of responsiveness, communication and organization was also associated with conduct problems and hyperactivity, but not with dmft. No significant associations with oral health behaviours were found. This study found a significant relationship between child behaviour problems and dental caries, which may be explained by an underlying influence of parenting and family functioning.
The triangulation in research methods of this thesis emphasised the influence of parenting practices and parent-child interaction on childhood dental caries. In addition, it should be noted that parenting during challenging situations and the way family members interact, in part, are influenced by characteristics and behaviours of the child. Future research should be focused on planning and testing parent-targeted interventions in which parents are guided to obtain (parenting) skills and practical tools. This could lead to a less strict, less coercive and thus more positive approach, from which children could benefit in behaviour change which could lead to various positive outcomes as less dental caries, a healthy weight and even the limitation of behaviour problems. Education for dental students is lacking in this field, so in case of positive results in prospective interventions, a paradigm shift will be required to educate a new generation and to introduce the consideration of these factors into daily practice.
SAMENVATTING

Dit proefschrift geeft resultaten weer van onderzoek dat gericht was op het meten van verbanden tussen opvoeding en gezinsfunctioneren enerzijds en mondgezondheid van kinderen anderzijds. Daarnaast werden verbanden tussen overgewicht, gedragsproblemen en cariës bij kinderen in kaart gebracht. Deze nieuwe kennis zou gebruikt kunnen worden voor verbetering van cariëspreventieve interventies.

In hoofdstuk 2 wordt een kwalitatief onderzoek beschreven: een totaal van 39 ouders met een verschillende achtergrond namen deel aan zes groepsinterviews. Het betrof ouders van 7-jarige kinderen die onder behandeling waren bij verschillende tandheelkundige kinderpraktijken in Nederland. In deze interviews stond de ervaring van ouders centraal; zij gaven aan wat stimulerend danwel remmend werkte in het volhouden van gezondheidsbevorderend gedrag. Concreet werd tandenpoetsen met fluoride-houdende tandpasta en het beperken van zoetmomenten besproken. Ouders noemden verschillende oorzaken van het feit dat het effectief tandenpoetsen bij hen niet lukte. Naast invloeden op kindniveau (bijv. gedrag van kinderen), werden ook gezins- en ouderfactoren genoemd zoals vertrouwen in het eigen kunnen, gewoontes, opvoedstrategieën en eigen opvattingen over het ontstaan van cariës. Een voorbeeld van een opvatting dat te maken heeft met ‘locus of control’ is dat ouders van mening kunnen zijn dat het ontstaan van cariës erfelijk is, of afhankelijk van toeval en pech. Ten aanzien van het beperken van het aantal zoetmomenten gaven ouders moeilijkheden aan op het gebied van de dagelijkse routine thuis. Daarnaast werden ook problemen buiten het gezin genoemd, bijv. groepsdruk en de sociale omgeving. Bij zowel het tandenpoetsen en het beperken van zoetmomenten erkenden ouders het belang van hun eigen opvoedgedrag, waarbij ze ook de uitdagingen noemden die ontstaan door onverzettelijkheid van het kind. Ten slotte werd in hoofdstuk 2 ook beoogd de mening van ouders in kaart te brengen betreffende de rol van conventionele tandheelkundige preventie in het gezond houden van de mond van hun kind. Naar hun mening werden ouders in de tandartspraktijk niet voldoende betrokken bij preventie en de informatie die werd overgebracht is vaak algemeen en soms tegenstrijdig met voorlichting die ze elders ontvingen, bijv. bij de huisarts of het consultatiebureau. De negatieve toon die mondzorgverleners soms gebruikten en het schijnbare onbegrip over de uitdagingen die ouders tegenkomen bij het volhouden van gezondheidsbevorderend gedrag werden als weinig stimulerend ervaren.
Tijdens bezoeken aan het consultatiebureau willen ouders al voorgelicht worden over de ontwikkeling van een gezond gebit van hun kind en hoe zij daaraan kunnen bijdragen. Soms was het voor ouders verwarrend als de voorlichting op het consultatiebureau, de kinderopvang en daarna op school niet eenduidig was.

In hoofdstuk 3 stond de relatie tussen opvoedvaardigheden, ouder-kind interactie en het voorkomen van cariës centraal. Het onderzoek vond plaats in een verwijspraktijk voor kindertandheelkunde in Nederland. De steekproef bestond uit kinderen in de leeftijd van 5 tot 8 jaar, die geselecteerd werden uit het patiëntenbestand. In een case-control design werden 28 kinderen met een dmft-getal van 4 of meer geselecteerd als cases. Dit dmft-getal geeft het aantal tanden of kiezen weer waarin cariës aanwezig is of die zijn behandeld in verband met cariës. De controls waren 26 cariësvrije (dmft = 0) kinderen die onder controle waren bij een algemene praktijk. De kern van het onderzoek bestond uit de observatie van ouder-kind interacties tijdens het uitvoeren van gestructureerde taken (Structured Interaction Tasks (SIT)). De interacties werden opgenomen op video en daarna beoordeeld ten aanzien van opvoedvaardigheden van de ouder, bijv. de mate van positieve bekrachtiging, dwingend disciplineren en probleemoplossend vermogen.

Bekend uit eerder onderzoek is dat er bij Nederlandse kinderen met een lagere sociaaleconomische status (SES) en bij kinderen van Turkse of Marokkaanse afkomst meer cariës voorkomt. In hoofdstuk 4 wordt beschreven hoe van eenzelfde onderzoeksdesign gebruik is gemaakt om bij 5- en 6-jarige kinderen van Nederlandse, Marokkaanse en Turkse afkomst de relatie tussen opvoedvaardigheden, ouder-kind interactie en het voorkomen van cariës te onderzoeken. Verder werd in hoofdstuk 4 de relatie tussen ouder- en gezinsfactoren en SES en etniciteit onderzocht. 92 ouder-kind paren werden geselecteerd uit het bestand van een grote kindertandartspraktijk in Den Haag. De indeling tussen cases en controls was dezelfde als in hoofdstuk 3: cases hadden 4 of meer cariës laesies en controls waren cariësvrij.

In hoofdstuk 3 en 4 kwam een uitgesproken en significant verschil naar voren tussen kinderen met en kinderen zonder cariës betreffende de gemeten gezinsfactoren. Positieve opvoedvaardigheden zoals positieve betrokkenheid, positieve bekrachtiging en probleemoplossend vermogen werden minder vaak gezien bij cases dan bij controls. Het onderzoek beschreven in hoofdstuk 3 liet ook een andere belangrijke uitkomst zien: kinderen van ouders die als opvoedstijl een dwingende en strenge manier van disciplineren hadden, gecombineerd met het uiten van weinig warmte, hadden grotere kans op het ontwikkelen van cariës.
Naast de video-observaties werden in hoofdstuk 4 gevalideerde vragenlijsten afgenomen om informatie te verzamelen over sociale achtergrond, demografische kenmerken, mondgezondheidsgevingen, eigen-effectiviteitsverwachting en ‘locus of control’ (LoC) van ouders. Zoals eerder genoemd betreft dit de opvatting dat cariës erfelijk zou zijn, of afhankelijk van pech of toeval. Ook opvoedvaardigheden en gezinsfunctioneren werden door middel van een vragenlijst in kaart gebracht. Ouders van cariësvrije kinderen hadden een meer interne LoC. Een lagere SES had verband met een lagere eigen-effectiviteit van ouders, een meer externe LoC en het laten zien van minder gunstige opvoedvaardigheden. Bovendien hadden ouders van Marokkaanse en Turkse ouders een meer externe LoC vergeleken met Nederlandse ouders. Dit alles suggereert dat de bovengenoemde ouderfactoren potentiele mediators zijn van het verschil tussen sociale klassen op het gebied van mondgezondheid.

Zowel cariës als overgewicht laten zich niet makkelijk door preventieve maatregelen beïnvloeden. Er is mogelijk overlap in de determinanten van beide ziektebeelden. Een volgend onderzoek was daarom gericht op het in kaart brengen van een mogelijk verband tussen Body Mass Index (BMI) en cariës. Bij 230 kinderen van 5 tot 8 jaar, onder behandeling bij de eerder genoemde verwijspraktijk voor kindertandheelkunde, werd het BMI-getal vastgesteld en gerelateerd aan het dmft-getal, verkregen uit het tandheelkundig dossier. Er kwam geen significant verband tussen BMI en het voorkomen van cariës naar voren.

Hoofdstuk 6 beschrijft onderzoek dat erop gericht was de relatie tussen cariës en gedragsproblemen van kinderen te onderzoeken. Daarnaast was het doel te bekijken of zowel gedragsproblemen als cariës op eenzelfde manier correleren met mondgezondheidsgeving, opvoeding en/of gezinsfunctioneren. Er werden cross-sectioneel gegevens verzameld in bovengenoemde verwijspraktijk. Uit de tandheelkundige dossiers werden de dmft scores verzameld. Het vóórkomsten van gedragsproblemen bij kinderen, gezondheidsbevorderend gedrag binnen het gezin, opvoeding en gezinsfunctioneren werden gemeten door middel van gevalideerde vragenlijsten, ingevuld door ouders. De respons bestond uit 251 kinderen in de leeftijd van 5 tot 8 jaar. Het bleek dat kinderen met gedragsproblemen een significant hogere dmft score hadden. Opvoedstijlen waren gerelateerd aan zowel cariës als gedragsproblemen: kinderen van strenge ouders hadden een hoger dmft, terwijl kinderen van ouders die minder warmte gebruiken in de opvoeding, meer gedragsproblemen hadden. Er kwam een
verband naar voren tussen gezinsfunctioneren en gedragsproblemen bij kinderen. Een verband met dmft werd in dit geval niet gevonden. Er werden geen significante relaties gevonden met gezondheidsbevorderend gedrag. In dit onderzoek werd een significante relatie tussen het vóórkomen van gedragsproblemen en de aanwezigheid van cariës bij kinderen gevonden, die wellicht kan worden verklaard door een onderliggende invloed van opvoeding en gezinsfunctioneren.

De drie onderzoeksmethoden (vragenlijsten, observaties en interviews) die in het bovengenoemde onderzoek werden gebruikt, maken alle een verband duidelijk tussen ouder-kind interactie en het voorkomen van cariës bij kinderen. Toekomstig onderzoek zou zich kunnen richten op het ontwerpen en testen van oudergerichte interventies, ingezet op het verwerven van positieve opvoedvaardigheden. Dit zou ouders kunnen brengen tot minder streng en dwingend opvoedgedrag en tot het uiten van meer betrokkenheid en warmte. Mogelijk zal dit leiden tot positieve uitkomsten zoals een afname van de aanwezigheid van cariës, een afname van overgewicht en zelfs misschien reductie van het voorkomen van gedragsproblemen bij kinderen. Er lijkt in de tandheelkundige opleidingen minder aandacht te zijn voor de achtergrond en context van het ontstaan en voorkomen van cariës. De resultaten uit dit proefschrift wijzen allen naar een noodzaak hier meer oog voor te hebben. Gunstige uitkomsten van nieuwe opvoedinggerichte interventies pleiten voor implementatie in zowel onderwijs als de dagelijkse praktijk.
Samenvatting
Dankwoord
Curriculum Vitae
List of publications
DANKWOORD

Iedere dag vind ik mijn werk een beetje leuker dan de dag ervoor … Ik realiseer me steeds vaker dat dit helemaal niet zo vanzelfsprekend is. Natuurlijk heb ik zelf een aantal stappen gezet waardoor ik mij op gebied van opleiding, praktijk en onderzoek heb kunnen ontwikkelen; maar het was niet gelukt zonder de hulp van meer dan een aantal belangrijke mensen in mijn werkende en privé leven. Ik vind het een voorrecht dat ik de onderzoeksvragen die in de praktijk zijn ontstaan, kon onderzoeken in diezelfde praktijk, met dit proefschrift als resultaat. Ik denk daadwerkelijk dat het leuker en makkelijker kan voor kinderen en hun ouders; met echt resultaat. Gewoon iets positiever allemaal? Zou dat het zijn? Wordt vervolgd!

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De sectie sociale tandheelkunde van ACTA, dankjewel dat ik bij jullie te gast mocht zijn. Johan Hoogstraten, dankjewel voor je vertrouwen tijdens de eerste fase van mijn traject. JanP, dankjewel voor mij laten inzien dat ik een pauze moest nemen toen het nodig was, terwijl dat voor jou uiteindelijk betekende dat onze samenwerking verloren is gegaan. Erik Vermaire, dank voor je interesse, het doorsturen van artikeltjes en je tip over Social Science and Medicine. Hanny, dank voor je ondersteuning en het altijd op orde houden van hele afdeling. Ad, jij faciliteerde heel wat schrijftuurtjes door jouw huisje beschikbaar te stellen, fantastisch! Arjen, voor mij ben je de docent van het jaar, hoor!

Guus, dank je dat me geadopteerd hebt bij CEP. Collega’s bij kindertandheelkunde: fijn dat ik af en toe van jullie spaarzame ruimte gebruik mag maken. Ik denk dat we nog wel wat ruimte gaan winnen! Tineke: dankjewel! Joost Bouwman, dank voor je laagdrempelig openstaan voor alle vragen en je snelle reacties op mails. Collega’s van het CBT in het Medisch Centrum Alkmaar: dank voor de gezellige jaren. Puck, wat heb ik veel van je geleerd! Gerda, ik mis je nog steeds … Peter, you beat me!

Alle tandarts-pedodontologen en andere mensen die er zo van genieten kinderen te behandelen: laten we veel kennis delen en op een volwassen manier eventuele meningsverschillen bespreken. En dan in onze diversiteit als één naar buiten treden …!
Dankwoord

De meeste gegevens zijn verzameld in mijn praktijk in Noordwijk. Ik wil graag alle patiëntjes en hun ouders bedanken die hebben meegewerkt met het onderzoek en daar ook nog enthousiast over waren! Daarnaast mochten we te gast zijn bij diverse jeugdtandverzorgingscentra. Meike, we hebben nooit een woord gesproken over het al dan niet slagen van het eerste observationele onderzoek, dus het was ‘opeens’ gewoon af. Wat hebben we hard gewerkt! Prof. dr. Corine de Ruiter en Jill Thijsen, wat een voorrecht om met jullie te mogen werken en zo onze verschillende vakgebieden te kunnen combineren.


Nora, jij weet als geen ander mijn ideeën te vertalen in beeld. Als ik twijfelde of mijn hersenspinsels iets te ver gingen, was jij altijd degene die dat inderdaad beaamde … Waardoor ik het kon loslaten, gewoon, omdat het al helemaal tof was. Dank voor alles! Suus! Dank voor het ad hoc klusje van de kaart! Marco, jij hebt me geholpen de door mij bedachte composites van al het bij elkaar gekochte en gezocht playmobil om te zetten in prachtige foto’s. Dank! Nicole Nijhuis van Gildeprint, dank voor je begrip in het soms wat langzamer aanleveren van alles, onder druk wordt alles vloeibaar. Het ziet er prachtig uit, dank!

Lieve Esmé, door jouw verantwoordelijkheidsgevoel en niet aflatende liefde voor de kinderen ging ik altijd met een gerust hart van huis. Dank voor je begrip voor mijn soms belachelijke schema, waardoor jouw schema ook wel eens wat bizar uitpakte. Ik weet dat je er niet voor altijd zal zijn, maar zonder jou was het niet gelukt!

Lieve Angelique, onderzoek doen naar gezondheidsbevorderend gedrag bleek soms makkelijker dan ernaar leven … Terwijl ik dat eerste bij tijd en wijle al erg pittig vond. Jij liet me stap-voor-stap zien dat het altijd kan, je leefstijl nog veranderen, ook als de grondslag ervan wat dieper reikt. Dankjewel daarvoor! En dankjewel dat je me de kou in bikini hebt leren trotseren! Dear Elee, I came to Poland with a mission. I think you will
never realise the gift you have given me. Because of you I could leave all my less wanted luggage behind; on top of that mountain. I therefore walked down as a better version of me. The light gets in through the crack!

De afgelopen jaren was ik niet altijd de meest attente vriendin die er bestaat. Dankjewel voor een aanhoudend wederzijds vertrouwen in tijden van drukte (soms ook in mijn hoofd) en verhuizingen. Een paar mensen wil ik graag noemen, wetende dat ik mensen vergeet. Lieve Sas, mijn BFF, al sinds 1989! Al lang voordat ik bedacht tandarts te worden in ieder geval. Wat hebben we veel meegemaakt samen! Iedereen verbergt zijn onzekerheid achter schijnzekerheid, arrogante types ;) We zien elkaar natuurlijk veel te weinig ... Maar in voor- en tegenspoed; ik weet zeker dat we elkaar blijven zien. Marjol, Wil, Ing, Peek en Loes: ik wil de fiscus wel weer zijn hoor! Wil, wat een sterke vrouw ben jij. Jij hebt me veel geleerd dit afgelopen jaar ... Lieve Claire, jij hebt mij in laten zien dat ik het op een bepaald moment dus even niet meer onder controle had. En dat ik daar dus even wat mee moest. Dat heb ik gedaan; met mijn Polen reis als punt op de i. Ik heb me bepist om jouw reactie daarover. En trouwens ook over alle foto’s en filmpjes die eigenlijk net niet kunnen. Blijven sturen! Lieve vriendinnen in Warmond, dat we in het begin twijfelden of Warmond wel de goede stap was voor ons, kan ik me nu niet eens meer voorstellen. Roos, jouw ervaringsdeskundige tip om ministappen af te vinken van mijn to-do lijst, bleek geniaal. Lies, lang leve whatsapp, wat hield je me goed in de gaten (overloper). Mech: binnenkort weekendje pinterest? Gaaf dat je ik je ook op ACTA zag. Jij bent de volgende toch? Lexie: ik was koppig, wilde het allemaal zelf doen, dank voor je meedenken! En ladies van de Groninger feesten- en partijen app: ik zit er nu niet voor niks meer in!

Mijn lieve schoonfamilie: lieve Youngones: Paul, Relie, de Pat, Kris, Reinier en Géraldine, dank voor jullie begrip en interesse. Lastig voor jullie om te bedenken waar ik precies mee bezig was, maar jullie bleven ernaar vragen. Relie en Paul, dank dat jullie ons leven zo goed begrijpen en dat jullie ons nooit veroordelen over de keuzes die we maken. Ik vind het geweldig om te zien hoe trots jullie op de (klein)kinderen zijn.
Lieve papa en Ria, bij ons in de familie heerst het gevoel: doe maar gewoon, dan doe je al gek genoeg, dat hoort geloof ik bij een Sallander. Ik geloof dat ik toch meer een Brabander ben … Toch lieten jullie mij indirect zien achter mijn bezigheden te staan: niets was te veel, de kinderen konden altijd logeren en dat heeft me heel erg geholpen.
Mink en Tom, we wonen helaas niet bij elkaar om de hoek, maar zussen, daar krijg je niks tussen. Dank voor jullie begrip als ik soms een verjaardag moest overslaan. Mama, het is niet altijd makkelijk geweest. Sterker nog, dat is het nog steeds niet. Ik ben je zeer dankbaar voor het feit dat jij boven alles je trots liet zien. Jij hebt me vanaf de basisschool geleerd dat ik alles kon worden wat ik wilde … Als ik mijn best maar deed. Ben ik toch maar goed terecht gekomen.

Lieve Tijnen, Cato en Seppe: ik weet dat ik me soms niet kan inhouden jullie te vertellen dat ik jullie op bepaalde momenten liever achter het behang wil plakken. Maar wat geniet ik van jullie en wat hebben we veel plezier! Omdat ik al het harde werk wilde compenseren met leuke dingen doen, hebben we jullie dit jaar wel heel erg verwend met mini-reisjes en fristi’s drinken in restaurants. Zo onbetaalbaar dat dat allemaal ‘zomaar’ mogelijk is, ik hou van jullie!

Lieve Pep, ik weet dat jij mensen helemaal voor gek verklaart die dit vrijwillig doen, een proefschrift schrijven. Het duurde even voordat ik het door had, maar stiekem stond juist jij al die tijd als een baken achter me. Je wilde me eigenlijk gewoon beschermen. Ik heb je af en toe wel echt in de steek gelaten thuis, maar zelfs dan aten de kinderen gewoon verse groente - aan tafel :)! Dankjewel voor zoveel. Zonder jou is er niks aan! IHVJ, UJ.
CURRICULUM VITAE


Naast het werk als kindertandarts heeft zij congressen mogen organiseren voor de Nederlandse Vereniging voor Kindertandheelkunde (NVvK), en heeft zij zitting in het Regionaal Overleg Jeugdtandzorg (ROJT) in haar regio. Maddelon is getrouwd met Pepijn, heeft drie jonge kinderen en woont in Warmond.
Maddelon grew up in the south of the Netherlands, within cycling distance of Eindhoven, where she attended the Lorentz Lyceum. She was part of the challenging first cohort after the reopening of the Groningen Faculty in 1995. Her interest in paediatric dentistry increased during an internship in Indonesia, where the research team visited many schools. Children’s oral health was very poor, as was the care of their teeth, which made making positive contact with the children even more important. After graduating she worked as a general dental practitioner, completed the post-doctoral training in paediatric dentistry in 2004 and remained connected to ACTA as a teacher. During that period she took part in releasing a number of practical books with case reports in paediatric dentistry. She also got the chance to start working at the department of special care dentistry at the Medical Centre Alkmaar. Maddelon’s interest and joy in treating children grew and grew and she decided to ‘retire’ from general dentistry. In 2008 she started a paediatric referral practice in Noordwijk. Nowadays the practice has grown to be a multidisciplinary centre, where besides dental professionals also a psychologist, anaesthesiologists and a speech therapist are based. During the treatment of children who need specific approaches or treatments, many questions arose on the way parents guide their children. In collaboration with TNO and later ACTA she started several research projects. Data on these research questions were gathered in the practice, resulting in this thesis, which is the basis for new research focusing on oral health interventions in the dental practice.

In addition to her work as a paediatric dentist, she organized congresses for the Dutch society of Pediatric Dentistry (NVvK) and is part of the Regional Consultations Youth dental care (ROJT) in her region. Maddelon is married, has three young children and now lives in the west of the Netherlands.
LIST OF PUBLICATIONS

In this thesis:


*Equal contributors

[chapter 2 in this thesis]


[chapter 3 in this thesis]


[chapter 4 in this thesis]


[chapter 5 in this thesis]
Other publications:

Lenters M. Wat zijn de effecten van antibiotica op het kindergebit? *Mondhygiënisten Vademecum* 2006, nummer 10, sept. (in Dutch)


Van Amerongen, E., de Jong-Lenters, M., Marks, L., & Veerkamp, J. (2010). *Casuïstiek in de kindertandheelkunde, deel 3*. Prelum uitgevers. (in Dutch)


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