Family Functioning and Oral Health of Pre-school Children

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Thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy in Dental Public Health

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August 2022

Abstract

Aim: The aim of this study was to examine the interrelationships of family functioning, parental socioeconomic position and child oral health.

Methods: Cross-sectional data of 733 parent-child (3-4-year-olds) dyads who participated in the East London Oral Health Inequalities (ELOHI) study were analysed. Parents reported their demographic characteristics, socioeconomic position (SEP), family functioning, and their child's demographic factors, dental behaviours (sugars intake, dental attendance pattern and toothbrushing frequency) and quality of life. Family functioning was assessed with the Family Assessment Device (60-item) that yielded a general functioning score and six domain scores (roles, communication, problem solving, affective involvement, affective responsiveness, and behaviour control). Dental caries was assessed clinically, from which the dmft, dt and mft scores were derived. Oral health-related quality of life was assessed with the Early Childhood Oral Health Impact Scale (ECOHIS) that measures the impacts of children's oral conditions on the child (child impact section, CIS) and family (family impact section, FIS). The independent, mediating and moderating role of family functioning in the association between family SEP and child oral health outcomes were explored in adjusted regression models.

Results: Unhealthy general family functioning was associated with high child sugars intake, greater dmft and dt scores and higher FIS, after adjustment for confounders. In analysis by domains, unhealthy functioning in roles was associated with high sugars intake, lower mft score and higher FIS whereas unhealthy behaviour control was associated with high sugars intake and lower mft score. There was also some evidence that general family functioning may partially mediate the associations of parental SEP

with high sugars intake, and dmft and dt scores. Roles and behaviour control showed the strongest evidence of mediation, particularly for the association of low parental SEP with high sugars intake and lower mft score. Finally, unhealthy general family functioning worsened the association of low parental SEP with higher dt score. By domains, unhealthy behaviour control intensified the association of low parental SEP with higher dt score.

Conclusions: This study showed that family functioning was associated with multiple child dental behaviours, dental caries and oral health-related quality of life, over and above well-known determinants of child oral health. Evidence on the mediating and moderating role of family functioning in the association between family SEP and child oral health was weaker and somewhat inconsistent. Effective assignment and fulfilment of roles as well as setting and control over daily routines might be relevant to improving child dental behaviours, and subsequently, child oral health.

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Acknowledgements

I am deeply grateful and thankful to my supervisors, Eduardo Bernabé and Sasha Scambler, for their contribution in the synthesis of this thesis, their continuous support and guidance throughout my studies, and for always being there to help whenever I needed.

I am also grateful for the individuals who organised and executed the ELOHI study and for the families who participated in this survey.

When writing about families, I could not be more thankful to my own family for their support, love and encouragement.

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Abbreviations:

ACFF: Alliance for a Cavity-Free Future

OHRQoL: Oral Health Related Quality of Life

ECC: Early Childhood Caries

GBD: Global Burden of Disease

DALYs: Disability Adjusted Life-Years

UK: United Kingdom

dmft: number of decayed, missing, filled primary teeth

WHO: World Health Organization

SEP: socioeconomic position

ONS: Office for National Statistics

FACES: Family Adaptability and Cohesion Scale

FAD: Family Assessment Device

SFI: Self-Report Family Inventory

FAM: Family Assessment Measure

SCORE: Systemic Clinical Outcome Routine Evaluation

FES/FRI: Family Environment Scale/Family Relationship Index

SMD: Standardised mean difference

GVL: Gezinsvragenlijst (translation: Family Questionnaire)

ADHD: Attention Deficit/Hyperactivity Disorder

BREALD: Brazilian version of the Rapid Estimate of Adult Literacy in Dentistry,

CI: confidence interval

ECOHIS: Early Childhood Oral Health Impact Scale

FES: Family Environment Scale

RR: rate ratio

OHL: oral health literacy

OR: odds ratio

SEM: structural equation modelling

SSB: sugar-sweetened beverages

USA: United States of America

ALSPAC: Avon Longitudinal Study of Parents and Children

ELOHI: East London Oral Health Inequalities study

ONEL: Outer North East London

dt: number of decayed primary teeth

mft: number of missing and filled primary teeth due to caries

CIS: Child Impacts Section

FIS: Family Impacts Section

NS-SEC: National Statistics Socioeconomic Classification

DAGs: directed acyclic graphs

ANOVA: analysis of variance

AOR: adjusted odds ratios

UOR: unadjusted odds ratios

RERI: relative excess risk due to interaction

SD: standard deviation

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Chapter 1

Introduction

Oral health is an all embracing term that relates to one's ability to "speak, smile, smell, taste, touch, chew, swallow and convey a range of emotions through facial expressions with confidence and without pain, discomfort and disease" (World Dental Federation, 2016). This definition reflects important functions of the oral cavity and its associated structures such as its physical, psychological, and social capacities (World Dental Federation, 2016). Conditions affecting the oral health of children, particularly dental caries, are among the most common, largely preventable, non-communicable diseases worldwide (World Health Organization, 2019, World Health Organization, 2021). It is estimated that 4.7% of children, aged between 1 and 4 years old, have untreated dental caries in their primary dentition globally (Bernabe et al., 2020). The disease is associated with substantial adverse impacts on children's health, wellbeing and quality of life, on the family and on society and the healthcare system (Casamassimo et al., 2009, Alkarimi et al., 2014, Abed et al., 2019, Jackson et al., 2011, Levine, 2021). Thus, oral health is fundamental to children, and efforts are made to ensure that all children achieve and sustain good oral health throughout their lifetimes. However, stark inequalities in child oral health still exists (Public Health England, 2021b, Peres and Heilmann, 2015), which warrant research to understand the determinants of child oral health and elucidate disease mechanisms and complex processes.

Families play a pivotal role in the upbringing and development of children (Blair et al., 2010). They constitute the immediate social environment that provides children with the values, beliefs, standards, and skills they need for survival and maintenance within

societies (Parke et al., 2008). This nurturing role of families has a powerful influence on children's health and wellbeing outcomes across the life course (Parke et al., 2008, Komro et al., 2011, Koellinger and Harden, 2018). Research suggests that a favourable family context promotes good child oral health and supports healthy dental behaviours (Nanjappa et al., 2015, Phantumvanit et al., 2018). Familial processes and interactions are fundamental in dealing with day-to-day challenges (Parke et al., 2008). The psychosocial characteristics of these familial dynamics or transactions is termed broadly as family functioning. Family functioning is thus a familial construct that embraces the quality and quantity of interactions and relationships including levels of conflict, adaptability, organisation, quality of communication, as well as the emotional attributes such as cohesion, closeness, responsiveness and involvement (Lewandowski et al., 2010, Booysen et al., 2021). The use of socio-medical frameworks have supported modelling of child oral health where the broader/distal social, community and family determinants, including family functioning, were integrated into the basic medical model of proximal determinants that are related to the individual/patient (biological, behavioural) (Fisher-Owens et al., 2007, Mattheus, 2010, Chi et al., 2017).

Family functioning has been explored in relation to child oral health in several studies (Renzaho and de Silva-Sanigorski, 2014, Renzaho et al., 2014, Duijster et al., 2014, Duijster et al., 2015, de Jong-Lenters et al., 2018, Nanjappa et al., 2015, Finlayson et al., 2018, Martin-Biggers et al., 2018, Bilal et al., 2021, de Moura et al., 2021b, de Moura et al., 2021a, de Moura et al., 2021c , Neves et al., 2020, Neves et al., 2021a, Neves et al., 2021b, Lopes et al., 2021 , Dutra et al., 2020, Lopes et al., 2020, Prata et al., 2021, Leal et al., 2022). The findings from these studies were inconclusive and many of these studies were subject to high risk of methodological bias. Whilst some evidence suggests a significant association between healthy family functioning and

better child oral health literacy and dental behaviours (particularly sugars consumption), the evidence on the association between family functioning with childhood dental caries and perceived child oral health outcomes was mixed. Beyond identifying an association, it is also important to understand how family functioning intertwines with the social determinants of child oral health (Booysen et al., 2021), and which dimensions of family functioning are more relevant to child oral health and, thus, could be targeted by intervention. Therefore, the aim of this study was to examine the interrelationships of family functioning, parental SEP and child oral health among preschool children in Outer North-East London, United Kingdom.

Chapter 2

Literature review

This chapter reviews the literature on the determinants of child oral health, with a focus on the influence of the family, in general, and family functioning, in particular, on the oral health of pre-school children. At the end of the chapter, a theoretical framework, rationale, aim and objectives for this project are presented.

2.1. The oral health of pre-school children

Preschool age (3 to 5 years old) is a time when children experience and achieve important developmental milestones, whether cognitive, linguistic, social, emotional or physical, through their interaction with their immediate environment (family) and their surrounding environment (e.g., preschool and neighbourhood settings), which consequently shape their personality and behaviours (Centers for Disease Control and Prevention, 2021).

The literature on the influence of families on children's health shows that early life experiences have a significant impact on the health and development of children and on their health outcomes later in life (Crall and Forrest, 2018, Mattheus, 2010). The evidence from life course epidemiological studies has emphasised the importance of supportive familial and parental contexts for young children facing poverty and disadvantage (Belsky et al., 2007). This was also emphasised in the Marmot Review (2010) on reducing social inequalities in health as the first policy objective was to give every child the best start in life.

Oral health embraces one's ability to "speak, smile, smell, taste, touch, chew, swallow and convey a range of emotions through facial expressions with confidence and without

pain, discomfort and disease of the head, face, and oral cavity" (World Dental Federation, 2016). This definition recognises oral health as a multi-faceted construct that reflects physiological, social, and psychological functions that are essential for quality of life. It also acknowledges the influence of personal experience, adaptability to changing circumstances, perceptions and expectations in shaping one's oral health (World Dental Federation, 2016). At pre-school age, children are expected to have a full set of 20 primary teeth in the mouth (dos Santos et al., 2013). International efforts are made to ensure that children have the best oral health they could have. This is evident in the Alliance for a Cavity-Free Future (ACFF) setting a goal that children born after 2026 should enjoy caries-free oral health for their lifetimes. Despite the overall goal of achieving and sustaining good child oral health, there is an increasing recognition that not all children enjoy good oral health. Indeed, the evidence suggest there is a socioeconomic gradient in child oral health wherein children from poorer socioeconomic backgrounds have the highest disease rates, are more likely to have unmet needs and untreated disease, and to need hospital treatment more often than their advantaged peers (Peres and Heilmann, 2015).

Measurement of oral health among pre-school children has been traditionally conducted through assessment of clinical outcomes (i.e., measurement of oral diseases rather than oral health status), especially in relation to dental caries (Locker, 1988, Locker, 1997). This has been the standard approach to inform practice, policy and oral health research to date, however, increasingly, oral health related quality of life (OHRQoL) measures are used alongside clinical measures to assess the impacts of oral conditions among children (McGrath et al., 2004, Tsakos et al., 2006, Pahel et al., 2007, Inglehart et al., 2002). The term OHRQoL refers to the functional and psychosocial outcomes of oral health conditions and the outcomes of treatment of these conditions (Locker and Allen,

2007). They capture the impact of oral disorders on aspects of everyday life that are important to people, with those impacts being of sufficient magnitude, whether in terms of severity, frequency or duration, to affect an individual's perception of their life overall (Locker and Allen, 2007). Therefore, measures of OHRQoL are expected to qualitatively analyse the effects of oral diseases on patients, quantitatively measure these impacts, and to address the meaning and importance that patients assign to their quality of life (Sischo and Broder, 2011, Faulks et al., 2022).

2.1.1. Early childhood caries

One of the most prevalent yet largely preventable oral conditions affecting young children is dental caries (Seow, 2018, Tinanoff et al., 2019, Selwitz et al., 2007, World Health Organization, 2019). Dental caries in young children is termed early childhood caries (ECC) and is defined as "the presence of one or more decayed (non-cavitated or cavitated) lesions, missing due to caries, or filled tooth surfaces in any primary tooth in a child under the age of six" (American Dental Association, 2021). The Global Burden of Disease (GBD) study listed untreated dental caries in primary teeth as a cause of Disability Adjusted Life-Years (DALYs) and defined untreated caries as "teeth with unmistakable coronal cavity at dentin level, root cavity in cementum that feels soft or leathery to probing, temporary or permanent restorations with a caries lesion" (Marcenes et al., 2013, Kassebaum et al., 2017, Bernabe et al., 2020). The GBD study showed that the global prevalence of untreated dental caries was 4.7% (95% uncertainty interval: 2.7% to 6.2%) for 1-4-year-old children in 2017, which remained static since 1990 when a prevalence of 4.9% (95% UI: 2.8 to 6.4) was observed (Bernabe et al., 2020). There were variations according to World Bank's income groups with a clear

inverted V-shaped relationship, whereby the lowest prevalence was noted for high- and low-income countries (3.8% and 4.3%, respectively) and the highest prevalence for upper and lower middle income countries (5.1% and 4.7%) (Bernabe et al., 2020).

In the United Kingdom (UK), data from the Child Dental Health Survey 2013 showed that a third (31%) of 5-year-old children had experienced dental caries in their primary teeth (Pitts et al., 2015). The mean number of decayed, missing, filled primary teeth (dmft index) was 0.9 among all 5-year-olds whereas an average of 3 teeth were affected among those with the disease. Furthermore, the survey found that 5-year-olds who were eligible for free school meals (i.e., those from poorer socioeconomic backgrounds) experienced more severe or extensive disease than those of the same age who were not eligible for free school meals (21% vs. 11%), demonstrating stark socioeconomic inequalities in child oral health (Pitts et al., 2015). In England, the oral health survey of three-year-old children in 2013 found that 12% of 3-year-olds had dental caries experience, with an average of 3.1 teeth affected per child with caries and a mean dmft of 0.4 for the whole sample (Public Health England, 2013).

Childhood dental caries poses a public health issue as the condition is associated with adverse impacts on children, families, societies and the healthcare system. Children with dental caries often experience physical symptoms such as pain, abscesses and difficulty in eating and chewing (Grund et al., 2015), sleep disruption (Vieira-Andrade et al., 2016), and adverse growth and development patterns (Alkarimi et al., 2014). Furthermore, children with dental caries are more likely to miss school and to perform poorly than those who are caries-free (Jackson et al., 2011). Moreover, family activities and family quality of life are often adversely affected when a child is experiencing dental caries. Parents often report taking time-off work as well as feeling guilty and stressed because of their child's oral health condition (Abed et al., 2019). Dental caries

is costly to treat and results in loss of work/school time which is a substantial burden on society (Casamassimo et al., 2009). Some children with caries need treatment under sedation or general anaesthesia in a hospital setting and this was found to be the most common reason for hospital admission of children in England (Levine, 2021).

2.1.2. Child Oral Health-Related Quality of Life (OHRQoL)

The definition of oral health stated above goes beyond the absence of disease to embrace the physiological, social, and psychological functions of the mouth and face that are vital to enjoy life (Faulks et al., 2022, Brondani and MacEntee, 2014). Research into the impact of oral conditions on the OHRQoL among pre-schoolers resulted in the development and testing of several measures specific for this age group. These measures aim to quantify an individual's oral health (in terms of biological function and aesthetics), their social and emotional well-being, their satisfaction and expectations of care services, and their overall sense of their oral health (Genderson et al., 2013). OHRQoL measures are used in clinical settings to evaluate treatment outcomes, identify which dental diseases have the greatest impact on children lives and identify children with poorer oral health and reduced access to care. They are also used in epidemiological surveys as an adjunct to clinical measures or as stand-alone oral health measures (Thomson and Broder, 2018b). However, OHRQoL in children is different from those of adults in that children have no control over their health behaviours and practices (i.e., they are dependent on their caregiver to meet their needs and to provide them with the support they require to lead healthy behaviours). Thus, the idea of measuring a child QoL is insufficient. Another major issue when assessing a child OHRQoL is the understanding that children are intrinsically different than adults

in their perception and interpretation of their personal experience. Therefore, children should be approached in a way that takes into account their developmental stage (Inglehart et al., 2002, Marshman and Hall, 2008).

Four components of child OHRQoL were seen as relevant to child oral health (Inglehart et al., 2002) and, therefore, formed the basis for numerous models of child OHRQoL (Jokovic et al., 2002, Pahel et al., 2007). These are the physical ability of the child to bite and chew (functional limitations), whether this ability is free from pain and discomfort (oral symptoms), whether the child is happy by the appearance of their teeth which consequently would affect their self-esteem (psychological/emotional well-being), and finally whether the child oral health disrupts the social aspects of their life, for example, activities in school and with friends (social well-being) (Inglehart et al., 2002). Certainly, dental caries experience, including increased severity of ECC, negatively impacts on the functional, psychological, and social aspects of child OHRQoL (Nora et al., 2018).

A few measures have been developed for use among pre-school children. They were all developed in the English language, namely the Parent-Child Perceptions Questionnaire (P-CPQ) (Jokovic et al., 2002), the Early Childhood Oral Health Impact Scale (ECOHIS) (Pahel et al., 2007), the Paediatric Oral Health-Related Quality of Life (POQL) (Huntington et al., 2011), the Scale of Oral Health Outcomes for 5-year-old children (SOHO-5) (Tsakos et al., 2012), and the Child Oral Health Impact Profile (COHIP-Preschool) (Ruff et al., 2017). A few reviews on OHRQoL measures for children have suggested that these measures demonstrated good psychometric properties and recommended their use in oral health research (Genderson et al., 2013, Gilchrist et al., 2014, Thomson and Broder, 2018b). Most of these measures use parent/carer reports as proxies because pre-schoolers are unable to, reliably, self-report

their OHRQoL, with the exception of POQL and SOHO-5 which are reported by both; child and parent/carer. This is a key limitation of proxy measures because discrepancies between the child and parent/carer perception cannot be eliminated (Wilson-Genderson et al., 2007). Furthermore, ECOHIS was identified as the most commonly used measure of OHRQoL among pre-school children (Nora et al., 2018, Perazzo et al., 2020) and it was found to outperform other measures, regarding its psychometric properties (validity and reliability), in this age category (Zaror et al., 2019).

2.2. Determinants of child oral health

Research suggests that child health, including oral health, is determined by complex interactions of an array of risk and protective factors interplaying at different layers of influence (Blair et al., 2010, Chi et al., 2017). Central to research on child health is the use of socio-medical frameworks which integrate social and contextual determinants (upstream or distal) with more conventional biological and behavioural determinants (downstream or proximal) of child health (Blair et al., 2010). The focus in this section is on factors related to ECC as it is the most common oral condition in children of this age group whilst also highlighting the influence of the family (the immediate social environment) in which pre-schoolers grow, thrive and develop.

ECC is a disease in which tooth structure is dissolved and lost by acids produced by bacteria that are present in the mouth after fermenting dietary sugars. It is characterised by the rapid and often extensive destruction of teeth (Pitts et al., 2017). This is the basic biological model of the disease; nevertheless, the caries process is affected by the wider social circumstances known to modify dental behaviours (Seow, 2018). Evidence has shown that children of families from deprived backgrounds (e.g., low income and low education attainment) are more likely to engage in unfavourable dental behaviours

(behaviours being the proximal predictors of the disease) such as high intake of free sugars, infrequent toothbrushing and irregular dental attendance to seek preventive care and treatment (World Health Organization, 2019). For children, one of the most effective/common methods of assessing the impact of socioeconomic disadvantage is to measure the socioeconomic position (SEP) of the parents (e.g., their income, education level, and occupation).

The mechanisms through which these early life experiences (e.g., parental and familial context, socioeconomic standing) affect oral health and dental behaviours in young children are complex and dynamic and are thought to be through pathways of critical periods and accumulation of risk (Heilmann et al., 2015, Nicolau et al., 2003, Mattheus, 2010). Critical or sensitive periods, such as, in early childhood, are time points where exposure to risk or preventive/protective factors, such as socioeconomic disadvantage, and family/parenting factors, results in an alteration of biological function and a change in behaviour (Belsky et al., 2007, Crall and Forrest, 2018). On the other hand, the accumulation of risk model suggests that cumulative exposures during the life span, for example, to risk factors such as a diet high in sugars and infrequent toothbrushing, predict poor oral health during childhood and later in adulthood (Heilmann et al., 2015, Crall and Forrest, 2018). However, the specific pathways of how socioeconomic circumstances affect dental status in young children and whether the family environment plays a role in the pathway is much less understood (Hooley et al., 2012). Fisher-Owens et al. (2007) proposed a conceptual model of the determinants of child oral health, which included a wide range of determinants nested within layers of influence at individual, family, and community levels (Figure 2.1). This model has been recently adopted by the WHO in their manual summarising the evidence on the aetiology and control of ECC (World Health Organization, 2019). The innermost layer

in the model reflects individual-level influences, which include the child's biological, genetic and developmental attributes, physical and demographic factors, health behaviours (including the use of dental services and dental insurance). The outermost layer in the model reflects community-level influences, which include the social environment and capital, the characteristics of the dental and health care systems, the physical environment and safety, the oral health of the community and the culture. The living conditions of children including their surrounding social, physical, and cultural contexts are important determinants of their oral health. Indeed, the evidence shows better oral health in children living in neighbourhoods and communities where parents are involved in schools and neighborhood activities and where there were community centers available (Moore, 2019, Emmanuelli et al., 2021). Similar findings were reported by Stormon et al. (2019), where poorer oral health was more commonly seen in children from rural, more deprived areas and those where there was a lower water fluoridation coverage.

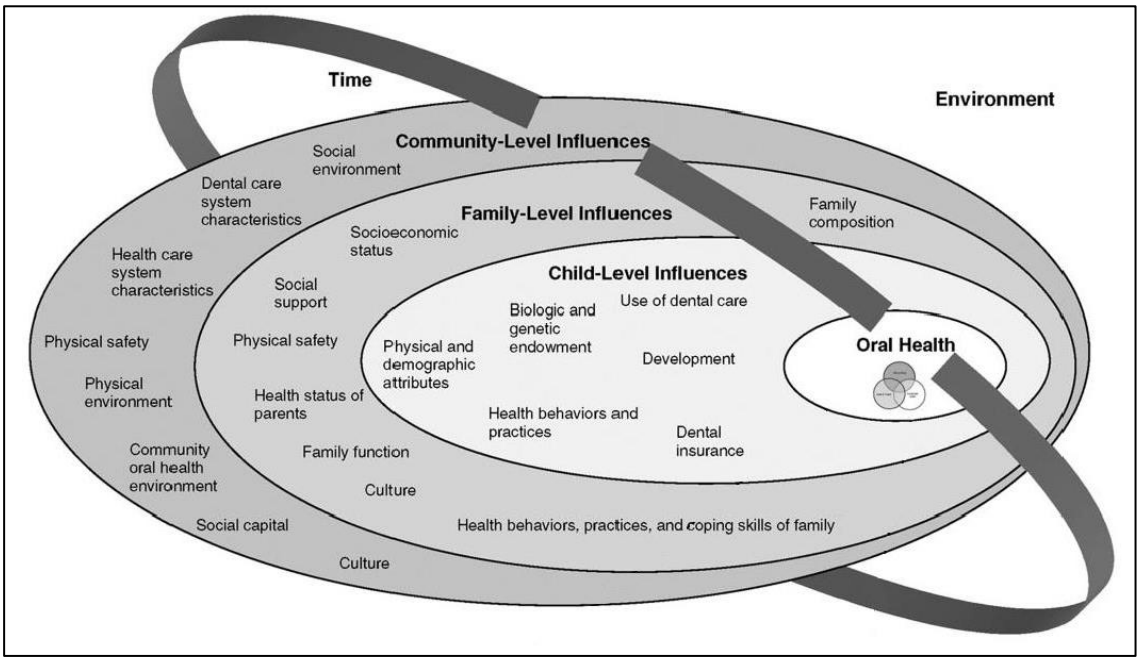

Figure 2. 1. Model of influences on child oral health (Fisher-Owens et al., 2007)

The middle layer in the model reflects family-level influences on child oral health including family SEP, family composition, family functioning, family practices and coping strategies, social support, the health status of parents and health behaviours within the family. The SEP of parents determine the family living conditions including type of housing, access to green spaces, safe neighbourhood/playground/school environments, ability to provide healthy food, and access to dental health care services (Coughlan et al., 2022). Facing financial hardship reciprocally increase parental/family stress resulting in maladaptive coping practices, such as engaging in unhealthy dental behaviours, that diminish the chances for children to live in a favourable context that support healthy choices and promote good oral health (Phantumvanit et al., 2018). Lower SEP often reflects on the health status, beliefs and attitudes of parents (Fisher-Owens et al., 2007, Kim Seow, 2012). Certainly, parents from disadvantaged SEP backgrounds are more likely to have lower oral health literacy which is linked to poorer oral health outcomes (Stormacq et al., 2019, Stormon et al., 2020). In relation to family composition, the evidence suggests that single parenthood is linked to higher risk of caries prevalence and severity in children (Kumar et al., 2016). This is attributed to lower financial resources and increased parental/family stress in single-parent families (Hooley et al., 2012, Kim Seow, 2012, Kumar et al., 2016). In addition, social support for young children primarily comes from parents and siblings and whether they acquire this support within healthy or unhealthy family processes and dynamics in terms of interactions and relationships between family members affects their oral health (Fisher-Owens et al., 2007, Kim Seow, 2012, Stormon et al., 2020).

As seen earlier in this chapter, the family has a vital influence over the child's biological composition (nature) as well as over how the child is raised and their psychosocial

attributes (nurture) (Blair et al., 2010). Families take a particular style, pattern or process when responding to day-to-day challenges (Parke et al., 2008). These family processes include interactions and interpersonal relations and are broadly known as functioning. Family functioning is a holistic construct that recognises the family as an operating system comprised of subsystems (parent-child, marital, and sibling relations). It uses the whole family as a unit of analysis rather than treating the subsystems as units of analysis (Parke et al., 2008). This operating system, based on a biopsychosocial approach to health, seeks equilibrium to achieve family health and avoid imbalance (dysfunction of the system). Family health is therefore defined as a balance between the individual characteristics and family functioning (Fine and Fincham, 2012). Thus, family functioning is a feature of the family environment that is vital to the health and wellbeing of family members.

The next section explores in more detail what we mean when we talk about family and how we might use a wider understanding of the family to better understand child oral health.

2.3. The family as the basic unit of a society

There is ongoing scientifc and political debate on what we mean when we say ‘family’ (Smith and Hamon, 2021) and different disciplines have their own variation on the definition (White et al., 2019). In the social sciences, the family is often defined through its structure, function, and interaction as a social institution and is generally recognised as a group of people who are related to each other by blood, marriage, adoption or cohabitation in which these relations form an emotional link and an economic unit (Keirns et al., 2016, Segrin and Flora, 2004). From a political standpoint, article sixteen of the United Nation’s (2015) Universal Declaration of Human Rights states that “the

family is the natural and fundamental unit of society and is entitled to protection by society and the state". As such, a family is built on a chain of personal connections and a genetic unity and constitute the foundation of communities (Almond, 2008).

Segrin and Flora (2004) identified three perspectives to define a family; namely structural, task-oriented and transactional. The structural perspective defines a family based on its form/structure by using a set of criteria that determines family membership (who is considered a family and who is not). A commonly used structural definition of family is "two or more people related by birth, marriage or adoption residing in the same unit" (Welsh, 2012). This definition provides a simple, standardised and objective method for family definition that is independent of subjective emotional connection and affinity and is useful in policy making and for demographic and legal purposes. According to this perspective, there are generally two types of families; the family into which an individual is born (family of orientation) and the family which an individual forms; often through marriage (family of procreation) which traditionally takes the format of a nuclear family (i.e., a husband and wife and their dependent children) (Gerhardt, 2016). Variations in the structure of families are recognised including single-parent family, extended family (family members who live in the family home, such as grandparents, aunts, uncles, adult un-married children and other cousins), step-family (blended and reconstituted families) and same-sex family (Keirns et al., 2016).

In the UK, the Office for National Statistics (ONS) has defined a family based on its structure as "a married, civil partnered or cohabiting couple with or without children, or a lone parent with at least one child, who lives at the same address; children may be dependent or non-dependent" (Office for National Statistics, 2022). The latest data by the ONS in 2018 showed there were 19.1 million families in the UK, up by 8% from a decade before. Further, recent trends in family structure indicate that married and civil

partner couple families continued to be the most common family type constituting 67.1% of all families, followed by the cohabiting couple family type (17.9%) which is the fastest growing family type and then followed by single-parent family type (15%). Data from the 2011 census showed that the proportion of married and civil partner couple families varied by ethnicity, where it constituted 47% of Asian families, 32.9% of White families, 21.6% of Black families, 19.9% of mixed families and 37% of families from other ethnic backgrounds. Single-parent family type constituted 24.3% of Black families, 19.1% of Mixed ethnic families, 10.5% of families of other ethnicity, 10.2% of White families and 8.8% of Asian families. Variation in the proportion of cohabiting couple family type across ethnic groups was also observed where it ranged between 3.5% of Asian families and 11.2% of Mixed ethnicity families (Office for National Statistics, 2019a, Office for National Statistics, 2019b).

Going back to the other two perspectives to define the family, the task-oriented definition places more emphasis on the instrumental role of the family whereas the transactional definition highlights the interaction in the family (Segrin and Flora, 2004). On one hand, the task-oriented perspective defines a family as a unit that accomplishes certain tasks for its members such as care and nurture, and support whether emotional or economic. Whoever fulfils the tasks demanded of family members is considered family, regardless of his or her structural connection to the other members. Although such flexibility is seen as an advantage of the task-oriented definition, deciding which tasks must be performed to term someone family becomes problematic. It is accepted that the primary functions of the family are to nurture and socialise family members, however, not all families fulfil these functions of care and socialisation.

On the other hand, the transactional perspective extended the task-oriented definition of family, arguing that a family is more than a group of people who perform certain

tasks for one another. The transactional perspective gives central importance to the communication among individuals and the subjective feelings generated by interactions. These family interactions refer to the subjective feelings of belonging, identity, intimacy, dedication, shared past and future. Certainly, the definition by DeGenova and Rice (2002) that the family is any group of persons united by the ties of marriage, blood, or adoption, or any sexually expressive relationship, in which "(1) the adults cooperate financially for their mutual support, (2) the people are committed to one another in an intimate interpersonal relationship, and (3) the members see their individual identities as importantly attached to the group with an identity of its own" captures the three perspectives to define a family.

It must also be noted that the family is a unique type of social grouping (Smith and Hamon, 2021). A family differs from other social groups (e.g., friends and co-workers) in at least four ways. First, family relationships last longer than most social groups and require lifetime membership. Second, families are inter-generational and virtually ensure a range of ages. Third, although most social groups are primarily based on affinity, families usually represent biological and affinal (e.g., legal) relationships. Finally, a family is a connection to larger kindship networks, including other families and organisations in society (e.g., workplace and schools). Members of a family often contribute to labour force and share economic resources (White et al., 2019). In all, the family is certainly the most important and enduring of all human social groupings.

2.3.1. The family as the nurturing environment for children

Families are the first agent for socilisation of young children (Laff and Ruiz, 2021). Within a family, significant physical and mental development of members takes place

(Dai and Wang, 2015). This includes the acquirement of beliefs, values, motives, behaviours and skills necessary for survival and maintanance within the cultural and societal contexts (Parke et al., 2008). Socialisation is, thus, defined as the process by which humans learn the standards, skills, attitudes, and how to interact and behave in a socially appropriate way (Parke et al., 2008). Not only socialisation but children also inherit from their familes the nature (genetic and biological composition) and the nurture characteristics (support) they need for cognitive, behavioural and physical development (Koellinger and Harden, 2018). It also constitutes a resource (a link) that provides access to extrafamilial services, support and wellbeing (e.g., schools, community groups, friends and relatives) (Mpofu et al., 2014).

Theorising this social unit is key in guiding research in the field of family studies by introducing a wide range of family concepts, ideas, and arguments and in developing and testing hypotheses related to them to help understand their complex processes. Thus, supplying the evidence base with empirical findings and helping in the organisation and accumulation of knowledge. Conceptualisation of this unit also provides coherence and logic to our understanding by clarifying family concepts, explaining and interpreting them, studying them at different levels of analysis, exploring the relationship between them, and in predicting future outcomes (White et al., 2019). The following section presents an overview of some of the most common family theories used in research.

2.4. Theoretical perspectives on the family

Before describing family theories, it is helpful to make a distinction between the terms of theory, theoretical framework, and theoretical perspective. Different authors defined

these terms and the relation between them in various ways using different research approaches (e.g., deductive versus inductive) (Varpio et al., 2020). A theory can generally be defined as a set of interrelated ideas (constructs or concepts), definitions, and propositions that present a systematic view of phenomena by specifying relations among variables, with the purpose of explaining and predicting the phenomena (Kerlinger and Lee, 2000). A theoretical framework can be defined as a structure or a scaffold which outlines and holds up concepts and theories, that are previously tested, to form a theoretical base or background for further research in a particular field of study (Kivunja, 2018). A theoretical perspective refers to the way of thinking (view of science) through which we examine and understand phenomena (Swanwick, 2013). It is the philosophical framework of assumptions by which ideas and thoughts are organised and filtered (Swanwick, 2013, Crossman, 2020). In this section, the term family theory is used collectively to refer to all the theories, frameworks and perspectives related to the family; however, when reviewing each, the term proposed by their authors is used.

Family theories seek to explain human behaviour or phenomena related to the family and are based on one or more family concepts or ideas. Each theory addresses different aspects of family life and answers different questions (Smith and Hamon, 2021). Some family concepts are concerned with the arrangement, composition or size of the family (Demo et al., 2005). Other concepts describe the processes of interaction between family members (Broderick, 1993). Some describe the relations of the family to the wider environment (Jack, 2000). A wide range of family concepts or ideas (variables) form many family theories, where some influences are internal (e.g., personality characteristics, marital affection) and some are external (e.g., economic circumstances, environmental and geopolitical contexts) (White et al., 2019).

White et al. (2019) suggested a classification of family theories based on the theme/nature of the explanation they provide. Four distinct themes of explanations for family theories are demonstrated, namely macro-level, normative-conformity, individual motivation, and social systems and functions. This section reviews the main theories related to the family presented in the order of their theme of explanations introduced above. A summary of their scope and applications was adapted from Lamanna et al. (2017) and White et al. (2019) and is presented and organised by the four themes in Table 2.1.

Table 2. 1. The scope and application of family theories in research and practice

Theme	Theories	Scope	Applications
Macro-level	Conflict theory	Understanding conflict related motives and behaviours	Family assault, abuse, and violence, effects of global economy on families
	Feminist theory	Gender struggle	Work and family, family power, domestic violence
Normative conformity	Symbolic interactionism	Understanding meanings of human interactions	Assignment of roles within marriage, power balance, doctor-patient interactions
	Family development theory	Understanding human predictable experiences over time	Timing of employment, marriage and parenthood, pathways to family formation.
Individual motivation	Social exchange	Understanding reward and cost analysis in human relationships	Entry and exit from marriage, family violence and power balance
Social systems and functions	Family ecology	Understanding the effect of socio-environmental contexts on human behaviour	Contextual effects on families such as family policies, migration and neighbourhoods
	Family systems	Understanding the processes by which human systems work	Family crises management and coping strategies, family communication and therapy

2.4.1. Macro-level theme

Theories in this theme are used to study sociological phenomena and social structures of a large number of people often at a state, country or even at a global level and

includes theories advocating for social changes through social movements (Hammond, 2010). Theories in this line of thinking suggest that individuals have limited ability to act upon the limits of their social structures and are rather driven by powers or forces, whether ideas, material, or biogenetic factors, which may shape the ways that people are able to act and the decisions that they make (White et al., 2019). Two key theories within this theme are the family conflict theory and the feminist theory.

2.4.1.1. Conflict theory

Conflict theory is a major sociological theory that has its intellectual roots in the work of Karl Marx and Friedrich Engels in which they proposed that social and historical changes are a result of a class/power struggle (Allen and Henderson, 2016). It focuses on the conflict or competition over scarce resources (inequality) and power struggle within and between social groups (class struggle) (White et al., 2019). Sprey (1979) identified conflict as a natural process and not a behaviour and that the emphasis should be on understanding how a family deal and manage conflict and maintain orderly cooperation rather than seeking harmony and abolishing disputes. Engels (2010) further applied the concepts of the conflict theory to the family and to the nature of male-female relationship, which laid the foundation for the system on gender-divide/inequality (Boss et al., 2009).

There are three main assumptions in the conflict theory. The first is that people naturally act out of self-interest. This means that family members ascribe values to things (e.g., praise from parents or own bedroom) and are in competition for scarce resources. The second assumption is that conflict exists between social groups as they compete over a perpetual scarcity of resources. Such competition leads to upheaval, social change and

growth. Conflict has positive aspects, meaning that the aftermath (the results) of conflict is beneficial. The third assumption is that conflict exists within social groups including families due to an imbalance between self-interest (autonomy) and the interest of the group (togetherness) (White et al., 2019, Smith and Hamon, 2021). Unlike other social groups, family membership is generally involuntary and permanent whereas relationships are more intense because they are closer in proximity and have a longer history. Therefore, families tend to tolerate a higher degree of conflict than other social groups (Sprey, 1979).

A main application of conflict theory in the field of childhood health research is the study of the physical, psychosocial and emotional outcomes in children of parents experiencing marital conflict, separation and divorce. In a qualitative analysis, Francia and Millear (2015) examined the psychological outcomes in children of separated parents who share care responsibilities. They found that responsive parenting and emotional security regulated the relationship between the parent and the child. Children who were experiencing ongoing conflict "competitive parenting" where there was a criticism and attack on the other parent in the presence of the child and where parents disputed and withheld their financial support of the child, children experienced feeling guilty and responsible for solving the conflict. That created barriers in the parent-child relationship and adversely impacted the child development. In comparison, children who experienced minimal or resolved conflict "cooperative parenting" where there was support for the other parent and the child's financial needs were met, children felt secure and their development was supported through open communication and involvement of both parents. The authors concluded that it was not the presence of conflict that created the psychological burden on children but rather how conflict was managed (Francia and Millear, 2015).

One of the criticisms of conflict theory is that it focuses on explaining conflict rather than order. In that regard, it analyses families in destructive, negative terms (e.g., conflict, power and competition) rather than constructive, positive terms (e.g., cooperation, equity and compassion) (White et al., 2019). Another criticism is that conflict theory does not go beyond describing family relationships in terms of its components of competition, power and access to resources. In other words, it does not propose how families can improve or how this knowledge can lead to skill-building (Smith and Hamon, 2021).

2.4.1.2. Feminist theory

Feminist theory is a derivative of the conflict theory and is based on the idea of gender inequality (Smith and Hamon, 2021). Feminism is a social movement and can be defined as an analysis of women's subordination for the purpose of figuring out how to change it (Gordon, 1979). This theory emphasises women's experiences, identifying the oppression against them and acting upon this oppression (White et al., 2019).

There are six assumptions of the feminist theory. The first is that the difference in experiences between men and women are not due to the negligible biological sex difference between them but rather generated socially by gender norms and expectations in all cultures. Thus, women's experiences are central to our understanding of families. The second assumption is that gender represents a social distinction in all societies and that distinction is based on cultural symbols and their meanings (e.g., baby girls are dressed in pink and baby boys in blue). The third assumption is that women as a social group are socially constructed as inferior to men and are oppressed. Social and historical contexts are therefore important as they define women's roles in families. The

fourth assumption is that oppression of women created a female identity or culture that serves as an alternative to the culture of Patriarchy (male dominance and superiority). The fifth assumption is that there are many forms of families. The family is not a solid static unit but rather embraces diversity in organisation, roles, division of labour and ethnic and culture variability. The sixth assumption is that the view of the family as a fixed invariable institution governed by moral rules and traditions is cultivating and reproducing oppression against women. Social change is thus emphasised. Activism is a way to challenge the status quo. However, feminist theorists also recognise the importance of the family as a supportive institution for women against other forms of social oppression (White et al., 2019, Smith and Hamon, 2021).

The literature on feminism in relation to child health has focused on studying the burden on women to achieve favourable child health outcomes, such as in advocacy for breastfeeding (Benoit et al., 2016, Asiodu et al., 2017), and control of childhood obesity (Maher et al., 2010). Feminist scholars have argued that women are experiencing a sense of responsibility and feelings of guilt and shame when they fail to achieve positive child health outcomes. They support the use of a broader cultural and environmental approach in advocacy for child health instead of blaming the mother (Benoit et al., 2016, Asiodu et al., 2017).

Some have challenged the feminist family theory because of paying too much attention to the oppression of one group to the exclusion of other forms of oppression (e.g., by race, ethnicity, age, disability and religion). Although helping women find their voice is paramount in today's multicultural climate, exploring dynamics related to race, culture, class, and sexuality is also increasingly important. Exploring the diverse and intersectional experiences of people across these many variables is a challenge (Smith and Hamon, 2021).

2.4.2. Normative-conformity theme

Theories in this theme focus on the study of individuals and small groups and are often referred to as socialisation-dependent theories (Hammond, 2010, White et al., 2019). In this line of thinking, human behaviour and activity are viewed as being based on social norms, rules and appropriateness that are learned through socialisation (Boss et al., 2009). Certainly, socialisation involves how to behave and interact in a way that is conforming to society's rules and expectations (Parke et al., 2008). Examples of theories following this theme include the symbolic interactionism and the family development framework.

2.4.2.1. The symbolic interactionism framework

This framework was developed from the work of Mead (1934) and the subsequent themes developed by Blumer (1986). It focuses on how interactions (e.g., attitudes, gestures and human behaviours) carry symbols/meanings which help individuals understand the world around them and communicate with one another (Lamanna et al., 2017). It has had the greatest impact on the study of families given its history and evolution (Smith and Hamon, 2021).

The symbolic interactionism framework has seven assumptions organised around 3 themes. They all sprang from the idea that family members understand and relate to their environment based on symbols they know or learn (Blumer, 1986). The first overarching theme is that meaning is a central element of human behaviour. It thus assumes that: (i) humans act and behave towards the things around them based on what these things carry as a meaning to them; (ii) the process of interaction between individuals give rise to the meaning; and (iii) individuals handle and alter meanings

based on an interpretation of reality through shared symbols. The second overarching theme has to do with self-concept. As active social beings, humans must have a sense of self before they can ascribe meaning to interaction with others. It thus assumes that: (iv) human infants are asocial and are not born with predetermined ideas about who they are, but social interactions help humans develop a sense of self; and (v) once a sense of self is developed, it provides motivation (i.e., through reflexion) and guides the future behaviour of the individual. The third and final overarching theme moves from a discussion of the self to a discussion of society. It thus assumes that: (vi) individuals are influenced by society, in the sense that societal norms, ideologies and values influence and constrain individual behaviour; and (vii) individuals learn the rules and values of society through everyday interactions within that culture and their involvement in the dynamic social structure (Blumer, 1986).

The principles of symbolic interactionism were studied in relation to child behaviour problems. Bernasiewicz (2017) suggested that children and adolescents with antisocial and lawbreaking behaviours have distorted definitions/meanings to the situations where they have the opportunity to behave unacceptably (e.g., when they have the opportunity to abuse someone or steal from someone or skip their school tasks and duties). These definitions do not conform to acceptable social rules but rather the child sees these situations as a chance for gain and taking advantage. The authors argued that those children have these distorted definitions because they were not socialised in a way that signifies social values and rules.

One key challenge of the symbolic interactionism framework is that it does not give enough attention to the role of important attributes among individuals such as emotions and power. These attributes can shape social interactions and their interpretations. It also places too much emphasis on the ability of individuals to create their own realities

and does not pay enough attention to the fact that they live in a world that they do not create by themselves. The theory has also been criticised for offering vague and ill-defined concepts. Despite its criticisms, symbolic interactionism has some valid capabilities that have contributed to its duration in the field (Smith and Hamon, 2021, White et al., 2019).

2.4.2.2. Family development theory

This theory was presented in the work of Bengtson and Allen (1993) and Elder Jr (1998), and focuses on the study of change over the life course of the family using a process-oriented, dynamic and contextual approach at the individual (micro-social) and the family unit (macro-social) levels of analysis (Boss et al., 2009). This theory draws attention to study various family relationships and behaviour across time. It also directs attention to study the change in interactions within the family and/or between the family and other social institutions or contexts following a transition through developmental stages. Family developmental stages refer to the period of time when a family structure, interaction and/or role is different from other periods of time and is characterised by particular events (Rodgers and White, 1993). For example, a family structure is often established with a stage of cohabitation or coupling followed by a stage of marriage, then a stage of child-rearing followed by child independence and lastly a stage of retirement/senior years (White, 1991). Certainly, those stages are not invariant, static or universal but indeed are dynamic processes that are randomly determined (i.e., not all families will go through the same stages, structures or sequence of events changes) (White, 1991).

The family development theory has three main assumptions. The first is that families, like individuals, change with the passage of time and there are tasks associated with each stage of development. These developmental processes are brought by (i) change in the structure of the family because of birth, passing away or leaving the family, (ii) growth of children with the subsequent passing of developmental stages (i.e., infant, toddler, pre-schooler, school aged child, adolescent, young adulthood), and (iii) change in the relationship of the family to other social institutions (e.g., retirement from work). The second assumption is that family change is analysed on different levels (i.e., individual family member, or the family unit as a group, or on a level of an institutional social norms). Institutional norms regulate family behaviour, by controlling which events are permitted, required and forbidden; the order in which the family should sequence stages; and the duration of those stages. The third assumption is that time is an important measure when studying the family (Elder et al., 2003). The order and time by which life events take place are thought to have a significant influence on how well the family performs its role (Lamanna et al., 2017).

Current applications of family development theory in relation to child health focus on understanding early childhood influences, parental influences, how inequalities in child health develop and policies targeting these inequalities (Black et al., 2017, Bethell et al., 2014, Halfon et al., 2014). Black et al. (2017) argued that millions of young children globally are not reaching their full developmental potential (i.e., behavioural, academic, emotional, social and economic competancies) because of early life adversity including, not receiving adequate nutrition, health, responsive care, learning, safety and security. The authors emphasised the importance of providing nurturing/supportive environment for young children starting with the parent-child relation and the home enviroment.

Because the original family development theory best describes the trajectory of intact, middle-class, two-parent, heterosexual families, a main criticism is the lack of sensitivity to pluralistic human experiences. In other words, it cannot incorporate the myriad family forms that are currently seen in any society (White et al., 2019). Moreover, it fails to include family identity factors such as race, SEP, ethnicity, and family structure. A final criticism is that it is rather descriptive and has little predictive power since it does not provide much insight into what governs a family's pattern of behaviours (Smith and Hamon, 2021).

2.4.3. Individual motivation theme

Theories in this theme provide explanations of social phenomena at the level of the individual. In this line of thinking, human behaviour is explained based on the beliefs, values and cognition of individuals, however, this view is challenged as to not being able to move causal explanations from the level of individual to higher levels of analysis (e.g., macro level social explanations) (White et al., 2019). A classic example in this theme is the social exchange theory.

2.4.3.1. Social exchange theory

This theory was developed from the work of Homans (1958), Blau (1964) and Thibaut and Kelley (1959). The basic premise of the social exchange theory is that human social relationships can be understood as revolving around the exchange of resources valued by the participants. Individuals make rational choices by weighting benefits or rewards

received and costs incurred for their behaviour and considering their alternatives in an exchange social relationship (Boss et al., 2009).

Because the theory focuses on the dynamics of relationships and how they are developed, maintained and dissolved, there are core assumptions regarding the nature of individuals and the nature of relationships (Smith and Hamon, 2021). For the nature of individuals, the theory has three assumptions. The first assumption is that people are motivated by self-interest, thus human beings seek benefits and profits and avoid penalties. The second assumption is that individuals are rational beings, thus they would weigh in benefits and costs on the information and experiences they had or the expectations they hold and try to maximise benefits and minimise costs when interacting with others. The last assumption about the nature of individuals is that humans are constrained by their choices, and it is within that range of possible choices that researchers strive to understand an individual's motivations. The social exchange theory also has assumptions regarding the nature of relationships. The first is interdependency, in which receiving benefits is dependent on the ability of providing them to others. The second assumption is that social exchanges are governed by the expectations or social norms of justice, fairness and reciprocity. Thus, individuals expect others to meet their needs if they attempt to meet others' needs, and individuals expect others to do so based on what is right or fair. The final assumption is that current developing experiences in a relationship govern future exchanges. Thus, the stability of a relationship and future exchanges are the result of a positive balance between levels of attraction and dependence experienced by the individuals in that relationship (White et al., 2019, Boss et al., 2009).

The social exchange theory has been used to understand how filial relationships are impacted by social exchange norms. One might expect parents to invest more in their

children earlier in life, but as parents age, adult children might increase their contributions to their parents, paying them back for all parents have done for them. However, if adult children do not fulfil their filial obligations aging parents may feel that distributive justice has been violated, and their morale may suffer (Smith and Hamon, 2021). The theory is also commonly used to understand commitment in romantic relationships, relationship continuity or discontinuity, especially in the presence of interpersonal violence. As applied to child health, it has been used to understand healthcare service use by parents and parental initiation and adherence to child treatment and care (Hamrin et al., 2010).

Social exchange theory continues to possess a great deal of influence in the study of families and interpersonal relationships. However, it has some criticisms worth mentioning. Many have challenged the assumption that humans are rational. Clearly, there seem to be occasions when people do not seem to act rationally, like having an extra-marital affair or staying with a violent partner. The theory has also been criticised for assuming that people are looking out for their own best interests, which goes against principles of solidarity and compassion embraced by most religions (Smith and Hamon, 2021).

2.4.4. Social systems and functions theme

Theories in this theme provide explanations to social phenomena based on the understanding of functions of a system. Systems have parts that are interconnected and are dynamically operating to perform particular functions (Boss et al., 2009, White et al., 2019). Examining the family as a system allows for detection of patterns of interaction, communication, and resistance or malleability to change (Allen and

Henderson, 2016). Following this theme are the most widely used family theoretical frameworks in the social sciences, the family ecology and family systems frameworks.

2.4.4.1. Family ecology framework

This framework has its roots in the seminal work of Hook and Paolucci (1970) and concentrates on the interaction and interdependence of humans, as biological and social entities, with the environment (Lamanna et al., 2017). While there is no doubt that the environment can affect families and their members, it is also true that families can adapt to, develop and sustain their environment (Bubolz and Sontag, 1993). Thus, individuals and families must be examined within the context of their environments, recognising that each influences and is changed by the other (Smith and Hamon, 2021).

There are a number of basic assumptions underlying the family ecology framework. The first assumption is that human beings and groups are a product of both genetics and environment. In other words, maximum human development is dependent on the successful interaction between the social (nurtured) and biological (nature) environments. The second assumption is that humans are dependent on their environment to meet their biological needs (e.g., water, air, food and shelter). Thus, individuals should make careful decisions relative to attaining their goals to preserve environmental assets. This is essential as human beings are finite, making time both a limitation and a resource. The third assumption is that humans are dependent on other human beings for development due to their social nature and spatial organisation which is a characteristic of human interaction. The need to live together, both with other human beings and with the environment, has generated some basic moral values of human ecology. The final assumption is that there are two levels of analysis of human

behaviour: the population level and the individual level. Therefore, the family is interdependent on the natural (biological) environment, human-made environment and the sociocultural environment they are embedded in (White et al., 2019).

Bronfenbrenner (1979) developed a bio-ecological systems model of human development in which he contextualised the ecological systems at four nested levels: microsystem, mesosystem, ecosystem and macro-system. Bronfenbrenner (1992) conceptualised the family unit as a microsystem in which substantial development and significant influence on a developing child occur. The interaction between the family and other environments for development, such as school, is considered a mesosystem. Other external settings which might affect development, such as neighbourhood, extended family and work environment are considered exosystems. The broader ideology, culture, norms, customs, beliefs and values in a society are considered the macro-system. The framework provides a method of studying how extra-familial contexts influence intra-familial processes. He argued that human behaviour is a result of the interaction between the environmental socialisation and the biological/physical development and maturation (Bronfenbrenner, 2005).

This theoretical perspective tracks the relationships between elements in the environment and social institutions (e.g., families). It is useful in drawing attention to the social problems affecting the family and it encourages researchers to assess what can be done towards them whether through neighbourhood and citizens or through policy, service development and lobbying for change. The aim is to improve the quality of life for families and the long-term outcomes for children (Lamanna et al., 2017).

The use of many abstract concepts, key terms and primary assumptions has led to some confusion among researchers. There is a plethora of concepts and terms that are difficult to understand and apply. The framework has undergone so much modification and

development over the years that it is not often evident at first glance which version of the theory is being used in any research. This has led to it being represented in many ways in the literature and most researchers only using portions of it (Smith and Hamon, 2021). As an all-encompassing framework, it has also been criticised for being difficult to test using traditional research methods, especially the issue of how to choose the unit of analysis when conducting research. Similarly, if one is to truly assess interactions within each system or context, data collection becomes a complex process (White et al., 2019). However, this theory allows looking at the way families function within the wider context of the society in which they are functioning. This enables to look at the impact of factors such as socioeconomic deprivation on family functioning.

2.4.4.2. Family systems theory

Bateson et al. (1956) introduced systems thinking into the study of the family. It is among the most recent theories on the family and is based on the general systems theory (Boulding, 1956) since the family is epitomised as being a self-regulating system in which members control each other's access to meaning, power, and affect (Kantor and Lehr, 1975).

The family systems theory has some basic assumptions. The first is that the whole is greater than the sum of the parts. This implies that a family is much more than a collection of individuals who live together and are related to each other. It has a holistic quality, which is a property of systems because there are behaviours of systems that do not originate from parts or components but rather from a specific pattern of arrangement of its components and the transactions among these components in their configuration. A second assumption is that individuals and family behaviour must be understood in

context. Human systems affect and are affected by their environment through a feedback loop where some of the output of the system return as an input to the system. All parts of the family are inter-connected, and the understanding of one part cannot be done in isolation from the whole of the system. This assumption is crucial for family therapy as the locus of pathology is not within the person but is seen as a system disfunction. The third assumption is that a family is a goal-seeking, self-reflexive and self-regulating system. Families pursue goals and develop tactics to achieve them. They adapt to change and shift their priorities as circumstances in their life-cycle change. To create, preserve and modify reality, families must communicate successfully (Boss et al., 2009, Smith and Hamon, 2021).

The family systems theory has evolved over time, with a current focus on processes that make a family function (Koerner and Fitzpatrick, 2002), which led to the application of family systems thinking in family therapy (Broderick, 1993). This focus on family processes underpins contemporary models of family therapy including the McMaster model (Epstein et al., 1978), the Circumplex model (Olson et al., 1979) and the Process model (Steinhauer et al., 1984). Family systems researchers and practitioners are more concerned with the ongoing processes within the family (process-oriented) than with the input to the system (i.e., personality traits of individual family members) or with the outcome or output of the system (i.e., results of family transactional patterns). Understanding the processes within the family, such as, family functioning, cohesion, closeness, conflict, communication, adaptation and coping with stresses can be accomplished when the family is seen as a system through the analysis of the transactions between family members (Boss et al., 2009). The transactional pattern of a family exhibits consistent repetition over time, i.e., recurring sequences of interaction or redundancy which can be predicted and computed from previous

sequential occurrences of the interaction by the same family members (Watzlawick and Beavin, 1967).

The family systems theory has been empirically applied to the study of marital and family communication, family functioning, family adjustment and adaptation, resiliency and coping. Recently, the family systems theory was applied in research studying childhood and youth obesity (Sung-Chan et al., 2013), childhood and adolescence behavioural and mental health (Feinberg et al., 2012) and interventions in childhood (Dunst, 2016).

Family systems theory is not without its critics. White et al. (2019) have summarised three main concerns. The first is that it does not qualify as a 'true' theory as it is seen as more of a model or flowchart for conceptualising. The major concepts seem to be too vague for empirical testing and they have little predictive power for quantification. The second criticism is that the theory is too broad and abstract and therefore virtually meaningless. In other words, it is too general to pick up important distinctions that would make it worthwhile. Finally, it makes the mistake of reifying the idea of system and the only reality to understand and modify through family therapy.

Each of the abovementioned family theories provides a unique set of lenses through which to view family functioning and offers different explanations as to why families behave the way they do. Thus, the family theory that is most appropriate to use will vary depending on the question, the situation and the outcome needed or expected. It is also true that many family theories base their explanations of human behaviour on more than one of the four overarching themes mentioned above. For example, the systems and functions perspective provides explanations close to the normative as well as the

systems and functions theories (i.e., social structures, including the family system, are expected to perform functions for the society in accordance to the norms, values and rules of that society) (White et al., 2019, Boss et al., 2009). Thus, it is now recognised that more than one family theory is required in most cases. First, because there is more than one type and one definition of family. Second, even if researchers can agree on how to define the family, they may disagree on which aspect of their interactions or behaviours to focus on. Finally, each theory offers an insight that others cannot provide because of their different lenses. Nowadays, it is therefore not uncommon to use two or more theories to guide research efforts.

The present project is underpinned by some of the principles presented in the family systems theory and the family ecology framework. The family systems theory provides a useful framework to understand family processes and functioning while the family ecological framework recognises that the family system itself is ecologically embedded in a network of external influences. Certainly, familial contexts are being studied extensively in relation to child health because families are vital to young children as they constitute the first socialisation agency and they exercise a powerful influence over children's health and related behaviours (Komro et al., 2011). Since children are born and raised within a family context (environment), these contexts can be either supportive or unfavourable and by using an ecological systems approach to understand family life, research have shown that a favourable family environment can offer a supportive circumstances that promotes health and oral health of young children (Hawkins et al., 2009, Nanjappa et al., 2015)

Building on the family systems theory approach the next section looks in more detail at family functioning and how it has been used to look at child health and child oral health.

The section starts with an overview of the main measures of family functioning that have been developed.

2.5. Family functioning

Family functioning refers to the social and structural properties of the family environment and includes the quality and quantity of interactions and relationships between family members, particularly levels of conflict, cohesion, adaptability, organisation, and quality of communication (Lewandowski et al., 2010). In a report by the Australian Department of Families, Housing, Community Services and Indigenous Affairs, family functioning was defined through a variety of domains that describe aspects of family life, including emotional attributes (e.g., warmth, tenderness, closeness, support, safety, responsiveness), the family's physical health environment (e.g., health habits, activities and products), family governance (e.g., boundary setting, establishment of expectations, routines and rules), quality of intra-familial relationships (i.e., parent-child, sibling and marital), characteristics of cognitive development and engagement (e.g., interaction and talking with children, spending time in reading and learning), extra-familial connectedness (i.e., involvement with extended family, neighbourhood, work, school and community service) (Pezzullo et al., 2010). As the construct includes a range of attributes, there is little consensus on a definition of family functioning in practice or research settings. However, family functioning can collectively refer to the ability of the family to work together as a unit to satisfy the basic needs of its members (Staccini et al., 2015).

Walsh (1994) identified ten processes that characterise functional families. They exhibit: (1) connectedness and commitment of members as a caring, mutually

supportive relationship unit; (2) respect for individual differences, autonomy and separate needs, fostering the development and well-being of members of each generation, from youngest to eldest; (3) for couples, a relationship between equal partners, characterised by mutual respect, support and equitable sharing of power, privilege and responsibilities; (4) effective parental or executive leadership and authority for nurturance and protection of children and for caretaking of elderly and other vulnerable family members; (5) organisational stability, characterised by clarity, consistency, and predictability in patterns of interaction; (6) adaptability: flexibility to meet internal or external demands for change, to cope effectively with stress and problems that arise, and to master normative and non-normative challenges and transitions across the life cycle; (7) open communication, characterised by clarity of rules and expectations, pleasurable interaction, and a range of emotional expression and empathic responsiveness; (8) effective problem-solving and conflict-resolution processes; (9) a shared belief system that enables mutual trust, problem mastery, connectedness with past and future generations, ethical values, and concern for the larger human community; and (10) adequate resources for basic economic security and psychosocial support in extended kin and friendship networks, and from community and larger social systems.

Most of the processes listed above are necessary for family function, regardless of the form or structure of the family. However, different cultures place differing emphasis on certain processes. Furthermore, the completely well-functioning and growing family is a rarity. All families have conflicts, and family members' feelings toward one another may be mixed or their love may not always be constant (Glick et al., 2015). This brings the question of what aspects of family life are worth evaluating. Numerous family variables have been posited as crucial to family functioning in family theories and have

emerged as significant in family research, such as adaptability, cohesion, conflict, monitoring, and expressiveness. Because family models begin with different views of what is essential to evaluate, their measures not only overlap but also tend often to have very different foci. Family functioning measures build on family system models, operationalising systems concepts into forms in which relevant aspects of families can be systemically evaluated. The best family functioning measures are multidimensional, capturing the complexity of family interaction processes, which are inherently multidimensional (Glick et al., 2015, Walsh, 2012).

Several integrative models (i.e., conceptualising various domains or dimensions) of family functioning have been developed to date (Walsh, 2012). However, the three most common are the Circumplex model (Sprenkle and Olson, 1978), the McMaster model (Epstein et al., 1978) and the Beavers model (Beavers, 1981). These multidimensional models allow assessment of the complexity of family life (Walsh, 2012). Although there are models that examine the relationship of a single aspect of family life, such as warmth to some other individual or parenting styles, the complexity of family life necessitates complex measures. This complexity is reflected in understanding the importance of perspective. Each family member has a perspective on life in their family. These *insider* perspectives often differ from one another. Others, who may be individuals involved with the family (e.g., teachers, neighbours or therapists) or trained to rate families, have *outsider* perspectives. Insiders and outsiders both have value in understanding family processes. Their perspectives are expected to differ and do so when such comparisons are made. For a complete picture, both insider and outsider measures are needed. Derived from these three multidimensional models are assessment measures of family functioning for research (such as self-report instruments) and observation tools for clinical therapy (Barker and Chang, 2013). The

Circumplex, McMaster, and Beavers models of family functioning, with their corresponding self-reported assessment tools, are presented below.

2.5.1. The Circumplex model of marital and family systems

This model was developed through the work of Olson and colleagues from conceptualisation and clustering of concepts explaining the dynamics in relationships within marriage and family (Sprenkle and Olson, 1978, Olson et al., 1979, Olson and Craddock, 1980, Olson et al., 1983, Barnes and Olson, 1985, Olson, 1986, Maynard and Olson, 1987, Olson, 1989a, Olson, 1989b, Olson et al., 1989, Olson, 1991, Olson, 1996, Olson, 2011, Olson et al., 2019). It is useful for explaining family and couple systems and for scheming the change these systems experience over time (Olson et al., 2019).

The focus of the model is on two dimensions of marital and family systems; namely cohesion and flexibility (also known as adaptability). A third dimension of family behaviour, communication, is presumed to allow families to change their degree of flexibility and cohesion in response to the demands they face (Olson, 2000). Family cohesion is defined as the emotional bonding that family members have towards one another, which can be assessed through measuring the balance between separateness (self-interest), e.g., space, time and boundaries, and togetherness (group interest), e.g., coalitions and decision making. Family flexibility refers to the amount (capacity) of change in the family leadership, role relationships and rules in which the change is brought by shifting developmental demands and stresses on the family. In the earlier versions of the model, the construct was termed as adaptability. This construct focuses on assessing the way family systems remain stable while maintaining the potential for

change which include how they lead, discipline, negotiate and share roles. Family communication focuses on assessment of how the family group communicate in terms of their skills (e.g. speaking for oneself, attentive listening, solving problems), disclosure and confiding in each other, clearness, coherence and respect for one another (Olson, 2000).

Cohesion and flexibility, illustrated in the model diagram (Figure 2.2), are thought to have a curvilinear presentation (i.e., extreme values whether very high or very low are considered problematic). This contrasts with most family dimensions where their presentation is linear (i.e., the higher the values of a dimension the better). Communication is considered a facilitating construct for the movement along the two other dimensions. Thus, it is not graphically presented in the diagram of the model (Olson et al., 2019).

Both the cohesion and flexibility dimensions are divided into five levels. The three middle levels indicate balanced levels of the two dimensions, whereas the two extreme levels (the highest and lowest) indicate unbalanced levels. Plotting the two dimensions orthogonal to each other results in nine balanced family groups (balanced levels on both constructs), twelve mid-range family groups (one construct is balanced while the other is not), and four unbalanced family groups (extreme values on both constructs) (Olson, 2000). In families experiencing balanced levels of cohesion, family members experience both independence and connectedness to their family which increases their tendency to be more functional. The two levels on the extremities of the cohesion construct (disengaged and enmeshed) are considered to represent problematic family functioning because family members experience unbalanced levels of independence and attachment (connectedness) to their families (Olson, 2000). Families experiencing balanced levels of flexibility often exhibit stability and the ability to change when

needed. This is evidenced by their democratic leadership and discipline, open negotiations and shared roles leading them to represent good family functioning. Whereas families on the two extreme levels of flexibility (rigid and chaotic) exhibit either too high or too low levels of control and leadership, limited ability to negotiate and unclear or rigid rules and roles which represents problematic family functioning on the long term (Olson, 2000).

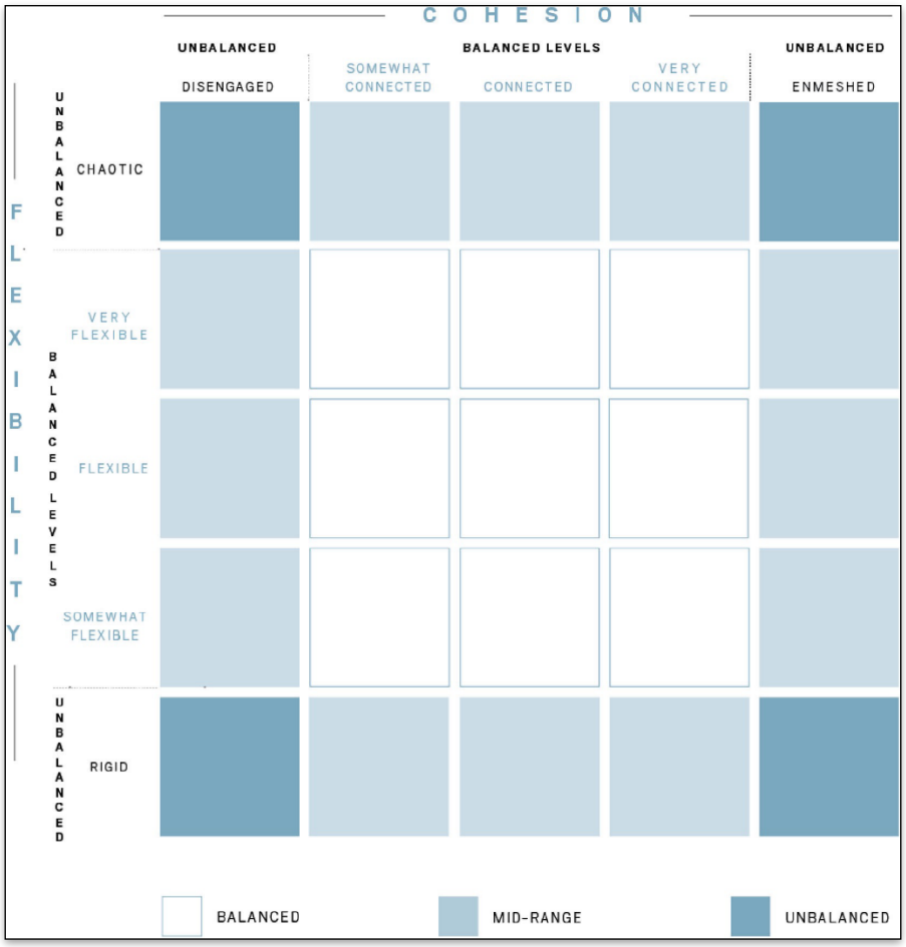

Figure 2.2. The Circumplex model of family functioning (Olson et al., 2019)

The Circumplex model has three main hypotheses. The first is that balanced families are shown to have better functioning (success and happiness) compared to unbalanced families. The second is that balanced families exhibit more positive communication

patterns than unbalanced families. The third is that balanced families are more effective in altering their levels of cohesion and flexibility to cope with stresses and changing developmental stages than unbalanced families (Olson, 2000, Olson et al., 2019).

The self-report instrument of the Circumplex model is the Family Adaptability and Cohesion Scale (FACES) (Olson, 2011). Several versions of the instrument were developed with the latest version being FACES-IV, which can be completed by one or more family members (Olson, 2011, Olson et al., 2019). The questionnaire is composed of 62-items covering primarily the dimensions of cohesion and flexibility. FACES-IV measures family functioning using 8 scales; four scales that assess unbalanced family functioning (high and low cohesion, high and low flexibility), two that measures balanced family functioning (balanced cohesion, balanced flexibility), one which measures family communication (a facilitating dimension between cohesion and flexibility), and lastly an additional scale that measures family satisfaction across the former 3 dimensions (Olson et al., 2019). A shorter version of FACES-IV containing 24 items was recently developed and is currently undergoing validity and reliability testing (Priest et al., 2020). Despite the limited number of studies testing the reliability and validity of FACES-IV, the instrument demonstrated good psychometric properties in terms of internal reliability, construct validity, and criterion validity, a stable factorial structure, and it was extensively used as a measure of family functioning in both clinical and research settings (Hamilton and Carr, 2016).

2.5.2. The McMaster model of family functioning

The work of Epstein and colleagues provided the background, theory, methodology and research bases for the McMaster approach to family assessment and treatment (Miller

et al., 1985a, Ryan et al., 2005). The model has evolved from the initial Family Category Schema (Epstein et al., 1968) and is based on the process variant of the family systems theory. It views the family as an open system with structural, organisational and transactional patterns. Disturbance in these patterns would alter the operating system of the family unit. Thus, these patterns were seen as an important determinant of the health, happiness and behaviour of family members (Ryan et al., 2005).

Epstein and colleagues identified multiple family functioning dimensions which describes aspects of family life. Six of these dimensions were judged to have the most influential impact on physical and emotional health of family members, and thus were targeted for family therapy (Ryan et al., 2005). The dimensions of the McMaster model of family functioning are problem solving, communication, roles, affective responsiveness, affective involvement and behaviour control (Table 2.2) (Epstein et al., 1978, Ryan et al., 2005).

Problem solving refers to the family's ability to solve instrumental and affective problems rapidly and efficiently. A normal functioning family in this domain can discuss their issues, identify components of the problem, communicate effectively with appropriate people regarding the issue, develop alternative solutions, decide on a solution, act upon the agreed solution, ensure that the act has been carried out and with the most effective families being able to review their problem-solving procedure. However, the presence of minor unresolved issues which does not disturb the family system is considered within the normal range (Staccini et al., 2015).

Communication refers to the ability of family members to verbally communicate and exchange information with each other in a way that is direct (i.e., transmitting and receiving messages with the intended person and not through a third person) and clear

(i.e., not masked or vague). Within the range of normal, family communication might be indirect or not clear at some instances (Staccini et al., 2015).

Table 2.2. Summary of the McMaster model of family functioning

Dimension (*goal*)	**Key concepts**	**Effectiveness of functioning**
Problem Solving (*Successful achievement of basic, developmental, and crisis tasks*)	Instrumental and affective problems: (1) problem identification (2) problem communication (3) development of action alternative (4) decision on alternative (5) action (6) monitoring (7) evaluation	**Most effective:** When all seven stages are carried out. **Least effective:** When cannot identify problem.
Communication (*Mutual understanding*)	Instrumental and affective: (1) Clear versus Masked (2) Direct versus Indirect.	**Most effective**: Clear and Direct. **Least effective:** Masked and Indirect.
Affective Responsiveness	Two groups of emotions: welfare and emergency.	**Most effective:** When full range of responses are appropriate in amount and quality to stimulus. **Least effective:** When very narrow range of responses exists (1-2 only) and/or amount and quality is distorted, given the context.
Affective Involvement (*Security and autonomy*)	Six involvement styles (1) absence of involvement (2) involvement devoid of feelings (3) narcissistic involvement (4) empathic involvement (5) over-involvement (6) symbiotic involvement.	**Most effective:** Empathic involvement **Least effective:** Symbiotic and Absence of involvement.
Roles (*Successful role integration*)	Necessary family functions: Instrumental (provision of resources), affective (nurturing and support), and mixed (skills development, system maintenance and management). Roles functioning is assessed by how the family allocated responsibilities and handles accountability for them.	**Most effective**: When all necessary family functions are achieved have clear allocation to reasonable individual(s) and accountability is built in. **Least effective**: When necessary, family functions are not addressed and/or allocation and accountability not maintained.
Behaviour control (*Maintenance and adaptation*)	Three situations: dangerous, meeting and expressing psychobiological needs and drives (eating, drinking, sleeping, sex, and aggression), and interpersonal socialising behaviour. Standard and latitude of acceptable behaviour in four styles: rigid, flexible, laissez-fair and chaotic. To maintain the style, various techniques are used and implemented under role functions	**Most effective**: Flexible behaviour control. **Least effective**: Chaotic behaviour control.

Family roles refer to the methods of allocating and fulfilling responsibilities and tasks among family members. Normal functioning families can provide resources, nurturing and support to their members at most times, although some occasional difficulties in management of the family system might occur. In some families, most roles can be handled by one member, however, in the most effective families there will be role sharing. Within the normal range are families whose members are willing to fulfil their tasks and are not overburden with their duties (Staccini et al., 2015).

Affective responsiveness refers to family members ability to experience a wide range of stimuli that provoke human feelings, and to respond to them appropriately, with reasonable intensity and duration. A normal range of variation in this domain involves difficulties of one or more family members in experiencing certain emotions or the occasional improper responses (inadequately or overly) to emotional stimuli (Staccini et al., 2015).

Affective involvement refers to family members way of showing interest and involvement in each other with appropriate degree and manner. A healthy pattern of affective involvement is demonstrated in families whose members exhibit concerns in the interest of each other even if these interests are peripheral to them at times. This pattern is referred to as empathic involvement. A normal variation in this dimension can be seen in occasional over-involvement or narcissistic involvement pattern. However, the farther the family from empathic involvement pattern the less effective it will be in functioning (Ryan et al., 2005).

Behaviour control refers to the ability of family members to set and respect rules and an expected standard of behaviour. It is expected that families establish a standard of acceptable behaviour as well as a degree of tolerance or flexibility in adherence to these

standards. It is within a normal range of functioning that family members set off general rules, while, disagreeing on minor details of accepted behaviour (Staccini et al., 2015).

When applied correctly, the model is capable of categorising families across widely diverse levels of functioning. The model focuses on the processes within the family unit rather than outcomes. This property enables the model to be applied across various cultural settings. The model was useful for assessment of family functioning in non-clinical (community) samples, and in identification of specific domains/dimensions of family functioning, which are problematic (Ryan et al., 2005, Staccini et al., 2015).

The self-report assessment instrument of the McMaster model of family functioning is the Family Assessment Device (FAD) (Epstein et al., 1983b). The FAD can be completed by family members aged 12 years old and above. The instrument is composed of a 60-item questionnaire designed to measure family functioning on 7 scales including the 6 dimensions of the McMaster model and a general (overall) functioning scale. The general functioning scale is comprised of 12 items and is used extensively as a shorter form of the FAD. The FAD was translated to over 26 languages and used across many cultures (Ryan et al., 2005, Epstein et al., 1983b). Psychometric testing of the instrument found that it demonstrated adequate internal reliability, test–retest reliability, construct validity, and criterion validity whether used for clinical or research purposes, however, the evidence suggests some overlaping exists on the factor structrure of FAD (Staccini et al., 2015, Hamilton and Carr, 2016).

2.5.3. The Beavers systems model

This model is based on the process variant of family systems theory and classifies families based on two dimensions of family functioning, namely, family competence

and family interaction style (Beavers, 1977, Beavers, 1981, Kelsey-Smith and Beavers, 1981, Beavers, 1982, Beavers, 1985, Beavers et al., 1985, Beavers and Hampson, 1990, Beavers and Hampson, 1993, Hampson and Beavers, 1996b, Hampson and Beavers, 1996a, Beavers and Hampson, 2000). These two dimensions are conceptualised as two orthogonal lines (vertical and horizontal) creating a diagram of this model of family functioning as shown in Figure 2.3 (Beavers and Hampson, 2000).

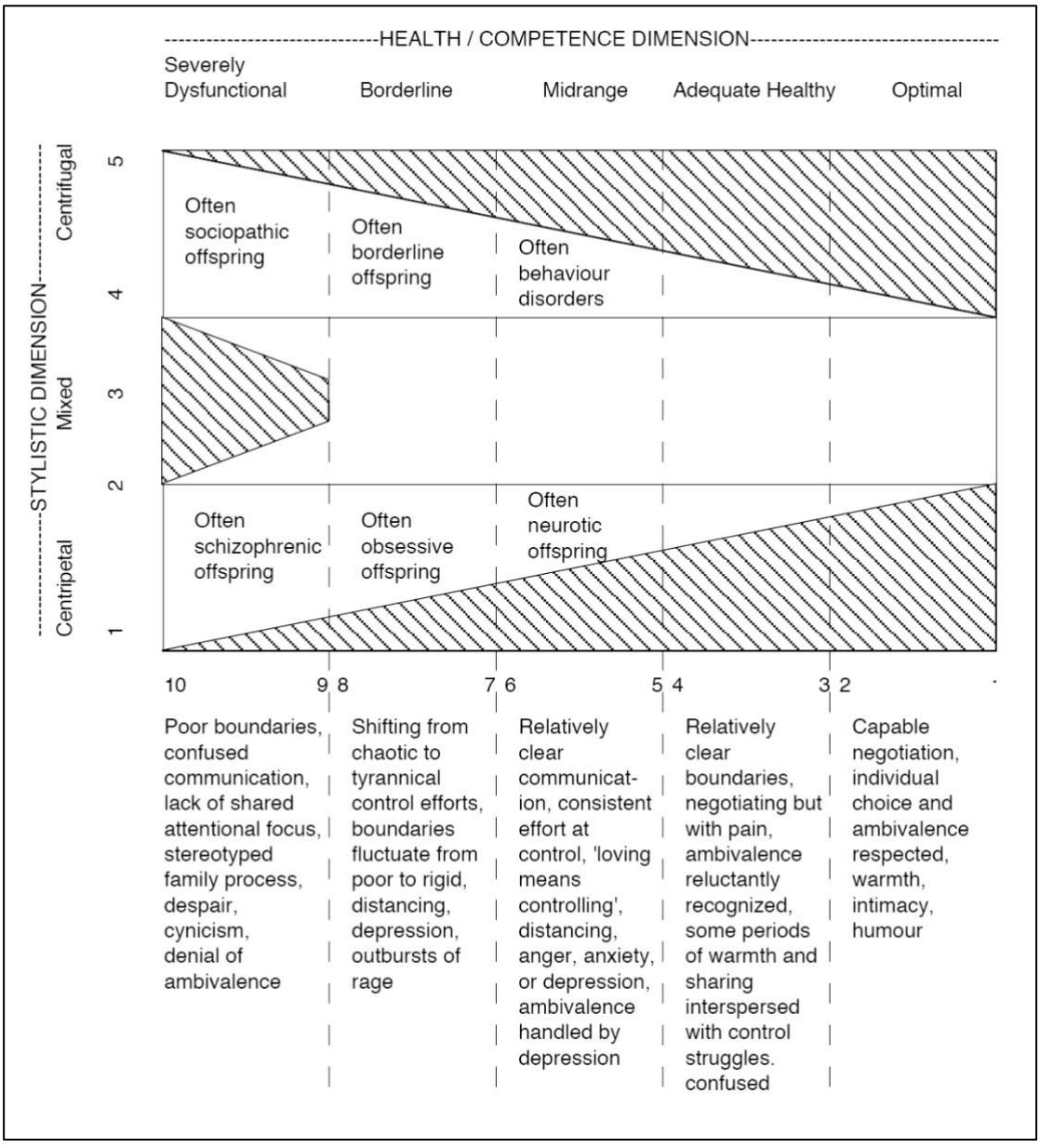

Figure 2.3. The Beavers Systems Model of Family Functioning (Beavers and Hampson, 2000)

The horizontal axis represents family competence, which refers to the flexibility and adaptability of the family system based on the available information that the system has regarding a stressful situation (Beavers and Hampson, 2000). This dimension ranges on a scale between optimal, adequate, mid-range, borderline to severely dysfunctional. It is proposed that the more flexible and adaptive the family is the more it can negotiate, function effectively and deal with stressors (Beavers and Hampson, 2000).

The vertical axis represents family style which refers to the characteristic quality of interaction in the family that ranges from centripetal to centrifugal. Centripetal family views satisfaction from an interaction as being originating from within the family. For example, a family with young children is expected to attain most satisfaction from an interaction from within the family rather than from the outside world. Whereas centrifugal family views the outside world as possessing the most satisfaction from interaction. An example would be a family with children in their late adolescence where most satisfaction from interactions is attained from friends and peers (Beavers and Hampson, 2000).

Plotting families along the two dimensions of the model (Figure 2.3) results in nine different family groupings. Group one represents optimal families with effective functioning in which family members are oriented that interactions are interchangeable and based on a cause-effect circle as in a system (e.g., harsh parental discipline results in misbehaviour of children). Thus, in this group equal-powered interactions, respect for individual choice, intimacy, negotiation capability and problem solving are usually seen (Beavers and Hampson, 1993, Beavers and Hampson, 2000). Group two represents adequate functioning families where in comparison with group one there is more use of overt power resulting in less delightful, open and intimate interactions and more gender-role divide (Beavers and Hampson, 1993, Beavers and Hampson, 2000).

Groups three, four and five represent midrange families which are considered dysfunctional. In these family groupings there is a use of overt power and intimidation to gain control and stability making them more susceptible to psychological health issues. There is also a more evident gender-role divide. Three styles of interactions can be seen in the mid-range families. Centripetal style where there is authoritarian control, rules and less expression of hostile behaviour. Centrifugal style where there is open expression of hostility, less intimacy, kindness and family time resulting in children trying to seek satisfaction from interactions from the neighbourhood and street. A mixed style of interaction can also be recognised in the mid-range families where alternate centripetal and centrifugal styles are seen (Beavers and Hampson, 1993, Beavers and Hampson, 2000).

Group six and seven represent borderline families that are considered dysfunctional due to the reduced ability of family members to meet the emotional needs of each other and a more chaos and struggles in the family with the use of overt power. In centripetal borderline families, power struggles are often profound, however, concealed in a way to adhere with rules and control. Psychological disorders might be seen in patient from such families. Centrifugal borderline families are characterised by the open expression of rage and anger, regular onset of conflicts and poor marital/parental relationships. Children from such families are vulnerable and susceptible to personality disorders (Beavers and Hampson, 1993, Beavers and Hampson, 2000).

Groups eight and nine represent the severely dysfunctional families where there is a lack of warmth, emotional support, satisfying interaction and a substantial deficiency in family member's ability to communicate coherently. Thus, hindering the ability to negotiate, adapt or solve conflicts. The functioning of families in these two groups is disordered. Severely centripetal families exhibit extreme adherence to the belief of

togetherness and family loyalty. Hence preventing children from socio-emotional development and progression in life and creating a tough boundary around the family. Whereas in severely dysfunctional centrifugal families there is a very weak boundary around the family resulting in members leaving the family frequently. There is also an open hostile behaviour with lack of tenderness. Both centripetal and centrifugal severely dysfunctional families share the characteristics of impeding the socio-emotional development of children and similar levels of severely disrupted communication and a general lack of adaptability (Beavers and Hampson, 1993, Beavers and Hampson, 2000).

The self-report assessment tool of the Beavers model is the Self-Report Family Inventory (SFI) (Beavers and Hampson, 1990). The SFI is a 36-item questionnaire designed to measure family functioning on the dimensions of family competence and style. The questionnaire can be completed by family members aged 11 years and over. It is designed to measure family functioning in 5 scales: health/competence, conflict, cohesion, leadership, and emotional expressiveness (Beavers and Hampson, 2000). No shorter form is available for the SFI. The instrument demonstrated good psychometric properties in terms of internal reliability and criterion validity, however, there is some evidence on inadequate test-retest reliability of some scales of SFI and inconclusive evidence on the factor structure of the instrument (Hamilton and Carr, 2016).

When comparing these models of family functioning, the measure developed through the McMasters model, the FAD, was the most widely used measure of family assessment in a review of instruments used to assess couple and family therapies (Sanderson et al., 2009). In addition, a series of systematic reviews conducted to identify empirical validation studies of seven self-report family assessment measures

revealed that only five were suitable for clinical use, namely the FAD, FACES-IV, SFI, Family Assessment Measure (FAM) and the Systemic Clinical Outcome Routine Evaluation (SCORE) (Hamilton and Carr, 2016). More specifically, Duijster et al. (2013) conducted a systematic review of self-report family functioning measures to assess their suitability for use in childhood caries research. They identified 29 measures with adequate psychometric properties, of which, they recommended the use of 5 measures judged to be relevant to oral health research because they covered dimensions/domains that were thought to influence health behaviours. These domains included organisation, communication, flexibility, warmth/involvement, control/discipline, and authoritative/rigid parenting style. The five measures included the following three generic measures: FACES (Olson et al., 2019), the FAD (Epstein et al., 1983b) and the FAM (Skinner et al., 1983). The SFI (Beavers and Hampson, 1990) was disregarded because it did not include all the domains hypothesised as relevant to child oral health. The two measures of specific areas/dimensions of family functioning recommended in the review were measures of parenting styles and practices, namely the Alabama Parenting Questionnaire (Shelton et al., 1996) and the Parental Authority Questionnaire (Buri, 1991).

The present research project uses family systems theory and family ecology framework, in general, and the McMaster model of family functioning, in particular, to understand the influence of the family on child oral health. The McMaster model which is based on the family systems theory allows for a comprehensive examination of the patterns of transactions (functioning) within the family unit whilst also providing information on aspects of family life that are thought to be more relevant to child oral health, such as control of behaviours and assignment and fulfilment of roles between family members, whereas the family ecology framework enables the contextualisation of the

family within the wider social context in which they are functioning. The next section will summarise the literature on family functioning and child health, then will focus on studies on child oral health.

2.6. Family functioning and child health

This section summarises evidence from systematic reviews on the relationship between family functioning and child health outcomes. The possible connection between poor family functioning and childhood obesity is particularly relevant given the common risk factors (sugars intake) of obesity and dental caries.

Halliday et al. (2014) systematically reviewed the evidence on the association of family functioning with childhood overweight and obesity. Thirteen different measures of family functioning were identified in the studies, including 12 self-reported measures and one observational assessment. The most frequently used measure was the FAD, in 6 studies, followed by FES and FACES, which were applied in 4 studies each. The authors argued that there was evidence of a link between family functioning and childhood obesity, in which poor family functioning was associated with an increased risk of the child being overweight or obese and that obese children tend to come from families with poor functioning. However, this link might not be independent of other biological, behavioural and environmental risk factors of childhood obesity. The authors argued that current theories suggest that this relationship could be bidirectional, wherein the presence of child obesity impacts on the functioning of the family as well (reverse causation). Poor cohesion, communication and behaviour control, high conflict level and low levels of governance, authority and decision power where the domains of family functioning positively associated with increased risk of child obesity. These

domains are thought to affect health behaviours by inducing psychophysiological stress responses that disrupt health behaviours (Kitzmann et al., 2008). Family stress is understood to result when there is an unhealthy emotional climate in the family such as low level of closeness and support for members, and high level of conflict. It is also thought to result when families are unable to provide their children with, for example, healthy food options, access to safe neighbourhood and green spaces which promote physical activity (i.e., in low the socioeconomic circumstances). The review concluded that higher level evidence with greater understanding of underlying pathways and standardised measures was still required.

Leeman et al. (2016) carried out a meta-analysis to examine the association between family functioning and child well-being among children with a wide range of chronic physical conditions. The review examined family functioning in families whose children are chronically ill (i.e., examining the effect of the presence of a child with a chronic health condition on the family's functioning). Included studies in the meta-analysis were restricted to those where family functioning was measured using three assessment tools: FACES, Family Environment Scale with its Family Relationship Index (FES/FRI), and FAD. In total, 37 studies with variable sample sizes were included in the meta-analysis. Most included studies used a cross-sectional design (43 studies), eight used a longitudinal design and two studies were randomised controlled trials. Most studies (n=33) were conducted in the United States. The most frequent child condition examined was diabetes (14 studies) followed by cancer (9 studies), sickle cell disease (8 studies), and asthma (6 studies). The analysis found a positive association of general family functioning and family cohesion with an aggregate measure of children's physical health (r=0.22 and 0.18, respectively). The authors did not discuss why general functioning and cohesion specifically were associated with child physical health

whereas, other domains/aspects such as adaptability, conflict, expressiveness and organisation were not. However, they argued that family related factors might affect childhood physical health through their effect on children's psychological health.

Robson et al. (2020) systematically reviewed the literature on the association between family meal frequency and family functioning outcomes in children aged 2 to 18 years. Three longitudinal studies and 9 cross-sectional studies were identified. The three longitudinal studies showed a positive association between family meal/dinner frequency and different family functioning outcomes (i.e., family cohesion, parent-child communication and parent-child relationship). A meta-analysis of cross-sectional studies showed that more frequent family meals (Standardised mean difference: 0.56, 95%CI: 0.50-0.62, 3 studies) and dinner family meals were associated with higher family connectedness (SMD: 0.46, 95%CI: 0.27-0.65; 3 studies), with substantial heterogeneity between studies. The authors suggested that family meal frequency could serve as a proxy indicator of family functioning, though a higher quality evidence is needed.

2.6.1. Family functioning and oral health

Several studies have examined the association of family functioning with different measures of oral health among children. They were identified through an electronic search of the literature using the terms shown in Appendix 1. The methodological details and key findings of the identified studies are presented in Table 2.3. The quality assessment of the identified studies is presented in Table 2.4 and was carried out using an adapted version of the Newcastle-Ottawa quality assessment scale for cross-sectional studies (Herzog et al., 2013).

The search identified 20 papers from 12 studies, of which, 4 were conducted in Brazil (de Moura et al., 2021b, de Moura et al., 2021a, de Moura et al., 2021c , Neves et al., 2020, Neves et al., 2021a, Neves et al., 2021b, Lopes et al., 2021 , Dutra et al., 2020, Lopes et al., 2020, Prata et al., 2021, Leal et al., 2022), 3 in the Netherlands (Duijster et al., 2014, Duijster et al., 2015, de Jong-Lenters et al., 2018), 2 in the United States (Finlayson et al., 2018, Martin-Biggers et al., 2018), and 1 each in Australia (Renzaho and de Silva-Sanigorski, 2014, Renzaho et al., 2014), England (Nanjappa et al., 2015) and Malaysia (Bilal et al., 2021). Six studies recruited population-based samples (Renzaho and de Silva-Sanigorski, 2014, Renzaho et al., 2014, Nanjappa et al., 2015, de Moura et al., 2021b, de Moura et al., 2021a, de Moura et al., 2021c , Neves et al., 2020, Neves et al., 2021a, Neves et al., 2021b, Lopes et al., 2021 , Dutra et al., 2020, Lopes et al., 2020, Prata et al., 2021, Leal et al., 2022), 3 studies recruited patient-based samples (Duijster et al., 2014, Duijster et al., 2015, de Jong-Lenters et al., 2018) and 3 studies recruited convenience samples (Finlayson et al., 2018, Martin-Biggers et al., 2018, Bilal et al., 2021). All studies were cross-sectional, with sample sizes ranging from 92 (Duijster et al., 2015) to 4602 participants (Renzaho et al., 2014). Child age varied across studies, with 5 studies recruiting preschool children (Martin-Biggers et al., 2018, Duijster et al., 2015, Duijster et al., 2014, Nanjappa et al., 2015, Bilal et al., 2021), 4 recruiting primary school children (de Jong-Lenters et al., 2018, de Moura et al., 2021b, de Moura et al., 2021a, de Moura et al., 2021c , Neves et al., 2020, Neves et al., 2021a, Neves et al., 2021b, Lopes et al., 2021, Leal et al., 2022) and 1 recruting adolescents (Dutra et al., 2020, Lopes et al., 2020, Prata et al., 2021). The remaining 2 studies recruited children aged 0-17 (Finlayson et al., 2018) and 1-12 years old (Renzaho and de Silva-Sanigorski, 2014, Renzaho et al., 2014). Family functioning was measured using the FACES-III in 4 studies (de Moura et al., 2021b, de Moura et al.,

2021a, de Moura et al., 2021c , Neves et al., 2020, Neves et al., 2021a, Neves et al., 2021b, Lopes et al., 2021 , Dutra et al., 2020, Lopes et al., 2020, Prata et al., 2021, Leal et al., 2022), the general functioning subscale of FAD (12-items) in 3 studies (Renzaho and de Silva-Sanigorski, 2014, Renzaho et al., 2014, Nanjappa et al., 2015, Bilal et al., 2021) and the Gezinsvragenlijst (GVL, Family Questionnaire) in 3 studies (Duijster et al., 2014, Duijster et al., 2015, de Jong-Lenters et al., 2018). Sections of the FES were used in two studies, namely all items in the family conflict and family cohesion subscales (Martin-Biggers et al., 2018) and five items of the cohesion subscale (Finlayson et al., 2018). In terms of oral health outcomes, dental caries was assessed in 6 studies, of which 3 measured dmft index from dental records (Duijster et al., 2014, Duijster et al., 2015, de Jong-Lenters et al., 2018) and 3 assessed dental caries through clinical examinations by trained examiners (de Moura et al., 2021b, de Moura et al., 2021a, de Moura et al., 2021c, Neves et al., 2020, Neves et al., 2021a, Neves et al., 2021b, Lopes et al., 2021, Dutra et al., 2020, Lopes et al., 2020, Prata et al., 2021). However, in one of those studies, dental caries was the exposure and family functioning the outcome (Duijster et al., 2015). Beyond clinical outcomes, 4 studies measured perceived outcomes, namely carer-rated child oral health (Renzaho and de Silva-Sanigorski, 2014), child OHRQoL using the ECOHIS (Bilal et al., 2021), self-perceived need of dental treatment (Prata et al., 2021) and self-reported bruxism (Leal et al., 2022). Other child oral health measures included were oral health literacy in 3 studies (de Moura et al., 2021a, Neves et al., 2021a, Lopes et al., 2020), dental visiting in 3 studies (Finlayson et al., 2018, de Moura et al., 2021b, Neves et al., 2021b), sugars intake in 3 studies (Renzaho et al., 2014, Nanjappa et al., 2015, Martin-Biggers et al., 2018) and oral hygiene behaviours in 1 study (Duijster et al., 2014).

The findings from these studies were inconclusive in relation to child oral health outcomes; however, there was some evidence that family functioning was associated with child oral health literacy and dental behaviours. The 6 studies on dental caries reported mixed findings. Only 2 studies found a significant association between family cohesion (but not adaptability) and dental caries after some adjustments (Neves et al., 2020, Dutra et al., 2020). de Jong-Lenters et al. (2018) found that poor functioning in communication was associated with child dmft score via the path child behaviour problems and brushing frequency. However, this finding came from a structural equation model with cross-sectional data. The remaining 3 studies reported non-significant associations at bivariate level (Duijster et al., 2015, de Moura et al., 2021c) or significant crude associations that were fully attenuated after adjustment for confounders (Duijster et al., 2014). Mixed findings were also noted for the 4 studies measuring perceived child oral health outcomes. On one hand, Renzaho and de Silva-Sanigorski (2014) found in confounder-adjusted analysis, that children from poorly functioning families were less likely to be rated by their parents/caregiver as having good oral health and Prata et al. (2021) reported that adolescents from enmeshed families, but not those in connected or separated families, had greater odds of perceiving a need for dental treatment, after adjustment for confounders. On the other hand, family functioning was not associated with child OHRQoL (Bilal et al., 2021) or with self-reported bruxism (Leal et al., 2022).

There was a consensus among the 3 studies measuring oral health literacy, whereby greater family cohesion and family adaptability were associated with higher levels of literacy among children (de Moura et al., 2021a, Neves et al., 2021a, Lopes et al., 2020) One of those studies also found that children in balanced families (i.e. showing both cohesion and flexibility) had greater oral health literacy than those in unbalanced

families (Lopes et al., 2021). Two of the 3 studies investigating the association between family functioning and child sugars intake reported significant findings with frequent consumption of sugary foods (≥4 times/day) (Nanjappa et al., 2015) and consumption of sweet beverages (Renzaho et al., 2014). The remaining study found that family conflict and cohesion were not associated with child intake of sugar-sweetened beverages (SSB) (Martin-Biggers et al., 2018). Of the 3 studies on child dental visits, 2 reported that greater family cohesion, but not family flexibility, was associated with child dental visits (de Moura et al., 2021b, Neves et al., 2021b) whereas the remaining study reported no association between family cohesion and child dental visits (Finlayson et al., 2018). Duijster et al. (2014) reported favourable oral hygiene behaviours (i.e., toothbrushing frequency, age toothbrushing was started, supervised brushing and re-brushing done by parents) in children from normal functioning families than in those from subclinical and clinical functioning families. However, no adjusted estimates for this associations were presented.

According to the NOS adapted for cross-sectional studies, all 12 studies were at risk of bias. In the selection domain, 5 studies were at high risk of bias because they recruited convenience samples (Finlayson et al., 2018, Martin-Biggers et al., 2018, Bilal et al., 2021) or did not report any random sampling technique to infer the sample was representative of the target population (Duijster et al., 2015, de Jong-Lenters et al., 2018); 4 studies were at high risk of bias because they did not provide a justified and satisfactory sample size calculation (Finlayson et al., 2018, Martin-Biggers et al., 2018, Bilal et al., 2021, de Jong-Lenters et al., 2018); and 7 studies were at high risk of bias because they did not report the response rate of the study (Finlayson et al., 2018, Martin-Biggers et al., 2018, Bilal et al., 2021), the response rate was reported but unsatisfactory (<50%) (Duijster et al., 2015) or having non-respondents they did not

compare the characteristics of respondents and non-respondents (Duijster et al., 2014, Duijster et al., 2015, Nanjappa et al., 2015, de Jong-Lenters et al., 2018). Regarding the last item in the selection domain, ascertainment of exposure, all 12 studies were at low risk of bias. Eleven studies assessed the exposure (family functioning) using the full or a reduced/shorter version of a validated measure. The remaining study assessed the exposure (dental caries) according to data from dental records (Duijster et al., 2015).

In the comparability domain, 2 studies were at high risk of bias because they did not account for any confounding factors in their analysis (Duijster et al., 2015, Leal et al., 2022). Of the 10 remaining studies, 5 were at low risk of bias because they reported associations adjusted for family SEP and parental and child demographic factors (Renzaho and de Silva-Sanigorski, 2014, Renzaho et al., 2014, Duijster et al., 2014, Martin-Biggers et al., 2018, Finlayson et al., 2018, Nanjappa et al., 2015) whereas the other 5 studies adjusted for family SEP only (de Jong-Lenters et al., 2018, Bilal et al., 2021, de Moura et al., 2021b, de Moura et al., 2021a, de Moura et al., 2021c, Neves et al., 2020, Neves et al., 2021a, Neves et al., 2021b, Lopes et al., 2021, Dutra et al., 2020, Lopes et al., 2020, Prata et al., 2021). In the outcome domain, 3 studies were at low risk of bias because they included clinical examinations by trained dentists (de Moura et al., 2021b, de Moura et al., 2021a, de Moura et al., 2021c, Neves et al., 2020, Neves et al., 2021a, Neves et al., 2021b, Lopes et al., 2021, Dutra et al., 2020, Lopes et al., 2020, Prata et al., 2021) whereas 9 studies were at moderate risk of bias because they used methods prone to measurement error, such as parental self-reports (Duijster et al., 2015, Renzaho and de Silva-Sanigorski, 2014, Renzaho et al., 2014, Nanjappa et al., 2015, Martin-Biggers et al., 2018, Finlayson et al., 2018, Bilal et al., 2021, Leal et al., 2022) or patient records (Duijster et al., 2014, de Jong-Lenters et al., 2018). In the last item of the outcome domain, statistical test, although all studies described clearly the

analysis performed and presented the point estimate of the association they examined with their corresponding 95% Confidence Intervals (CI), 7 studies were at high risk of bias because they used inadequate statistical techniques, such as bivariate analysis only (Duijster et al., 2015, Leal et al., 2022), structural equation modelling with cross-sectional data (de Jong-Lenters et al., 2018) and stepwise selection of variables for inclusion in the final model (de Moura et al., 2021b, de Moura et al., 2021a, de Moura et al., 2021c, Neves et al., 2020, Neves et al., 2021a, Neves et al., 2021b, Lopes et al., 2021, Dutra et al., 2020, Lopes et al., 2020, Prata et al., 2021, Leal et al., 2022).

In summary, the evidence found was mixed and the quality of the identified studies varied considerably. All identified studies were at risk of bias due to limitations in the selection of participants (7 studies), comparability between exposed and unexposed groups (2 studies) and outcome assessment (7 studies). The most common limitations were the low response rate (7 studies), the use of inadequate statistical techniques (7 studies), the use of non-random sampling (5 studies), no justification of sample size (4 studies), and no adjustment for confounders (2 studies). Higher quality evidence is, therefore, needed utilising longitudinal designs and standardised assessment for exposure (family functioning) and child oral health (outcome) to draw a conclusion on the influence of family functioning on child oral health.

Table 2.3. Methodological details of studies on family functioning and oral health

Author (year)	Study design, setting and participants	Exposure	Outcome	Adjustments	Key findings
Renzaho and de Silva-Sanigorski (2014) and Renzaho et al. (2014)	State-wide cross-sectional telephone survey of 5000 primary carers of children aged 0-12 years who were recruited for the 2006 Victorian Child Health and Wellbeing study (Australia), using random digital dialling (86.6% response rate). 4590 and 4602 carers of children aged 1-12 years were included in the analyses, respectively.	FAD general functioning subscale, completed by primary carers. Cut-offs were healthy (<2) and poor (≥2).	Carers' perception of their child's oral health (poor, fair, good, very good and excellent)	Parent age, gender and education, child age, gender and general health status, household income, family structure and language spoken at home	Children in poorly functioning families had lower odds of having better child oral health than those in healthy functioning families: 1-3-year-olds (OR=0.42, 95%CI: 0.28, 0.63); 4-7-year-olds (OR=0.67, 95%CI: 0.48, 0.94) and 8-12-year-olds (OR=0.58, 95%CI: 0.44, 0.77).
			Child intake of potato crisps and potato chips (times/week), takeaway foods (times/month), sweet beverages (cups/day)	Child age and gender, responding caregiver's age and gender, household income, responding caregiver's educational attainment, family structure, and home ownership	Children in poorly functioning families had higher intake of potato crisps and chips (RR=1.14, 95%CI: 1.02, 1.27), take away foods (RR=1.02, 95%CI: 1.01, 1.03) and sweet beverages (RR=1.03, 95% CI 1.02, 1.04) than those in healthy functioning families.
Duijster et al. (2014)	Cross-sectional survey of 630 5-6-year-olds from six large paediatric dental centres in Enschede, Utrecht, Den Haag, Rijswijk, Zoetermeer and Nijmegen (Netherlands), randomly selected from those who had their last dental visit in past 6 months between June 2011 and March 2012 (53.9% response rate). Children in boarding	The 5 domains of the GVL, completed by a parent or caregiver. Cut-offs for responsiveness, communication, organisation, partner-relation and social network were ≥16, 22, 18, 18 and 22 for subclinical functioning, and ≥19, 26, 21, 22 and 25 for clinical functioning.	Toothbrushing frequency [≥2/day vs. ≤1/day], age toothbrushing was started (<1, 1-2, 2-3, ≥3 years), supervised tooth brushing (always, often and occasionally/never) and re-brushing (always, often and occasionally, never) and dental caries (dmft) from personal dental records.	Only crude estimates were reported for oral hygiene behaviours. For dmft, adjustments were made for child's age, sex and ethnicity, mother's highest level of education, family structure, other family functioning dimensions and oral hygiene behaviours	At bivariate level, better family functioning in all five domains was associated with starting brushing earlier in life, supervised brushing and re-brushing whereas only better family functioning in organisation was associated with frequent brushing. Adjusted estimates were not reported. Poorer functioning in responsiveness, communication, organisation and social network, but not in partner-relation, were associated with lower dmft scores at bivariate level. However, these estimates were fully attenuated after adjustments.

	schools or in special needs education were excluded.				
Duijster et al. (2015)	Cross-sectional study including 92 dyads of parents and 5-6-year-olds from Dutch, Moroccan and Turkish origin, recruited from a large paediatric dental centre in the Hague (Netherlands) between September 2013 and March 2014 (34% response rate). Children with behavioural disorders, special needs and tooth enamel defects were excluded.	Dental caries (dmft) from patient dental records, classified as follows: 46 cases (dmft≥4) and 46 controls (caries free).	The organisation and social network dimensions of the GVL, completed by a parent. Continuous scores used.	Only crude findings reported	No differences in mean GVL organisation and social network scores between cases and controls.
Nanjappa et al. (2015)	Cross-sectional community survey of 698 3-4-year-old children and their mothers recruited from Outer Northeast London using stratified random sampling between 2008 and 2010 (56.8% response rate).	FAD general functioning subscale, completed by mothers. Continuous score used.	Child sugars intake (times/day) from 7 items (4 foods and 3 beverages), categorised as <=4 and >4 times/day.	Mother's ethnicity and education, area deprivation, and children's age and sex	Greater family functioning score was associated with lower frequent consumption of sugary foods (OR=0.23, 95%CI: 0.11 to 0.46).
Martin-Biggers et al. (2018)	Cross-sectional online survey of 550 mothers who were 18-45 years old, English-speakers, main household food gatekeeper, had at least one child between 2-5 years of age and panel	The family conflict and family cohesion domains of the FES. Item responses were used to create three clusters (low, middle and high) in each domain.	Child intake (servings/week) of 100% fruit and vegetable juice and SSBs	Mother's ethnicity, education, paid hours of employment per week, general health status and weight status, household composition and number of children, family affluence, meals	Family conflict and cohesion were not associated with child intake of SSBs. Family cohesion was not associated with child intake of 100% fruit and vegetable juice. Children in families with high cohesion (Coefficient=0.32, 95%CI: -0.06 to 0.71) had greater intake of 100% fruit and vegetable juice than those in families with

	members of the Survey Sampling International, recruited using convenience sampling. No survey dates were reported.			per week, meal atmosphere and food insecurity risk, and child's sex, age, weight status, and general health status.	normal cohesion. However, no differences were found between children in families with low and normal cohesion.
de Jong-Lenters et al. (2018)	Cross-sectional study of 251 high-risk children aged 5-8 years old recruited from a large paediatric dental centre in Noordwijk (Netherlands) (Response rate: 55.7%). Children with special needs were excluded. No survey dates were reported.	The responsiveness, communication and organisation dimensions of the GVL, completed by a parent. Cut-offs for responsiveness, communication and organisation were ≥16, 22 and 18 for subclinical functioning, and ≥19, 26 and 21 for clinical functioning.	Dental caries (dmft) from patient dental records.	Mother's education in SEM.	Children in families with clinical functioning in responsiveness, communication and organisation had greater dmft than those in families with normal functioning in crude models. No differences were found between children in families with subclinical and normal functioning. In SEM, communication was associated with dmft via child behaviour problems and brushing frequency.
Finlayson et al. (2018)	Cross-sectional study of 142 Mexican-migrant caregivers of children 0-17 years old, enrolled in a community programme in California (USA) between 2013 and 2014, and recruited using convenience sampling.	Cohesion subscale from the FES, completed by caregiver. Continuous score used.	Child dental visit in the past year (yes/no), reported by caregiver.	Child age, gender, usual source of care, dental insurance and dental cavities, caregiver's marital status, education, dental visit in past year, depressive symptoms, acculturation, and employment, household income and size.	Greater family cohesion was associated with greater odds of reporting a child dental visit in past year at bivariate level. However, this association was fully attenuated after adjustments.
de Moura et al. (2021b), de Moura et al. (2021a),	Cross-sectional survey of 448 12-year-olds recruited from private and public schools in Cajazeiras (Brazil), using simple	FACES III, completed by children. Continuous scores for family cohesion and adaptability were used.	Child OHL, using the BREALD-30 score.	Maternal education, family income, and teacher's report of ADHD.	Greater family cohesion was associated with higher (RR=1.02, 95% CI: 1.01, 1.03) whereas poorer family adaptability was associated with lower (RR=0.99, 95% CI: 0.98-0.99) child BREALD-30 score.

de Moura et al. (2021c)	random sampling, between April and November 2017 (90% response rate). Children unable to read, wearing orthodontic appliances and with physical, sensory or neurological problems (based on teachers' reports and confirmed by parents) were excluded.	FACES III, completed by children. Families were classified as disengaged (10-34), separated (35-40), connected (41-45) and enmeshed (46-50) in terms of cohesion and as rigid (10-19), structured (20-24), flexible (25-29) or chaotic (30-50) in terms of adaptability.	Child has ever been to a dentist's office (yes/no).	Family income, number of residents at home, maternal schooling, and child sex, toothache in the previous 6 months, OHL, and parental report of attention deficit.	Family adaptability was not associated with child dental visiting in crude or adjusted models. As for cohesion, children in enmeshed (OR=1.08, 95%CI: 1.01, 1.15) and connected families (OR=1.06, 95%CI: 1.01, 1.13) but not those in separated families had greater odds of having ever visited the dentist.
		FACES III, completed by children, was used to classified families as having low (<28.56), medium (28.56-39.98) or high (>39.98) cohesion and low (<19.64), medium (19.64-30.88) or high (>30.88) adaptability. Cut offs corresponded to +-1SD in their continuous scores.	DMFT index from clinical examination by one trained dentist	Stepwise regression used to generate the final regression model, which left family cohesion and adaptability out.	Family cohesion and adaptability were not associated with child DMFT at bivariate level. Neither family cohesion nor adaptability were retained in the final model.
Neves et al. (2020), Neves et al. (2021a), Neves et al. (2021b), Lopes et al. (2021)	Cross-sectional survey of 740 12-year-olds in public and private schools in Campina Grande (Brazil) using two-stage cluster sampling between October 2016 and July 2017 (96.2% response rate). Children not fluent in Portuguese, with	FACES III, completed by children. Scores were used to classified families as disengaged (10-34), separated (35-40), connected (41-45) and enmeshed (46-50) in terms of cohesion and as rigid (10-19), structured (20-24), flexible (25-29)	Child OHL, using the BREALD-30 score.	Mother's schooling, caregiver's age, and child sex, and type of dental service used.	Children in connected families (RR=1.12, 95%CI: 1.05, 1.20), but not those in enmeshed and separated families, had greater BREALD-30 scores than those in disengaged families. Children in rigid (RR=1.14, 95%CI: 1.04, 1.25), and structured families (RR=1.11, 95%CI: 1.04, 1.20), but not those in flexible families, had greater BREALD-30 scores than those in chaotic families.

	orthodontic appliances, retained primary teeth or behavioural challenges were excluded.	or chaotic (30-50) in terms of adaptability. The cohesion and adaptability categories were cross-tabulated to classify families as balanced (when both domains were in the two middle categories), mid-range (when only one of the two domains was in the highest or lowest categories) and unbalanced (when the two domains were in the highest or lowest categories).		Mother's schooling, guardian's age, and child sex and type of dental service used.	Children in balanced families (RR=1.08, 95%CI: 1.01, 1.14) had greater BREALD-30 scores than those in unbalanced families. The estimate for mid-range families was not reported.
			Child ever visited the dentist (yes/no).	Family social class, mother's schooling, and child OHL and toothache in the past 6 months.	Children in enmeshed (PR=1.55, 95% CI: 1.19, 2.02) and connected families (PR=1.22, 95%CI: 1.03, 1.44) were more likely to have ever visited the dentist than those in disengaged families. The estimate for separated families was not reported. Family adaptability was not associated with child dental visit.
			Number of cavitated carious lesions, from clinical examinations by two trained dentists	Family social class, number of residents at home, and child OHL and type of dental service used.	Children in connected (RR=5.05, 95% CI: 1.71, 14.86), separated (RR=5.66, 95%CI: 2.22, 14.40) and disengaged families (RR=5.57, 95%CI: 1.96, 15.82) had more cavitated lesions than those in enmeshed families. Family adaptability was not associated with cavitated carious lesions.
Dutra et al. (2020), Lopes et al. (2020), Prata et al. (2021)	Cross-sectional survey of 746 15-19-year-olds recruited from private and public schools in Campina Grande (Brazil), using two-stage random sampling, between October 2016 and July 2017 (97% response rate). Children undergoing orthodontic treatment, with any retained primary teeth and with learning difficulties, neurological	FACES III, completed by children, was used to classified families as disengaged (10-34), separated (35-40), connected (41-45) and enmeshed (46-50) in terms of cohesion and as rigid (10-19), structured (20-24), flexible (25-29) or chaotic (30-50) in terms of adaptability.	Child OHL, using the BREALD-30 score.	Monthly family income, number of residents at home, mother's schooling and marital status, child ethnicity and type of dental service used.	Children in enmeshed families (RR=1.21, 95%CI: 1.12, 1.30), but not those in connected or separated families, had greater BREALD-30 scores than those in disengaged families. Children in rigid (RR=1.11, 95%CI: 1.04, 1.19), and structured families (RR=1.06, 95%CI: 1.01, 1.12), but not those in flexible families, had greater BREALD-30 scores than those in chaotic families.
			Child self-perceived need for dental treatment (yes/no).	Child untreated caries, any tooth loss due to caries and toothache in past 6 months.	Children in enmeshed families (OR=10.23, 95%CI: 3.96, 26.4), but not those in connected or separated families, had greater odds of perceiving a need for dental

	disorders, physical disabilities or in need of specialised support (as reported by teachers) were excluded.				treatment. Family adaptability was associated with perceived need at bivariate level but was left out of the final model.
			Number of cavitated carious lesions, from clinical examinations by two trained dentists	Family social class.	Children in disengaged (RR=6.30, 95%CI: 1.24, 31.88), separated (RR=4.80, 95%CI: 1.03, 22.35) and connected families (RR=5.23, 95%CI: 1.27, 21.59) had more lesions than those in enmeshed families. Family adaptability was not evaluated.
Bilal et al. (2021)	Cross-sectional study of 180 Chinese 4-6-year-olds recruited from a private school (Malaysia) through convenience sampling (80.5% response rate). No survey dates were reported.	FAD general functioning subscale, completed by primary carers. Cut-offs were good (<2) vs. poor functioning (≥2).	OHRQoL using by the ECOHIS. The ECOHIS total score was categorised using the median (≤6 vs >6).	Child dental caries status, number of siblings and relationship of the respondent to the child	Poor family functioning was associated with greater odds of reporting an ECOHIS score>6 at bivariate level. However, this association was attenuated after adjustments.
Leal et al. (2022)	Cross-sectional survey of 739 8-10-year-olds, recruited from public and private schools in a city of Brazil, using cluster random sampling (97.2% response rate). No survey dates reported. Children undergoing orthodontic treatment and those with physical or intellectual disabilities were excluded.	FACES III, completed by children, was used to classified families as disengaged (10-34), separated (35-40), connected (41-45) and enmeshed (46-50) in terms of cohesion and as rigid (10-19), structured (20-24), flexible (25-29) or chaotic (30-50) in terms of adaptability.	Child report on clenching or griding teeth during the day (yes/no).	Stepwise regression used to develop the final regression model, which left family cohesion and adaptability out.	Neither family cohesion nor adaptability were associated with child self-reported bruxism at bivariate level. Neither domain was retained in the final model.

ADHD: Attention Deficit/Hyperactivity Disorder, BREALD: Brazilian version of the Rapid Estimate of Adult Literacy in Dentistry, CI: confidence interval, dmft: decayed, missing and filled teeth, ECOHIS: Early Childhood Oral Health Impact Scale, FAD: family assessment device, FES; Family Environment Scale, GVL: Gezinsvragenlijst, RR: rate ratio, OHL: oral health literacy, OHRQoL: Oral Health Related Quality of Life, OR: Odds ratio; SEM: Structural equation modelling, SSB: sugar-sweetened beverages, USA: United States of America.

Table 2.4. Quality assessment of studies on family functioning and child oral health using the Newcastle-Ottawa scale (adapted for cross-sectional studies)

Authors (year)	Sample representativeness (*)	Sample size (*)	Non-respondents (*)	Ascertainment of exposure (**)	Comparability (**)	Outcome assessment (**)	Statistical test (*)
Renzaho and de Silva-Sanigorski (2014), Renzaho et al. (2014)	*	*	*	**	**	*	*
Duijster et al. (2014)	*	*		**	**	*	*
Duijster et al. (2015)		*		*		*	
Nanjappa et al. (2015)	*	*		**	**	*	*
Martin-Biggers et al. (2018)				*	**	*	*
de Jong-Lenters et al. (2018)				**	*	*	
Finlayson et al. (2018)				**	**	*	*
de Moura et al. (2021b), de Moura et al. (2021a), de Moura et al. (2021c)	*	*	*	**	*	**	
Neves et al. (2020), Neves et al. (2021a), Neves et al. (2021b), Lopes et al. (2021)	*	*	*	**	*	**	
Dutra et al. (2020), Lopes et al. (2020), Prata et al. (2021)	*	*	*	**	*	**	
Bilal et al. (2021)				**	*	*	
Leal et al. (2022)	*	*	*	**		*	

Criteria to judge methodology quality: Sample representativeness: one star; truly representative of the average in the target population (all subjects or random sampling); Sample size: one star; justified and satisfactory; Non-respondents: one star; comparability between respondents and non-respondents' characteristics is established and the response rate is described and satisfactory (>50%); Ascertainment of the exposure (risk factor): two stars; validated measurement tool. One star; non-validated measurement tool, but the tool is available or described; Comparability: one star; the study controls for the most important confounding factor (family SEP). Additional star; the study control for any additional factor (parental and child demographic factors); Outcome: two stars; the outcome was assessed clinically by trained examiners. One star; self-report; Statistical test: one star; test used is clearly described and appropriate, the measurement of the association is presented, including 95%CI and p-value.

As has been outlined in this review, the available evidence suggests that in order to understand child oral health both the individual family in which the child is living in and the context in which that family is functioning need to be taken into account. As in common in studies on the family, this draws together two theoretical approaches, the family systems theory approach and the ecological approach. In order to use these approaches effectively it is useful to put together a conceptual framework which illustrates the way the theories can be used in combination. The conceptual framework adopted in this study is outlined below.

2.7. Conceptual model for this study

A conceptual model was developed for this project (Figure 2.4), based on existing frameworks characterising the multiple determinants of child oral health (Fisher-Owens et al., 2007, Mattheus, 2010, Chi et al., 2017). They were chosen because they underscore family influences, in general, and family functioning, in particular, on child oral health. The conceptual model developed for this project, underpinned by the family ecological framework and family systems theories, suggests that the family system, through its functioning, influences child health behaviours and subsequently child oral health. It also considers the influence of the wider social, environmental and structural determinants of health which also exert an influence on child health behaviours and oral health. Health behaviours profoundly affect child oral health and can help explain, at least partially, differences in child oral health. Therefore, child oral health is seen as being determined through interactions of child level factors (demographic, biological and behavioural), family level influences including family structure and functioning, and the wider social and structural determinants of health, such as social and economic circumstances, health care service characteristics, culture, physical environment,

culture and social capital. The interaction of the wider social determinants of health with the individual and family influences is complex and changes over time, which makes measurement of these determinants challenging. Thus, posing difficulties in teasing out mechanisms or pathways of influence (Braveman et al., 2011).

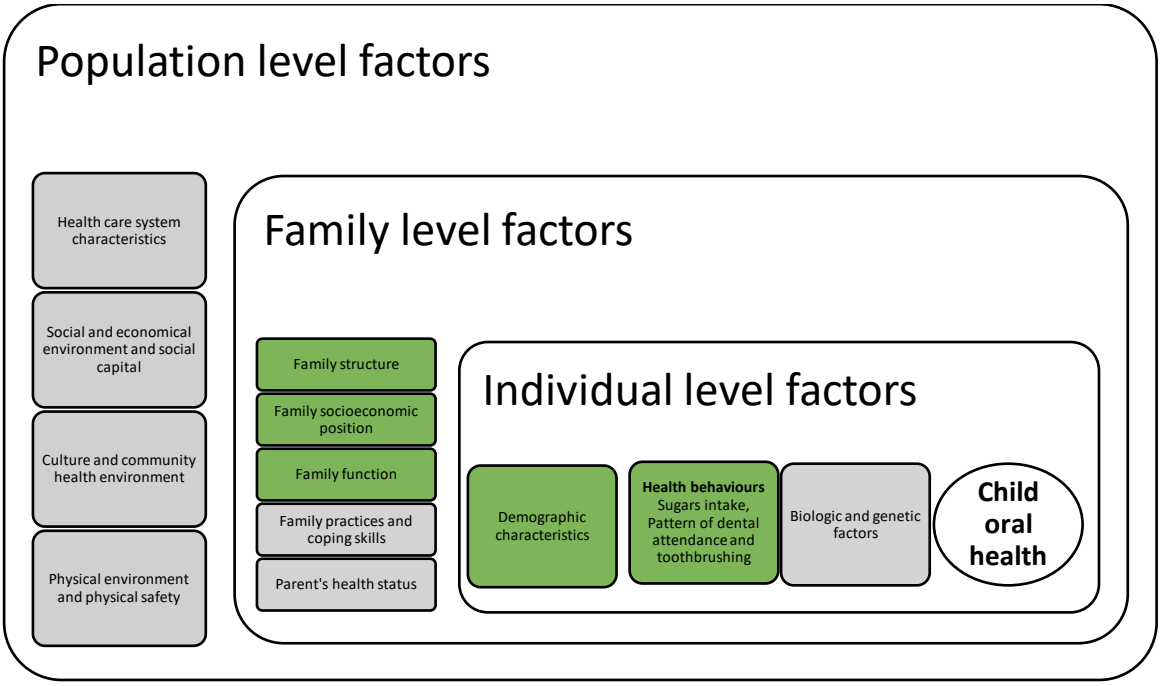

Figure 2.4. A conceptual model of the multilevel influences on children's oral health adapted from Fisher-Owens et al. (2007). Highlighted in green are the variables that will be considered for hypothesis testing.

The conceptual framework for this project highlights the role of family functioning as an independent risk factor, over and above the effects of established determinants of child oral health. The proposition here is that poor family functioning leads to unhealthy behaviours which ultimately leads to poor child oral health. However, the framework also recognises that family functioning might play other, not mutually exclusive, roles in relation to child oral health. Family functioning could be in the causal pathway between family SEP and child oral health (mediating role), and as such, explain, at least

partially, socioeconomic inequalities in child oral health (Booysen et al., 2021). The proposition here is that poor SEP (a strong social determinant of health) affects the family and leads to unhealthy functioning which ultimately leads to poor child oral health. Finally, family functioning could act as a buffer (antagonise) of the effect of poor SEP on child oral health or could intensify (synergise) the adverse impacts of poor SEP on child oral health (moderating role). The concepts of mediating and moderating roles are explored in detail in the following chapter where the methods of the study are outlined. The proposition here is that healthy functioning could protect family members, including children, from the adverse impact of living in socioeconomic disadvantage (Booysen et al., 2021).

2.8. Rationale for the study

Child oral health is an integral and an important part of their health and wellbeing (World Health Organization, 2021). That is because dental diseases, particularly ECC, have profound adverse impacts on the child (functionally, socially and psychologically) as well as negative impacts on the family and the dental care service (World Health Organization, 2019, World Health Organization, 2021). Thus, promotion of child oral health requires a clear understanding of the influences on child oral health. This study will seek to extend the knowledge of the role of family on child oral health by incorporating a novel family construct, family functioning, into a model of child oral health and empirically testing the interrelationships between family SEP, family functioning and child oral health.

The review of the literature carried out for this project showed that there are a range of different ways in which families can be understood and shaped by the social contexts in which they exist. It also showed that there is mixed evidence on the association

between family functioning and child oral health. All previous dental studies focused on investigating the independent contribution of family functioning to oral health among children. There is a lack of evidence assessing whether family functioning can play other roles in relation to child oral health (mediation and moderation). This study also explores which domains/dimensions of family functioning are more relevant to child oral health and, thus, could be targeted by intervention. This would add knowledge to the evidence-base concerned with understanding/improving child oral health and tackling inequalities in childhood oral health using a population-based sample and validated, reliable measures of family functioning and child oral health (the outcome) overcoming the limitations of previous research.

2.9. Aim, objectives and hypothesis

2.9.1. Aim

The aim of this study was to examine the interrelationships of family functioning, parental socioeconomic position (SEP) and child oral health among preschool children in Outer North-East London, United Kingdom.

2.9.2. Objectives

The objectives were:

1) To investigate the association of family functioning with child oral health independent of known confounders.

2) To test whether family functioning mediates the association of parental SEP with child oral health.

3) To evaluate whether the association of parental SEP with child oral health was modified by family functioning.

2.9.3. Hypothesis

The general hypothesis tested in this project is that families with healthy functioning, in which there is good behaviour control, clear communication, successful problem solving, properly defined and accomplished roles, adequate responsiveness and involvement, provide their children with an environment which favours adopting healthy behaviours which consequently are associated with better oral health.

Chapter 3

Methodology

The present project was based on secondary analysis of existing data. This chapter reports the data used and how it was handled in the current study.

3.1. Data source

This study used data from the East London Oral Health Inequalities (ELOHI) study, a mixed-methods survey designed to further the understanding of the relationships and pathways between area deprivation, dental behaviours and oral health status (Nanjappa et al., 2015). The ELOHI study was chosen as the source of data for this research project because it carried out a comprehensive assessment of the family environment and child oral health, thus allowing testing of the research hypotheses. Although other surveys were available, such as the Millennium Cohort Study and the Avon Longitudinal Study of Parents and Children (ALSPAC), they only included a limited assessment of family functioning or child oral health.

3.1.1. Study population

The ELOHI study was conducted over two phases (quantitative and qualitative studies) in a deprived area of Outer North East London (Barking and Dagenham, Redbridge and Waltham Forest boroughs). The ELOHI study was approved by the Outer North East London (ONEL) Research Ethics Committee (08/H0701/93). Phase 1 of the ELOHI

study was a cross-sectional survey of adults (16-65 years) and children (3-4 years) living in the area recruited using a multi-stage stratified random sampling technique in 2009-2010. Phase 2 of the ELOHI study was a qualitative study exploring the barriers to accessing dental care perceived by families living in ONEL as well as dentists and services commissioners working in the area, carried out in 2011-2012. Only data from the quantitative study was used in the present research project, and it is therefore described in detail below.

For the cross-sectional study, a sampling frame was constructed with a list of all addresses stratified by the number of wards in each borough (17 in Barking and Dagenham, 21 in Redbridge and 20 in Waltham Forest). Thus, the total number of wards (strata) in the three boroughs was 58. Thereafter, a random sample of around 55 addresses in each ward was selected yielding 3193 addresses. The ELOHI research team contacted potential participants by post to invite them to take part in the survey. The invitation letter explained to potential participants that they could take part in the study by filling-in and sending back the opt-in card by post or by default where an appointment would be sent out to them if they did not respond within two weeks of receiving the invitation letter. The information sheet described the purpose of the study and explained that participation was voluntary. The opt-in card collected information on contact details, availability, and the gender preference of the examining dentist.

Non-respondent addresses were visited to determine vacancy of the premises and age of residents. A total of 457 commercial or vacant addresses and 208 ineligible premises (i.e., all residents were outside the target age brackets) were excluded. Thus, the final sampling frame included 2528 addresses. Of which, 1437 addresses agreed to take part in the survey. An attempt was made to replace non-respondent households with randomly selected households in the same postcode area (same Index of Multiple

Deprivation score). This approach ensured that non-respondents and replacements were comparable. No further replacements were sought if the new household declined to participate. After replacements, the response rate in the ELOHI cross-sectional study was 56.8% (Barking and Dagenham: 61.0%, Redbridge: 52.2% and Waltham Forest: 61.2%, respectively). In each selected household, a maximum of two adults and one child were invited to participate, and all agreed yielding a sample of 2343 (16-65-year-old) adults and 994 (3-4-year-old) children, respectively. Adults and children with special care needs were excluded from ELOHI survey.

A subsample of ELOHI participants was selected (families in which a child and one of the parents participated) and their data were used in the analysis of this study.

3.1.2. Data collection

Participants who agreed to take part in the ELOHI study were visited in their own homes by a team consisting of a trained interviewer and a dentist. During the visit, the dentist carried out clinical oral examinations for adults and/or children whilst the trained interviewer recorded the clinical data. Thereafter, the interviewer distributed questionnaires to parents/carers and helped to clarify any issues related to the questionnaires if needed.

3.1.2.1. Child clinical examinations

Participating children were examined by the dentist. Their teeth were not brushed or professionally cleaned before the clinical examination. During the examination, children were seated comfortably in a chair with a good support. Each examination was

completed in less than 5 minutes and no radiographs were taken as part of the examination. All teeth were inspected using standard mouth mirrors and periodontal probes and under artificial illumination from Daray light lamps. Plaque levels, dental abscesses and dental caries were recorded during clinical examinations.

Dental caries was assessed at the tooth level adhering to the Child Dental Health Survey protocol. Decayed teeth were detected at the caries-into-dentine threshold (including visual dentinal caries) (Pitts et al., 2006). Prior to the survey, a senior examiner (gold standard) led a training exercise in which the 11 dentists (examiners who were to collect the ELOHI data) were familiarised with the study protocol, diagnostic criteria and codes for the clinical examination. To assess examiner's reliability in fieldwork conditions, the gold standard examiner carried out repeated clinical examinations on 69 children (including 1380 teeth) who had been previously examined by one of the 11 examiners. Percent agreement and unweighted Kappa were used to evaluate the level of inter-examiner reliability for dental caries assessment at tooth level. A percent agreement of 98% and an overall Kappa score of 0.67 (95% CI: 0.56, 0.78) were recorded.

3.1.2.2. Questionnaires

Parents completed two questionnaires, one for adult information (Appendix 2) and one for child information (Appendix 3). The adult questionnaire consisted of two parts with each part having multiple sections. In part one of the adult questionnaire, participants were asked to provide information on their use of dental services, health behaviours, perceptions of oral health and socio-demographic circumstances. Part two of the adult questionnaire included an assessment of family functioning.

Parents/carers of children who were clinically examined were asked to fill in a child questionnaire. The child questionnaire included questions on the child's demographic characteristics, dental behaviours and oral health-related quality of life (OHRQoL).

3.1.3. Selection of variables

Variables for the current analysis were chosen based on the conceptual model presented in Section 2.7, namely child oral health (outcomes), family functioning (exposure) and variables that could act as confounders of the association of family functioning with child oral health.

3.1.3.1. Outcome measures

Three measures of child oral health were chosen as outcomes for this analysis. They were child dental behaviours, dental caries and OHRQoL.

Child dental behaviours

Each child dental behaviour was reported by parents/carers in the child questionnaire. Child dental attendance was assessed with two questions. Parents were asked to report how long ago the child had his last dental visit, with four possible response options: less than 6 months ago, more than 6 months up to 1 year ago, more than 1 year, and never). The second question asked parents to report the reason for the child last visit to the dentist, with the following response options: you knew a routine check-up was due, the dentist sent you a reminder for a check, the oral health professional at the pre-school/day-care advised it, and the child had toothache or some other problem. Dental

attendance was then classified into two categories; children who had a check-up in the last year were considered regular attenders whereas those who have never visited the dentist or whose last visit was due to trouble with their teeth were considered problem-oriented attenders. Frequency of toothbrushing was also reported in the child questionnaire using a 5-point ordinal scale (never, less than once a day, once a day, twice a day, three times a day or more). Responses were categorised as once a day or less often (indicating infrequent toothbrushing) versus twice a day or more often (frequent toothbrushing). Questions on both, child dental attendance and toothbrushing frequency, were adapted from the Child Dental Health Survey (Pitts et al., 2006). Child intake of sugars was assessed through parents/carers reports on an adapted version of the food frequency questionnaire used in the National Diet and Nutrition Survey of children aged 1.5- to 4.5-year-olds (Hinds and Gregory, 1995). Parents reported their child's intake of seven sugary food items (chocolate, biscuits or cookies, cakes, confectionary or other sweets, sweetened milk, sweetened fruit juice and sweetened fizzy drinks). Responses were recorded on a 7-point ordinal scale (more than once a day, once a day, most days, at least once a week, at least once a month, less than once a month, and never). Weighted scores were used to match the lower frequency of consumption in each response category, namely more than once a day=2, once a day=1, most days (4/7)=0.57, once a week (1/7)=0.14, once a month=0 and never=0. An estimate of the child sugars intake was calculated by adding-up the weighted scores. The estimated child sugars intake, which ranged between 0 and 14 times a day, was categorised as ≤4 sugary foods a day versus >4 sugary foods a day (Bernabe et al., 2014, Nanjappa et al., 2015). Hence, the three child dental behaviours were treated as categorical variables in the analysis.

Child dental caries

Child dental caries was determined from clinical examinations and summarised using the sum of decayed, missing and filled primary teeth (dmft index, representing the child past and present caries experience), the number of decayed primary teeth (dt index, representing current untreated disease) and the number of missing and filled primary teeth due to caries (mft index, representing treatment experience). The numbers of missing and filled teeth were combined for analyses given the small number of children with treatment experience. The dmft, dt and mft scores were used as counts when analysed as outcomes. Further, dmft index was categorised into (dmft=0 and dmft>0) to be used as a binary explanatory variable in the analysis of child OHRQoL.

Child OHRQoL

This outcome was measured using the Early Childhood Oral Health Impact Scale (ECOHIS) (Pahel et al., 2007). The instrument consists of 13 items arranged into 2 sections. The Child Impacts Section (CIS) has four domains: child symptoms (1 item), child function (4 items), child psychological domain (2 items) and child self-image/social interaction (2 items). The Family Impacts Section (FIS) has two domains: parent distress (2 items) and family function domain (2 items). Parents/carers reported whether the child or the family have had an impact on their quality of life considering the child entire life span (lifetime impact is measured due to the relatively low prevalence of oral diseases among young children). Responses were coded as 0=never, 1=hardly ever, 2=occasionally, 3=often, 4=very often and 5=don't know. A total ECOHIS score was calculated as a sum of the items' codes after recoding the fifth response option (don't know) into missing. In cases where there was up to two missing

responses in CIS and up to one missing response in FIS, a replacement of missing values with the average of the remaining items in that section was carried out. Total ECOHIS, CIS and FIS scores were used as count variables in the analysis. ECOHIS shown good validity and reliability when tested in various settings (Yang et al., 2020, Perazzo et al., 2020).

3.1.3.2. Exposure measure

The exposure variable was family functioning which was measured with the Family Assessment Device (FAD) (Epstein et al., 1983a). FAD is 60 item self-report scale that measures family functioning in six domains: affective involvement (7 items), affective responsiveness (6 items), behaviour control (9 items), communication (9 items), problem solving (6 items) and roles (11 items). It also includes a general functioning subscale (12 items) that assess the overall family functioning. Responses to the FAD are recorded through agreement with each item (response options: 1=strongly agree, 2=agree, 3=disagree, 4=strongly disagree).

Each FAD item indicates a functioning status; either healthy (positively worded) or unhealthy (negatively worded). Responses to negatively phrased items require reverse coding prior to calculation of domain score. Table 3.1 shows which of the 60 FAD items were positively and negatively phrased. Domain scores were calculated by summing up item scores and dividing them by the number of items in that domain. In cases where there were 40% or more missing responses to items in a domain, a domain score could not be calculated (Ryan et al., 2005). The cut-off scores that differentiate healthy versus unhealthy functioning in each domain are presented in Table 3.2 (Miller et al., 1985b) and were used in the analysis to generate categorical variables for each

domain. The FAD has been widely used in research and clinical settings. It has demonstrated good validity, reliability and has been used a cross languages and cultures (Staccini et al., 2015). Moreover, FAD was recommended to be used in oral health research as it demonstrated sound psychometric properties (Duijster et al., 2013).

Table 3.1. FAD items by domains and phrasing

	FAD items	
	Positively phrased	Negatively phrased[a]
Problem solving	2, 12, 24, 38, 50, 60	
Communication	3, 18, 29, 43, 59	14, 22, 35, 52
Roles	10, 30, 40	4, 8, 15, 23, 34, 45, 53, 58
Affective responsiveness	49, 57	9, 19, 28, 39
Affective involvement		5, 13, 25, 33, 37, 42, 54
Behaviour control	20, 32, 55	7, 17, 27, 44, 47, 48
General functioning	6, 16, 26, 36, 46, 56	1, 11, 21, 31, 41,51

[a] These items require reverse-scoring before creating domain scores

Table 3.2. Number of items and cut-off scores for FAD domains

Domains	**Items**	**Cut-off scores**
Problem solving	6	2.2
Communication	9	2.2
Roles	11	2.3
Affective responsiveness	6	2.2
Affective involvement	7	2.1
Behaviour control	9	1.9
General functioning	12	2.0

3.1.3.3. Confounders

Parental demographic characteristics

Parents/carers were asked to report their age, sex, ethnicity and marital status in the adult questionnaire. Parental age was calculated from the date of birth and was used as a continuous variable in the analysis whereas parental sex was a binary variable (male

vs. female). Ethnicity was self-assigned from a list of 21 possible categories organised around five main ethnic groups (White, Asian, Black, Mixed and Other), which was taken from the UK census 2001. For analysis, the Mixed and Other ethnic groups were merged due to the small number of participants in those categories. Marital status was classified as living alone (single, separated, widowed or divorced) and living with a partner (married, remarried or cohabiting).

Parental SEP indicators

Parental SEP was indicated by education and the National Statistics Socioeconomic Classification (NS-SEC), which were reported in the adult questionnaire. Education was assessed by the highest degree or qualification on a 6-point ordinal scale (no qualifications, secondary school, A levels, technical qualifications, first university degree or higher degree). For the purposes of this analysis, A-levels and technical qualification were collapsed into one group and first university degree or higher degree were collapsed into another group. The final education variable had four categories (none, secondary school, A-levels and higher education). The NS-SEC was derived using the self-coded method and based on current or last main job or occupation, employment status, size of organisation and supervisory status (Office for National Statistics, 2005). The result was three NS-SEC classes: managerial and professional, intermediate, and semi-routine and routine occupations. A fourth group (not working) was added to allow a complete coverage of the population and included respondents who were full-time students, those who had never worked or those who were in long-term unemployment (Office for National Statistics, 2005).

Child demographic characteristics

Parents/carers specified in the child questionnaire the age and the sex of the child, which were treated as binary variables in the analysis.

3.2. Data analysis

3.2.1. Alternative operationalisations of the role of family functioning

Although all previous dental studies (Section 2.6.1) focused on the independent association between family functioning and child oral health, it is possible that family functioning plays a different role when known determinants of child oral health are considered. Recently, Booysen et al. (2021) conceptualised the potential causal connections between family SEP, family functioning and child health using directed acyclic graphs (DAGs). When researchers are interested in evaluating a system of three variables, the so-called third-variable analysis (Kraemer et al., 2008, Baron and Kenny, 1986), they are presented with alternative ways to characterise how the variables relate to each other. In epidemiology, this requires distinguishing between the notions of confounding, mediation and interaction (Figures 3.1, 3.2, and 3.3, respectively).

Confounding is the bias that arises due to common causes of exposure and outcome (Hernán and Robins, 2020). It follows that a confounder is a variable causally related to both the exposure and outcome, which could explain any relationship between them (Meinert and Tonascia, 1986, MacKinnon et al., 2000). Biased estimates of the exposure-outcome association are obtained if a relevant confounder is not accounted for during analysis of observational studies (Hernán and Robins, 2020). In Figure 3.1, the effect of an exposure (family functioning) on an outcome (child oral health) is

conceptualised as being independent of the effect of a known confounder (family SEP). Because family SEP directly affects both family functioning and child oral health, it thus confounds the association between them. The effect of family SEP needs to be accounted for during data analysis to yield an accurate estimate of the independent association between family functioning and child oral health (Booysen et al., 2021).

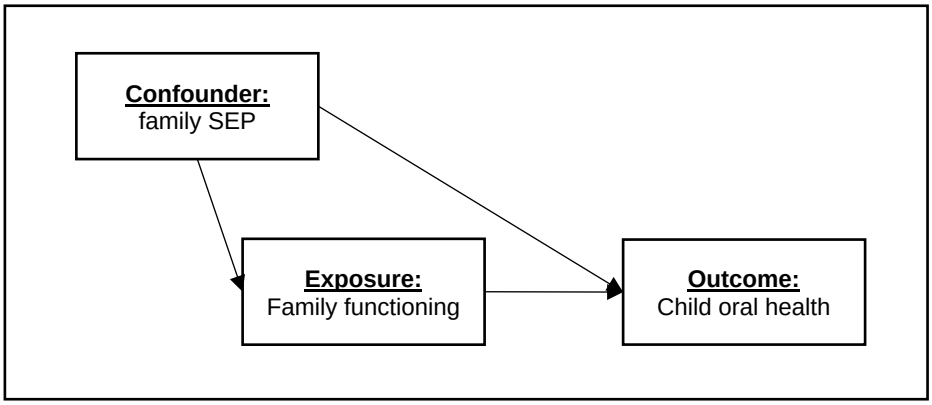

Figure 3.1. Model showing family SEP as a confounder of the relationship between family functioning and child oral health

Mediation analysis refers to exploring the causal pathway by which an exposure influences an outcome (VanderWeele, 2015). An exposure can affect an outcome through two pathways; the first pathway is through a direct relationship between the two (path a in Figure 3.2), known as the direct effect. The second pathway is through causing an effect on an intermediate factor (i.e., the mediator), which consequently affects the outcome. This causal path is known as the mediated effect or indirect effect (paths b and c in Figure 3.2) (MacKinnon et al., 2000, VanderWeele, 2016). A mediator, therefore, accounts to an extent, for the effect of the exposure on the outcome (Baron and Kenny, 1986, MacKinnon et al., 2007). This is the simplest scenario in mediation analysis (i.e., a one-mediator model), but an exposure can affect an outcome through

multiple mediators acting either in sequence or independently of each other (VanderWeele, 2015, MacKinnon et al., 2007). In Figure 3.2, family functioning is conceptualised as a mediator of the association between the exposure (family SEP which is a strong social determinant of health) and the outcome (child oral health) (Booysen et al., 2021).

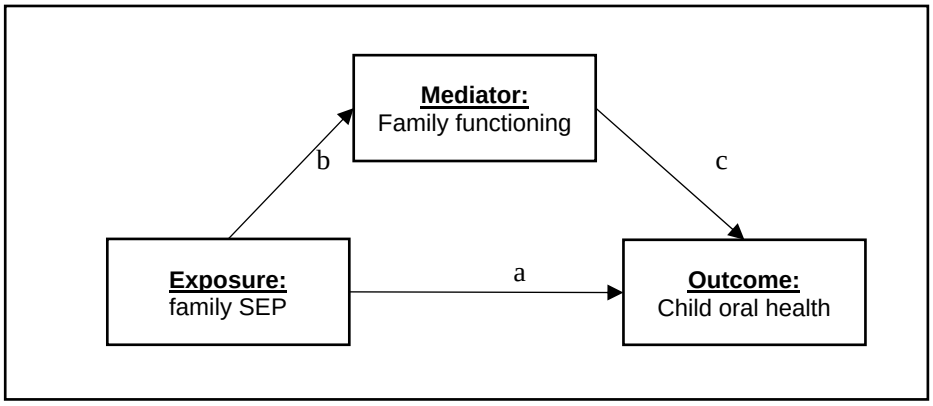

Figure 3.2. Models showing family functioning as a mediator of the relationship between family SEP and child oral health

The term interaction is used to describe the situation where the effect of one exposure on an outcome depends in some way on the level of another exposure, the so-called moderator (VanderWeele, 2015, Hernán and Robins, 2020). Some researchers make a distinction between interaction and effect modification based on whether the focus is on both or only one exposure (VanderWeele, 2009). The term interaction is used when the causal effect of intervening on two exposures is of interest whereas the term effect modification is used when the causal effect of intervening on one exposure (i.e., the moderator), across strata of another factor, is of interest (Knol and VanderWeele, 2012, VanderWeele and Knol, 2014). In Figure 3.3, family functioning is conceptualised as a moderator of the association between SEP and child oral health whereby having healthy

family functioning would buffer the negative impacts of living in poor SEP on child oral health. In other words, the effect of poor family SEP on child oral health is stronger in families with unhealthy functioning than in families with healthy functioning (i.e., antagonism) (Booysen et al., 2021).

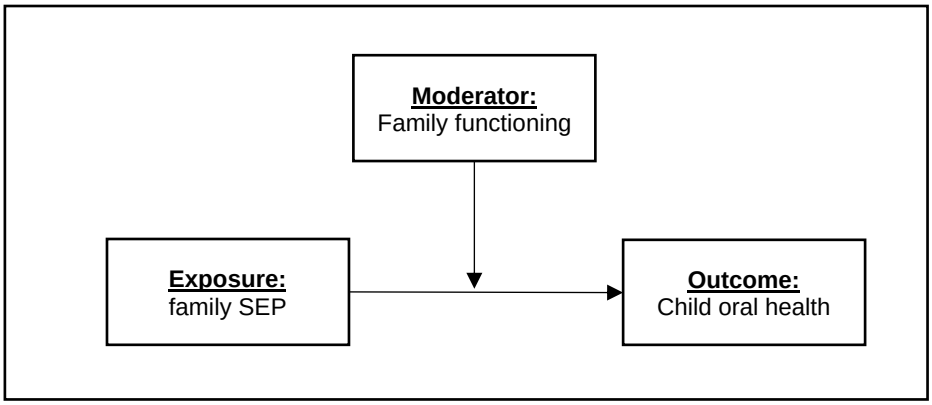

Figure 3.3. Model showing the moderating role of family functioning in the relationship between family SEP and child oral health

3.2.2. Statistical methods

Survey weights were used to account for the unequal probabilities of selection and non-response and to produce population-level estimates. Using survey weights made the study sample representative of the demographic characteristics (age, sex and ethnicity) of the ELOHI population as per the UK Census 2001. The sampling features of the survey (stratification and clustering) were also incorporated during the analysis to produce corrected standard errors and 95% confidence intervals (CI). All data analysis was carried out using Stata/MP 16 (StataCorp LLC 2019, College Station, Texas).

Analyses were carried out in 4 phases following the objectives of the study and presented in separate chapters as described below.

3.2.2.1. Description of the sample (chapter 4)

The analyses in this chapter were organised in 3 sections. The first section evaluated the impact of excluding those with missing data on the representativeness of the study sample. All variables were initially tabulated to examine the extent of missing data in each. Thereafter, the characteristics of participants in the study sample and in the group excluded because of missing data were compared. The Chi-squared test was used to compare categorical variables, namely parental sociodemographic characteristics (sex, age, ethnicity, marital status, education and socioeconomic classification) and family functioning (both general and specific domains) as well as child demographic characteristics (sex and age) and dental behaviours (sugars intake, dental attendance pattern and toothbrushing frequency) between included and excluded participants. The Student's t-test was used to compare numerical variables, namely child dental caries (dmft, dt and mft scores) and OHRQoL (total ECOHIS, CIS and FIS scores) between the two groups.

The second section presented an assessment of the distribution of responses across the 60 items of the FAD. This was done in tabular form (using the original four response options) as well as using the mean and standard deviation (SD) for each FAD item. It was followed by an assessment of the internal consistency of the FAD using Cronbach's alpha coefficients and inter-item correlations for each domain.

The third and final section of this chapter presented the prevalence of unhealthy family functioning according to parental and child characteristics. The Chi-squared test was used to compare the prevalence of unhealthy general family functioning between unordered groups (parental sex, ethnicity and marital status, child age and sex) whereas the Chi-squared for linear trends was used to compare it between ordered groups (parental age groups, education and socioeconomic classification). The same tests were

used to compare the prevalence of unhealthy family functioning in each domain according to parental and child factors.

3.2.2.2. The association between family functioning and child oral health (chapter 5)

The analyses in this section were carried out to test the associations of family functioning with child oral health independent of known confounders (objective 1). Adjustment for the effect of confounders is a common practice in epidemiological research and is carried using randomisation, methods based on measuring enough variables to block all backdoor paths (i.e., G-methods and stratification-based methods), and methods based on alternatives to blocking backdoor paths (i.e., instrumental variables, difference-in-difference, regression discontinuity design, etc.) (Kahlert et al., 2017, Hernán and Robins, 2020). Statistical adjustment using regression models, a type of stratification-based methods, was used to control for known confounders. These analyses were organised in three sections according to the child oral health outcomes (dental behaviours, dental caries and OHRQoL).

The first section focused on the three child dental behaviours (sugars intake, dental attendance pattern, toothbrushing frequency). Each child behaviour was compared by parental and child characteristics, and domains of family functioning using the Chi-squared test for unordered groups and the Chi-squared for trends for ordered groups. The association between unhealthy general family functioning and each of the three child dental behaviours was assessed in binary logistic regression models as these child outcomes were dichotomous variables. These analyses were based on the DAG shown in Figure 3.4. The association was presented in crude and adjusted regression models.

The adjusted models controlled for parental sociodemographic factors and child demographic factors. Odds ratios (ORs) with 95% CIs were reported from these regression models as the measure of association. A similar set of regression models was fitted using each specific domain of family functioning as the main exposure in relation to each child dental behaviour.

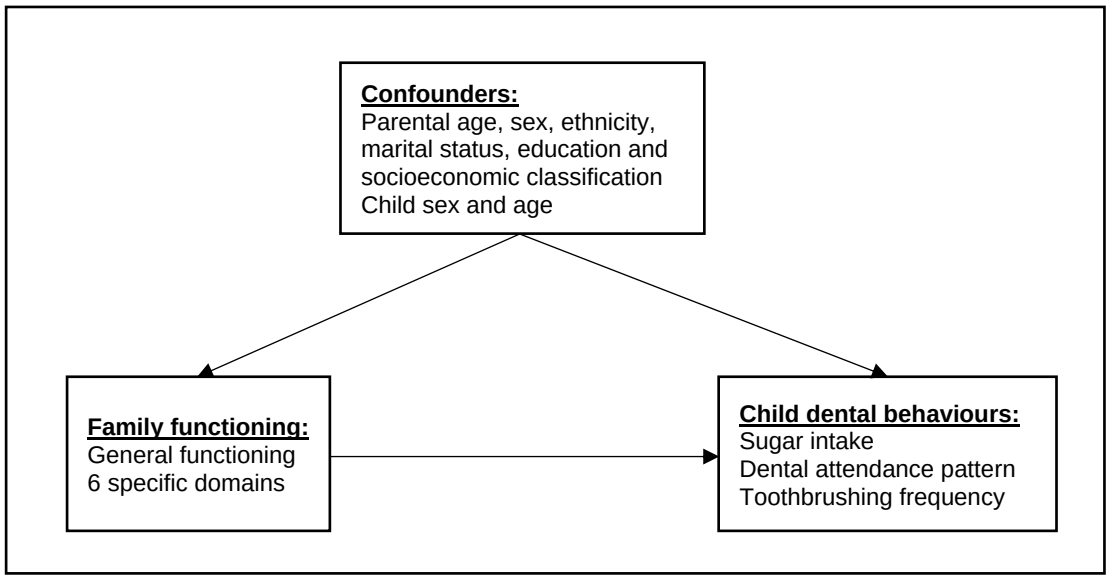

Figure 3.4. DAG for the independent association of family functioning with different child oral health outcomes.

The second section focused on the three child dental caries indicators (dmft, dt and mft). Each caries indicator was compared by parental sociodemographic characteristics, child demographic factors, and domains of family functioning using Student's t-test for two groups, analysis of variance (ANOVA) for more than two unordered groups, and the test for linear trend for ordered groups. The association between unhealthy general family functioning and each caries indicator was assessed in crude and adjusted negative binominal regression models as the latter indicators were count variables with overdispersion (alpha greater than 1). The analyses in this section were based on the DAG presented in Figure 3.5. The adjusted models controlled for parental

sociodemographic factors and child demographic factors. Rate ratios (RRs) with 95% CIs were reported from these models as the measure of association. The same set of negative binominal regression models was fitted using each specific domain of family functioning as the main exposure in relation to each child dental caries indicator.

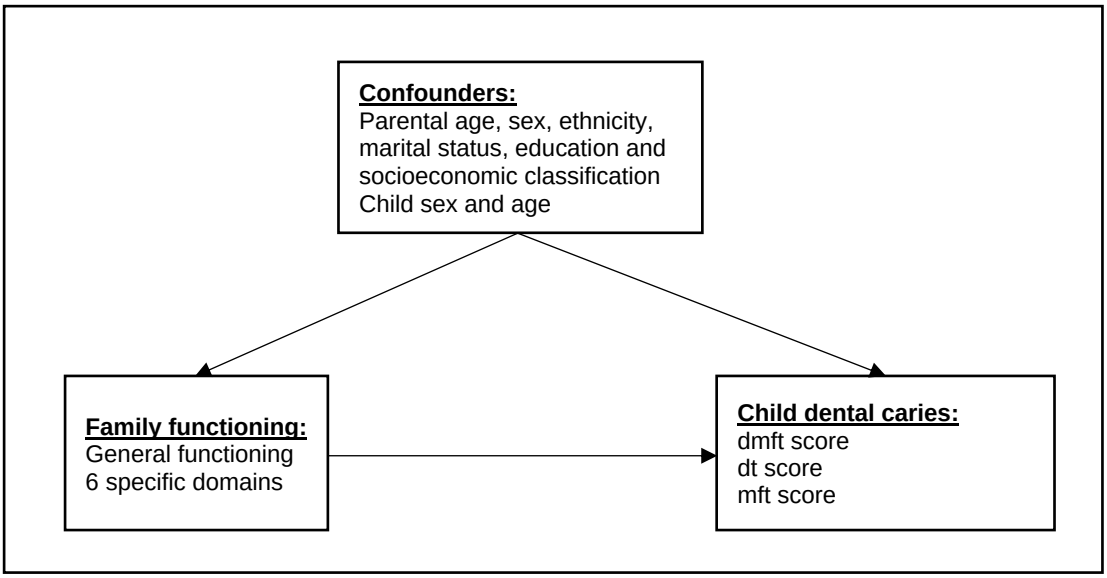

Figure 3.5. DAG for the independent association of family functioning with different child oral health outcomes.

The third and last section focused on the three child OHRQoL outcomes (ECOHIS total, CIS and FIS scores). Each OHRQoL indicator was compared by parental sociodemographic characteristics, child demographic factors and caries experience, and domains of family functioning using Student's t-test for two groups, ANOVA for more than two unordered groups, and the test for linear trend for ordered groups. The association between unhealthy general family functioning and each OHRQoL indicator was assessed in crude and adjusted negative binominal regression models as these indicators were count variables with overdispersion. These analyses were based on the DAG in Figure 3.6. The adjusted models controlled for parental sociodemographic

characteristics and child demographic factors and caries experience. RRs with 95% CIs were used to quantify associations. The same set of crude and adjusted negative binominal regression models were fitted using each specific domain of family functioning as the main exposure in relation to each child OHRQoL indicator.

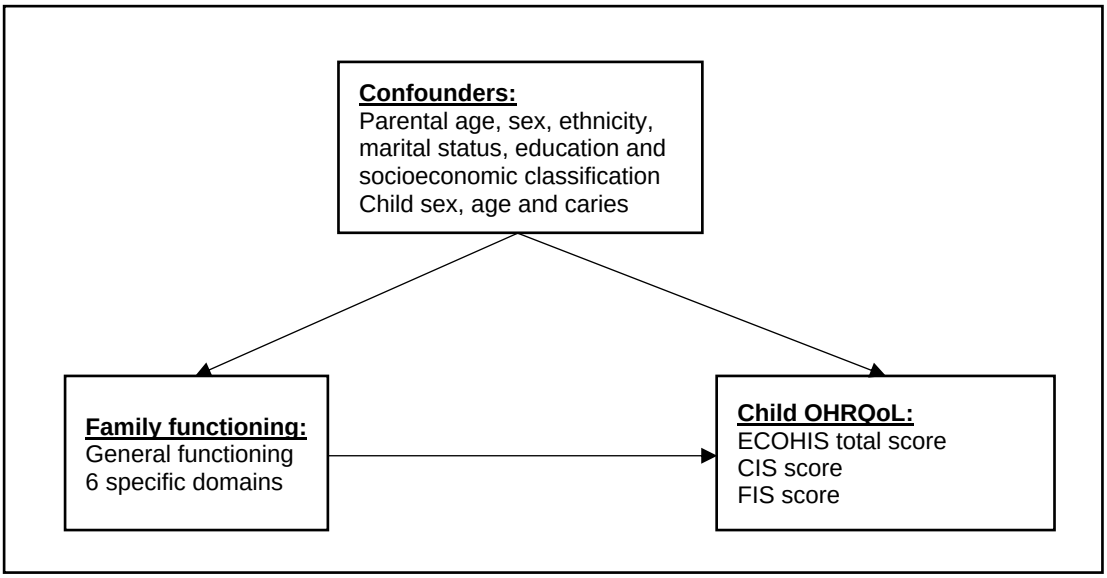

Figure 3.6. DAG for the independent association of family functioning with different child oral health outcomes.

3.2.2.3. The mediating role of family functioning in the association of parental SEP with child oral health (chapter 6)

Analyses in this section were carried out to test whether family functioning mediated the association of parental SEP with child oral health (objective 2). There are several approaches in mediation analysis, including conventional regression, structural equation modelling (SEM) and path analysis, and the counterfactual approach (VanderWeele, 2015, VanderWeele, 2016). In SEM, an estimate of the direct and indirect (mediated) effect of the exposure on the outcome is calculated by modelling covariance structure and building correlation matrices (VanderWeele, 2015). The

counterfactual approach extended the general definitions and capabilities of the traditional SEM to include models where non-linearities and interactions are present and enabled decomposition of the total effects (VanderWeele, 2015). Generally, measurements of the exposure, mediator and outcome should be made at different time points (longitudinally) to enable temporal ordering (i.e., the exposure preceding and affecting the mediator which affects the outcome afterwards), and thus, causal inferences. Given the cross-sectional nature of the data used in this project, conventional regression was adopted to explore pathways under the assumption of no reverse causation (i.e., the mediator affecting the exposure).

Two main methods to test for mediation have been identified in epidemiological and social science research (MacKinnon, 2012, VanderWeele, 2015). In the difference method two regression models are fitted. The first estimates the effect of the exposure and covariates on the outcome, whereas the second estimates the effects of the exposure, covariates and the potential mediator on the outcome. (i.e., adding the effect of the mediator to the model). Then, the difference in the regression coefficients of the exposure before and after adding the mediator is examined. If the effect of exposure is reduced after adding the mediator to the model, this is indicative of mediation (i.e., the mediator explained part of the effect of the exposure on the outcome) (VanderWeele, 2016). Whereas in the product method, which is also known as the Baron and Kenny (1986) approach, a series of regression models are fitted to assess: (1) the effect of the exposure, mediator and covariates on the outcome (direct effect), (2) the effect of the exposure and covariates on the mediator, and (3) the effect of the mediator on the outcome. The product of the effect of exposure on the mediator times the effect of the mediator on the outcome is then considered the indirect effect (VanderWeele, 2016). Therefore, this approach allows for assessment of the direct (independent) effect of

parental SEP on child oral health outcomes, the indirect (mediated) effect, and the total effect (direct + indirect) and was thus utilised in this study (VanderWeele, 2015). Fairly strong assumptions must be held regarding control of confounding to correctly interpret the findings. These assumptions are: no unmeasured confounders of the exposure-outcome relationship (assumption 1), mediator-outcome relationship (assumption 2), and exposure-mediator relationships (assumption 3). Assumption 4 requires that there should be no other confounder of the mediator-outcome relationship that is itself affected by the exposure (assumption 4) (VanderWeele, 2016).

The Baron and Kenny (1986) approach for testing mediation uses four criteria which must be all met to claim there is evidence of mediation. Criterion 1 tests if there is an association between the exposure and outcome. Criterion 2 tests if there is an association between the exposure and potential mediator. Criterion 3 tests if there is an association between the potential mediator and outcome. Finally, criterion 4 tests if the association between exposure and outcome from criterion 1 is attenuated, either partially or fully, when the mediator is added to the model (Baron and Kenny, 1986).

These analyses were presented in three sections according to the outcome of interest. The first section of chapter 6 focused on the three child dental behaviours (sugars intake, dental attendance pattern, toothbrushing frequency). These analyses were based on a DAG (Figure 3.7) depicting the relationships between exposure (parental SEP), mediator (family functioning), outcome (child dental behaviour) and confounders. Following the Baron and Kenny (1986) method, the first criterion estimated the association of each parental SEP indicator (education and socioeconomic classification) with each child dental behaviour in binary logistic regression models. This model captured the total effect of parental SEP on each child dental behaviour, including the direct and the mediated effects (paths a and b→c in Figure 3.7, respectively). Odds

ratios were adjusted (AOR) for confounders (parental sex, age, ethnicity, marital status, child sex and age) and the other SEP indicator.

The second criterion estimated the association between parental SEP and general family functioning in binary logistic regression models (path b in Figure 3.7). Odds ratios were reported unadjusted (UOR) and adjusted (AOR) for confounders. The third criterion estimated the association between general family functioning and each child dental behaviour in binary logistic regression models adjusted for all confounders, including parental SEP (path c in Figure 3.7). The fourth criterion compared the estimate for the association (ORs) of each SEP indicator with each child dental behaviour before and after adjusting for general family functioning. The change in the ORs was calculated using the formula: $(coefficient_{unadjusted}-coefficient_{adjusted})/coefficient_{adjusted}*100\%$ (Lynch et al., 2006, Singh-Manoux et al., 2008).

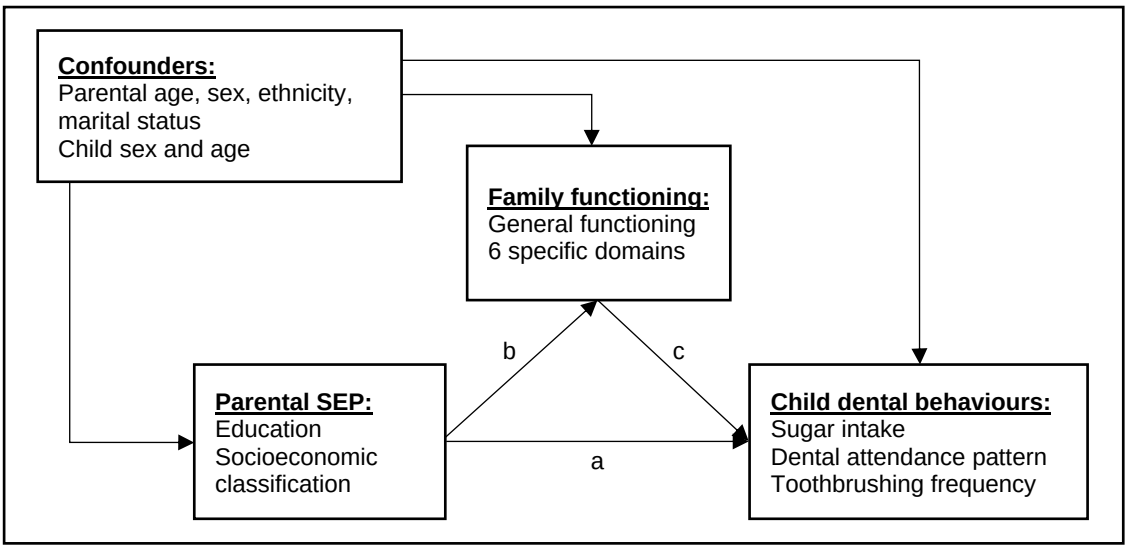

Figure 3.7. DAG for the mediating role of family functioning in the association of parental SEP with different child oral health outcomes.

The second section focused on the three dental caries indicators (dmft, dt and mft). Analyses in this section were based on the DAG in Figure 3.8 for the associations between the exposure (parental SEP), mediators (family functioning and child dental behaviours), outcome (child dental caries) and confounders. According to the Baron and Kenny (1986) approach, the first criterion estimated the association of each parental SEP indicator with each child dental caries indicator in negative binominal regression models. These models estimated the total effects of parental SEP on child caries indicators (paths a and b→c in Figure 3.8, respectively) adjusting for confounders (parental sex, age, ethnicity, marital status, child sex and age) and the other SEP indicator. Rate ratios with 95% CIs were reported from these models.

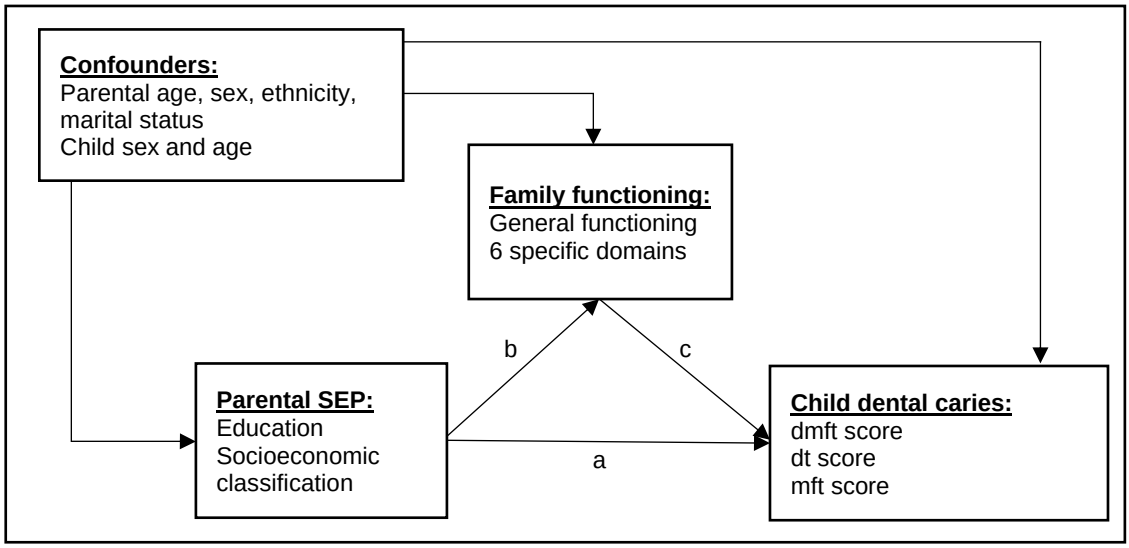

Figure 3.8. DAG for the mediating role of family functioning in the association of parental SEP with different child oral health outcomes. * Path c includes direct effects and indirect effects via dental behaviours

For criterion 2, the association between parental SEP and general family functioning (path b in Figure 3.8) was estimated in binary logistic regression models and ORs were reported unadjusted (UOR) and adjusted (AOR) for confounders. The third criterion

estimated the association between general family functioning and each child dental caries indicator in negative binominal regression models first adjusted for all confounders (path c in Figure 3.8) and then additionally for child dental behaviours (as these were considered a mediator of this association). The fourth criterion compared the estimate for the association (RRs) of each SEP indicator with each child dental caries indicator before and after adjusting for general family functioning. The same formula in the previous section was used to estimate the change in the RRs. The same set of analyses was used to test the mediating role of each family functioning domain in the association of parental SEP with each child dental caries indicator.

The third and final section in chapter 6 focused on the three child OHRQoL outcomes (ECOHIS total, CIS and FIS). Similar to the previous two sections, the analyses were based on a DAG (Figure 3.6) representing the relationships between exposure (parental SEP), mediators (family functioning, child dental behaviours and child caries experience), outcome (OHRQoL) and confounders. Based on the Baron and Kenny (1986) method, estimation of the association of each parental SEP indicator with each child OHRQoL indicator was carried out by fitting negative binominal regression models. These models estimated the total effects of parental SEP on each child OHRQoL indicator (paths a and b→c in Figure 3.9, respectively) adjusting for confounders and the other SEP indicator. Rate ratios with 95% CIs were reported from these models. The association between parental SEP and general family functioning (criterion 2) was estimated in binary logistic regression models (path b in Figure 3.9) and ORs were reported unadjusted (UOR) and adjusted (AOR) for confounders. The association between general family functioning and each child OHRQoL indicator (criterion 3) was estimated by fitting negative binominal regression models. RRs were reported first adjusted for all confounders (path c in Figure 3.9) and additionally for

child dental behaviours and child caries experience. For the fourth criterion, the estimates for the association (RRs) of each SEP indicator with each child OHRQoL indicator before and after adjusting for general family functioning were compared and the change in RRs was estimated using the aforementioned formula. The same 4-criterion approach was used to test the mediating role of each family functioning domain in the association of parental SEP with each child OHRQoL indicator.

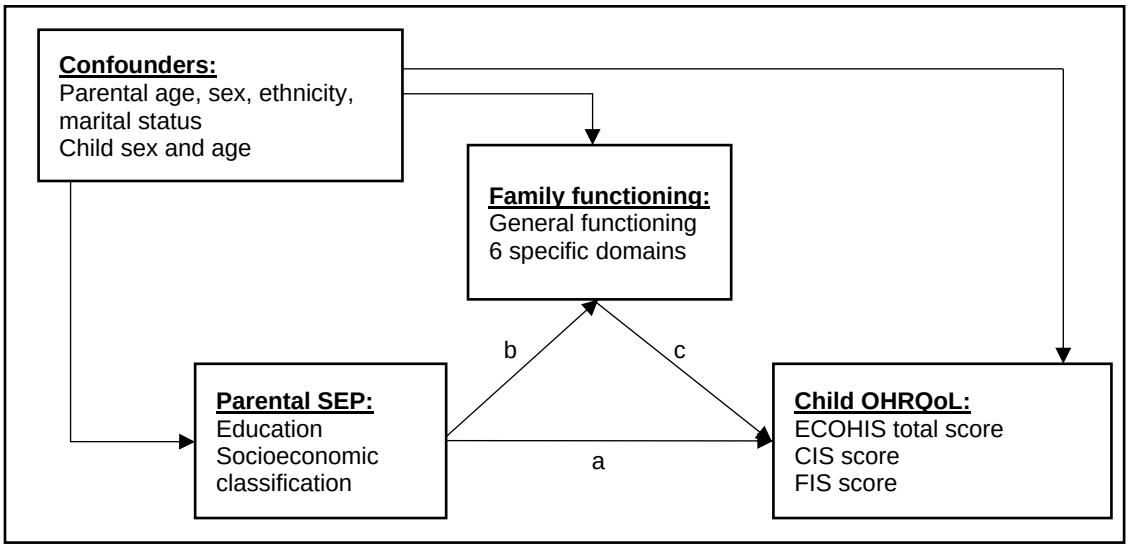

Figure 3. 9. DAG for the mediating role of family functioning in the association of parental SEP with different child oral health outcomes. * Path c includes direct effects and indirect effects via dental behaviours and caries experience

3.2.2.4. The moderating role of family functioning in the association between family SES and child oral health (chapter 7)

The analyses in this section evaluated whether the association of parental SEP with child oral health was modified by family functioning (objective 3). Two approaches to test interactions are commonly used, namely interactions on the additive scale and interactions on the multiplicative scale (Knol and VanderWeele, 2012, VanderWeele, 2015). Additive interaction measure whether the combined effect of the two variables

(parental SEP and family functioning) is greater or smaller than the sum of their (added) individual effects (Knol et al., 2011). Additive interactions are regarded as more relevant to public health because they inform decisions regarding which subgroups to target for intervention to maximise return on investment (Knol and VanderWeele, 2012, Saracci, 1980). Additive interactions are tested with the relative excess risk due to interaction (RERI), which is calculated as the difference between the (expected) effect based on the summation of the separate effects of the two risk factors and the (observed) effect in the joint exposure category. If RERI>0 the interaction is said to be positive or super-additive and if RERI<0 the interaction is said to be negative or sub-additive (VanderWeele, 2015). On the other hand, interactions on a multiplicative scale measure whether the effect of the two exposures together is greater or smaller than the product (multiplied effect) of the two individual factors. Multiplicative interactions are tested by adding the cross-product of the two factors to a regression model containing all main effects and checking its statistical significance. A significant interaction indicates that at least one category of the cross-product is different from the others (Knol et al., 2011, VanderWeele and Knol, 2014). Regardless of the scale used to test for interactions, it is essential to control for confounders of the association between the primary exposure (parental SEP) and the outcome as well as for confounders of the association between the moderator (family functioning) and the outcome (VanderWeele, 2015). The current recommendation is to report both additive and multiplicative measures of interaction (Knol and VanderWeele, 2012).

In chapter 7, education was reverse coded (higher education was used as the reference group) to ensure those with both the highest SEP and healthy functioning were the reference group for comparison. The analyses in this chapter were organised according

to child oral health outcomes into three sections. Interactions were reported in tables, following current international recommendations (Knol and VanderWeele, 2012).

The first section focused on whether the association of parental SEP with child dental behaviours (sugars intake, dental attendance pattern and toothbrushing frequency) was dependent on the level of family functioning (whether healthy or unhealthy) as presented in Figure 3.10. The odds of reporting each child dental behaviour were estimated for different combinations of parental SEP and general family functioning relative to those of the reference group, after adjustment for confounders (parental age, sex, ethnicity, marital status, child age and sex, and the other SEP indicator) using binary logistic regression. Additive interactions were tested by estimating the RERI with 95% CIs for unhealthy general family functioning at each decreasing level of parental SEP. Multiplicative interactions were tested by adding the cross-product of each parental SEP indicator with general family functioning, one at a time, to the model containing the main effects for both parental SEP indicators, general family functioning

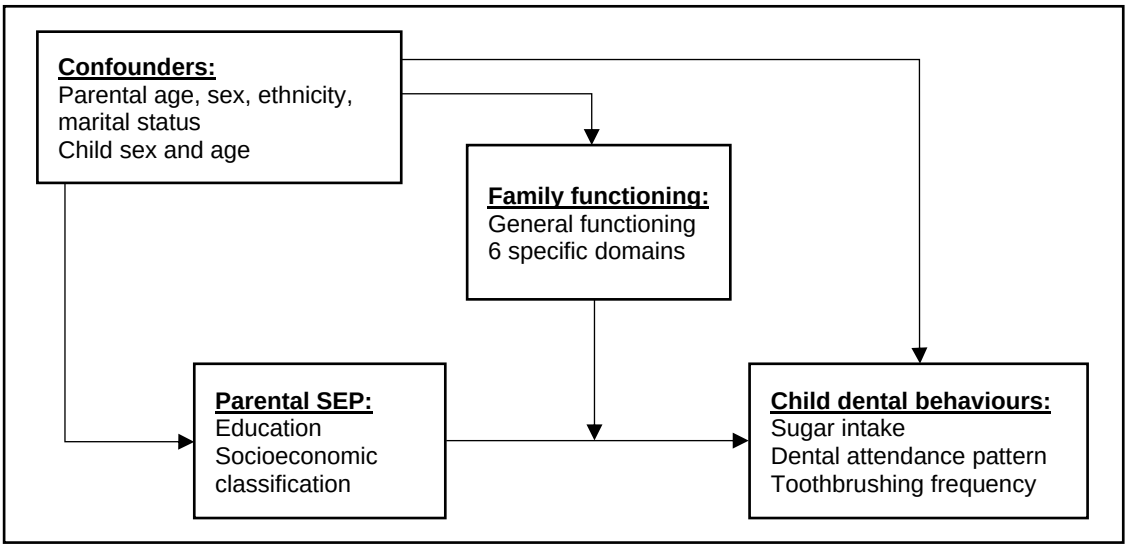

Figure 3.10. DAG for the moderating role of family functioning in the association of parental SEP with different child oral health outcomes.

and the confounders. A joint test for each of the two interactions tested (parental education by general family functioning and parental socioeconomic classification by general family functioning) was used to reduce the impact of multiple comparisons. The same modelling strategy was used for the interaction between each specific domain of family functioning and parental SEP.

The second section focused on whether the association of parental SEP with child dental caries (dmft, dt and mft) varied according to family functioning as presented in Figure 3.11. The dmft, dt and mft scores were estimated from negative binominal regression models for different combinations of parental SEP and general family functioning relative to those of the reference group, after adjustment for confounders (parental age, sex, ethnicity, marital status, child age and sex, and the other socioeconomic indicator in each). Similar to the first section, interactions were reported on the additive scale using RERI with 95% CIs as well as on the multiplicative scale using a joint test of statistical significance. These models were fitted for the general family functioning and each one of the six specific domains.

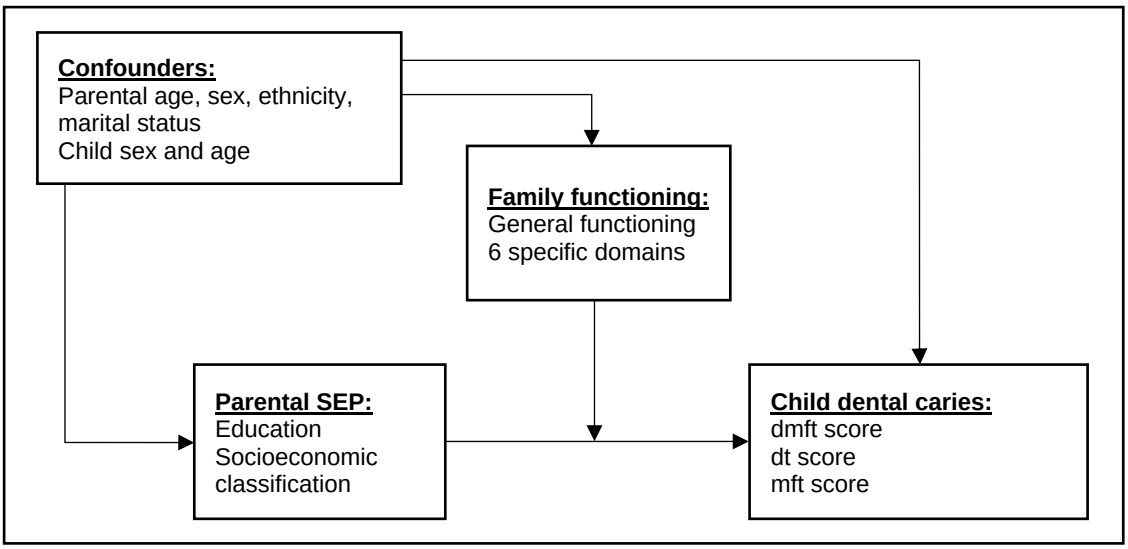

Figure 3. 11. DAG for the moderating role of family functioning in the association of parental SEP with different child oral health outcomes.

The third and final section focused on whether the association between parental SEP and child OHRQoL outcomes (ECOHIS total, CIS and FIS) was modified by the level of family functioning as shown in Figure 3.12. The scores for each OHRQoL indicator were estimated for each different combination of parental SEP and general family functioning relative to those of the reference group, after adjusting for confounders (parental age, sex, ethnicity, marital status, child age and sex, and the other socioeconomic indicator) using negative binominal regression models. Interactions were reported on the additive scale (RERI with 95% CIs), as well as on the multiplicative scale (a joint test of statistical significance per interaction). Similar models were fitted for each domain of family functioning.

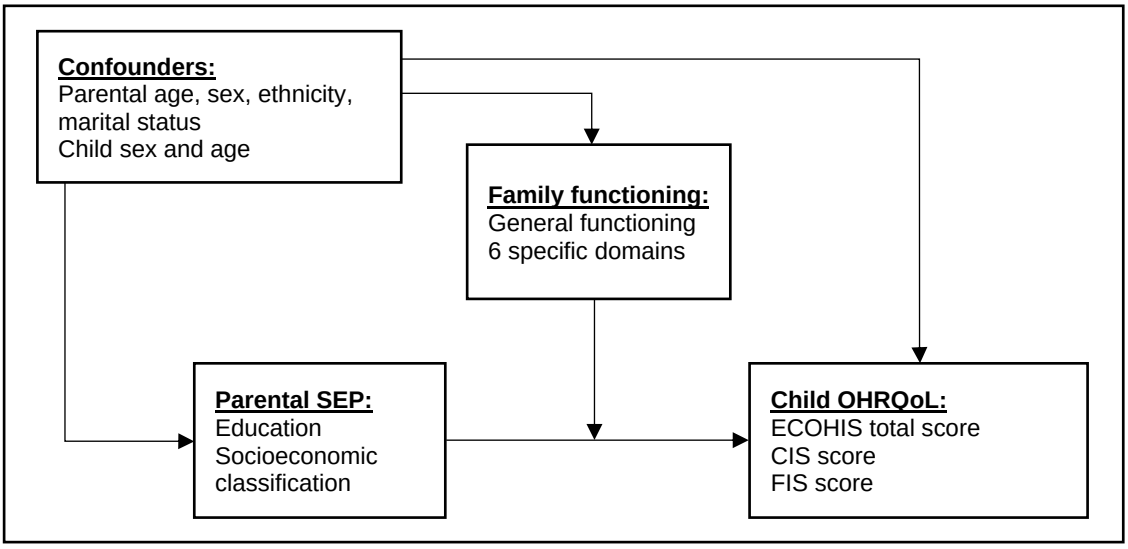

Figure 3.12. DAG for the moderating role of family functioning in the association of parental SEP with different child oral health outcomes.

3.3. Summary of methods

The first section in this chapter described in detail the data used in this project. Data from the ELOHI cross-sectional surveys of adults (16-65 years old) and children (3-4

years old) living in Outer North East London were used. Information on families' socioeconomic circumstances and functioning (using the 60-item Family Assessment Device), parents/carers' demographic and their child characteristics were collected in questionnaires as well as a clinical assessment of child dental caries.

The second part of the chapter described the alternative operationalisations of the role of family functioning (independent, mediation and moderation roles) and the statistical methods used for analysis, which was carried out in 4 phases following the objectives of the study. In the first phase, a description of the sample, an assessment of the impact of missing data on the representativeness of the sample, and the distribution of family functioning by parental and child factors were presented (Chapter 4). In the second phase, the modelling strategy to test the association between family functioning and child oral health (objective 1) was reported (Chapter 5). In the third phase, the analyses to test whether family functioning was a mediator of the relationship between parental SEP and child oral health (objective 2) were reported (chapter 6). In the fourth and last stage, the methods to test whether family functioning was a moderator of the association between parental SEP and child oral health (objective 3) were reported (chapter 7).

Chapter 4

Description of the sample

This chapter describes the study sample for this project, including an assessment of the impact of missing data on the representativeness of the sample, and how family functioning scores varied according to parental and child factors.

4.1. Impact of missing data on the representativeness of the sample

4.1.1. Extent and patterns of missing data

There were 994 families where at least one parent and at least one 3-4 year-old child participated in the ELOHI surveys of adults and children, respectively. Of them, 690 (69.4%) included information from one child and one parent (either mother or father), 190 (19.1%) included information from one child and both parents, 94 (9.5%) included information from two children and one parent, and 20 (2.0%) included information from two children and both parents. Of this pool of 994 eligible dyads, 733 (73.7%) were included in the study sample as they had complete data on all variables relevant for analysis. In families where both parents completed the survey questionnaire, maternal responses were used as mothers were regarded as the primary carers of children in this study. However, paternal responses were chosen in 13 cases because the mother's questionnaire had missing data on one or more relevant variables.

Table 4.1 presents the extent of missing data for each variable in this study. The variables with the greatest proportion of missing values were family functioning (between 132 and 137 participants with missing data depending on the FAD domain)

and family socioeconomic indicators (77 and 56 participants with missing data on parental education and socioeconomic classification, respectively). Other covariates had less than 5% of participants with missing values.

Table 4.1. Extent of missing data per variable (n=994)

Variable	n	%
Parent's sex	0	0
Parent's age	25	2.5
Parent's ethnicity	2	0.2
Marital status	6	0.6
Parent's education	77	7.7
Parent's socioeconomic classification	56	5.6
Child sex	0	0
Child age	0	0
FAD - General functioning	134	13.5
FAD - Problem solving	134	13.5
FAD - Communication	131	13.2
FAD - Roles	131	13.2
FAD - Affective responsiveness	137	13.8
FAD - Affective involvement	137	13.8
FAD - Behaviour control	135	13.6
Child sugars intake	15	1.5
Child dental attendance pattern	20	2.0
Child toothbrushing frequency	7	0.7
Dental caries experience (dmft)	0	0
Untreated dental caries (dt)	0	0
Treated dental caries (mft)	0	0
ECOHIS total score	39	3.9
Child Impact section (CIS) score	26	2.6
Family Impact section (FIS) score	29	2.9

Counts and frequencies were unweighted.
FAD: Family Assessment Device; ECOHIS: Early Childhood Oral Health Impact Scale.

The proportion of participants with missing values in the two scales with multiple items, FAD and ECOHIS, was large despite following rules for imputation of missing response available for each instrument. The calculation of FAD domain scores for participants with up to 40% missing items per domain recovered 63 participants for the

general functioning domain as well as between 36 and 60 participants for specific FAD domains (affective involvement and roles, respectively). The replacement of ECOHIS missing values with the mean across all remaining items in that section (up to 2 missing items in CIS and 1 missing item in FIS) recovered 29 participants in the CIS and 9 participants in the FIS. The numbers presented in Table 4.1 refer to participants with missing values in FAD and ECOHIS after application of imputation rules.

Table 4.2. Distribution of participants according to the extent of missing data

Set of variables used	n[a]	%
All survey participants	994	100.0
Analyses of childhood dental caries		
Caries data	994	100.0
Caries + FAD data	853	85.8
Caries + FAD + parental socioeconomic data	761	76.6
Caries + FAD + parental socioeconomic and demographic data	761	76.6
Caries + FAD + parental factors + child demographic data	761	76.6
Caries + FAD + parental factors + child demographic and behavioural data	733	73.7
Analyses of child OHRQoL		
ECOHIS data	955	96.1
ECOHIS + FAD data	822	82.7
ECOHIS + FAD + parental socioeconomic data	740	74.4
ECOHIS + FAD + parental socioeconomic and demographic data	740	74.4
ECOHIS + FAD + parental + child demographic data	740	74.4
ECOHIS + FAD + parental + child demographic and behavioural data	714	71.8
ECOHIS + FAD + parental + child demographic, behavioural and caries data	714	71.8

[a] Counts and frequencies were unweighted.

The number of participants with complete data was different depending on the outcome (Table 4.2). When childhood dental caries was the outcome, there were 994 children with caries data, of which 141 were excluded for missing FAD data. A further 92 and 28 participants were excluded because of missing parental socioeconomic data and missing child behavioural data, respectively. Therefore, the final analytical sample for analysis using childhood dental caries as the outcome was 733 participants. When child

OHRQoL was the outcome, there were 955 children with OHRQoL data, of which 133 were excluded due to missing FAD data. A further 82 and 26 participants were excluded due to missing parental socioeconomic data and child behavioural data, respectively. Thus, the size of the analytical sample using OHRQoL as the outcome was 714 participants.

4.1.2. Comparison of included and excluded participants

Participants who were included in the study sample (n=733) were compared against those who were excluded due to incomplete data (n=261) in terms of parental- and child-level factors as well as child oral health outcomes.

The comparison by parental sociodemographic characteristics is presented in Table 4.3. There were no major differences in demographic characteristics (sex, age and ethnicity) or socioeconomic indicators (education and socioeconomic classification) between parents included in the study sample and those excluded, except for their marital status. The proportion of parents living alone was lower among participants in the study sample than among those excluded (18.4% versus 28.4%). In the study sample, most respondents were female (91.1%), 16-34-years old (49.6%), White (55.9%), and had higher education (40.7%) and managerial or professional occupations (44.6%).

The comparison of child demographic characteristics (sex and age) and behavioural factors (sugars intake, dental attendance pattern and toothbrushing frequency) showed no difference between children included and excluded in the sample (Table 4.4). In the study sample, children were approximately equally distributed across age (3 and 4 years old) and sex (boys and girls). In addition, most children consumed 4 or less sugary

items per day (83.2%), visited the dentist for trouble or had never visited one (59.9%), and brushed their teeth twice or more often daily (68.0%).

Table 4.3. Comparison of parental sociodemographic characteristics between participants in the study sample and those excluded for missing values

	Study sample (n=733)		Excluded (n=261)		P-value[b]
	n[a]	%	n[a]	%	
Parent's sex					0.386
Male	72	8.9	27	12.1	
Female	661	91.1	234	87.9	
Parent's age[b]					0.462
16 to 34 years	380	49.6	139	55.7	
35 to 44 years	321	46.1	101	39.0	
45 to 65 years	32	4.3	12	5.3	
Parent's ethnicity					0.159
White	258	55.9	84	54.4	
Asian	240	27.2	84	21.8	
Black	213	11.2	79	13.6	
Other	22	5.7	12	10.3	
Marital status					0.011
Cohabiting	609	81.6	181	71.6	
Living alone	124	18.4	74	28.4	
Parent's education					0.350
None	63	9.6	24	11.3	
Secondary school	182	25.3	55	30.2	
A-levels	185	24.4	47	27.7	
Degree or higher	303	40.7	58	30.8	
Parent's socioeconomic classification					0.184
Managerial/professional	309	44.6	69	33.9	
Intermediate	110	15.4	27	16.1	
Routine/manual	115	13.9	30	16.5	
Not working	199	26.1	79	33.5	

[a] Counts were unweighted.
[b] Chi-square test was used for comparisons.
[c] These categories were used for presentation purposes only.

No differences in family functioning scores between included and excluded participants were observed either (Table 4.5). In the study sample, the mean score for general functioning was 1.84 (SD: 0.38, range: 1-4). By FAD domains, the mean scores for

problem solving was 1.92 (SD: 0.35, range: 1-4), for communication was 2.08 (SD: 0.33, range: 1-4), for roles was 2.23 (SD: 0.35, range: 1-4), for affective responsiveness was 1.99 (SD: 0.43, range: 1-4), for affective involvement was 2.06 (SD: 0.46, range: 1-4), and for behaviour control was 1.91 (SD: 0.42, range: 1-4).

Table 4.4. Comparison of child demographic characteristics and dental behaviours between participants in the study sample and those excluded for missing values

	Study sample (n=733)		**Excluded (n=261)**		**P-value**[b]
	n[a]	**%**	**n**[a]	**%**	
Child sex					0.992
Boy	386	48.7	131	48.6	
Girl	347	51.3	130	51.4	
Child age					0.625
3 years	381	50.1	132	52.4	
4 years	352	49.9	129	47.6	
Child sugars intake					0.808
≤4 sugary foods a day	603	83.2	192	82.3	
>4 sugary foods a day	130	16.8	54	17.7	
Child dental attendance pattern					0.904
Trouble visit or never visited	491	59.9	157	60.5	
Check-up in the last year	242	40.1	84	39.5	
Child toothbrushing frequency					0.447
Once daily or less	277	32.0	88	28.8	
Twice daily or more	456	68.0	166	71.2	

[a] Counts were unweighted.
[b] Chi-square test was used for comparisons.

Finally, the comparison of child dental caries and OHRQoL also showed no differences between participants included and excluded in the study sample (Table 4.6). The mean dmft score was 0.99 (SD: 2.25, range: 0-20), with 25.3% of children having dental caries experience. The main contributor to the dmft score was the number of decayed teeth (dt), with a mean of 0.78 (SD: 1.96, range: 0-20). The prevalence of children with untreated caries (dt>0) was 21.7%.

Table 4.5. Comparison of family functioning domain scores between participants in the study sample and those excluded due to missing data

	Study sample (n=733)			Excluded (n=261)			P-value[b]
	n[a]	Mean	(SD)	n[a]	Mean	(SD)	
General functioning	733	1.84	(0.38)	127	1.87	(0.40)	0.554
Problem solving	733	1.92	(0.35)	127	1.99	(0.37)	0.137
Communication	733	2.08	(0.33)	130	2.05	(0.35)	0.605
Roles	733	2.23	(0.35)	130	2.25	(0.39)	0.712
Affective responsiveness	733	1.99	(0.43)	124	2.01	(0.42)	0.766
Affective involvement	733	2.06	(0.46)	124	2.13	(0.51)	0.333
Behaviour control	733	1.91	(0.42)	126	1.91	(0.42)	0.939

[a] Counts were unweighted.
[b] Chi-square test was used for comparisons.

Table 4.6. Comparison of oral health outcomes between participants in the study sample and those excluded due to missing data

	Study sample (n=733)			Excluded (n=261)			P-value[b]
	n[a]	Mean	(SD)	n[a]	Mean	(SD)	
dmft score	733	0.99	(2.25)	261	1.03	(2.74)	0.850
dt score	733	0.78	(1.96)	261	0.84	(2.34)	0.730
mft score	733	0.21	(0.92)	261	0.19	(1.16)	0.763
ECOHIS total score	714	1.38	(3.86)	241	1.61	(4.36)	0.549
CIS score	722	0.94	(2.73)	246	1.45	(3.56)	0.094
FIS score	718	0.43	(1.44)	247	0.27	(1.64)	0.292

ECOHIS: Early Childhood Oral Health Impact Scale; CIS: Child Impact Section; FIS: Family Impact Section.
[a] Counts were unweighted.
[b] Student's test was used for comparisons.

The mean ECOHIS score was 1.38 (SD: 3.86, range: 0-32.43) with 23.9% of families reporting lifetime oral impacts on their quality of life. The mean CIS was 0.94 (SD: 2.73, range: 0-24.4), with 20.0% of parents reporting lifetime impacts on their child's quality of life. Furthermore, the mean score for FIS was 0.43 (SD: 1.44, range: 0- 12),

with 13.2% of parents reporting lifetime impacts on their family's quality of life because of their child dental problems or treatments.

The distribution of participants' responses to the 13 ECOHIS items is presented in Table 4.7. Among the 9 items in the CIS, only a small proportion of parents reported their child's life being affected due to dental problems or dental treatments. Most impacts were reported on items related to symptoms, followed by those on child function, psychological and self-image/social interaction domains. The proportion of parents reporting their children had symptoms (pain) was 12.6%. Of the 4 items in the child function domain, the highest proportion of participants reporting impacts was for difficulty in eating some foods (8.8%) whereas the lowest proportion was for missing preschool, day-care or school (6.4%). Of the two items in the child psychological domain, 7.1% of parents reported their child had been irritable or frustrated and 5.9% reported their child had had trouble sleeping. Of the two items in the child self-image/social interaction domain, 4.2% and 3.4% of parents reported their child avoided smiling/laughing around other children and talking with other children, respectively, because of the child's dental problems or dental treatments.

Among the 4 items in the FIS, less than 10% of respondents reported that their child dental problems or treatments have had an impact on their family's quality of life. In the parent distress domain of FIS, 11.1% and 8.9% of respondents reported being upset and feeling guilty, respectively. For the family function domain, 5.8% and 4.0% of participants reported taking time off from work and having had a financial impact on family, respectively, because of their child oral health condition.

Table 4.7. Distribution of responses across the 13-item ECOHIS scale in included participants (n=733)

ECOHIS sections, domains and items	Response options										n	Mean	(SD)
	Never		Hardly ever		Occasionally		Often		Very often				
	n[a]	%	n[a]	%	n[a]	%	n[a]	%	n[a]	%			
Child Impact Section (CIS)													
Child symptoms domain													
Pain in teeth, mouth, or jaws	631	87.4	50	5.5	36	5.0	12	1.8	4	0.2	733	0.22	(0.62)
Child function domain													
Difficulty drinking hot or cold beverages	676	94.0	27	3.4	15	1.5	4	0.9	3	0.2	725	0.10	(0.44)
Difficulty eating some foods	659	92.1	30	3.7	23	2.8	7	1.0	4	0.4	723	0.14	(0.52)
Difficulty pronouncing any words	667	93.1	16	1.8	22	2.4	11	2.0	6	0.7	722	0.16	(0.61)
Missed preschool, day care or school	679	94.5	31	3.8	11	1.5	2	0.2	0	0.0	723	0.07	(0.32)
Child psychological domain													
Trouble sleeping	688	94.9	22	2.8	14	2.2	0	0.0	1	0.1	725	0.07	(0.34)
Been irritable or frustrated	677	93.7	21	2.3	26	3.9	0	0.0	1	0.1	725	0.10	(0.41)
Child self-image/social interaction domain													
Avoided smiling/laughing around other children	695	96.6	16	2.0	9	1.0	3	0.3	1	0.04	724	0.05	(0.29)
Avoided talking with other children	700	97.5	11	1.2	10	1.1	2	0.2	1	0.04	724	0.04	(0.28)
Family Impact Section (FIS)													
Parent distress domain													
Been upset	661	90.4	28	3.7	24	4.1	5	1.8	1	0.1	719	0.18	(0.58)
Felt guilty	673	92.7	16	1.8	25	4.4	3	0.9	1	0.1	718	0.14	(0.52)
Family function domain													
Taken time off from work	683	95.6	24	2.9	11	1.1	2	0.4	0	0.0	720	0.06	(0.32)
Had a financial impact on family	704	97.4	10	1.1	6	0.7	2	0.9	0	0.0	722	0.05	(0.33)

4.2. The Family Assessment Device (FAD)

4.2.1. Distribution of FAD scores

The distribution of responses across the 60-item FAD scale is presented in Table 4.8, organised by FAD domain. FAD items are either positively phrased (25 items) in which higher scores indicate poorer family functioning, or negatively phrased (35 items) in which lower scores indicate poorer functioning and would be reverse coded for calculation of domain scores. Of the 12 items in the FAD general functioning domain, the highest and lowest mean scores among the 6 positively phrased items were for "We can make decisions about how to solve problems" (1.89) and "In times of crisis we can turn to each other for support" (1.62) whereas the highest and lowest mean scores among the 6 negatively phrased items were for "We don't get along well together" (3.32) and "We avoid discussing our fears and concerns" (2.92).

All the 6 items in the problem solving domain were positively phrased. The highest and lowest mean scores were for "after solving a problem, we discuss whether it worked or not" (2.17) and "we resolve most everyday problems around the house" (1.84), respectively. Among the 9 items in the communication domain, the highest mean score for the 5 positively phrased items was for "people come right out and say things instead of hinting at them" (2.31) whereas the lowest mean score was found in two items, namely "we are frank with each other" and "when we don't like what someone has done. We tell them" (1.91 for both). Across the 4 negatively phrased items, the highest and lowest mean scores were for "it is difficult to talk to each other about tender feelings" (2.90) and "we often don't say what we mean" (2.82).

Of the 11 items in the roles domain, the highest and lowest mean score across the 3 positively phrased items were for "we discuss who is to do household jobs" and "we

make sure members meet their family responsibilities" (2.22 and 1.88, respectively). Among the 8 negatively phrased items, the highest mean score was for "we don't have reasonable transport" (3.08) whereas the lowest mean score was for "when you ask to do something, you have to check they did it" (2.22).

Across the 6 items in the affective responsiveness domain, the highest mean score of the 2 positively phrased items was for "we cry openly" (2.01) and the lowest mean score was for "we express tenderness" (1.85). The highest and lowest mean scores for the 4 negatively phrased items were for "we do not show our love for each other" and "some of us just don't respond emotionally" (3.21 and 2.71, respectively). All the 7 items in the affective involvement domain were negatively phrased. The highest and lowest mean scores were for "family shows interest only when they get something out of it" (3.16) and "if someone is in trouble, the others become too involved" (2.49).

Finally, among the 9 items in the behaviour control domain, the highest mean score across the 3 positively phrased items was for "we have rules about hitting people" (1.92) whereas the lowest mean score was for "we know what to do in an emergency" (1.78). The highest and the lowest mean scores for the 6 negatively phrased items were for "we don't know what to do when an emergency comes up" and "you can easily get away with breaking the rules" (3.18 and 2.93, respectively).

Table 4.8. Distribution of responses across the 60-item FAD scale in included participants (n=733)

FAD domains and items	Response options								n	Mean	(SD)
	Strongly agree		Agree		Disagree		Strongly disagree				
	n[a]	%	n[a]	%	n[a]	%	n[a]	%			
General functioning											
Planning family activities is difficult*	22	2.5	121	15.0	397	53.3	191	29.2	731	3.09	(0.71)
In times of crisis we can turn to each other for support	315	42.7	386	53.1	22	3.3	5	0.9	728	1.62	(0.58)
We cannot talk to each other about the sadness we feel*	21	1.8	85	10.3	428	57.9	196	30.1	730	3.16	(0.65)
Individuals are accepted for what they are	162	24.1	510	68.6	50	5.9	9	1.4	731	1.85	(0.56)
We avoid discussing our fears and concerns*	24	3.4	129	17.4	467	63.1	111	16.1	731	2.92	(0.67)
We can express feelings to each other	145	22.4	534	70.7	45	6.1	6	0.8	730	1.85	(0.53)
There are lots of bad feelings in the family*	15	2.5	64	7.5	415	56.8	236	33.2	730	3.21	(0.66)
We feel accepted for what we are	157	24.0	516	69.8	52	5.8	5	0.4	730	1.83	(0.52)
Making decisions is a problem for our family*	19	2.8	86	10.6	476	64.4	147	22.3	728	3.06	(0.64)
We can make decisions about how to solve problems	120	16.9	569	77.8	34	5.1	4	0.2	727	1.89	(0.45)
We don’t get along well together*	12	1.8	31	3.3	423	55.6	260	39.2	726	3.32	(0.61)
We confide in each other	168	25.8	505	67.8	35	5.5	10	1.0	718	1.82	(0.55)
Problem solving											
We resolve most everyday problems around the house	188	27.1	484	64.4	43	6.2	14	2.3	729	1.84	(0.61)
We usually act on our decisions regarding problems	106	14.8	558	79.2	51	4.4	9	1.6	724	1.93	(0.49)
After solving a problem, we discuss whether it worked or not	67	9.3	502	66.6	143	21.9	19	2.3	731	2.17	(0.60)
We resolve most emotional upsets that come up	130	21.3	552	73.4	40	4.2	9	1.1	731	1.85	(0.51)
We confront problems involving feelings	123	20.1	526	70.1	70	8.9	7	0.9	726	1.91	(0.55)
We try to think of different ways to solve problems	140	19.1	564	77.7	19	2.8	5	0.4	728	1.85	(0.45)
Communication											
When someone is upset the others know why	115	17.2	512	69.9	96	11.7	8	1.2	731	1.97	(0.57)
You can’t tell how one is feeling from what they are saying*	25	2.5	193	25.7	417	57.3	95	14.5	730	2.84	(0.67)

People come right out and say things instead of hinting at them	50	7.2	429	58.4	224	30.9	23	3.5	726	2.31	(0.64)
It is difficult to talk to each other about tender feelings*	22	4.3	147	18.1	451	61.5	109	16.2	729	2.90	(0.69)
We talk to people directly rather than through go-betweens	130	21.0	492	64.8	77	10.3	29	3.9	728	1.97	(0.67)
We often don't say what we mean*	18	3.4	177	25.2	432	57.3	103	14.2	730	2.82	(0.69)
We are frank with each other	139	17.4	537	75.0	44	6.8	6	0.8	726	1.91	(0.50)
We don't talk to each other when we are angry*	18	3.7	195	26.9	387	51.1	127	18.2	727	2.84	(0.74)
When we don't like what someone has done. We tell them	117	16.0	551	77.1	52	6.4	6	0.5	726	1.91	(0.47)
Roles											
When you ask to do something, you have to check they did it*	73	11.3	444	57.7	193	28.6	20	2.4	730	2.22	(0.65)
We sometimes run out of things that we need*	39	5.1	350	45.1	259	37.9	75	11.9	723	2.56	(0.75)
We make sure members meet their family responsibilities	134	19.0	549	74.4	42	6.3	3	0.3	728	1.88	(0.49)
Family tasks don't get spread around enough*	26	4.4	215	29.3	413	55.2	72	11.1	726	2.73	(0.69)
We have trouble meeting our bills*	31	3.3	176	21.8	423	58.0	101	16.9	731	2.89	(0.69)
Each of us has particular duties and responsibilities	102	13.8	560	76.3	56	8.0	13	1.9	731	1.98	(0.53)
There's little time to explore personal interests*	34	5.1	249	31.8	358	49.9	90	13.2	731	2.71	(0.74)
We discuss who is to do household jobs	63	9.9	468	61.3	175	26.2	22	2.6	728	2.22	(0.63)
If people are asked to do something, they need reminding*	32	5.6	444	63.0	217	25.7	35	5.8	728	2.32	(0.65)
We are dissatisfied with the family duties assigned to us*	15	4.0	97	12.5	479	63.3	138	20.2	729	3.00	(0.68)
We don't have reasonable transport*	17	2.9	110	14.5	422	54.5	179	28.1	728	3.08	(0.71)
Affective responsiveness											
We are reluctant to show our affection for each other*	33	4.6	128	13.6	345	47.2	220	34.6	726	3.12	(0.79)
Some of us just don't respond emotionally*	17	2.5	260	33.3	387	54.6	62	9.6	726	2.71	(0.65)
We do not show our love for each other*	24	4.7	57	6.4	400	51.7	248	37.2	729	3.21	(0.74)
Tenderness takes second place to other things in our family*	23	3.5	177	21.5	426	58.9	99	16.1	725	2.88	(0.69)
We express tenderness	148	25.7	498	64.2	69	9.4	8	0.7	723	1.85	(0.58)
We cry openly	107	19.7	439	60.7	163	18.5	14	1.1	723	2.01	(0.64)
Affective involvement											
If someone is in trouble, the others become too involved*	80	7.7	314	41.2	305	45.9	31	5.2	730	2.49	(0.69)
You only get their interest when it is important to them*	16	2.5	203	27.5	413	56.4	91	13.6	723	2.81	(0.67)

We are too self-centred*	11	1.7	110	13.7	475	66.1	133	18.5	729	3.01	(0.61)
We get involved only when something interests us*	21	2.3	139	20.7	434	56.4	134	20.5	728	2.95	(0.69)
We show interest when we can get something out of it*	12	1.9	85	10.1	471	63.6	161	24.4	729	3.11	(0.62)
Family shows interest only when they get something out of it*	14	1.6	70	8.6	462	62.2	185	27.6	731	3.16	(0.62)
We intrude too much into each other's lives*	16	2.6	134	14.4	437	60.7	142	22.4	729	3.03	(0.67)
Behaviour control											
We don't know what to do when an emergency comes up*	22	2.2	71	9.2	425	57.0	210	31.6	728	3.18	(0.66)
You can easily get away with breaking the rules*	10	1.5	130	17.8	486	66.3	106	14.3	732	2.93	(0.60)
We know what to do in an emergency	194	29.5	484	63.5	43	6.2	7	0.8	728	1.78	(0.57)
We have no clear expectations about toilet habits*	25	3.2	108	12.1	398	54.8	194	29.9	725	3.11	(0.71)
We have rules about hitting people	212	34.6	348	46.4	114	11.2	54	7.8	728	1.92	(0.85)
We don't hold to any rules or standards*	18	2.2	135	15.3	402	56.1	176	26.4	731	3.07	(0.69)
If the rules are broken, we don't know what to expect*	16	2.3	115	13.1	491	68.5	108	16.0	730	2.98	(0.60)
Anything goes in our family*	15	2.5	118	13.6	413	58.3	172	25.7	718	3.07	(0.68)
There are rules about dangerous situations	187	29.9	448	59.5	81	9.0	12	1.6	728	1.82	(0.63)

*Negatively phrased items in which lower scores indicates poorer family functioning (these items are to be reverse coded for calculation of domain scores)

4.2.2. FAD internal consistency

The FAD items were tested to confirm the reliability of the scale. Cronbach's alpha coefficients and inter-item correlations are presented in Table 4.9. An alpha of 0.849 was found for the general functioning domain of the FAD. All the 78 inter-item correlations between the 12 items in this FAD domain were positive, with an average inter-item correlation of 0.16 (ranging from 0.05 to 0.55).

Table 4.9. Internal consistency of the family assessment device (FAD)

FAD domain	Number of items	Cronbach's Alpha	Inter-item correlations		
			Mean	Minimum value	Maximum value
General functioning	12	0.849	0.16	0.05	0.55
Problem solving	6	0.670	0.14	0.05	0.37
Communication	9	0.658	0.14	0.03	0.52
Roles	11	0.706	0.14	-0.02	0.57
Affective responsiveness	6	0.665	0.22	0.07	0.66
Affective involvement	7	0.775	0.22	0.03	0.54
Behaviour control	9	0.773	0.20	0.04	0.75

[a] Correlations were estimated after reverse-coding negatively phrased items

The alpha for the problem solving scale was 0.670 and all the 21 inter-item correlations among the 6 items in this domain were positive with an average of 0.14 (ranging from 0.05 to 0.37). The alpha for the 9 items in the communication scale was 0.658 where all the 45 inter-item correlations were positive and a mean of correlation of 0.14 was found (ranging from 0.03 to 0.52). An alpha of 0.706 was found for the 11 items in the roles domain of the FAD where all 66 inter-item correlations but four were positive. The mean inter-item correlation was 0.14 (ranging from -0.02 to 0.57). The alpha for the 6 items on affective responsiveness was 0.665 with all 21 inter-item correlations being positive and having an average of 0.22 (range: 0.07 to 0.66). An alpha of 0.775

was found for the 7 items in the affective involvement scale where all 28 inter-item correlations were positive with an average of 0.22 (ranging from 0.03 to 0.54). The alpha for the 9 items behaviour control scale was 0.773 where all 45 inter-item correlations were positive and a mean of 0.20 was found (range: 0.04 to 0.75).

4.2.3. Prevalence of unhealthy family functioning

The proportion of participants reporting unhealthy family functioning varied across the 7 scales of the FAD (Table 4.10). Almost half of parents (49.1%) reported unhealthy general family functioning. For the six specific domains of the FAD, the proportion of parent who reported unhealthy family functioning ranged from 12.0% for the problem solving domain to 56.6% for the behaviour control domain.

Table 4.10. Prevalence of unhealthy family functioning across the 7 domains of the family assessment device (FAD) in the study sample (n=733)

FAD domains	Cut-off score[b]	Healthy family functioning		Unhealthy family functioning	
		n[a]	%	n[a]	%
General functioning	2.0	355	50.9	378	49.1
Problem solving	2.2	640	88.0	93	12.0
Communication	2.2	434	61.2	299	38.8
Roles	2.3	415	57.4	318	42.6
Affective responsiveness	2.2	516	73.8	217	26.2
Affective involvement	2.1	330	48.2	403	51.8
Behaviour control	1.9	286	43.4	447	56.6

[a] Counts were unweighted
[b] Greater than or equal to cut-off scores indicating unhealthy family functioning (Ryan et al., 2005).

Table 4.11 illustrates the prevalence of unhealthy general family functioning by parental and child characteristics. Significant differences in the prevalence of unhealthy

general family functioning were noted according to parental ethnicity and SEP. The proportion of parents reporting unhealthy general functioning was significantly higher among South Asians (62.8%) than among those of White, Black or Mixed/Other ethnicity (43.5%, 46.4% and 44.1%, respectively). In addition, clear monotonic trends in the prevalence of unhealthy general functioning were observed according to both family SEP indicators (parental education and socioeconomic classification). Indeed, the prevalence of unhealthy general family functioning was higher among less educated parents and among parents with manual occupations. No differences in the prevalence of unhealthy general family functioning were found according to parental or child sex and age.

The prevalence of unhealthy functioning in specific FAD domains by child and parental factors is presented in Table 4.12. As with the FAD general functioning, most differences in reporting unhealthy functioning were seen across parental ethnicity and SEP groups. Unhealthy functioning in communication, affective involvement and behaviour control was more common in parents from South Asian ethnicity (52.0%, 68.1% and 76.5%, respectively) than in those from White (33.1%, 42.5% and 45.7%, respectively), Black (40.0%. 60.0% and 62.4%, respectively) and Mixed/Other (30.4%, 48.6% and 56.6%, respectively) ethnicity whereas unhealthy functioning in affective responsive was more common in parents of Mixed/Other ethnicity (37.7%) than those of White (20.6%), South Asian (32.5%) and Black (33.2%) ethnicities.

Clear gradients in unhealthy functioning for most of the 6 FAD domains were found according to SEP indicators. In terms of parental education, unhealthy functioning in communication, roles, affective responsiveness, affective involvement and behaviour control was more commonly reported among parents with lower levels of education. In terms of socioeconomic classification, unhealthy functioning in communication,

affective responsiveness, affective involvement and behaviour control was more commonly reported among parents with routine and manual occupations and those who were not working at the time of the survey.

Table 4.11. Prevalence of unhealthy general family functioning by parental and child characteristics (n=733)

	n[a]	**%**	**P-value**[b]
Parent's sex			0.521
Male	40	44.3	
Female	338	49.6	
Parent's age			0.448
16 to 34 years	200	51.1	
35 to 44 years	162	47.2	
45 to 65 years	16	46.2	
Parent's ethnicity			0.011
White	112	43.5	
South Asian	152	62.8	
Black	102	46.4	
Mixed/Other	12	44.1	
Marital status			0.617
Cohabiting	312	49.7	
Living alone	66	46.4	
Parent's education			<0.001
None	44	70.1	
Secondary school	112	60.5	
A-levels	105	50.1	
Degree or higher	117	36.4	
Parent's socioeconomic classification			<0.001
Managerial and professional	118	34.0	
Intermediate	59	47.9	
Routine and manual	79	72.6	
Not working	122	63.0	
Child age			0.721
3 years	192	48.3	
4 years	186	49.9	
Child sex			0.266
Male	206	51.9	
Female	172	46.5	

[a] Counts are unweighted.
[b] Chi-squared and Chi-squared for linear trends were used to compare unordered and ordered groups, respectively.

Table 4.12. Prevalence of unhealthy functioning in each FAD domain by parental and child factors (n=733)

Explanatory variables	Problem solving		Communication		Roles		Affective responsiveness		Affective involvement		Behaviour control	
	n[a]	%	n[a]	%	n[a]	%	n[a]	%	n[a]	%	n[a]	%
Parent's sex												
Male	12	19.3	39	43.8	30	44.4	27	32.1	39	44.7	49	54.3
Female	81	11.3	260	38.4	288	42.4	190	25.6	364	52.5	398	56.8
P-value[b]	*0.164*		*0.487*		*0.811*		*0.335*		*0.332*		*0.774*	
Parent's age												
16 to 34 years	50	12.0	165	42.1	172	43.5	125	30.4	230	59.6	248	63.6
35 to 44 years	37	11.1	122	36.3	131	42.0	83	22.6	158	44.9	178	48.8
45 to 65 years	6	22.0	12	28.9	15	38.0	9	16.8	15	35.1	21	59.3
P-value for trend	0.655		*0.142*		*0.636*		*0.041*		*0.001*		*0.017*	
Parent's ethnicity												
White	20	9.1	85	33.1	105	42.1	50	20.6	101	42.5	117	45.7
Asian	39	14.8	126	52.0	100	42.8	87	32.5	164	68.1	186	76.5
Black	28	11.9	80	40.0	105	47.5	72	33.2	126	60.0	131	62.4
Mixed / other	6	27.4	8	30.4	8	35.9	8	37.7	12	48.6	13	56.6
p-value	*0.051*		*0.009*		*0.757*		*0.044*		*<0.001*		*<0.001*	
Marital status												
Cohabiting	74	11.8	251	39.7	242	39.2	173	24.7	324	50.9	375	57.3
Living alone	19	13.0	48	35.3	76	57.6	44	32.9	79	56.0	72	53.2
p-value	*0.746*		*0.483*		*0.007*		*0.144*		*0.444*		*0.534*	
Parent's education												
None	6	11.9	34	63.7	36	51.3	27	40.8	44	78.8	49	80.7
Secondary school	32	16.8	83	45.6	99	59.3	59	28.7	107	53.1	118	60.4
A-levels	23	11.8	82	37.6	72	33.4	58	27.3	104	53.6	114	56.5
Degree or higher	32	9.2	100	29.5	111	35.6	73	20.6	148	43.5	166	48.6

p-value for trend	*0.142*		*<0.001*		*0.001*		*0.010*		*<0.001*		*0.001*	
Parent's socioeconomic classification												
Managerial and professional	39	10.3	104	31.9	113	34.8	66	16.6	140	39.4	152	45.0
Intermediate	15	13.1	54	36.9	58	56.8	40	29.7	58	47.3	60	44.6
Routine and manual	12	13.5	64	59.6	61	51.2	39	35.3	77	65.7	85	73.8
Not working	27	13.5	77	40.8	86	42.8	72	35.6	128	68.3	150	74.3
p-value for trend	*0.364*		*0.028*		*0.107*		*<0.001*		*<0.001*		*<0.001*	
Child age												
3 years	55	14.2	160	42.2	166	43.1	114	29.0	208	51.2	232	56.7
4 years	38	9.9	139	35.5	152	42.1	103	23.5	195	52.4	215	56.4
p-value	*0.163*		*0.154*		*0.828*		*0.169*		*0.818*		*0.956*	
Child sex												
Male	46	12.0	156	37.4	162	39.7	112	25.8	207	51.0	235	56.9
Female	47	12.0	143	40.2	156	45.3	105	26.6	196	52.6	212	56.3
p-value	*0.980*		*0.547*		*0.250*		*0.833*		*0.759*		*0.909*	

[a] Counts are unweighted
[b] Chi-squared was and Chi-squared for linear trends were used to compare unordered and ordered groups, respectively.

Finally, significant differences were also found according to parental age and marital status. Decreasing trends in unhealthy functioning in three FAD domains were observed by age. Unhealthy functioning in affective responsiveness, affective involvement and behaviour control was more common among parents aged 16 to 34 years (30.4%, 59.6% and 63.6%) than those aged 35 to 44 years (22.6%, 44.9% and 48.8%), and 45 to 65 years (16.8%, 35.1% and 59.3%). Furthermore, unhealthy functioning in roles was more commonly reported among parents who were living alone than among those who were living with a partner (57.6% and 39.2%, respectively).

4.3. Summary of chapter 4

This study included 733 dyads (one parent and one 3-4-year-old) out of the 994 families with at least one parent and one child participated in the ELOHI surveys. The main factors that drove missing data were family functioning and parental socioeconomic indicators. Generally, there were no noticeable differences in sociodemographic characteristics and oral health outcomes between participants who were included in the study sample and those who were excluded due to incomplete data. The only difference was seen in terms of marital status, with more parents living alone among those excluded than among those included in the study sample.

The FAD showed good internal consistency in the study sample with a Cronbach's alpha of 0.845 for the general functioning domain and values between 0.658 for communication and 0.775 for affective involvement. Almost half of the parents (49.1%) reported unhealthy general family functioning, with large variation across FAD domains (from 12.0% for problem solving to 56.6% for behaviour control). The prevalence of unhealthy functioning varied according to parental and child

sociodemographic characteristics. Clear socioeconomic gradients in unhealthy family functioning were found, with greater prevalence of unhealthy functioning among parents from lower education and occupational groups.

Chapter 5

The association between family functioning and child oral health

This chapter reports findings on the association of family functioning with child dental behaviours, dental caries and OHRQoL.

5.1. The association of family functioning with child dental behaviours

Three child dental behaviours were evaluated, namely sugars intake, dental attendance and toothbrushing frequency. Table 5.1 presents the frequency of each child dental behaviour by parental and child characteristics. The proportion of children with high sugars intake was significantly higher among Asian parents (27.0%) than those of White (12.0%), Black (16.0%) and Mixed/Other ethnicity (17.2%) as well as among 4-year-olds than 3-year-olds (20.1% versus 13.5%). Significant linear trends were also found according to parental age, education and socioeconomic classification. The proportion of children with high sugars intake was significantly greater among younger and less educated parents as well as among those with lower occupations. The proportion of children who visited the dentist for check-up during the past year was significantly higher among White parents (52.1%) than those of Asian (24.3%), Black (27.5%) and Mixed/Other ethnicity (22.0%). Significant linear trends were also found according to parental age, education and socioeconomic classification. The proportion of children who had a dental check-up in the past year was significantly greater among older and more educated parents as well as among those with higher occupations. The

Table 5.1. Child dental behaviours by parental and child characteristics (n=733)

	More than 4 sugary items a day		Dental check-up in last year		Brushing twice or more times a day	
	n[a]	**%**	**n**[a]	**%**	**n**[a]	**%**
Parent's sex						
Men	13	14.5	24	39.2	38	46.5
Women	117	17.1	218	40.2	418	70.2
p-value[b]	*0.622*		*0.912*		*0.002*	
Parent's age						
16 to 34 years	81	21.5	107	30.5	236	66.2
35 to 44 years	46	12.7	121	49.0	197	70.5
45 to 65 years	3	6.2	14	55.0	23	63.5
p-value for trend	*0.007*		*<0.001*		*0.599*	
Parent's ethnicity						
White	29	12.0	123	52.1	193	76.3
Asian	66	27.0	60	24.3	131	56.1
Black	31	16.0	54	27.5	120	57.1
Mixed/Other	4	17.2	5	22.0	12	65.5
p-value	*0.007*		*<0.001*		*<0.001*	
Marital status						
Cohabiting	108	17.1	202	40.1	369	66.5
Living alone	22	15.8	40	39.9	87	74.9
p-value	*0.783*		*0.978*		*0.156*	
Parent's education						
None	15	20.5	14	23.8	39	63.5
Secondary school	41	22.3	51	36.6	118	68.2
A-levels	38	20.0	62	43.7	111	67.8
Degree or higher	36	10.7	115	43.9	188	69.2
p-value for trend	*0.008*		*0.035*		*0.586*	
Parent's socioeconomic classification						
Managerial/professional	30	6.6	118	44.7	193	70.3
Intermediate	19	20.2	39	48.7	64	67.1
Routine/manual	23	18.6	33	30.9	74	68.3
Not working	58	31.3	52	32.0	125	64.6
p-value for trend	*<0.001*		*0.018*		*0.323*	
Child age						
3 years	62	13.5	122	37.8	234	69.3
4 years	68	20.1	120	42.4	222	66.8
p-value	*0.048*		*0.349*		*0.546*	
Child sex						
Male	75	20.0	132	38.4	237	66.3
Female	55	13.9	110	41.7	219	69.7
p-value	*0.084*		*0.502*		*0.436*	

[a] Counts are unweighted.
[b] Chi-squared test and Chi-squared for trends were used for comparisons.

proportion of children with frequent toothbrushing was higher among female than male respondents (70.2% versus 46.5%) as well as among White parents (76.3%) than those of Asian (56.1%), Black (27.5%) and Mixed/Other ethnicity (65.5%).

Table 5.2. Child dental behaviours by family functioning domains (n=733)

Family functioning domains	More than 4 sugary items a day		Dental check-up in last year		Brushing twice or more times a day	
	n[a]	**%**	**n**[a]	**%**	**n**[a]	**%**
General functioning						
Healthy	39	10.1	136	44.4	231	72.3
Unhealthy	91	23.8	106	35.6	225	63.7
p-value[b]	*<0.001*		*0.085*		*0.054*	
Problem solving						
Healthy	108	15.7	211	39.5	399	68.4
Unhealthy	22	25.1	31	44.0	57	65.1
p-value	*0.100*		*0.557*		*0.634*	
Communication						
Healthy	62	13.2	161	45.5	276	69.9
Unhealthy	68	22.5	81	31.5	180	65.1
p-value	*0.009*		*0.006*		*0.286*	
Roles						
Healthy	67	12.9	147	42.1	276	72.8
Unhealthy	63	22.0	95	37.3	180	61.7
p-value	*0.009*		*0.356*		*0.015*	
Affective responsiveness						
Healthy	78	13.8	176	42.8	326	69.0
Unhealthy	52	25.2	66	32.3	130	65.4
p-value	*0.004*		*0.062*		*0.470*	
Affective involvement						
Healthy	39	9.1	132	48.1	219	73.6
Unhealthy	91	24.0	110	32.6	237	62.9
p-value	*<0.001*		*0.002*		*0.015*	
Behaviour control						
Healthy	25	7.6	120	50.1	191	74.3
Unhealthy	105	23.9	122	32.4	265	63.2
p-value	*<0.001*		*<0.001*		*0.017*	

[a] Counts are unweighted.
[b] Chi-squared test was used for comparisons.

Table 5.2 shows the proportion of children with each dental behaviour according to family functioning. Children in families with unhealthy general functioning had

significantly higher sugars intake than those in families with healthy general functioning (23.8% versus 10.1%). By FAD domains, children in families with unhealthy functioning in affective involvement (24.0%, 32.6% and 62.9%) and behaviour control (23.9%, 32.4% and 63.2%) had higher sugars intake, lower dental attendance and less frequent toothbrushing than those in families with healthy functioning in affective involvement (9.1%, 48.1% and 73.6%) and behaviour control (7.6%, 50.1% and 74.3%), respectively. In addition, children in families with unhealthy functioning in communication had higher sugars intake (22.5%) and lower dental attendance (31.5%) than those with healthy functioning in that FAD domain (13.2 % and 45.5%) whereas children in families with unhealthy functioning in roles had higher sugars intake (22.0% versus 12.9%) and less frequent toothbrushing (61.7% versus 72.8%) than those in families with healthy functioning in that domain. Moreover, children in families with unhealthy functioning in affective responsiveness had higher sugars intake than those with healthy functioning in that domain (25.2% versus 13.8%).

Table 5.3 presents the crude and adjusted associations of general functioning with the three child dental behaviours**.** Unhealthy general family functioning was associated with 2.77 (95% CI: 1.62-4.74) times greater odds of the child consuming more than 4 sugary items a day. This association was attenuated but remained significant after adjustment for parental sociodemographic factors and child demographic factors (OR: 1.78, 95% CI: 1.01-3.13). After adjustments, other variables associated with child sugars intake were parental ethnicity and socioeconomic classification. Children of Asian parents as well as those whose parents were in intermediate occupations and not working had higher odds of consuming more than 4 sugary food items a day than children of White parents and those whose parents were in professional or managerial occupations, respectively. Unhealthy general functioning was not associated with child

dental attendance or toothbrushing frequency in crude or adjusted models. In the corresponding adjusted models, parental age, ethnicity and education were associated with child dental attendance whereas parental sex and ethnicity were associated with child toothbrushing frequency. Children of older and more educated parents had greater odds of visiting the dentist for check-up in the past year whereas children of Asian, Black, and Mixed/Other-ethnicity parents had lower odds of visiting the dentist for check-up in the past year than those of White parents. Female respondents had greater odds of reporting child frequent toothbrushing whereas Asian and Black parents had lower odds of reporting child frequent toothbrushing than male respondents and White parents, respectively.

Table 5.4 presents the crude and adjusted associations of family functioning domains with the three dental behaviours. Unhealthy functioning in all domains, except problem solving, was associated with high child sugars intake in crude models. After adjustments for confounders, only three domains remained associated with child sugars intake. Unhealthy functioning in roles, affective involvement and behaviour control were associated, respectively, with 1.81 (95%CI: 1.09-3.02), 2.21 (95%CI: 1.25-3.92) and 2.61 (95%CI: 1.31-5.21) times greater odds of high child sugars intake. Unhealthy functioning in communication, affective involvement and behaviour control were associated with lower odds of child regular dental attendance in unadjusted models. However, these associations were fully attenuated after adjustments for confounders. Unhealthy functioning in roles, affective involvement and behaviour control were associated with lower odds of child frequent toothbrushing in crude models. The odds ratios for affective involvement and behaviour control were fully attenuated after adjustments. However, unhealthy functioning in roles remained associated with lower

Table 5.3. Regression models for the association of general functioning with child dental behaviours (n=733)

Explanatory variables	More than 4 sugary items a day		Dental check-up in last year		Brushing twice or more times a day	
	UOR[a] [95% CI]	**AOR[a] [95% CI]**	**UOR[a] [95% CI]**	**AOR[a] [95% CI]**	**UOR[a] [95% CI]**	**AOR[a] [95% CI]**
General functioning						
Healthy	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Unhealthy	2.77 [1.62-4.74]*	1.78 [1.01-3.13]*	0.69 [0.45-1.05]	0.98 [0.62-1.53]	0.67 [0.45-1.01]	0.76 [0.50-1.18]
Parent's sex						
Men	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Women	1.22 [0.56-2.64]	0.90 [0.40-2.03]	1.04 [0.51-2.15]	1.01 [0.52-1.95]	2.70 [1.42-5.14]*	2.90 [1.34-6.29]*
Parent's age, in years	0.95 [0.91-0.99]*	0.97 [0.94-1.01]	1.05 [1.02-1.09]*	1.04 [1.01-1.08]*	1.01 [0.98-1.05]	1.02 [0.98-1.05]
Parent's ethnicity						
White	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Asian	2.72 [1.56-4.73]*	2.26 [1.20-4.26]*	0.30 [0.19-0.46]*	0.26 [0.16-0.43]*	0.40 [0.25-0.63]*	0.42 [0.26-0.68]*
Black	1.40 [0.75-2.59]	1.27 [0.65-2.49]	0.35 [0.22-0.56]*	0.31 [0.18-0.51]*	0.41 [0.26-0.66]*	0.40 [0.24-0.64]*
Mixed/Other	1.52 [0.38-6.10]	1.40 [0.37-5.32]	0.26 [0.07-0.92]*	0.22 [0.06-0.81]*	0.59 [0.20-1.71]	0.52 [0.18-1.57]
Marital status						
Cohabiting	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Living alone	0.91 [0.46-1.80]	0.78 [0.37-1.63]	0.99 [0.57-1.72]	1.29 [0.71-2.36]	1.50 [0.85-2.63]	1.42 [0.76-2.65]
Parent's education						
None	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Secondary school	1.11 [0.46-2.68]	1.19 [0.48-2.92]	1.85 [0.76-4.49]	1.72 [0.67-4.42]	1.23 [0.55-2.76]	1.43 [0.63-3.25]
A-levels	0.97 [0.40-2.33]	1.05 [0.40-2.71]	2.48 [1.00-6.15]	3.46 [1.28-9.38]*	1.21 [0.54-2.71]	1.57 [0.70-3.51]
Degree or higher	0.46 [0.19-1.11]	0.68 [0.25-1.91]	2.51 [1.05-5.99]*	3.19 [1.19-8.54]*	1.29 [0.59-2.82]	1.70 [0.74-3.94]
Parents' socioeconomic classification						
Managerial/professional	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Intermediate	3.60 [1.58-8.20]*	3.28 [1.38-7.78]*	1.17 [0.63-2.17]	1.38 [0.76-2.50]	0.86 [0.47-1.57]	0.85 [0.47-1.53]
Routine/manual	3.25 [1.59-6.64]*	1.97 [0.90-4.32]	0.55 [0.31-1.00]*	0.91 [0.46-1.80]	0.91 [0.51-1.61]	1.30 [0.68-2.50]
Not working	6.49 [3.59-11.71]*	3.96 [1.85-8.45]*	0.58 [0.35-0.98]*	1.08 [0.60-1.96]	0.77 [0.47-1.27]	1.02 [0.59-1.77]

Child age						
3 years	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
4 years	1.61 [1.00-2.59]	1.49 [0.89-2.50]	1.21 [0.81-1.81]	1.29 [0.84-1.97]	0.89 [0.61-1.30]	0.85 [0.58-1.26]
Child sex						
Boy	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Girl	0.64 [0.39-1.06]	0.67 [0.39-1.15]	1.15 [0.77-1.70]	1.09 [0.72-1.64]	1.17 [0.79-1.74]	1.08 [0.72-1.62]

[a] Logistic regression model was fitted for each child dental behaviour. Odds ratios were reported unadjusted (UOR) and adjusted for all variables in the table (AOR).
* $p<0.05$

Table 5.4. Regression models for the association of family functioning domains with child dental behaviours (n=733)

Family functioning domains	More than 4 sugary items a day		Dental check-up in last year		Brushing twice or more times a day	
	UOR[a] [95% CI]	**AOR[a] [95% CI]**	**UOR[a] [95% CI]**	**AOR[a] [95% CI]**	**UOR[a] [95% CI]**	**AOR[a] [95% CI]**
Problem solving						
Healthy	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Unhealthy	1.80 [0.89-3.65]	1.63 [0.77-3.48]	1.20 [0.65-2.21]	1.74 [1.00-3.01]	0.86 [0.46-1.60]	1.03 [0.55-1.93]
Communication						
Healthy	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Unhealthy	1.90 [1.17-3.11]*	1.59 [0.92-2.75]	0.55 [0.36-0.85]*	0.78 [0.49-1.25]	0.80 [0.53-1.20]	0.99 [0.64-1.53]
Roles						
Healthy	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Unhealthy	1.90 [1.17-3.10]*	1.81 [1.09-3.02]*	0.82 [0.53-1.26]	0.91 [0.58-1.44]	0.60 [0.40-0.91]*	0.58 [0.38-0.89]*
Affective responsiveness						
Healthy	1.00 [Reference]	1.00. [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Unhealthy	2.10 [1.25-3.51]*	1.60 [0.92-2.80]	0.64 [0.40-1.02]	0.88 [0.52-1.48]	0.85 [0.54-1.32]	1.05 [0.66-1.69]
Affective involvement						
Healthy	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Unhealthy	3.17 [1.92-5.22]*	2.21 [1.25-3.92]*	0.52 [0.34-0.79]*	0.79 [0.50-1.23]	0.61 [0.41-0.91]*	0.73 [0.47-1.12]
Behaviour control						
Healthy	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Unhealthy	3.81 [2.04-7.14]*	2.61 [1.31-5.21]*	0.48 [0.31-0.73]*	0.76 [0.47-1.23]	0.59 [0.39-0.91]*	0.75 [0.46-1.20]

[a] Logistic regression model was fitted for each child dental behaviour. Odds ratios were reported unadjusted (UOR) and adjusted (AOR) for parental demographic factors (age, gender, ethnicity and marital status), socioeconomic conditions (education and socioeconomic classification), and child demographic factors (age and gender).
* $p<0.05$

odds of child frequent toothbrushing after adjustments. Children in families with unhealthy functioning in roles had 42% (0.58, 95%CI: 0.38-0.89) lower odds of brushing their teeth twice or more a day than those in families with healthy functioning in that domain.

5.2. The association of family functioning with child dental caries

This section reports the associations between family functioning and dental caries indicators (dmft, dt and mft) in children. Table 5.5 presents the three caries indicators by parental sociodemographic and child demographic factors. Significant linear trends in the three caries indicators were found according to parental socioeconomic classification where higher mean dmft, dt and mft scores were found among parents with lower occupations and those not working. Significant linear trends in dmft and dt scores were also found according to parental education, with greater scores found among children of parents with less education. In addition, the mean mft score was significantly higher in children of female than male respondents (0.23 versus 0.03).

Table 5.6 compares child caries indicators across family functioning domains. Children from families with unhealthy general functioning had significantly higher mean dmft (1.31) and dt (1.07) scores than those from families with healthy general functioning (0.68 and 0.50, respectively) whereas no differences were found in the mft score between children from families with healthy and unhealthy general functioning. By FAD specific domains, only one significant difference was found between families with healthy and unhealthy functioning. Children from families with unhealthy functioning in roles had significantly lower mean mft scores than those from families with healthy roles (0.12 and 0.28, respectively).

Table 5.5. Child dental caries by parental and child characteristics (n=733)

	dmft		Dt		mft	
	Mean	**(SD)**	**Mean**	**(SD)**	**Mean**	**(SD)**
Parent's sex						
Men	0.95	(2.18)	0.92	(2.13)	0.03	(0.33)
Women	0.99	(2.26)	0.76	(1.95)	0.23	(0.95)
p-value	*0.915*		*0.632*		*0.018*	
Parent's age						
16 to 34 years	1.08	(2.39)	0.84	(2.07)	0.25	(1.03)
35 to 44 years	0.92	(2.16)	0.73	(1.90)	0.19	(0.83)
45 to 65 years	0.63	(1.34)	0.54	(1.31)	0.08	(0.39)
p-value for trend	*0.280*		*0.438*		*0.305*	
Parent's ethnicity						
White	0.93	(1.78)	0.75	(1.56)	0.18	(0.62)
Asian	1.21	(2.52)	0.91	(2.17)	0.31	(1.23)
Black	0.96	(4.04)	0.78	(3.49)	0.18	(1.84)
Mixed/Other	0.48	(0.94)	0.39	(0.91)	0.09	(0.29)
p-value	*0.338*		*0.630*		*0.416*	
Marital status						
Cohabiting	0.93	(2.18)	0.72	(1.89)	0.21	(0.96)
Living alone	1.22	(2.49)	1.01	(2.22)	0.21	(0.76)
p-value	*0.309*		*0.233*		*0.992*	
Parent's education						
None	1.96	(3.40)	1.85	(3.35)	0.11	(0.39)
Secondary school	0.91	(2.27)	0.78	(2.00)	0.14	(0.85)
A-levels	1.20	(2.31)	0.76	(1.76)	0.44	(1.27)
Degree or higher	0.67	(1.65)	0.53	(1.37)	0.14	(0.79)
p-value for trend	*0.014*		*0.005*		*0.681*	
Parent's socioeconomic classification						
Managerial/professional	0.52	(1.42)	0.41	(1.22)	0.11	(0.53)
Intermediate	1.24	(2.24)	1.02	(1.89)	0.21	(1.00)
Routine/manual	1.16	(2.45)	0.81	(2.10)	0.36	(1.24)
Not working	1.55	(3.09)	1.23	(2.77)	0.31	(1.19)
p-value for trend	*<0.001*		*<0.001*		*0.013*	
Child sex						
Boy	1.10	(2.61)	0.83	(2.27)	0.27	(1.14)
Girl	0.88	(1.89)	0.73	(1.66)	0.16	(0.68)
p-value	*0.315*		*0.592*		*0.158*	
Child age						
3 years	0.81	(2.05)	0.68	(1.90)	0.13	(0.73)
4 years	1.17	(2.41)	0.88	(2.02)	0.29	(1.06)
p-value	*0.083*		*0.273*		*0.082*	

[a] Student's t-test and analysis of variance were used to compare 2 and more than 2 unordered groups respectively, whereas the test for linear trend was used to compare ordered groups.

Table 5.6. Comparison of child dental caries by family functioning domains (n=733)

Family functioning domains	dmft		dt		mft	
	Mean	**(SD)**	**Mean**	**(SD)**	**Mean**	**(SD)**
General functioning						
Healthy	0.68	(1.71)	0.50	(1.40)	0.18	(0.78)
Unhealthy	1.31	(2.70)	1.07	(2.42)	0.24	(1.06)
p-value[a]	*0.002*		*0.001*		*0.460*	
Problem solving						
Healthy	1.00	(2.27)	0.79	(1.96)	0.21	(0.93)
Unhealthy	0.91	(2.10)	0.67	(1.97)	0.24	(0.83)
p-value	*0.779*		*0.674*		*0.836*	
Communication						
Healthy	1.00	(2.32)	0.76	(1.95)	0.24	(0.99)
Unhealthy	0.96	(2.13)	0.80	(1.99)	0.16	(0.78)
p-value	*0.844*		*0.853*		*0.383*	
Roles						
Healthy	0.95	(2.24)	0.67	(1.88)	0.28	(1.05)
Unhealthy	1.04	(2.27)	0.92	(2.06)	0.12	(0.69)
p-value	*0.688*		*0.224*		*0.040*	
Affective responsiveness						
Healthy	0.96	(2.18)	0.72	(1.82)	0.24	(0.99)
Unhealthy	1.08	(2.43)	0.94	(2.36)	0.13	(0.63)
p-value	*0.584*		*0.255*		*0.318*	
Affective involvement						
Healthy	0.88	(2.03)	0.64	(1.55)	0.24	(1.05)
Unhealthy	1.08	(2.45)	0.90	(2.31)	0.18	(0.75)
p-value	*0.348*		*0.142*		*0.431*	
Behaviour control						
Healthy	0.80	(1.91)	0.58	(1.59)	0.22	(0.84)
Unhealthy	1.13	(2.50)	0.92	(2.23)	0.21	(0.98)
p-value	*0.177*		*0.133*		*0.929*	

[a] Student's t-test was used for comparisons.

The crude and adjusted associations of general functioning with the three child dental caries indicators are presented in Table 5.7. In the crude model, children in families with unhealthy general functioning had 1.93 (95%CI: 1.27-2.94) times greater dmft score than those in families with healthy general functioning. This association remained significant after adjusting for confounders (ARR: 1.52; 95%CI: 1.03-2.26). Parents living alone, and those with intermediate occupations and not working had greater dmft

scores than those cohabiting and those with professional and managerial occupations, respectively. Also, parents with higher levels of education had children with lower dmft score. Children in families with unhealthy general functioning had 2.15 (95% CI: 1.35-3.42) times greater dt score than those in families with healthy general functioning in the crude model. This association remained significant after adjustment for confounders (ARR: 1.93; 95% CI: 1.24-2.99). Greater dt scores were found among children of parents living alone than children of parents living with a partner as well as among children of parents with intermediate occupations and not working than those of parents with professional and managerial occupations. Furthermore, lower dt scores were found among children of parents with higher level of education. The association of general family functioning to mft score was not significant in both crude and adjusted models. However, lower mft scores were found among children of Mixed/Other-ethnicity parents than those of White parents whereas greater mft scores were found among children of parents with A levels/technical qualifications than those of parents with no education, among children of parents in routine and manual occupations than those in managerial and professional occupations, and among 4-year-olds than 3-year-olds.

Table 5.8 presents the regression models for the association of family functioning domains with child caries indicators. No family functioning domain was significantly associated with dmft or dt scores in unadjusted or adjusted models. Three family functioning domains were significantly associated with child mft score in the adjusted models. Children from families with unhealthy functioning in roles, affective responsiveness, and behaviour control had 63% (AOR: 0.37; 95%CI: 0.18-0.77), 64% (0.36; 95%CI: 0.15-0.88) and 75% (0.25; 95%CI: 0.11-0.55) lower mft scores than those with healthy functioning in each of these domains, respectively.

Table 5.7. Models for the associations of general functioning with child dental caries (n=733)

Explanatory variables	dmft		dt		mft	
	URR[a] [95% CI]	**ARR[a] [95% CI]**	**URR[a] [95% CI]**	**ARR[a] [95% CI]**	**URR[a] [95% CI]**	**ARR[a] [95% CI]**
General functioning						
Healthy	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Unhealthy	1.93 [1.27-2.94]*	1.52 [1.03-2.26]*	2.15 [1.35-3.42]*	1.93 [1.24-2.99]*	1.34 [0.62-2.88]	0.70 [0.34-1.46]
Parent's gender						
Men	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Women	1.04 [0.49-2.20]	0.61 [0.29-1.29]	0.83 [0.38-1.80]	0.46 [0.21-1.02]	7.62 [1.42-40.80]*	4.20 [0.49-35.67]
Parent's age, in years	0.98 [0.95-1.02]	1.00 [0.97-1.04]	0.98 [0.94-1.02]	1.00 [0.96-1.03]	1.00 [0.94-1.06]	1.02 [0.96-1.08]
Parent's ethnicity						
White	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Asian	1.30 [0.83-2.04]	1.33 [0.84-2.10]	1.21 [0.73-2.01]	1.36 [0.82-2.27]	1.67 [0.73-3.83]	2.34 [0.93-5.90]
Black	1.03 [0.59-1.80]	1.13 [0.67-1.91]	1.04 [0.56-1.91]	1.13 [0.65-1.97]	1.01 [0.31-3.22]	1.27 [0.48-3.38]
Mixed/Other	0.51 [0.15-1.80]	0.35 [0.12-1.04]	0.52 [0.12-2.27]	0.43 [0.12-1.50]	0.47 [0.06-3.68]	0.18 [0.04-0.89]*
Marital status						
Cohabiting	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Living alone	1.31 [0.78-2.21]	1.83 [1.01-3.29]*	1.40 [0.81-2.44]	1.82 [1.01-3.29]*	1.00 [0.40-2.52]	2.13 [0.84-5.42]
Parent's education						
None	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Secondary school	0.47 [0.21-1.01]	0.44 [0.22-0.91]*	0.42 [0.18-0.96]*	0.37 [0.18-0.79]*	1.24 [0.37-4.14]	1.75 [0.56-5.43]
A-levels	0.61 [0.29-1.30]	0.88 [0.41-1.88]	0.41 [0.18-0.92]*	0.50 [0.23-1.11]	4.04 [1.32-12.33]*	9.35 [3.20-27.34]*
Degree or higher	0.34 [0.16-0.73]*	0.46 [0.23-0.92]*	0.29 [0.13-0.63]*	0.39 [0.19-0.83]*	1.31 [0.40-4.23]	1.79 [0.57-5.62]
Parents' socioeconomic classification						
Managerial/professional	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Intermediate	2.39 [1.38-4.16]*	2.33 [1.31-4.15]*	2.48 [1.43-4.32]*	2.39 [1.33-4.29]*	2.04 [0.58-7.25]	1.65 [0.57-4.78]
Routine/manual	2.25 [1.26-4.02]*	1.66 [0.91-3.02]	1.96 [0.97-3.96]	1.30 [0.65-2.58]	3.40 [1.16-9.94]*	4.36 [1.45-13.04]*

Not working	3.00 [1.77-5.06]*	2.35 [1.41-3.93]*	3.00 [1.67-5.37]*	2.19 [1.27-3.79]*	2.98 [1.13-7.84]*	2.25 [0.90-5.65]
Child age						
3 years	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
4 years	1.44 [0.95-2.17]	1.24 [0.83-1.84]	1.30 [0.81-2.07]	1.13 [0.74-1.75]	2.15 [0.91-5.12]	2.47 [1.30-4.68]*
Child gender						
Boy	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Girl	0.80 [0.52-1.23]	0.95 [0.64-1.40]	0.88 [0.54-1.42]	1.04 [0.69-1.57]	0.58 [0.27-1.23]	0.98 [0.48-2.03]

[a] Negative binominal regression models were fitted for dmft, dt and mft. Rate ratios were reported unadjusted (URR) and adjusted (ARR) for all variables in the table.
* $p<0.05$

Table 5.8. Regression models for the association of family functioning domains with child dental caries (n=733)

Family functioning domains[b]	dmft		dt		mft	
	URR[a] [95% CI]	**ARR[a] [95% CI]**	**URR[a] [95% CI]**	**ARR[a] [95% CI]**	**URR[a] [95% CI]**	**ARR[a] [95% CI]**
Problem solving						
Healthy	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Unhealthy	0.91 [0.48-1.73]	0.80 [0.45-1.43]	0.85 [0.40-1.81]	0.66 [0.35-1.23]	1.15 [0.31-4.29]	0.72 [0.25-2.02]
Communication						
Healthy	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Unhealthy	0.96 [0.62-1.47]	0.88 [0.58-1.34]	1.05 [0.64-1.71]	1.02 [0.64-1.62]	0.68 [0.28-1.63]	0.57 [0.26-1.25]
Roles						
Healthy	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Unhealthy	1.09 [0.70-1.70]	1.07 [0.72-1.59]	1.37 [0.83-2.27]	1.35 [0.87-2.08]	0.44 [0.20-0.96]*	0.37 [0.18-0.77]*
Affective responsiveness						
Healthy	1.00 [Reference]	1.00. [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Unhealthy	1.13 [0.74-1.72]	1.01 [0.66-1.55]	1.32 [0.82-2.11]	1.21 [0.75-1.98]	0.56 [0.18-1.76]	0.36 [0.15-0.88]*
Affective involvement						
Healthy	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Unhealthy	1.23 [0.80-1.89]	0.95 [0.62-1.44]	1.42 [0.89-2.26]	1.08 [0.68-1.70]	0.74 [0.34-1.58]	0.54 [0.25-1.17]
Behaviour control						
Healthy	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Unhealthy	1.42 [0.85-2.36]	1.16 [0.72-1.85]	1.59 [0.87-2.91]	1.55 [0.96-2.49]	0.96 [0.44-2.12]	0.25 [0.11-0.55]*

[a] Negative binominal regression models were fitted for dmft, dt and mft. Rate ratios were reported unadjusted (URR) and adjusted (ARR) for parental demographic factors (age, gender, ethnicity and marital status), socioeconomic conditions (education and socioeconomic classification), and child demographic factors (age and gender).
* $p<0.05$

5.3. The association of family functioning with child OHRQoL

This section reports findings on the association of family functioning with OHRQoL scores (ECOHIS total, CIS, and FIS). Table 5.9 compares the three OHRQoL scores by parental and child characteristics. Children of Asian (1.74) and White (1.40) parents had significantly higher ECOHIS total scores than children of Black (0.94) and Mixed/Other-ethnicity parents (0.31). In addition, children with dental caries experience (dmft>0) had higher ECOHIS total score than those without caries experience (3.07 and 0.82 respectively). Similarly, children with dental caries experience had higher CIS score than those with no caries experience (1.91 and 0.63 respectively). In addition, children of White (0.54) and Asian (0.41) parents had significantly higher FIS scores than children of Black (0.11) and Mixed/Other-ethnicity parents (0.06). A significant difference in FIS scores was also seen between families of children with (1.15) and without dental caries experience (0.19).

The distribution of child OHRQoL scores across the categories of family functioning for each FAD domain is presented in Table 5.10. Although families with unhealthy general functioning had higher ECOHIS total (1.48 versus 1.28), CIS (1.02 versus 0.89) and FIS scores (0.46 versus 0.39) than those with healthy general functioning, these differences were not significant. By specific domains of FAD, no differences in ECOHIS total, CIS and FIS scores were noted between families with healthy and unhealthy functioning either.

Table 5.9. Child OHRQoL scores by parental and child characteristics (n=714)

	ECOHIS		CIS		FIS	
	Mean	**(SD)**	**Mean**	**(SD)**	**Mean**	**(SD)**
Parent's sex						
Men	1.84	(5.85)	1.30	(3.80)	0.54	(2.21)
Women	1.33	(3.61)	0.92	(2.61)	0.42	(1.34)
p-value[a]	*0.570*		*0.489*		*0.730*	
Parent's age						
16 to 34 years	1.31	(3.65)	0.94	(2.69)	0.37	(1.29)
35 to 44 years	1.53	(4.14)	1.00	(2.84)	0.52	(1.61)
45 to 65 years	0.61	(1.79)	0.52	(1.56)	0.09	(0.38)
p-value for trend	*0.995*		*0.848*		*0.751*	
Parent's ethnicity						
White	1.40	(3.17)	0.86	(2.07)	0.54	(1.35)
Asian	1.74	(4.70)	1.33	(3.60)	0.41	(1.30)
Black	0.94	(4.05)	0.83	(3.66)	0.11	(0.83)
Mixed/Other	0.31	(0.81)	0.26	(0.58)	0.06	(0.41)
p-value	*0.019*		*0.059*		*<0.001*	
Marital status						
Cohabiting	1.22	(3.64)	0.87	(2.69)	0.35	(1.22)
Living alone	2.09	(4.51)	1.30	(2.83)	0.79	(2.03)
p-value	*0.150*		*0.294*		*0.054*	
Parent's education						
None	1.28	(3.12)	0.79	(2.15)	0.49	(1.47)
Secondary school	1.48	(4.14)	1.06	(2.75)	0.42	(1.56)
A-levels	1.42	(4.03)	0.97	(3.09)	0.45	(1.36)
Degree or higher	1.32	(3.70)	0.91	(2.61)	0.41	(1.37)
p-value for trend	*0.877*		*0.905*		*0.852*	
Parent's socioeconomic classification						
Managerial/professional	0.92	(2.71)	0.63	(1.98)	0.29	(1.02)
Intermediate	2.26	(4.90)	1.50	(3.33)	0.76	(1.90)
Routine/manual	1.64	(5.08)	1.10	(3.22)	0.53	(2.14)
Not working	1.50	(4.04)	1.09	(3.12)	0.41	(1.24)
p-value for trend	*0.127*		*0.093*		*0.398*	
Child sex						
Boy	1.30	(3.92)	0.93	(2.82)	0.37	(1.41)
Girl	1.46	(3.76)	0.97	(2.63)	0.48	(1.44)
p-value	*0.680*		*0.863*		*0.460*	
Child age						
3 years	1.04	(2.91)	0.73	(2.14)	0.31	(1.17)
4 years	1.71	(4.51)	1.17	(3.15)	0.54	(1.63)
p-value	*0.050*		*0.054*		*0.122*	
Child dental caries experience						
dmft=0	0.82	(2.54)	0.63	(1.94)	0.19	(0.78)
dmft>0	3.07	(6.10)	1.91	(4.20)	1.15	(2.42)
p-value	*<0.001*		*<0.001*		*<0.001*	

[a] Student's t-test and analysis of variance were used to compared 2 and more than 2 unordered groups, respectively, whereas the test for linear trend was used to compare ordered groups.

Table 5.10. Child OHRQoL scores by family functioning domains (n=714)

Family functioning domains	ECOHIS		CIS		FIS	
	Mean	**(SD)**	**Mean**	**(SD)**	**Mean**	**(SD)**
General functioning						
Healthy	1.28	(3.53)	0.89	(2.45)	0.39	(1.39)
Unhealthy	1.48	(4.16)	1.02	(3.00)	0.46	(1.47)
p-value	*0.629*		*0.638*		*0.672*	
Problem solving						
Healthy	1.36	(3.83)	0.94	(2.70)	0.42	(1.45)
Unhealthy	1.49	(3.94)	1.00	(2.89)	0.49	(1.29)
p-value	*0.806*		*0.881*		*0.685*	
Communication						
Healthy	1.39	(3.80)	0.97	(2.72)	0.42	(1.38)
Unhealthy	1.36	(3.92)	0.92	(2.73)	0.43	(1.51)
p-value	*0.929*		*0.863*		*0.950*	
Roles						
Healthy	1.27	(3.70)	0.91	(2.66)	0.37	(1.31)
Unhealthy	1.52	(4.03)	1.01	(2.81)	0.51	(1.58)
p-value	*0.554*		*0.701*		*0.415*	
Affective responsiveness						
Healthy	1.49	(4.08)	1.02	(2.82)	0.47	(1.53)
Unhealthy	1.08	(2.87)	0.75	(2.32)	0.32	(1.00)
p-value	*0.242*		*0.283*		*0.356*	
Affective involvement						
Healthy	1.35	(3.61)	0.92	(2.49)	0.43	(1.45)
Unhealthy	1.41	(4.06)	0.98	(2.94)	0.42	(1.41)
p-value	*0.885*		*0.805*		*0.958*	
Behavior control						
Healthy	1.36	(3.64)	0.89	(2.48)	0.47	(1.44)
Unhealthy	1.39	(4.00)	1.00	(2.92)	0.39	(1.41)
p-value	*0.952*		*0.706*		*0.612*	

[a] Student's t-test was used for comparisons.

Table 5.11 presents the crude and adjusted associations of general family functioning with child OHRQoL scores. Unhealthy general functioning was not significantly associated with the ECOHIS total score in the crude (URR: 1.15; 95% CI: 0.65-2.02) or adjusted models (ARR: 1.39; 95% CI: 0.82-2.37). Only parental ethnicity and child dental caries experience were significantly associated with ECOHIS total score in the adjusted model. Children of Mixed/Other-ethnicity parents had lower ECOHIS total

scores than those of White parents whereas children with caries experience had greater ECOHIS total scores than those without caries experience. The association between general family functioning and the CIS score was not significant in crude (URR: 1.15; 95%CI: 0.65-2.02) or adjusted models (ARR: 1.19; 95%CI: 0.68-2.08). In the adjusted model, significantly lower CIS scores were found among Mixed/Other-ethnicity parents than White parents whereas significantly higher CIS scores were seen in children who experienced dental caries than in those who did not. The association between general family functioning and the FIS score was not significant in the crude model (URR: 1.17; 95%CI: 0.56-2.47) but became significant after adjustment for confounders. Families with unhealthy general functioning had 2.12 (95%CI: 1.15-3.90) times greater CIS score than those with healthy family functioning. Parental ethnicity and child dental caries experience were also associated with the FIS score in the adjusted model. Black and Mixed/Other-ethnicity parents had significantly lower FIS scores than White parents. On the other hand, families of children with dental caries experience had significantly higher FIS scores than families of children with no caries experience.

Table 5.12 shows the association of specific domains of family functioning with child OHRQoL scores. No family functioning domain was significantly associated with the ECOHIS total score or the CIS score in either crude or adjusted models. On the other hand, three family functioning domains were associated the FIS score after adjustment for confounders. Families with unhealthy functioning in problem solving, roles and affective involvement domains had, respectively, 2.45 (95% CI: 1.07-5.64), 2.17 (95% CI: 1.21-3.91) and 2.00 (95% CI: 1.09-3.70) times greater FIS scores than those with healthy functioning in each of those FAD domains.

Table 5.11. Regression models for the associations of general functioning with child OHRQoL scores (n=714)

Explanatory variables	ECOHIS		CIS		FIS	
	URR[a] [95% CI]	ARR[a] [95% CI]	URR[a] [95% CI]	ARR[a] [95% CI]	URR[a] [95% CI]	ARR[a] [95% CI]
General functioning						
Healthy	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Unhealthy	1.15 [0.64-2.07]	1.39 [0.82-2.37]	1.15 [0.65-2.02]	1.19 [0.68-2.08]	1.17 [0.56-2.47]	2.12 [1.15-3.90]*
Parent's gender						
Men	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Women	0.73 [0.24-2.20]	0.73 [0.32-1.64]	0.70 [0.26-1.90]	0.71 [0.32-1.61]	0.78 [0.18-3.30]	0.81 [0.30-2.18]
Parent's age, in years	1.00 [0.97-1.04	0.99 [0.95-1.03]	1.00 [0.97-1.04]	1.00 [0.96-1.04]	1.01 [0.95-1.07]	0.98 [0.92-1.03]
Parent's ethnicity						
White	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Asian	1.24 [0.68-2.26]	1.69 [0.91-3.15]	1.54 [0.84-2.82]	1.89 [1.00-3.59]	0.76 [0.39-1.50]	1.43 [0.69-3.00]
Black	0.67 [0.36-1.25]	0.96 [0.50-1.84]	0.97 [0.51-1.84]	1.18 [0.61-2.28]	0.20 [0.09-0.46]*	0.34 [0.13-0.88]*
Mixed/Other	0.22 [0.06-0.78]*	0.20 [0.06-0.68]*	0.30 [0.08-1.15]	0.26 [0.07-0.97]*	0.10 [0.01-0.84]*	0.08 [0.02-0.37]*
Marital status						
Cohabiting	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Living alone	1.71 [0.82-3.56]	1.74 [0.94-3.24]	1.48 [0.71-3.11]	1.65 [0.85-3.21]	2.29 [0.99-5.31]	1.90 [0.91-3.99]
Parent's education						
None	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Secondary school	1.16 [0.47-2.85]	1.25 [0.50-3.11]	1.34 [0.54-3.29]	1.31 [0.49-3.50]	0.86 [0.24-3.04]	1.41 [0.42-4.73]
A-levels	1.11 [0.50-2.45]	1.05 [0.42-2.64]	1.22 [0.53-2.84]	1.11 [0.41-3.04]	0.92 [0.29-2.87]	0.98 [0.31-3.09]
Degree or higher	1.03 [0.43-2.45]	1.38 [0.51-3.81]	1.14 [0.47-2.77]	1.35 [0.46-3.90]	0.84 [0.26-2.77]	1.80 [0.48-6.75]
Parents' socioeconomic classification						
Managerial/professional	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Intermediate	2.45 [1.09-5.53]*	1.85 [0.80-4.28]	2.39 [1.09-5.25]*	1.94 [0.86-4.37]	2.59 [0.93-7.21]	1.67 [0.62-4.45]
Routine/manual	1.77 [0.75-4.18]	1.00 [0.48-2.06]	1.75 [0.79-3.90]	1.19 [0.58-2.45]	1.82 [0.60-5.55]	0.74 [0.28-1.99]

Not working	1.62 [0.88-3.00]	1.33 [0.64-2.74]	1.73 [0.92-3.26]	1.45 [0.71-2.98]	1.39 [0.63-3.08]	0.92 [0.34-2.46]
Child age						
3 years	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
4 years	1.65 [1.00-2.73]	0.90 [0.56-1.44]	1.62 [0.99-2.63]	0.93 [0.57-1.51]	1.74 [0.86-3.51]	0.96 [0.56-1.66]
Child gender						
Boy	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Girl	1.12 [0.65-1.93]	0.86 [0.56-1.34]	1.05 [0.62-1.78]	0.84 [0.53-1.32]	1.30 [0.64-2.64]	1.04 [0.61-1.76]
Child dental caries experience						
dmft=0	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
dmft>0	3.76 [2.17-6.52]*	3.69 [2.16-6.31]*	3.04 [1.75-5.29]*	2.73 [1.58-4.75]*	6.20 [3.12-12.31]*	7.46 [4.03-13.79]*

[a] Negative binominal regression models were fitted for ECOHIS total, CIS and FIS scores. Rate ratios were reported unadjusted (URR) and adjusted (ARR) for all variables listed in the table.
* $p<0.05$

Table 5.12. Regression models for the association of family functioning domains with child OHRQoL scores (n=714)

Family functioning domains	ECOHIS		CIS		FIS	
	URR[a] [95% CI]	ARR[a] [95% CI]	URR[a] [95% CI]	ARR[a] [95% CI]	URR[a] [95% CI]	ARR[a] [95% CI]
Problem solving						
Healthy	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Unhealthy	1.09 [0.54-2.22]	1.30 [0.65-2.62]	1.06 [0.50-2.25]	1.07 [0.50-2.29]	1.17 [0.55-2.49]	2.45 [1.07-5.64]*
Communication						
Healthy	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Unhealthy	0.97 [0.54-1.75]	1.21 [0.73-2.00]	0.95 [0.54-1.68]	1.03 [0.60-1.79]	1.02 [0.48-2.19]	1.38 [0.74-2.57]
Roles						
Healthy	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Unhealthy	1.20 [0.66-2.16]	1.58 [0.96-2.60]	1.12 [0.64-1.96]	1.33 [0.79-2.24]	1.39 [0.63-3.07]	2.17 [1.21-3.91]*
Affective responsiveness						
Healthy	1.00 [Reference]	1.00. [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Unhealthy	0.72 [0.42-1.24]	0.77 [0.45-1.31]	0.74 [0.42-1.29]	0.69 [0.38-1.22]	0.69 [0.32-1.52]	0.91 [0.46-1.78]
Affective involvement						
Healthy	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Unhealthy	1.04 [0.58-1.88]	1.21 [0.74-1.97]	1.07 [0.61-1.90]	1.01 [0.61-1.69]	0.98 [0.47-2.06]	2.00 [1.09-3.70]*
Behaviour control						
Healthy	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Unhealthy	1.02 [0.56-1.86]	1.17 [0.67-2.06]	1.12 [0.62-2.04]	1.12 [0.63-1.99]	0.82 [0.39-1.73]	1.11 [0.54-2.32]

[a] Negative binominal regression models were fitted for ECOHIS total, CIS and FIS score. Rate ratios were reported unadjusted (URR) and adjusted (ARR) for parental demographic factors (age, gender, ethnicity and marital status), socioeconomic conditions (education and socioeconomic classification), child demographic factors (age and gender) and dental caries experience.
* $p<0.05$

5.4. Summary of chapter 5

This chapter presented findings on the independent association of family functioning with dental behaviours, caries experience and OHRQoL among young children. In relation to child dental behaviours, unhealthy general family functioning was positively associated with high sugars intake after adjustment for confounders. In analysis by specific domains of family functioning, unhealthy functioning in roles, affective involvement and behaviour control were associated with high child sugars intake whereas unhealthy functioning in roles was inversely associated with frequent child toothbrushing.

In terms of childhood dental caries, general family functioning was inversely associated with higher levels of caries experience (dmft score) and untreated caries (dt score) but not with the level of treated teeth (mft score) after adjustments. In the analysis by domains though, unhealthy functioning in roles, affective responsiveness, and behaviour control were inversely associated with the level of treated teeth.

Finally, unhealthy general functioning was associated with more impacts on family life due to the child oral condition (FIS score), but not with more impacts on the child life (CIS score) or both aspects combined (ECOHIS total score). In further analysis by domains of family functioning, unhealthy functioning in problem solving, roles and affective involvement were positively associated with poorer family quality of life due to the child oral condition.

Chapter 6

The mediating role of family functioning in the association of parental socioeconomic position with child oral health

This chapter reports analyses testing if family functioning mediates the association of parental SEP with child dental behaviours, dental caries and OHRQoL. Mediation analysis refers to whether a variable (family functioning in this case) is part of the causal pathway between an exposure (parental SEP, which included parental education and NS-SEC classification) and an outcome (child oral health) and thus transmit part or all the effect of the exposure on the outcome.

6.1. Family functioning as a mediator of the association between parental socioeconomic position and child dental behaviours

The results in this section are organised according to child dental behaviour (sugars intake, dental attendance and toothbrushing frequency) and following the four criteria of the Baron and Kenny's (1986) approach for testing mediation.

6.1.1. Child sugars intake

The first criterion in the Baron and Kenny's approach was to test the association between the exposure (parental SEP) and the outcome (child high sugars intake). These estimates are shown in Model 1 of Table 6.1. Parental socioeconomic classification, but

Table 6.1. Models for the associations of parental SEP and family functioning domains with child high sugars intake (n=733).

	Model 1	**Model 2A**	**Model 2B**	**Model 2C**	**Model 2D**
	AOR[a] [95% CI]	**AOR[a] [95% CI]**	**AOR[a] [95% CI]**	**AOR[a] [95% CI]**	**AOR[a] [95% CI]**
Parent's education					
None	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Secondary school	1.10 [0.45-2.67]	1.19 [0.48-2.92]	1.10 [0.48-2.54]	1.29 [0.52-3.19]	1.20 [0.51-2.80]
A-levels	0.91 [0.36-2.33]	1.05 [0.40-2.71]	1.03 [0.42-2.53]	1.07 [0.42-2.73]	1.06 [0.43-2.64]
Degree or higher	0.57 [0.21-1.56]	0.68 [0.25-1.91]	0.61 [0.23-1.62]	0.67 [0.24-1.85]	0.65 [0.24-1.72]
Parent's socioeconomic classification					
Managerial/professional	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Intermediate	3.44 [1.41-8.36]*	3.28 [1.38-7.78]*	3.14 [1.30-7.55]*	3.31 [1.37-8.00]*	3.53 [1.49-8.34]*
Routine/manual	2.27 [1.03-5.00]*	1.97 [0.90-4.32]	2.19 [0.99-4.87]	2.07 [0.95-4.53]	1.90 [0.88-4.11]
Not working	4.37 [2.09-9.17]*	3.96 [1.85-8.45]*	4.46 [2.14-9.31]*	3.98 [1.91-8.29]*	3.72 [1.75-7.90]*
General functioning					
Healthy		1.00 [reference]			
Unhealthy		1.78 [1.01-3.13]*			
Roles					
Healthy			1.00 [reference]		
Unhealthy			1.81 [1.09-3.02]*		
Affective involvement					
Healthy				1.00 [reference]	
Unhealthy				2.21 [1.25-3.92]*	
Behaviour control					
Healthy					1.00 [reference]
Unhealthy					2.61 [1.31-5.21]*

[a] Logistic regression was fitted and adjusted odds ratios (AOR) reported. Model 1 was adjusted for confounders (parental sex, age, ethnicity and marital status as well as child sex and age) and the other socioeconomic indicator in the table. Models 2A-2D were additionally adjusted for one family functioning domain at a time. * $p<0.05$

not parental education, was associated with child high sugars intake after adjustment for confounders. Children whose parents had intermediate occupations, routine/manual occupations and were not working had, respectively, 3.44 (95% CI: 1.41-8.36), 2.27 (95% CI: 1.03-5.00) and 4.37 (95% CI: 2.09-9.17) times greater odds of consuming more than 4 sugary items per day than children whose parents had managerial/professional occupations.

Table 6.2. Models for the association between parental socioeconomic indicators with general family functioning (n=733)

	UOR[a]	**[95% CI]**	**AOR**[a]	**[95% CI]**
Parent's education				
None	1.00	[reference]	1.00	[reference]
Secondary school	0.80	[0.33-1.92]	0.74	[0.30-1.85]
A-levels	0.55	[0.23-1.32]	0.40	[0.16-1.00]
Degree or higher	0.42	[0.18-1.00]	0.27	[0.11-0.70]*
Parent's socioeconomic classification				
Managerial/professional	1.00	[reference]	1.00	[reference]
Intermediate	1.55	[0.85-2.82]	1.59	[0.85-2.96]
Routine/manual	3.99	[2.16-7.39]*	3.96	[2.07-7.58]*
Not working	2.66	[1.58-4.47]*	2.27	[1.31-3.93]*

[a] Logistic regression was fitted. Odds ratios were reported unadjusted (UOR) and adjusted (AOR) for confounders (parental sex, age, ethnicity and marital status as well as child sex and age) and the other socioeconomic indicator in the table. * $p<0.05$

The second criterion in the Baron and Kenny's approach was to test the association between the exposure (parental SEP) and the potential mediator (family functioning). These findings are presented in Table 6.2 for general functioning and Table 6.3 for the six specific domains of family functioning. Both parental education and socioeconomic classification were associated with general family functioning after adjustment for confounders. Parents with higher education had 73% (OR: 0.27, 95% CI: 0.11-0.70) lower odds of reporting unhealthy general family functioning than those with no

qualifications. In addition, parents in routine/manual occupations and those not working had, respectively, 3.96 (95% CI: 2.07-7.58) and 2.27 (95% CI: 1.31-3.93) times greater odds of reporting unhealthy general functioning than those in managerial/professional occupations.

In analysis by domains of family functioning, parental education was inversely associated with unhealthy functioning in three domains (communication, affective involvement and behaviour control) after adjustment for confounders. Compared to parents with no qualifications, those with A-levels and higher education had 73% (OR: 0.27, 95% CI: 0.12-0.62) and 81% (OR: 0.19, 95% CI: 0.08-0.45) lower odds of reporting unhealthy functioning in the communication domain. They also had 72% (OR: 0.28, 95% CI: 0.11-0.66) and 78% (OR: 0.22, 95% CI: 0.09-0.53) lower odds of reporting unhealthy functioning in the affective involvement domain. Moreover, they had 74% (OR: 0.26, 95% CI: 0.08-0.83) and 77% (OR: 0.23, 95% CI: 0.08-0.73) lower odds of reporting unhealthy functioning in the behaviour control domain, respectively. Parental socioeconomic classification was inversely associated with unhealthy functioning in four domains (communication, affective responsiveness, affective involvement and behaviour control) after adjustment for confounders. Compared to parents in managerial/professional occupations, those in routine/manual occupations had 2.04 (95% CI: 1.12-3.71) times greater odds of reporting unhealthy functioning in the communication domain, 1.98 (95% CI: 1.00-3.92) times greater odds of reporting unhealthy functioning in the affective responsiveness domain, 1.93 (95% CI: 1.06-3.51) times greater odds of reporting unhealthy functioning in the affective involvement domain and 2.46 (95% CI: 1.27-4.77) times greater of reporting unhealthy functioning in the behaviour control domain, respectively.

Table 6.3. Models for the association between parental socioeconomic position and family functioning domains (n=733)

	Problem solving		Communication		Roles	
	UOR[a] [95%CI]	**AOR[a] [95%CI]**	**UOR[a] [95%CI]**	**AOR[a] [95%CI]**	**UOR[a] [95%CI]**	**AOR[a] [95%CI]**
Parent's education						
None	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Secondary school	1.52 [0.49-4.77]	1.68 [0.55-5.10]	0.51 [0.22-1.19]	0.49 [0.22-1.12]	1.28 [0.57-2.88]	1.31 [0.56-3.04]
A-levels	1.02 [0.31-3.40]	0.86 [0.25-2.97]	0.38 [0.16-0.88]*	0.27 [0.12-0.62]*	0.48 [0.21-1.10]	0.49 [0.21-1.16]
Degree or higher	0.80 [0.24-2.62]	0.67 [0.20-2.18]	0.29 [0.12-0.70]*	0.19 [0.08-0.45]*	0.56 [0.25-1.25]	0.58 [0.24-1.37]
Parent's socioeconomic classification						
Managerial/professional	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Intermediate	1.10 [0.39-3.10]	1.03 [0.34-3.15]	1.11 [0.58-2.10]	1.09 [0.56-2.13]	2.02 [1.07-3.79]*	1.90 [0.99-3.64]
Routine/manual	1.13 [0.43-2.97]	1.03 [0.36-2.94]	2.35 [1.30-4.23]*	2.04 [1.12-3.71]*	1.56 [0.85-2.86]	1.34 [0.74-2.43]
Not working	1.17 [0.57-2.42]	1.08 [0.52-2.23]	1.12 [0.63-1.97]	0.82 [0.46-1.44]	1.16 [0.70-1.92]	1.01 [0.59-1.75]
	Affective responsiveness		**Affective involvement**		**Behaviour control**	
	UOR[a] [95%CI]	**AOR[a] [95%CI]**	**UOR[a] [95%CI]**	**AOR[a] [95%CI]**	**UOR[a] [95%CI]**	**AOR[a] [95%CI]**
Parent's education						
None	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Secondary school	0.63 [0.28-1.39]	0.60 [0.27-1.34]	0.36 [0.15-0.88]*	0.31 [0.13-0.71]*	0.49 [0.16-1.48]	0.43 [0.14-1.32]
A-levels	0.64 [0.29-1.45]	0.53 [0.23-1.24]	0.39 [0.15-0.96]*	0.28 [0.11-0.66]*	0.41 [0.13-1.26]	0.26 [0.08-0.83]*
Degree or higher	0.56 [0.26-1.22]	0.46 [0.20-1.05]	0.34 [0.14-0.83]*	0.22 [0.09-0.53]*	0.41 [0.14-1.21]	0.23 [0.08-0.73]*
Parent's socioeconomic classification						
Managerial/professional	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Intermediate	2.10 [1.08-4.07]*	2.06 [1.02-4.17]*	1.40 [0.78-2.53]	1.36 [0.72-2.57]	0.95 [0.52-1.75]	0.92 [0.48-1.77]
Routine/manual	2.42 [1.26-4.62]*	1.98 [1.00-3.92]*	2.50 [1.37-4.56]*	1.93 [1.06-3.51]*	2.95 [1.56-5.57]*	2.46 [1.27-4.77]*
Not working	2.49 [1.44-4.33]*	2.02 [1.14-3.58]*	2.90 [1.73-4.88]*	1.85 [1.08-3.16]*	3.13 [1.77-5.53]*	2.20 [1.19-4.04]*

[a] Logistic regression was fitted. Odds ratios were reported unadjusted (OUR) and adjusted (AOR) for confounders (parental sex, age, ethnicity and marital status as well as child sex and age) and the other socioeconomic indicator in the table. * $p<0.05$

The third criterion in the Baron and Kenny's approach was to test the association between the potential mediator (family functioning) and the outcome (child sugars intake) after adjustment for confounders (including parental SEP). These results are presented in Model 2A of Table 6.1. Children in families with unhealthy general functioning had 1.78 (95% CI: 1.01-3.13) times greater odds of consuming more than 4 sugary items per day than those in families with healthy general functioning.

The last criterion in the Baron and Kenny's approach was to compare the ORs for the SEP indicators before and after adjusting for general family functioning (Model 1 and 2A in Table 6.1, respectively). The ORs for the association of parental education with child sugars intake changed between -20% to 8% whereas the ORs for the association of parental socioeconomic classification with child sugars intake were attenuated by between 5% to 13%, after adjustment for general family functioning.

Only three of the six domains of family functioning were associated with child high sugars intake. Children in families with unhealthy functioning in the roles (Model 2B), affective involvement (Model 2C) and behaviour control (Model 2D) domains had, respectively, 1.81 (95% CI: 1.09-3.02), 2.21 (95% CI: 1.25-3.92) and 2.61 (95% CI: .31-5.21) times greater odds of consuming over 4 sugary items a day than those in families with healthy functioning in each of those domains. The ORs for parental education and socioeconomic classification changed between -13% to 0% and -9% to 2% after adjustment for the roles domain, between -18% to +18% and -4% to -9% after adjustment for the affective involvement domain, and between -16% to 9% and -16% to 3% after adjustment for the behaviour control domain, respectively.

In summary, the findings supported the mediating role of general family functioning in the association between parental socioeconomic classification and child sugars intake, explaining up to 13% of that association. Roles, affective involvement and behaviour

control were the specific domains of family functioning that met the four criteria of the Baron and Kenny's approach for testing mediation.

6.1.2. Child dental attendance pattern

For the first criterion, estimates for the association between parental SEP and child dental attendance pattern are presented in Model 1 of Table 6.4. Parental education, but not socioeconomic classification, was associated with child dental attendance after adjustment for confounders. Children of parents with A-levels and higher education had 3.48 (95% CI: 1.28-9.44) and 3.21 (1.20-8.56) times greater odds of visiting the dentist for check-up in the past year than children of parents with no qualifications.

Table 6.4. Models for the associations of parental socioeconomic position and family functioning domains with child dental attendance (n=733).

	Model 1	**Model 2**
	OR[a] [95% CI]	**OR[a] [95% CI]**
Parent's education		
None	1.00 [reference]	1.00 [reference]
Secondary school	1.72 [0.67-4.43]	1.72 [0.67-4.42]
A-levels	3.48 [1.28-9.44]*	3.46 [1.28-9.38]*
Degree or higher	3.21 [1.20-8.56]*	3.19 [1.19-8.54]*
Parent's socioeconomic classification		
Managerial/professional	1.00 [reference]	1.00 [reference]
Intermediate	1.38 [0.76-2.48]	1.38 [0.76-2.50]
Routine/manual	0.91 [0.47-1.76]	0.91 [0.46-1.80]
Not working	1.08 [0.60-1.93]	1.08 [0.60-1.96]
General functioning		
Healthy		1.00 [reference]
Unhealthy		0.98 [0.62-1.53]

[a] Logistic regression model was fitted and adjusted odds ratios (AOR) reported. Model 1 was adjusted for confounders (parental sex, age, ethnicity and marital status as well as child sex and age) and the other SEP indicator in the table. Model 2 was also adjusted for general family functioning. * $p<0.05$

For the second criterion, the findings of the association between family socioeconomic indicators and family functioning have been reported in Tables 6.2 and 6.3. For the third criterion, the association between family functioning and child dental attendance, after adjustment for confounders, is presented in Model 2 of Table 6.4. No differences in child dental attendance were observed between families with healthy and unhealthy general functioning (OR: 0.98, 95% CI: 0.62-1.53). Similar non-significant findings were noted in analyses by the six specific domains of family functioning. For the fourth and last criterion, the ORs for the associations of parental education and socioeconomic classification with child dental attendance were attenuated by between -1% to 0% and -1% to 0% after adjustment for general functioning, respectively.

To sum up, the findings did not support the mediating role of family functioning in the association between family SEP and child dental attendance.

6.1.2. Child toothbrushing frequency

The association between parental SEP indicators and child toothbrushing frequency are presented in Model 1 of Table 6.5 (criterion one). Neither parental education nor socioeconomic classification was associated with child toothbrushing frequency in regression models adjusted for confounders. For criterion two, the associations of parental SEP indicators with general and specific domains of family functioning have been reported in Tables 6.2 and 6.3, respectively.

For criterion three, confounder-adjusted estimates of the association between family functioning and child toothbrushing frequency are presented in Models 2A of Table 6.5. Unhealthy general functioning was associated with 24% (OR: 0.76, 95% CI: 0.50-1.18) lower odds of the child brushing their teeth twice daily or more often, however

this association was not significant. In further analysis by domains of family functioning, unhealthy functioning in the roles domain was inversely associated with child toothbrushing frequency. Children in families with unhealthy functioning in the roles domain had 42% (95% CI: 0.38-0.89) lower odds of brushing their teeth twice daily or more often than those in families with healthy functioning in that domain. The other specific domains of family functioning were not associated with child toothbrushing frequency.

Table 6.5. Models for the associations of parental socioeconomic position and family functioning domains with child toothbrushing frequency (n=733).

	Model 1	**Model 2A**	**Model 2B**
	OR[a] [95% CI]	**OR[a] [95% CI]**	**OR[a] [95% CI]**
Parent's education			
None	1.00 [reference]	1.00 [reference]	1.00 [reference]
Secondary school	1.45 [0.63-3.34]	1.43 [0.63-3.25]	1.51 [0.66-3.43]
A-levels	1.65 [0.73-3.73]	1.57 [0.70-3.51]	1.52 [0.67-3.45]
Degree or higher	1.83 [0.79-4.26]	1.70 [0.74-3.94]	1.73 [0.75-3.99]
Parent's socioeconomic classification			
Managerial/professional	1.00 [reference]	1.00 [reference]	1.00 [reference]
Intermediate	0.82 [0.45-1.49]	0.85 [0.47-1.53]	0.89 [0.49-1.62]
Routine/manual	1.20 [0.63-2.27]	1.30 [0.68-2.50]	1.25 [0.66-2.38]
Not working	0.97 [0.56-1.69]	1.02 [0.59-1.77]	0.97 [0.56-1.68]
General functioning			
Healthy		1.00 [reference]	
Unhealthy		0.76 [0.50-1.18]	
Roles			
Healthy			1.00 [reference]
Unhealthy			0.58 [0.38-0.89]*

[a] Logistic regression models were fitted and adjusted odds ratios (AOR) reported. Model 1 was adjusted for confounders (parental sex, age, ethnicity and marital status as well as child sex and age) and the other socioeconomic indicator in the table. Models 2A-2B were additionally adjusted for general family functioning and roles domain, respectively. * $p<0.05$

For criterion four, the ORs for the associations of parental education and socioeconomic classification with child toothbrushing frequency changed between -7% to -2% and -5% to 8%, respectively, after adjustment for general family functioning.

In all, the findings did not support the mediating role of family functioning in the association between family SEP and child toothbrushing frequency.

6.2. Family functioning as a mediator of the association between parental socioeconomic position and child dental caries

The results in this section are organised according to dental caries indicators, namely child levels of caries experience, untreated disease and treatment experience.

6.2.1. Child dental caries experience (dmft)

Table 6.6 shows the associations between parental SEP indicators and child dmft (criterion 1). Both SEP indicators were inversely associated with child dmft after adjustment for confounders (Model 1). Children of parents with secondary school, A-levels and higher education had, respectively, 57% (RR: 0.43, 95% CI: 0.21-0.90), 12% (RR: 0.88, 95% CI: 0.41-1.89) and 59% (RR: 0.41, 95% CI: 0.20-0.82) lower dmft scores than those whose parents had no qualifications. Furthermore, children of parents in intermediate occupations, routine/manual occupations and not working had, respectively, 2.53 (95% CI: 1.44-4.46), 1.97 (95% CI: 1.05-3.68), and 2.59 (95% CI: 1.55-4.35) times greater dmft scores than those of parents in managerial/professional occupations.

Results for criterion 2 (exposure-mediator association) were shown in Tables 6.2 and 6.3. The association between unhealthy general family functioning and child caries experience, after adjustment for confounders, is shown in Model 2A of Table 6.6 (criterion 3). Children in families with unhealthy general functioning had 1.52 (95% CI: 1.03-2.26) times greater dmft scores than those in families with healthy general

functioning. This association was fully attenuated after further adjustment for the three child dental behaviours (RR: 1.46, 95% CI: 0.99-2.15).

Table 6.6. Models for the associations of parental socioeconomic position, general functioning and child dental behaviours with child dmft (n=733).

	Model 1	**Model 2**	**Model 3**
	RR[a] [95% CI]	**RR[b] [95% CI]**	**RR[c] [95% CI]**
Parent's education			
None	1.00 [reference]	1.00 [reference]	1.00 [reference]
Secondary school	0.43 [0.21-0.90]*	0.44 [0.22-0.91]*	0.45 [0.22-0.92]*
A-levels	0.88 [0.41-1.89]	0.88 [0.41-1.88]	0.95 [0.44-2.04]
Degree or higher	0.41 [0.20-0.82]*	0.46 [0.23-0.92]*	0.48 [0.24-0.96]*
Parent's socioeconomic classification			
Managerial/professional	1.00 [reference]	1.00 [reference]	1.00 [reference]
Intermediate	2.53 [1.44-4.46]*	2.33 [1.31-4.15]*	2.20 [1.22-3.95]*
Routine/manual	1.97 [1.05-3.68]*	1.66 [0.91-3.02]	1.72 [0.94-3.17]
Not working	2.59 [1.55-4.35]*	2.35 [1.41-3.93]*	2.37 [1.38-4.09]*
General functioning			
Healthy		1.00 [reference]	1.00 [reference]
Unhealthy		1.52 [1.03-2.26]*	1.46 [0.99-2.15]
Child sugars intake			
≤4 sugary foods a day			1.00 [reference]
>4 sugary foods a day			1.05 [0.66-1.67]
Child dental attendance pattern			
Trouble visit or never visited			1.00 [reference]
Check-up in the last year			0.99 [0.63-1.57]
Child toothbrushing frequency			
Once daily or less			1.00 [reference
Twice daily or more			0.63 [0.43-0.93]*

[a] Negative binominal regression models were fitted and rate ratios (RR) were reported. Model 1 was adjusted for confounders (parental sex, age, ethnicity and marital status as well as child sex and age) and the other socioeconomic indicator in the table. [b] Model 2 was also adjusted for general family functioning. [c] Model 3 was also adjusted for the three child dental behaviours. * $p<0.05$

The RRs for the association of parental education with child dmft were attenuated by about 0.5-12% whereas the RRs for the association of parental socioeconomic classification with child dmft were attenuated by around 8-16%, after adjustment for general family functioning (criterion 4). However, none of the six specific domains of family functioning were associated with child dmft.

Overall, the findings supported the mediating role of general family functioning in the associations of parental education and socioeconomic classification with child caries experience, explaining up to 12% and 16% of those associations respectively. However, no specific domain of family functioning met the four criteria of the Baron and Kenny's approach for testing mediation.

6.2.2. Child number of decayed teeth (dt)

Table 6.7 shows the associations between parental SEP indicators and child dt (criterion 1). Both parental education and socioeconomic classification were inversely associated with child dt after adjustment for confounders (Model 1). Children of parents with secondary school, A-levels and higher education had, respectively, 63% (RR: 0.37, 95% CI: 0.17-0.79), 47% (RR: 0.53, 95% CI: 0.23-1.22) and 67% (RR: 0.33, 95% CI: 0.15-0.70) lower dt scores than those whose parents had no qualifications. Furthermore, children of parents in intermediate occupations, routine/manual occupations and not working had, respectively, 2.59 (95% CI: 1.46-4.60), 1.61 (95% CI: 0.77-3.36), and 2.46 (95% CI: 1.43-4.23) times greater dt scores than those of parents in managerial/professional occupations.

For criterion 2, the findings were already presented in Tables 6.2 and 6.3. The association between unhealthy general family functioning and child untreated caries (criterion 3) is shown in Model 2 of Table 6.7. Children in families with unhealthy general functioning had 1.93 (95% CI: 1.24-2.99) times greater dt score than those in families with healthy general functioning, after adjustment for confounders. This association remained significant after further adjustment for child dental behaviours

(RR: 1.85, 95% CI: 1.21-2.82) as shown in Model 3 of Table 6.7. However, none of the six specific domains of family functioning were associated with child dt.

Table 6.7. Models for the association of parental socioeconomic position, general functioning and child dental behaviours with child dt (n=733).

	Model 1	**Model 2**	**Model 3**
	RR[a] [95% CI]	**RR[b] [95% CI]**	**RR[c] [95% CI]**
Parent's education			
None	1.00 [reference]	1.00 [reference]	1.00 [reference]
Secondary school	0.37 [0.17-0.79]*	0.37 [0.18-0.79]*	0.39 [0.18-0.81]*
A-levels	0.53 [0.23-1.22]	0.50 [0.23-1.11]	0.55 [0.25-1.20]
Degree or higher	0.33 [0.15-0.70]*	0.39 [0.19-0.83]*	0.44 [0.21-0.92]*
Parent's socioeconomic classification			
Managerial/professional	1.00 [reference]	1.00 [reference]	1.00 [reference]
Intermediate	2.59 [1.46-4.60]*	2.39 [1.33-4.29]*	2.32 [1.26-4.27]*
Routine/manual	1.61 [0.77-3.36]	1.30 [0.65-2.58]	1.37 [0.70-2.72]
Not working	2.46 [1.43-4.23]*	2.19 [1.27-3.79]*	2.35 [1.31-4.21]*
General functioning			
Healthy		1.00 [reference]	1.00 [reference]
Unhealthy		1.93 [1.24-2.99]*	1.85 [1.21-2.82]*
Child sugars intake			
≤4 sugary foods a day			1.00 [reference]
>4 sugary foods a day			0.92 [0.57-1.49]
Child dental attendance pattern			
Trouble visit or never visited			1.00 [reference]
Check-up in the last year			0.76 [0.47-1.24]
Child toothbrushing frequency			
Once daily or less			1.00 [reference]
Twice daily or more			0.57 [0.38-0.85]*

[a] Negative binominal regression models were fitted and rate ratios (RR) were reported. Model 1 was adjusted for confounders (parental sex, age, ethnicity and marital status as well as child sex and age) and the other socioeconomic indicator in the table. Model 2 was also adjusted for general family functioning. Model 3 was also adjusted for the three child dental behaviours. * $p<0.05$

For criterion 4, the RRs for the association of parental education with child dt changed between -20% to 5% after adjustment for general family functioning whereas the RRs for the association of parental socioeconomic classification with child dt were attenuated by around 8% to 19% after the same adjustment.

In short, the findings in this section supported the mediating role of general family functioning in the associations of parental education and socioeconomic classification with child untreated caries, explaining up to 18% and 20% of those associations respectively. However, no specific domain of family functioning met the four criteria of the Baron and Kenny's approach for testing mediation.

6.2.3. Child number of missing and filled teeth (mft)

The associations between parental SEP indicators and child mft (criterion 1) are presented in Model 1 of Table 6.8. While parental education was positively associated with child mft, parental socioeconomic classification was inversely associated with child mft after adjustment for confounders. Children of parents with secondary school, A-levels and higher education had, respectively, 1.74 (95% CI: 0.55-5.51), 9.75 (95% CI: 3.32-28.69) and 1.94 (95% CI: 0.62-6.00) times higher mft scores than those whose parents had no qualifications. Furthermore, children of parents in intermediate occupations, routine/manual occupations and not working had, respectively, 1.44 (95% CI: 0.49-4.23), 3.46 (95% CI: 1.11-10.78), and 1.98 (95% CI: 0.78-5.05) times greater mft scores than those of parents in managerial/professional occupations.

Results for criterion 2 (exposure-mediator association) were shown in Tables 6.2 for general family functioning and Table 6.3 for specific domains of family functioning. The association between general family functioning and child caries treatment experience (criterion 3) is shown in Model 2 of Table 6.8. Children in families with unhealthy general functioning had 30% (RR: 0.70, 95% CI: 0.34-1.46) lower mft score than those in families with healthy general functioning. However, this association was

not significant and remained as such after further adjustment for the three child dental behaviours (RR: 0.62, 95% CI: 0.30-1.30) as shown in Model 3 of Table 6.8.

Table 6.8. Models for the association of parental socioeconomic position, general functioning and child dental behaviours with child mft (n=733).

	Model 1	**Model 2**	**Model 3**
	RR[a] [95% CI]	**RR[a] [95% CI]**	**RR[a] [95% CI]**
Parent's education			
None	1.00 [reference]	1.00 [reference]	1.00 [reference]
Secondary school	1.74 [0.55-5.51]	1.75 [0.56-5.43]	1.35 [0.40-4.51]
A-levels	9.75 [3.32-28.69]*	9.35 [3.20-27.34]*	7.49 [2.16-26.01]*
Degree or higher	1.94 [0.62-6.00]	1.79 [0.57-5.62]	1.37 [0.39-4.77]
Parent's socioeconomic classification			
Managerial/professional	1.00 [reference]	1.00 [reference]	1.00 [reference]
Intermediate	1.44 [0.49-4.23]	1.65 [0.57-4.78]	1.46 [0.50-4.29]
Routine/manual	3.46 [1.11-10.78]*	4.36 [1.45-13.04]*	3.76 [1.28-11.03]*
Not working	1.98 [0.78-5.05]	2.25 [0.90-5.65]	1.79 [0.71-4.52]
General functioning			
Healthy		1.00 [reference]	1.00 [reference]
Unhealthy		0.70 [0.34-1.46]	0.62 [0.30-1.30]
Child sugars intake			
≤4 sugary foods a day			1.00 [reference]
>4 sugary foods a day			1.37 [0.60-3.12]
Child dental attendance pattern			
Trouble visit or never visited			1.00 [reference]
Check-up in the last year			2.31 [1.16-4.60]*
Child toothbrushing frequency			
Once daily or less			1.00 [reference]
Twice daily or more			0.53 [0.25-1.13]

[a] Negative binominal regression models were fitted and rate ratios (RR) were reported. Model 1 was adjusted for confounders (parental sex, age, ethnicity and marital status as well as child sex and age) and the other socioeconomic indicator in the table. Model 2 was also adjusted for general family functioning. Model 3 was also adjusted for the three child dental behaviours. * $p<0.05$

For criterion 4, the RRs for the association of parental education with child mft were attenuated by about 1-7% after adjustment for general family functioning whereas the RRs for the association of parental socioeconomic classification with child mft changed between 14 to 26%, after a similar adjustment.

In the analysis by domains, three of the six domains of family functioning were associated with the child caries treatment experience (Tables 6.9, 6.10 and 6.11). Children in families with unhealthy functioning in roles, affective responsiveness and behaviour control had, respectively, 63% (RR: 0.37, 95% CI: 0.18-0.77), 64% (RR: 0.36, 95% CI: 0.15-0.88) and 75% (RR: 0.25, 95% CI: . 0.11-0.55) lower mft scores than those in families with healthy functioning in each of those domains. The RRs for

Table 6.9. Models for the associations of parental socioeconomic position, roles domains and child dental behaviours with child mft (n=733).

	Model 1	**Model 2**	**Model 3**
	RR[a] [95% CI]	**RR[b] [95% CI]**	**RR[c] [95% CI]**
Parent's education			
None	1.00 [reference]	1.00 [reference]	1.00 [reference]
Secondary school	1.74 [0.55-5.51]	1.58 [0.49-5.09]	1.21 [0.33-4.39]
A-levels	9.75 [3.32-28.69]*	7.57 [2.50-22.88]*	5.97 [1.55-22.98]*
Degree or higher	1.94 [0.62-6.00]	1.80 [0.54-5.99]	1.38 [0.53-5.48]
Parent's socioeconomic classification			
Managerial/professional	1.00 [reference]	1.00 [reference]	1.00 [reference]
Intermediate	1.44 [0.49-4.23]	1.97 [0.67-5.76]	1.66 [0.57-4.89]
Routine/manual	3.46 [1.11-10.78]*	4.74 [1.59-14.12]*	3.78 [1.29-11.05]*
Not working	1.98 [0.78-5.05]	2.11 [0.89-5.02]	1.60 [0.64-3.98]
Roles			
Healthy		1.00 [reference]	1.00 [reference]
Unhealthy		0.37 [0.18-0.77]*	0.33 [0.16-0.68]*
Child sugars intake			
≤4 sugary foods a day			1.00 [reference]
>4 sugary foods a day			1.49 [0.68-3.29]
Child dental attendance pattern			
Trouble visit or never visited			1.00 [reference]
Check-up in the last year			2.45 [1.25-4.79]*
Child toothbrushing frequency			
Once daily or less			1.00 [reference]
Twice daily or more			0.52 [0.24-1.11]

[a] Negative binominal regression models were fitted and rate ratios (RR) were reported. Model 1 was adjusted for confounders (parental sex, age, ethnicity and marital status as well as child sex and age) and the other socioeconomic indicator in the table. Model 2 was also adjusted for general family functioning. Model 3 was also adjusted for the three child dental behaviours. * $p<0.05$

the association of parental education and socioeconomic classification with child mft score changed between -22% to -7% and 7% to 37% after adjustment for the roles domain, between -20% to -13% and 6% to 46% after adjustment for the affective responsiveness domain and between -35% to -24% and 30% to 56% after adjustment for the behaviour control domain, respectively.

Table 6.10. Models for the associations of parental socioeconomic position, affective responsiveness domain and child dental behaviours with child mft (n=733).

	Model 1	**Model 2**	**Model 3**
	RR[a] [95% CI]	**RR[b] [95% CI]**	**RR[c] [95% CI]**
Parent's education			
None	1.00 [reference]	1.00 [reference]	1.00 [reference]
Secondary school	1.74 [0.55-5.51]	1.40 [0.44-4.42]	1.17 [0.34-4.02]
A-levels	9.75 [3.32-28.69]*	8.50 [2.71-26.65]*	7.24 [1.94-27.06]*
Degree or higher	1.94 [0.62-6.00]	1.67 [0.51-5.53]	1.41 [0.39-5.09]
Parent's socioeconomic classification			
Managerial/professional	1.00 [reference]	1.00 [reference]	1.00 [reference]
Intermediate	1.44 [0.49-4.23]	1.53 [0.52-4.53]	1.33 [0.43-4.06]
Routine/manual	3.46 [1.11-10.78]*	5.06 [1.56-16.43]*	4.01 [1.26-12.78]*
Not working	1.98 [0.78-5.05]	2.11 [0.85-5.23]	1.68 [0.66-4.29]
Affective responsiveness			
Healthy		1.00 [reference]	1.00 [reference]
Unhealthy		0.36 [0.15-0.88]*	0.40 [0.17-0.95]*
Child sugars intake			
≤4 sugary foods a day			1.00 [reference]
>4 sugary foods a day			1.38 [0.62-3.05]
Child dental attendance pattern			
Trouble visit or never visited			1.00 [reference]
Check-up in the last year			2.04 [1.04-3.97]*
Child toothbrushing frequency			
Once daily or less			1.00 [reference]
Twice daily or more			0.64 [0.32-1.31]

[a] Negative binominal regression models were fitted and rate ratios (RR) were reported. Model 1 was adjusted for confounders (parental sex, age, ethnicity and marital status as well as child sex and age) and the other socioeconomic indicator in the table. Model 2 was also adjusted for general family functioning. Model 3 was also adjusted for the three child dental behaviours. * $p<0.05$

Table 6.11. Models for the associations of parental socioeconomic position, behaviour control domain and child dental behaviours with child mft (n=733).

	Model 1	**Model 1**	**Model 1**
	RR[a] [95% CI]	**RR[b] [95% CI]**	**RR[c] [95% CI]**
Parent's education			
None	1.00 [reference]	1.00 [reference]	1.00 [reference]
Secondary school	1.74 [0.55-5.51]	1.23 [0.41-3.70]	1.01 [0.30-3.37]
A-levels	9.75 [3.32-28.69]*	7.44 [2.43-22.77]*	6.36 [1.77-22.89]*
Degree or higher	1.94 [0.62-6.00]	1.25 [0.39-4.02]	1.07 [0.29-3.94]
Parent's socioeconomic classification			
Managerial/professional	1.00 [reference]	1.00 [reference]	1.00 [reference]
Intermediate	1.44 [0.49-4.23]	2.00 [0.67-5.97]	1.70 [0.56-5.13]
Routine/manual	3.46 [1.11-10.78]*	4.51 [1.61-12.61]*	3.68 [1.31-10.35]*
Not working	1.98 [0.78-5.05]	3.10 [1.23-7.81]*	2.35 [0.89-6.15]
Behaviour control			
Healthy		1.00 [reference]	1.00 [reference]
Unhealthy		0.25 [0.11-0.55]*	0.27 [0.12-0.58]*
Child sugars intake			
≤4 sugary foods a day			1.00 [reference]
>4 sugary foods a day			1.44 [0.62-3.32]
Child dental attendance pattern			
Trouble visit or never visited			1.00 [reference]
Check-up in the last year			2.04 [1.05-3.94]*
Child toothbrushing frequency			
Once daily or less			1.00 [reference]
Twice daily or more			0.56 [0.27-1.16]

[a] Negative binominal regression models were fitted and rate ratios (RR) were reported. Model 1 was adjusted for confounders (parental sex, age, ethnicity and marital status as well as child sex and age) and the other socioeconomic indicator in the table. Model 2 was also adjusted for general family functioning. Model 3 was also adjusted for the three child dental behaviours. * $p<0.05$

In the end, the findings did not support the mediating role of general family functioning in the association of family SEP with child caries treatment experience. However, there was evidence that three specific domains of family functioning (roles, affective responsiveness and behaviour control) mediate the association between parental education and child caries treatment experience.

6.3. Family functioning as a mediator of the association between parental socioeconomic position and child OHRQoL

The findings in this section are organised according to the three OHRQoL scores assessed, namely ECOHIS total score, CIS score and FIS score, respectively.

6.3.1. ECOHIS total score

For criterion 1, the association between parental SEP indicators and the child ECOHIS total score is shown in Table 6.12. Parental socioeconomic classification, but not parental education, was associated with the ECOHIS total score after adjustment for confounders (Model 1). Children of parents in intermediate occupations, routine/manual occupations and not working had, respectively, 2.16 (95% CI: 1.06-4.41). 1.45 (95% CI: 0.71-2.94) and 1.52 (95% CI: 0.77-3.02) times greater ECOHIS total scores than those of parents in managerial/professional occupations.

For criterion 2, the results of the exposure-mediator association were already shown in Tables 6.2 and 6.3. For criterion 3, the association between unhealthy general family functioning and the ECOHIS total score is shown in Model 2 of Table 6.12. Children in families with unhealthy general functioning had 1.39 (95% CI: 0.83-2.34) times greater ECOHIS total score than those in families with healthy general functioning after adjustment for confounders. This association was not significant and remained unchanged after further adjustments for child dental behaviours in Model 3 (RR: 1.51, 95% CI: 0.92-2.48), and child dental caries experience in Model 4 (RR: 1.41, 95% CI: 0.86-2.34). Similarly, none of the six specific domains of family functioning were associated with the ECOHIS total score after adjustment for confounders.

Table 6.12. Models for the associations of parental socioeconomic position, general family functioning, child dental behaviours and child dental caries with ECOHIS total score (n=714).

	Model 1	**Model 2**	**Model 3**	**Model 4**
	RR[a] [95% CI]	**RR[b] [95% CI]**	**RR[c] [95% CI]**	**RR[c] [95% CI]**
Parent's education				
None	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Secondary school	1.17 [0.49-2.78]	1.14 [0.48-2.70]	0.85 [0.35-2.04]	0.83 [0.34-2.02]
A-levels	1.42 [0.61-3.32]	1.45 [0.61-3.43]	1.62 [0.62-4.21]	1.17[0.45-3.02]
Degree or higher	1.09 [0.45-2.64]	1.23 [0.48-3.13]	1.44 [0.53-3.92]	1.48 [0.54-4.05]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Intermediate	2.16 [1.06-4.41]*	2.11 [1.04-4.30]*	2.37 [1.18-4.78]*	1.96 [0.98-3.93]
Routine/manual	1.45 [0.71-2.94]	1.32 [0.63-2.76]	1.28 [0.67-2.47]	1.04 [0.55-1.95]
Not working	1.52 [0.77-3.02]	1.65 [0.83-3.27]	1.67 [0.83-3.35]	1.30 [0.63-2.66]
General functioning				
Healthy		1.00 [reference]	1.00 [reference]	1.00 [reference]
Unhealthy		1.39 [0.83-2.34]	1.51 [0.92-2.48]	1.41 [0.86-2.34]
Child sugars intake				
≤4 sugary foods a day			1.00 [reference]	1.00 [reference]
>4 sugary foods a day			2.25 [1.20-4.23]*	2.62 [1.35-5.06]*
Child dental attendance pattern				
Trouble visit or never visited			1.00 [reference]	1.00 [reference]
Check-up in the last year			0.57 [0.35-0.93]*	0.57 [0.36-0.92]*
Child toothbrushing frequency				
Once daily or less			1.00 [reference]	1.00 [reference]
Twice daily or more			1.68 [1.03-2.73]*	2.11 [1.34-3.34]*
Child dental caries experience				
dmft=0				1.00 [reference]
dmft>0				4.11 [2.50-6.74]*

[a] Negative binominal regression models were fitted and rate ratios (RR) were reported. Model 1 was adjusted for confounders (parental sex, age, ethnicity and marital status as well as child sex and age) and the other socioeconomic indicator in the table. Model 2 was also adjusted for general family functioning. Model 3 was further adjusted for the three child dental behaviours. Model 4 was also adjusted for child dental caries experience. * $p<0.05$

For criterion 4, the RRs for the association between parental education and the ECOHIS total score varied between -3% to 12% after adjustment for general family functioning whereas the RRs for the association of parental socioeconomic classification with the ECOHIS total score changed between -9% to 8%, after the same adjustment.

In conclusion, the findings did not support the mediating role of family functioning in the association between family SEP and the ECOHIS total score.

6.3.2. Child Impacts Section (CIS) score

Table 6.13 shows the associations between the two parental SEP indicators and the CIS score (criterion 1). Parental socioeconomic classification, but not parental education, was associated with the CIS score after adjustment for confounders (Model 1). Children of parents in intermediate occupations, routine/manual occupations and not working had, respectively, 2.25 (95% CI: 1.10-4.60), 1.47 (95% CI: 0.75-2.91) and 1.69 (95% CI: 0.84-3.37) times greater CIS scores than those of parents in managerial/professional occupations (Model 1).

Estimates for the exposure-mediator association (criterion 2) were shown earlier in Tables 6.2 and 6.3. The confounder-adjusted association between unhealthy general family functioning and the CIS score (criterion 3) is shown in Model 2 of Table 6.13. Children in families with unhealthy general functioning had 1.20 (95% CI: 0.69-2.10) times greater CIS score than those in families with healthy general functioning. However, this association was not significant and remained as such after further adjustments for child dental behaviours in Model 3 (RR: 1.29, 95% CI: 0.76-2.19), and child dental caries experience in Model 4 (RR: 1.22, 95% CI: 0.71-2.08). Similar to results for general functioning, none of the six specific domains of family functioning were associated with the CIS score after adjustment for confounders.

For criterion 4, the RRs for the association of parental education with the CIS score changed between -2% to 6% after adjustment for general functioning whereas the RRs

for the association of parental socioeconomic classification with the CIS score changed between by -7% to 5%, after such an adjustment.

Summing up, the findings did not support the mediating role of family functioning in the association between family SEP and the CIS score.

Table 6.13. Models for the associations of parental socioeconomic position, general family functioning , child dental behaviours and child dental caries with CIS score (n=714).

	Model 1	**Model 2**	**Model 3**	**Model 4**
	RR[a] [95% CI]	**RR[b] [95% CI]**	**RR[c] [95% CI]**	**RR[c] [95% CI]**
Parent's education				
None	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Secondary school	1.43 [0.57-3.56]	1.40 [0.56-3.51]	1.39 [0.60-3.23]	1.12 [0.43-2.93]
A-levels	1.51 [0.61-3.74]	1.53 [0.61-3.81]	2.41 [0.97-5.95]	1.58 [0.57-4.41]
Degree or higher	1.30 [0.50-3.36]	1.38 [0.51-3.68]	2.20 [0.85-5.71]	1.81 [0.63-5.23]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Intermediate	2.25 [1.10-4.60]*	2.22 [1.08-4.55]*	2.29 [1.14-4.64]*	1.95 [0.97-3.90]
Routine/manual	1.47 [0.75-2.91]	1.37 [0.67-2.81]	1.47 [0.75-2.88]	1.28 [0.67-2.47]
Not working	1.69 [0.84-3.37]	1.76 [0.88-3.54]	1.58 [0.78-3.20]	1.33 [0.64-2.73]
General functioning				
Healthy		1.00 [reference]	1.00 [reference]	1.00 [reference]
Un-healthy		1.20 [0.69-2.10]	1.29 [0.76-2.19]	1.22 [0.71-2.08]
Child sugars intake				
≤4 sugary foods a day			1.00 [reference]	1.00 [reference]
>4 sugary foods a day			2.54 [1.36-4.75]*	2.70 [1.41-5.18]*
Child dental attendance pattern				
Trouble visit or never visited			1.00 [reference]	1.00 [reference]
Check-up in the last year			0.51 [0.31-0.84]*	0.52 [0.31-0.85]*
Child toothbrushing frequency				
Once daily or less			1.00 [reference	1.00 [reference]
Twice daily or more			1.50 [0.91-2.46]	1.82 [1.13-2.92]*
Child dental caries experience				
dmft=0				1.00 [reference]
dmft>0				2.93 [1.73-4.94]*

[a] Negative binominal regression models were fitted and rate ratios (RR) were reported. Model 1 was adjusted for confounders (parental sex, age, ethnicity and marital status as well as child sex and age) and the other socioeconomic indicators in the table. Model 2 was also adjusted for general family functioning. Model 3 was further adjusted for the three child dental behaviours. Model 4 was also adjusted for child dental caries experience. * $p<0.05$

6.3.3. Family Impacts Section (FIS) score

Table 6.14 presents the associations between parental SEP indicators and the FIS score (criterion 1). Neither parental education nor socioeconomic classification was associated with the FIS score after adjustment for confounders (Model 1). The results for criterion 2 were shown earlier in Tables 6.2 and 6.3.

Table 6.14. Models for the associations of parental socioeconomic position, general family functioning, child dental behaviours and child dental caries with FIS score (n=714).

	Model 1	**Model 2**	**Model 3**	**Model 4**
	RR[a] [95% CI]	**RR[b] [95% CI]**	**RR[c] [95% CI]**	**RR[c] [95% CI]**
Parent's education				
None	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Secondary school	0.77 [0.23-2.64]	0.74 [0.22-2.43]	0.45 [0.13-1.54]	0.85 [0.26-2.74]
A-levels	1.09 [0.36-3.31]	1.13 [0.37-3.44]	0.92 [0.26-3.33]	0.86 [0.25-2.93]
Degree or higher	0.76 [0.24-2.43]	0.97 [0.30-3.12]	0.86 [0.23-3.21]	1.62 [0.42-6.20]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Intermediate	2.08 [0.88-4.87]	1.98 [0.85-4.59]	2.45 [1.04-5.76]*	1.81 [0.78-4.21]
Routine/manual	1.59 [0.61-4.16]	1.46 [0.54-3.96]	1.18 [0.43-3.21]	0.61 [0.24-1.52]
Not working	1.12 [0.48-2.61]	1.23 [0.52-2.91]	1.28 [0.54-3.02]	0.91 [0.34-2.43]
General functioning				
Healthy		1.00 [reference]	1.00 [reference]	1.00 [reference]
Un-healthy		1.90 [1.03-3.49]	1.99 [1.09-3.62]*	2.08 [1.13-3.82]*
Child sugars intake				
≤4 sugary foods a day			1.00 [reference]	1.00 [reference]
>4 sugary foods a day			1.75 [0.77-3.95]	2.16 [1.02-4.61]*
Child dental attendance pattern				
Trouble visit or never visited			1.00 [reference]	1.00 [reference]
Check-up in the last year			0.58 [0.30-1.13]	0.70 [0.37-1.31]
Child toothbrushing frequency				
Once daily or less			1.00 [reference	1.00 [reference]
Twice daily or more			2.23 [1.18-4.22]	3.01 [1.57-5.76]*
Child dental caries experience				
dmft=0				1.00 [reference]
dmft>0				8.29 [4.69-14.66]*

[a] Negative binominal regression models were fitted and rate ratios (RR) were reported. Model 1 was adjusted for confounders (parental sex, age, ethnicity and marital status as well as child sex and age) and the other socioeconomic indicators in the table. Model 2 was also adjusted for general family functioning. Model 3 was further adjusted for the three child dental behaviours. Model 4 was also adjusted for child dental caries experience. * $p<0.05$

The association between unhealthy general family functioning and the FIS score (criterion 3) is shown in Model 2 of Table 6.14. After adjustment for confounders, children in families with unhealthy general functioning had 1.90 (95% CI: 1.03-3.49) times greater FIS score than those in families with healthy general functioning, although this association was not significant. However, this association became significant after further adjustments for the three child dental behaviours in Model 3 (RR: 1.99, 95% CI: 01.09-3.62), and remained significant after additional adjustment for child dental caries experience in Model 4 (RR: 2.08, 95% CI: 1.13-3.82). After adjustment for general family functioning, the RRs for the association of parental education with the FIS score changed between -28% to 3% whereas the RRs for the association of parental socioeconomic classification with the FIS score changed between -8% to 9% (criterion 4).

In the analysis by domains of family functioning, three of the six domains of family functioning were associated with the FIS score. Children in families with unhealthy functioning in the problem solving domain had 2.12 (95% CI: 0.95-4.71) times higher FIS score than those in families with healthy functioning, after adjustment for confounders (Model 2 in Table 6.15). Although this association was not significant, it become significant after further adjustment for child dental behaviours in Model 3 (RR: 2.67, 95% CI: 1.17-6.07) and remained significant after additional adjustment for dental caries in Model 4 (RR: 2.84, 95% CI: 1.13-7.12). The RRs for the association of parental education with the FIS score increased between 6% and 10% whereas the RRs for the association of parental socioeconomic classification with the FIS score changed between -1% to 13% after adjustment for the problem solving domain.

Table 6.15. Models for the associations of parental socioeconomic position, problem solving domain, child dental behaviours and child dental caries with the FIS score (n=714).

	Model 1	**Model 2**	**Model 3**	**Model 4**
	RR[a] [95% CI]	**RR[a] [95% CI]**	**RR[a] [95% CI]**	**RR[a] [95% CI]**
Parent's education				
None	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Secondary school	0.77 [0.23-2.64]	0.72 [0.21-2.49]	0.36 [0.10-1.34]	0.76 [0.23-2.54]
A-levels	1.09 [0.36-3.31]	0.98 [0.32-3.00]	0.70 [0.18-2.66]	0.68 [0.20-2.34]
Degree or higher	0.76 [0.24-2.43]	0.71 [0.22-2.27]	0.57 [0.14-2.31]	1.19 [0.31-4.48]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Intermediate	2.08 [0.88-4.87]	2.23 [0.94-5.27]	2.92 [1.22-6.98]*	2.08 [0.87-4.98]
Routine/manual	1.59 [0.61-4.16]	1.58 [0.61-4.09]	1.31 [0.49-3.51]	0.77 [0.31-1.92]
Not working	1.12 [0.48-2.61]	1.28 [0.53-3.05]	1.37 [0.59-3.18]	1.07 [0.44-2.62]
Problem solving				
Healthy		1.00 [reference]	1.00 [reference]	1.00 [reference]
Unhealthy		2.12 [0.95-4.71]	2.67 [1.17-6.07]*	2.84 [1.13-7.12]*
Child sugars intake				
≤4 sugary foods a day			1.00 [reference]	1.00 [reference]
>4 sugary foods a day			1.87 [0.80-4.37]	2.48 [1.08-5.69]*
Child dental attendance pattern				
Trouble visit or never visited			1.00 [reference]	1.00 [reference]
Check-up in the last year			0.53 [0.27-1.05]	0.64 [0.32-1.27]
Child toothbrushing frequency				
Once daily or less			1.00 [reference]	1.00 [reference]
Twice daily or more			2.29 [1.21-4.34]*	2.97 [1.58-5.58]*
Child dental caries experience				
dmft=0				1.00 [reference]
dmft>0				8.44 [4.69-15.19]*

[a] Negative binominal regression models were fitted and rate ratios (RR) were reported. Model 1 was adjusted for confounders (parental sex, age, ethnicity and marital status as well as child sex and age) and the other socioeconomic indicators in the table. Model 2 was also adjusted for general family functioning. Model 3 was further adjusted for the three child dental behaviours. Model 4 was also adjusted for child dental caries experience. * $p<0.05$

Furthermore, children in families with unhealthy functioning in the roles domain had 1.74 (95% CI: 0.93-3.25) times higher FIS score than those in families with healthy functioning in those domains, after adjustment for confounders (Model 2 in Table 6.16). This association become significant only after further adjustments for child dental behaviours and child caries experience in Model 4 (RR: 1.94, 95% CI: 1.06-3.55). The

RRs for the association between parental education and the FIS score changed between -12% and 21% after adjustment for the roles domain whereas the RRs for the association between parental socioeconomic classification and the FIS score changed between -4% to 7% after the same adjustment.

Table 6.16. Models for the associations of parental socioeconomic position, roles domain, child dental behaviours and child dental caries with the FIS score (n=714).

	Model 1	**Model 2**	**Model 3**	**Model 4**
	RR[a] [95% CI]	**RR[a] [95% CI]**	**RR[a] [95% CI]**	**RR[a] [95% CI]**
Parent's education				
None	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Secondary school	0.77 [0.23-2.64]	0.61 [0.18-2.10]	0.39 [0.11-1.43]	0.71 [0.23-2.20]
A-levels	1.09 [0.36-3.31]	1.08 [0.35-3.38]	0.88 [0.23-3.40]	0.86 [0.26-2.82]
Degree or higher	0.76 [0.24-2.43]	0.85 [0.26-2.84]	0.70 [0.17-2.77]	1.47 [0.40-5.37]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Intermediate	2.08 [0.88-4.87]	1.99 [0.81-4.88]	2.34 [0.95-5.74]	1.73 [0.74-4.04]
Routine/manual	1.59 [0.61-4.16]	1.70 [0.63-4.55]	1.37 [0.49-3.81]	0.74 [0.31-1.77]
Not working	1.12 [0.48-2.61]	1.20 [0.52-2.78]	1.27 [0.55-2.90]	1.02 [0.41-2.55]
Roles				
Healthy		1.00 [reference]	1.00 [reference]	1.00 [reference]
Unhealthy		1.74 [0.93-3.25]	1.53 [0.81-2.89]	1.94 [1.06-3.55]*
Child sugars intake				
≤4 sugary foods a day			1.00 [reference]	1.00 [reference]
>4 sugary foods a day			1.80 [0.79-4.07]	2.23 [1.02-4.90]*
Child dental attendance pattern				
Trouble visit or never visited			1.00 [reference]	1.00 [reference]
Check-up in the last year			0.66 [0.33-1.30]	0.78 [0.40-1.51]
Child toothbrushing frequency				
Once daily or less			1.00 [reference]	1.00 [reference]
Twice daily or more			2.17 [1.15-4.10]*	2.92 [1.54-5.51]*
Child dental caries experience				
dmft=0				1.00 [reference]
dmft>0				8.70 [4.96-15.28]*

[a] Negative binominal regression models were fitted and rate ratios (RR) were reported. Model 1 was adjusted for confounders (parental sex, age, ethnicity and marital status as well as child sex and age) and the other socioeconomic indicators in the table. Model 2 was also adjusted for general family functioning. Model 3 was further adjusted for the three child dental behaviours. Model 4 was also adjusted for child dental caries experience. * $p<0.05$

Table 6. 17. Models for the associations of parental socioeconomic position, affective involvement domain, child dental behaviours, and child dental caries with FIS score (n=714).

	Model 1	**Model 2**	**Model 3**	**Model 4**
	RR[a] [95% CI]	**RR[a] [95% CI]**	**RR[a] [95% CI]**	**RR[a] [95% CI]**
Parent's education				
None	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Secondary school	0.77 [0.23-2.64]	0.75 [0.22-2.56]	0.46 [0.13-1.63]	0.83 [0.26-2.71]
A-levels	1.09 [0.36-3.31]	1.19 [0.38-3.78]	0.99 [0.26-3.78]	0.96 [0.27-3.39]
Degree or higher	0.76 [0.24-2.43]	0.90 [0.27-2.94]	0.76 [0.20-2.96]	1.54 [0.41-5.85]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Intermediate	2.08 [0.88-4.87]	1.89 [0.80-4.48]	2.28 [0.96-5.40]	1.61 [0.70-3.70]
Routine/manual	1.59 [0.61-4.16]	1.60 [0.58-4.43]	1.31 [0.45-3.80]	0.64 [0.26-1.60]
Not working	1.12 [0.48-2.61]	1.03 [0.45-2.33]	1.12 [0.50-2.52]	0.78 [0.31-1.95]
Affective involvement				
Healthy		1.00 [reference]	1.00 [reference]	1.00 [reference]
Unhealthy		1.62 [0.83-3.16]	1.49 [0.78-2.88]	1.90 [1.04-3.47]*
Child sugars intake				
≤4 sugary foods a day			1.00 [reference]	1.00 [reference]
>4 sugary foods a day			1.92 [0.84-4.35]	2.38 [1.10-5.12]*
Child dental attendance pattern				
Trouble visit or never visited			1.00 [reference]	1.00 [reference]
Check-up in the last year			0.63 [0.32-1.25]	0.75 [0.39-1.44]
Child toothbrushing frequency				
Once daily or less			1.00 [reference	1.00 [reference]
Twice daily or more			2.11 [1.13-3.97]*	2.95 [1.58-5.49]*
Child dental caries experience				
dmft=0				1.00 [reference]
dmft>0				8.80 [4.95-15.65]*

[a] Negative binominal regression models were fitted and rate ratios (RR) were reported. Model 1 was adjusted for confounders (parental sex, age, ethnicity and marital status as well as child sex and age) and the other socioeconomic indicators in the table. Model 2 was also adjusted for general family functioning. Model 3 was further adjusted for the three child dental behaviours. Model 4 was also adjusted for child dental caries experience. * $p<0.05$

Finally, children in families with unhealthy functioning in the affective involvement domain had 1.62 (95% CI: 0.83-3.16) times higher FIS score than those in families with healthy functioning in that domain, after adjustment for confounders (Model 2 in Table 6.17). This association become significant only after additional adjustments for child dental behaviours and childhood caries experience (RR: 1.90, 95% CI: 1.04-3.47). The

RRs for the association between parental education and the FIS score changed between -3% and 18% after adjustment for the affective involvement domain whereas the association between parental socioeconomic classification and the FIS score changed between -9% and 1% after adjustment for that same domain.

In brief, the findings did not support the mediating role of family functioning in the association between family SEP and the FIS score.

6.5. Summary of chapter 6

This chapter reported findings from analyses testing the mediating role of family functioning in the association between family SEP and child oral health, according to the Baron and Kenny's approach. For child dental behaviours, there was evidence that family functioning mediated, at least partially, the association of parental socioeconomic classification with child sugars intake, but not with child dental attendance or toothbrushing frequency. Roles, affective involvement and behaviour control were the specific domains with the strongest evidence supporting mediation.

For caries indicators, there was evidence that general family functioning mediated, partially, the association of family SEP with child caries experience (dmft) and untreated caries (dt). However, no specific domains of family functioning met the four criteria to support their mediating role. The opposite was true for caries treatment experience (mft), for which there was evidence of mediation for the domains of roles, affective responsiveness and behaviour control, but not for general functioning.

Finally, there was no evidence that general or specific domains of family functioning mediated the association between family SEP and child OHRQoL.

Chapter 7

The moderating role of family functioning in the association between family SEP and child oral health

This chapter reports analyses testing whether the associations of family SEP with child dental behaviours, dental caries and OHRQoL are modified by family functioning. There is moderation when the effect of an exposure (e.g., parental SEP) on an outcome (child oral health) varies depending on the level of a third variable (family functioning).

7.1. The moderating role of family functioning in the association between family SEP and child dental behaviours

The findings in this section are organised by chid dental behaviours (sugars intake, toothbrushing frequency and dental attendance).

7.1.1. Child sugars intake

Table 7.1 presents the ORs for each stratum of family SEP (according to education or socioeconomic classification) and general family functioning using participants with the lowest odds of high child sugars intake as a reference category (i.e., parents with higher education and healthy family functioning as well as parents with managerial/professional occupations and healthy family functioning), after adjustment for confounders. There was no interaction between parental education and general family functioning on the multiplicative or additive scales. Furthermore, no interaction

between parental socioeconomic classification and general family functioning was found in either the additive or the multiplicative scales.

Table 7.1. Estimates for the moderating role of general family functioning in the association between family SEP and child sugars intake

	General functioning		**Measure of interaction**	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	OR[a] **[95% CI]**	**OR**[a] **[95% CI]**	**OR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	1.74 [0.68-4.46]		
A-levels	1.94 [0.68-5.51]	2.30 [0.92-5.76]	0.68 [0.18-2.63]	-0.38 [-2.90, 2.13]
Secondary school	1.37 [0.45-4.15]	3.37 [1.30-8.77]*	1.41 [0.36-5.53]	1.26 [-1.43, -3.94]
None	0.93 [0.13-6.50]	2.76 [0.84-9.01]	1.71 [0.19-15.58]	1.09 [-2.22, 4.40]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	2.28 [0.87-5.99]		
Intermediate	2.87 [0.86-9.53]	7.84 [2.19-28.00]*	1.20 [0.23-6.34]	3.69 [-5.03, 12.41]
Routine/manual	0.96 [0.20-4.73]	4.63 [1.67-12.85]*	2.11 [0.34-13.00]	2.39 [-1.47, 6.25]
Not working	6.81 [2.21-21.00]*	6.47 [2.40-17.46]*	0.42 [0.12-1.48]	-1.61 [-7.68, 4.45]

[a] Logistic regression was fitted and odds ratios (OR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of general functioning with parent's education (p=0.724) and general functioning with parent's socioeconomic classification (p=0.231).

Of the six specific domains of family functioning assessed, only problem solving was found to modify the association of parental socioeconomic classification with child sugars intake (Table 7.2). There was evidence of a negative multiplicative, negative additive interaction with parental socioeconomic classification, which was limited to children whose parents had routine/manual occupations and unhealthy problem solving. Children of parents with routine/manual occupations and unhealthy problem solving had lower odds, in both the multiplicative (OR: 0.03, 95% CI: 0.00-0.40) and additive scales (RERI: -4.35, 95% CI: -8.66, -0.04), of consuming over 4 sugary items a day than children whose parents only had one of those characteristics (either routine/manual occupations or unhealthy problem solving).

Table 7.2. Estimates for the moderating role of problem solving in the association between family SEP and child sugars intake

	Problem solving		**Measure of interaction**	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	OR[a] **[95% CI]**	**OR**[a] **[95% CI]**	**OR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	4.06 [1.04-15.80]*		
A-levels	1.83 [0.88-3.84]	3.02 [0.94-9.74]	0.41 [0.07-2.27]	-1.87 [-7.95, 4.20]
Secondary school	2.29 [1.04-5.07]*	2.48 [0.80-7.63]	0.27 [0.05- 1.48]	-2.87 [-8.90, 3.15]
None	2.25 [0.79-6.38]	1.37 [0.15-12.37]	0.15 [0.01- 2.13]	-3.94 [-10.52, 2.64]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	2.49 [0.84-7.40]		
Intermediate	3.26 [1.27-8.38]*	11.73 [1.56-88.22]*	1.45 [0.15-13.82]	6.99 [-15.83, 29.81]
Routine/manual	3.12 [1.34-7.26]*	0.26 [0.03-2.42]	0.03 [0.00-0.40]*	-4.35 [-8.66, -0.04]*
Not working	4.86 [2.17-10.85]*	7.44 [2.38-23.31]*	0.62 [0.15-2.57]	1.08 [-6.07, 8.27]

[a] Logistic regression was fitted and odds ratios (OR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of problem solving with parent's education (p= 0.380) and problem solving with parent's socioeconomic classification (p= 0.047).

7.1.2. Child dental attendance

Table 7.3 shows the ORs for each stratum of family SEP (either education or socioeconomic classification) and general family functioning as well as the measures of interaction in the multiplicative and additive scales. There was no evidence that general family functioning moderated the associations of parental education and socioeconomic classification with child dental attendance in either the multiplicative or additive scale.

Similarly, there was no evidence that any of the six specific domains of family functioning modified the associations of parental education and socioeconomic classification with child dental attendance on the multiplicative or additive scale.

Table 7.3. Estimates for the moderating role of general family functioning in the association between family SEP and child dental attendance

	General functioning		Measure of interaction	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	OR[a] **[95% CI]**	**OR**[a] **[95% CI]**	**OR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	1.34 [0.71-2.52]		
A-levels	1.87 [0.89-3.94]	0.73 [0.34-1.59]	0.29 [0.10-0.89]*	-1.47 [-3.20, 0.26]
Secondary school	0.54 [0.23-1.25]	0.64 [0.32-1.29]	0.88 [0.30-2.59]	-0.24 [-1.19, 0.72]
None	0.19 [0.04-0.88]*	0.42 [0.14-1.29]	1.62 [0.26-10.19]	-0.11 [-1.05, 0.83]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	0.97 [0.50-1.87]		
Intermediate	1.01 [0.45-2.26]	1.92 [0.86-4.29]	1.97 [0.61-6.38]	0.94 [-0.65, 2.54]
Routine/manual	1.96 [0.75-5.11]	0.63 [0.27- 1.48]	0.33 [0.09-1.25]	-1.30 [-3.34, 0.75]
Not working	1.02 [0.42-2.48]	1.10 [0.54-2.23]	1.11 [0.35-3.48]	0.11 [-1.05, 1.27]

[a] Logistic regression was fitted and odds ratios (OR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of general functioning with parent's education (p= 0.116) and general functioning with parent's socioeconomic classification (p=0.141).

7.1.3. Child toothbrushing frequency

Table 7.4 presents the ORs for each stratum of family SEP and general family functioning as well as the measures of interaction. No interaction between family SEP (either parental education or socioeconomic classification) and general family functioning was seen in either the multiplicative or additive scales.

In subsequent analysis, there was evidence of interaction with family SEP for two of the six specific domains of family functioning. For the affective involvement domain, there was evidence of a positive multiplicative positive additive interaction with parental education (Table 7.5). On the additive scale, children of parents with A-level education and unhealthy affective involvement (RERI: 0.60, 95% CI: 0.09, 1.10), those of parents with secondary school education and unhealthy affective involvement (RERI: 0.83, 95% CI: 0.38, 1.27), and those of parents with no qualifications and unhealthy affective involvement (RERI: 0.61, 95% CI: 0.07, 1.14) had greater odds of

brushing their teeth twice or more often a day than children whose parents had only that specific education level or unhealthy affective involvement. On the multiplicative scale, children of parents with secondary school education and unhealthy affective involvement had greater odds of brushing their teeth twice or more often a day (OR: 4.10, 95% CI: 1.46-11.57) than those of parents with only one of those two characteristics (either secondary school education or unhealthy affective involvement). For the behaviour control domain, there was evidence of a no multiplicative positive additive interaction with parental education, although this effect was limited to the stratum of parents with no qualifications and unhealthy behaviour control (Table 7.6). Children of parents with no qualifications and unhealthy behaviour control had greater odds, on the additive scale (RERI: 0.69, 95% CI: 0.13, 1.25), of brushing their teeth twice or more often a day than children whose parents had only one of those conditions (either higher education or unhealthy behaviour control).

Table 7.4. Estimates for the moderating role of general family functioning in the association between family SEP and child toothbrushing frequency

	General functioning		**Measure of interaction**	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	OR[a] **[95% CI]**	**OR**[a] **[95% CI]**	**OR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	0.77 [0.40-1.49]		
A-levels	0.96 [0.46-2.03]	0.67 [0.34-1.33]	0.91 [0.33-2.52]	-0.06 [-0.95, 0.84]
Secondary school	0.69 [0.31-1.53]	0.70 [0.35-1.43]	1.31 [0.46-3.74]	0.24 [-0.52, 0.99]
None	0.98 [0.24-4.01]	0.37 [0.14-0.94]*	0.48 [0.09-2.51]	-0.39 [-1.88, 1.11]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	1.06 [0.55-2.04]		
Intermediate	1.01 [0.47-2.19]	0.69 [0.30-1.58]	0.65 [0.21-2.01]	-0.38 [-1.48, 0.73]
Routine/manual	1.35 [0.44-4.16]	1.14 [0.55-2.37]	0.80 [0.21-3.00]	-0.27 [-1.94, 1.41]
Not working	1.64 [0.76-3.54]	0.74 [0.37-1.51]	0.43 [0.16-1.19]	-0.94 [-2.39, 0.50]

[a] Logistic regression was fitted and odds ratios (OR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of general functioning with parent's education (p= 0.723) and general functioning with parent's socioeconomic classification (p= 0.437).

Table 7.5. Estimates for the moderating role of affective involvement in the association between family SEP and child toothbrushing frequency

	Affective involvement		**Measure of interaction**	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	OR[a] **[95% CI]**	**OR**[a] **[95% CI]**	**OR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	0.36 [0.18-0.73]*		
A-levels	0.56 [0.25-1.23]	0.52 [0.25-1.05]	2.55 [0.89-7.27]	0.60 [0.09, 1.10]*
Secondary school	0.39 [0.18-0.81]*	0.58 [0.26-1.30]	4.10 [1.46-11.57]*	0.83 [0.38, 1.27]*
None	0.35 [0.10-1.22]	0.32 [0.11-0.90]	2.51 [0.53-11.86]	0.61 [0.07, 1.14]*
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	0.60 [0.30-1.19]		
Intermediate	0.78 [0.36-1.69]	0.54 [0.23-1.27]	1.16 [0.36-3.67]	0.16 [-0.62, 0.94]
Routine/manual	1.12 [0.42-3.02]	0.84 [0.37-1.90]	1.26 [0.36-4.40]	0.13 [-1.07, 1.32]
Not working	0.71 [0.33-1.54]	0.74 [0.36-1.53]	1.75 [0.61-5.00]	0.43 [-0.27, 1.13]

[a] Logistic regression was fitted and odds ratios (OR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of affective involvement with parent's education (p=0.052) and affective involvement with parent's socioeconomic classification (p=0.776).

Table 7.6. Estimates for the moderating role of behaviour control in the association between family SEP and child toothbrushing frequency

	Behaviour control		**Measure of interaction**	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	OR[a] **[95% CI]**	**OR**[a] **[95% CI]**	**OR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	0.55 [0.27-1.13]		
A-levels	0.75 [0.34-1.67]	0.57 [0.27-1.22]	1.39 [0.48-4.02]	0.27 [-0.44, 0.99]
Secondary school	0.63 [0.28-1.43]	0.54 [0.25-1.18]	1.57 [0.53-4.66]	0.36 [-0.28, 1.01]
None	0.21 [0.04-1.02]	0.46 [0.17-1.25]	3.89 [0.66-23.01]	0.69 [0.13, 1.25]*
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	0.76 [0.38-1.51]		
Intermediate	0.74 [0.33-1.63]	0.69 [0.30-1.59]	1.24 [0.39-3.99]	0.20 [-0.66, 1.06]
Routine/manual	1.57 [0.54-4.53]	0.91 [0.41-2.00]	0.77 [0.21-2.75]	-0.42 [-2.13, 1.30]
Not working	1.12 [0.41-3.05]	0.75 [0.38-1.47]	0.88 [0.26-2.99]	-0.13 [-1.36, 1.11]

[a] Logistic regression was fitted and odds ratios (OR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of behaviour control with parent's education (p=0.485) and behaviour control with parent's socioeconomic classification (p=0.918).

7.2. The moderating role of family functioning in the association between family SEP and child dental caries

The findings in this section are organised according to chid dental caries indicator, namely child caries experience, untreated disease and treated disease (dmft, dt and mft indices respectively).

7.2.1. Child dental caries experience (dmft)

Table 7.7 shows the RRs for each stratum of family SEP and general family functioning as well as the measures of interaction in the multiplicative and additive scales. There was evidence of a no multiplicative positive additive interaction between parental education and general family functioning, however this effect was limited to the stratum of parents with A-levels and unhealthy general family functioning. Children of parents with A-level education and unhealthy general family functioning had greater dmft score, in the additive scale (RERI: 2.41, 95% CI: 0.49, 4.33), than children whose parents had one of those factors only (either A-level education or unhealthy general functioning). No interaction between parental socioeconomic classification and general family functioning was seen in either scale.

Furthermore, none of the six specific domains of family functioning were found to modify the associations of parental education and socioeconomic classification with child dental caries experience.

Table 7.7. Estimates for the moderating role of general family functioning in the association between family SEP and child dmft

	General functioning		Measure of interaction	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	RR[a] **[95% CI]**	**RR**[a] **[95% CI]**	**RR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	1.17 [0.66-2.06]		
A-levels	1.10 [0.42-2.84]	3.68 [2.08-6.50]*	2.87 [0.95-8.66]	2.41 [0.49, 4.33]*
Secondary school	1.04 [0.46-2.40]	1.26 [0.66-2.42]	1.03 [0.37-2.89]	0.05 [-1.09, 1.19]
None	2.65 [1.15-6.09]*	2.60 [1.05-6.41]*	0.84 [0.24-2.91]	-0.22 [-3.20, 2.75]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	1.09 [0.54-2.17]		
Intermediate	2.15 [0.94-4.88]	3.02 [1.47-6.20]*	1.30 [0.44-3.81]	0.78 [-1.40, 2.97]
Routine/manual	0.91 [0.35-2.38]	2.57 [1.22-5.42]*	2.60 [0.77-8.73]	1.57 [-0.15, 3.29]
Not working	1.71 [0.84-3.50]	3.57 [1.83-6.96]*	1.92 [0.70-5.24]	1.77 [-0.25, 3.79]

[a] Negative binominal regression was fitted and rate ratios (RR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of general functioning with parent's education (p=0.259) and general functioning with parent's socioeconomic classification (p=0.389).

7.2.2. Child number of decayed teeth (dt)

Table 7.8 presents the RRs for each stratum of family SEP (education and socioeconomic classification) and general family functioning as well as the measures of interaction. There was evidence of a positive multiplicative positive additive interaction between parental education and general family functioning, although this interaction was limited to one stratum. Children of parents with A-level education and unhealthy general family functioning had greater dt scores, on the multiplicative (RR: 6.64, 95% CI: 2.01-21.95) and additive scales (RERI: 2.69, 95% CI: 0.76, 4.62), than those of parents with only one of those conditions (either had A-level education or unhealthy family functioning).

Table 7.8. Estimates for the moderating role of general family functioning in the association between family SEP and child dt

	General functioning		Measure of interaction	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	RR[a] **[95% CI]**	**RR**[a] **[95% CI]**	**RR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	1.16 [0.61-2.20]		
A-levels	0.42 [0.16-1.15]	3.28 [1.71-6.30]*	6.64 [2.01-21.95]*	2.69 [0.76, 4.62]*
Secondary school	0.94 [0.40- 2.21]	1.36 [0.69- 2.69]	1.25 [0.41-3.80]	0.26 [-0.94, 1.46]
None	3.01 [1.24-7.30]*	3.11 [1.19- 8.12]*	0.89 [0.24-3.34]	-0.06 [-3.67, 3.56]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	1.76 [0.83- 3.77]		
Intermediate	2.70 [1.19-6.14]*	3.71 [1.71-8.03]*	0.78 [0.25-2.38]	0.24 [-2.59, 3.08]
Routine/manual	0.93 [0.29-2.96]	2.63 [1.10- 6.26]*	1.60 [0.39-6.60]	0.93 [-1.23, 3.10]
Not working	1.85 [0.83-4.13]	4.38 [2.17-8.84]*	1.34 [0.45-4.03]	1.76 [-0.85, 4.37]

[a] Negative binominal regression was fitted and rate ratios (RR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of general functioning with parent's education (p= 0.014) and general functioning with parent's socioeconomic classification (p= 0.715).

Two of the six domains of family functioning (problem solving and behaviour control) were found to modify the association of family SEP with child dt score. For the problem solving domain, there was evidence of a negative multiplicative zero additive interaction as well as a positive multiplicative zero additive interaction with parental socioeconomic classification (Table 7.9). Children of parents with routine/manual occupations and unhealthy problem solving had lower dt scores, on the multiplicative scale (RR: 0.07, 95% CI: 0.01-0.68), than those of parents with only one of those conditions (either routine/manual occupations or unhealthy problem solving). On the contrary, children whose parents were not working and had unhealthy problem solving had greater dt scores, on the multiplicative scale (4.93, 95% CI: 1.30-18.71), than those whose parents were either not working or had unhealthy problem solving.

Table 7.9. Estimates for the moderating role of problem solving in the association between family SEP and child dt

	Problem solving		**Measure of interaction**	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	RR[a] **[95% CI]**	**RR**[a] **[95% CI]**	**RR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	0.34 [0.12-0.99]*		
A-levels	1.68 [0.89-3.16]	0.40 [0.14-1.13]	0.70 [0.15-3.21]	-0.62 [-1.79, 0.54]
Secondary school	1.03 [0.55-1.93]	1.26 [0.51-3.08]	3.55 [0.88-14.23]	0.88 [-0.26, 2.03]
None	2.95 [1.32-6.59]*	3.44 [0.47-25.32]	3.38 [0.34-33.93]	1.14 [-5.78, 8.06]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	0.35 [0.13-0.96]*		
Intermediate	2.63 [1.43-4.82]*	1.09 [0.37-3.26]	1.19 [0.26-5.49]	-0.88 [-2.76, 1.00]
Routine/manual	1.75 [0.82-3.73]	0.04 [0.01-0.31]*	0.07 [0.01-0.68]*	-1.06 [-2.50, 0.38]
Not working	2.07 [1.17-3.67]*	3.58 [1.44-8.92]*	4.93 [1.30-18.71]*	2.16 [-0.91, 5.23]

[a] Negative binominal regression was fitted and rate ratios (RR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of problem solving with parent's education (p= 0.083) and problem solving with parent's socioeconomic classification (p= 0.001).

Table 7.10. Estimates for the moderating role of behaviour control in the association between family SEP and child dt

	Behaviour control		**Measure of interaction**	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	RR[a] **[95% CI]**	**RR**[a] **[95% CI]**	**RR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	1.38 [0.69-2.78]		
A-levels	0.67 [0.25-1.81]	3.13 [1.49-6.58]*	3.37 [1.06-10.73]*	2.07 [0.26, 3.89]*
Secondary school	1.14 [0.48-2.71]	1.48 [0.69-3.18]	0.94 [0.32-2.80]	-0.04 [-1.40, 1.32]
None	7.87 [1.92-32.27]*	2.82 [1.22-6.54]*	0.26 [0.05-1.34]	-5.43 [-16.42, 5.57]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	1.58 [0.74- 3.38]		
Intermediate	2.16 [0.85-5.48]	4.56 [2.09-9.97]*	1.34 [0.41-4.35]	1.82 [-1.26, 4.91]
Routine/manual	1.44 [0.48-4.30]	2.34 [0.92-5.95]	1.03 [0.27-4.00]	0.32 [-1.90, 2.54]
Not working	2.91 [0.98-8.67]	3.44 [1.63-7.26]*	0.75 [0.21-2.68]	-.06 [-3.27, 3.15]

[a] Negative binominal regression was fitted and rate ratios (RR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of behaviour control with parent's education (p= 0.028) and behaviour control with parent's socioeconomic classification (p= 0.874).

For the behaviour control domain, there was evidence of a positive multiplicative positive additive interaction with parental education, which was limited to one stratum (Table 7.10). Children of parents with A-level education and unhealthy behaviour control had greater dt scores, on the multiplicative (RR: 3.37, 95% CI: 1.06-10.73) and additive scales (RERI: 2.07, 95% CI: 0.26, 3.89), than children of parents with only one of those characteristics (either A-level education or unhealthy behaviour control).

7.2.3. Child number of missing and filled teeth (mft)

Table 7.11 shows the RRs for each stratum of family SEP and general family functioning as well as the measures of interaction on both scales. No interactions were found between family SEP indicators (education and socioeconomic classification) and general family functioning on the multiplicative or additive scales.

Table 7.11. Estimates for the moderating role of general family functioning in the association between family SEP and child mft

	General functioning		**Measure of interaction**	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	RR[a] **[95% CI]**	**RR**[a] **[95% CI]**	**RR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	1.15 [0.39- 3.40]		
A-levels	6.59 [1.67-26.06]*	3.88 [1.30-11.54]*	0.51 [0.08- 3.21]	-2.86 [-11.91, 6.20]
Secondary school	1.83 [0.40-8.33]	0.55 [0.19-1.59]	0.26 [0.04-1.61]	-1.43 [-4.49, 1.64]
None	0.79 [0.12-5.32]	0.42 [0.12-1.50]	0.46 [0.05-4.15]	-0.53 [-2.55, 1.49]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	0.13 [0.02-0.73]*		
Intermediate/	0.67 [0.17-2.65]	1.22 [0.29-5.15]	14.58 [1.34-158.68]*	1.43 [-0.43, 3.29]
Routine/manual	1.23 [0.23- 6.54]	3.03 [0.87-10.55]	19.70 [1.59-244.70]*	2.68 [-0.94, 6.29]
Not working	1.14 [0.33- 3.91]	1.48 [0.51-4.29]	10.39 [1.21-89.44]*	1.22 [-0.33, 2.76]

[a] Negative binominal regression was fitted and rate ratios (RR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of general functioning with parent's education (p= 0.529) and general functioning with parent's socioeconomic classification (p= 0.061).

In further analysis by domains of family functioning, problem solving, roles and behaviour control were found to modify the association of family SEP with child mft score. For the problem solving domain, there was evidence of a positive multiplicative zero additive interaction with parental education, although limited to a single stratum (Table 7.12). Children of parents with A-level education and unhealthy problem solving had greater mft scores, on the multiplicative scale (RR: 52.59, 95% CI: 3.89-710.64) than children of parents with only one of those two factors (A-level education or unhealthy problem solving). However, the CIs were very wide despite collapsing some education categories due to small numbers of participants in some strata.

Table 7.12. Estimates for the moderating role of problem solving in the association between family SEP and child mft

	Problem solving		**Measure of interaction**	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	RR[a] **[95% CI]**	**RR**[a] **[95% CI]**	**RR [95% CI]**	**RERI [95% CI]**
Parent's education				
Higher education	1.00 [reference]	0.09 [0.01-0.75]*		
A-levels	3.98 [1.51-10.52]*	17.96 [3.59-90.00]*	52.59 [3.89-710.64]*	14.89 [-12.83, 42.62]
Secondary school/none	0.94 [0.38-2.34]	0.08 [0.01-0.93]*	0.95 [0.04-24.95]	0.05 [-0.82, 0.92]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	0.09 [0.01-0.57]*		
Intermediate/routine/manual	1.42 [0.54-3.74]	5.67 [1.30-24.63]*	43.97 [4.41-438.57]*	5.16 [-2.80, 13.12]
Not working	1.66 [0.64-4.30]	0.23 [0.04-1.21]	1.51 [0.17-13.07]	-0.53 [-2.03, 0.97]

[a] Negative binominal regression was fitted and rate ratios (RR)) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of problem solving with parent's education (p= 0.002) and problem solving with parent's socioeconomic classification (p= 0.001).

For the roles domain, there was evidence of a negative multiplicative zero additive interaction with parental education, although limited to two strata (Table 7.13). Children of parents with A-level education and unhealthy roles functioning and those of parents with secondary school education and unhealthy roles functioning had lower

mft scores, on the multiplicative scale (RR: 0.16, 95% CI: 0.03-0.75 and RR: 0.15, 95% CI: 0.03-0.71, respectively) than children of parents with either that specific level of education or unhealthy roles functioning only.

Table 7.13. Estimates for the moderating effect of roles in the association between family SEP and child mft

	Roles		**Measure of interaction**	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	RR[a] **[95% CI]**	**RR**[a] **[95% CI]**	**RR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	0.90 [0.31- 2.62]		
A-levels	7.48 [2.54-22.09]*	1.04 [0.34- 3.22]	0.16 [0.03-0.75]*	-6.34 [-14.41, 1.73]
Secondary school	2.00 [0.57-6.98]	0.28 [0.09-0.87]*	0.15 [0.03-0.71]*	-1.61 [-4.39, 1.16]
None	0.67 [0.17- 2.74]	0.38 [0.07-2.00]	0.63 [0.08-4.84]	-0.19 [-1.60, 1.23]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	0.15 [0.03-0.89]*		
Intermediate	1.19 [0.25-5.62]	0.83 [0.25-2.72]	4.58 [0.36-58.40]	0.49 [-1.47, 2.45]
Routine/manual	2.23 [0.49-10.11]	2.68 [0.67-10.67]	7.88 [0.67-92.52]	1.29 [-2.79, 5.38]
Not working	1.98 [0.75-5.20]	0.49 [0.12- 1.97]	1.64 [0.18-14.81]	-0.63 [-2.49, 1.22]

[a] Negative binominal regression was fitted and rate ratios (RR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of roles with parent's education (p=0.028) and roles with parent's socioeconomic classification (p=0.302).

For the behaviour control domain, there was evidence of a positive multiplicative positive additive interaction with one stratum of parental socioeconomic classification as well as a positive multiplicative zero additive interaction with another stratum (Table 7.14). Children of parents with intermediate occupations and unhealthy behaviour control had greater mft scores, on the multiplicative (RR: 25.73, 95% CI: 1.98-334.44) and additive scales (RERI: 1.24, 95% CI: 0.13, 2.35), than children of parents with either intermediate occupations or unhealthy behaviour control. Furthermore, children whose parents were not working and had unhealthy behaviour control had greater mft

scores, on the multiplicative scale (RR: 20.13, 95% CI: 1.83-221.00) than those whose parents either were not working or had unhealthy behaviour control.

Table 7.14. Estimates for the moderating role of behaviour control in the association between family SEP and child mft

	Behaviour control		**Measure of interaction**	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	RR[a] **[95% CI]**	**RR**[a] **[95% CI]**	**RR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	0.73 [0.25- 2.07]		
A-levels	12.51 [3.04- 51.40]*	1.92 [0.62-5.93]	0.21 [0.04-1.17]	-10.31 [-27.53, 6.90]
Secondary school	2.29 [0.59-8.93]	0.25 [0.08-0.81]*	0.15 [0.03-0.79]*	-1.76 [-5.06, 1.52]
None	1.14 [0.10- 13.42]	0.32 [0.09- 1.12]	0.39 [0.03-5.36]	-0.54 [-3.49, 2.40]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	0.06 [0.01-0.36]*		
Intermediate	0.45 [0.10-2.03]	0.76 [0.20-2.91]	25.73 [1.98-334.44]*	1.24 [0.13, 2.35]*
Routine/manual	6.53 [1.47-29.06]*	0.65 [0.19-2.21]	1.55 [0.14-16.70]	-4.94 [-14.42, 4.54]
Not working	0.73 [0.14-3.84]	0.95 [0.31-2.96]	20.13 [1.83-221.00]*	1.16 [-0.08, 2.39]

[a] Negative binominal regression was fitted and rate ratios (RR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of behaviour control with parent's education (p=0.097) and behaviour control with parent's socioeconomic classification (p=0.005).

7.3. The moderating role of family functioning in the association between family SEP and child Oral Health Related Quality of Life

The findings in this section are organised according to the three child OHRQoL indicators, namely ECOHIS total score, the CIS score and the FIS score.

7.3.1. ECOHIS total score

Table 7.15 presents the RRs for each stratum of family SEP (education and socioeconomic classification) and general family functioning as well as measures of multiplicative and additive interaction. There was evidence of an inverted interaction

between parental socioeconomic classification and general family functioning, although it was limited to one stratum. Children of parents not working and with unhealthy general family functioning had lower ECOHIS total score, on the multiplicative (RR: 0.12, 95% CI: 0.03-0.40) and additive scales (RERI: -4.92, 95% CI: -9.72, -0.13) than children of parents with only one of those circumstances (either not working or having unhealthy general functioning).

Table 7.15. Estimates for the moderating role of general family functioning in the association between family SEP and ECOHIS total score (n=714)

	General functioning		**Measure of interaction**	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	RR[a] **[95% CI]**	**RR**[a] **[95% CI]**	**RR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	0.91 [0.41-2.03]		
A-levels	0.75 [0.32-1.75]	1.71 [0.80-3.62]	2.52 [0.79-8.01]	1.05 [-0.12, 2.23]
Secondary school	0.50 [0.19-1.30]	1.41 [0.61-3.24]	3.09 [0.81-11.82]	1.00 [-0.22-2.21]
None	1.29 [0.26-6.54	0.61 [0.25-1.48]	0.52 [0.09-3.09]	-0.59 [-2.78, 1.60]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	3.08 [1.44-6.59]*		
Intermediate	2.72 [1.03-7.19]*	4.05 [1.55-10.57]*	0.48 [0.12-2.01]	-0.75 [-5.34, 3.85]
Routine/manual	1.08 [0.32-3.71]	2.67 [1.21-5.88]*	0.80 [0.19-3.33]	-0.49 [-3.20, 2.22]
Not working	4.41 [1.84-10.57]*	1.56 [0.65-3.72]	0.12 [0.03-0.40]*	-4.92 [-9.72, -0.13]*

[a] Negative binominal regression was fitted and rate ratios (RR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of general functioning with parent's education (p=0.117) and general functioning with parent's socioeconomic classification (p= 0.007).

In subsequent analysis by domains of family functioning, there was evidence of interaction with family SEP indicators for four of the six specific domains of family functioning (communication, roles, affective involvement and behaviour control). For the communication domain, there was evidence of a negative multiplicative zero additive interaction with education and parental socioeconomic classification (Table 7.16). Children of parents with no qualification and unhealthy communication had

lower ECOHIS total scores, on the multiplicative scale (RR: 0.11, 95% CI: 0.03-0.48), than those of parents with either no qualifications or unhealthy communication alone. In addition, children of parents with intermediate occupations and unhealthy communication and children of parents not working and with unhealthy communication had lower ECOHIS total scores, on the multiplicative scale (RR: 0.16, 95% CI: 0.05-0.57 and RR: 0.24, 95% CI: 0.07-0.83, respectively) than those whose parents had either that specific occupational status or unhealthy communication only.

Table 7.16. Estimates for the moderating role of communication in the association between family SEP and ECOHIS total score (n=714)

	Communication		**Measure of interaction**	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	RR[a] **[95% CI]**	**RR**[a] **[95% CI]**	**RR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	1.09 [0.49-2.40]		
A-levels	1.20 [0.55-2.64]	1.67 [0.69-4.04]	1.28 [0.38-4.28]	0.39 [-1.15, 1.93]
Secondary school	0.63 [0.27-1.50]	1.66 [0.65-4.21]	2.41 [0.64-9.07]	0.94 [-0.61, 2.48]
None	2.46 [0.90-6.75]	0.30 [0.10-0.88]*	0.11 [0.03-0.48]*	-2.24 [-4.98, 0.49]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	2.70 [1.26-5.78]*		
Intermediate	3.95 [1.68, 9.25]*	1.72 [0.68-4.37]	0.16 [0.05-0.57]*	-3.92 [-7.99, 0.14]
Routine/manual	1.94 [0.79-4.76]	2.21 [0.89-5.48]	0.42 [0.12-1.51]	-1.43 [-4.32, 1.47]
Not working	2.90 [1.24-6.78]*	1.87 [0.71-4.87]	0.24 [0.07-0.83]*	-2.74 [-6.10, 0.63]

[a] Negative binominal regression was fitted and rate ratios (RR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of communication with parent's education (p=0.001) and communication with parent's socioeconomic classification (p=0.018).

For the roles domain, there was evidence of a positive multiplicative positive additive interaction with parental education, although limited to two strata only. Children of parents with A-level education and unhealthy roles, and children of parents with secondary school education and unhealthy roles, had higher ECOHIS total scores, on the multiplicative (RR: 4.44, 95% CI: 1.40-14.02 and RR: 7.34, 95% CI: 2.25-23.96,

respectively) and additive scales (RERI: 1.52, 95% CI: 0.10, 2.95 and RERI: 1.45, 95% CI: 0.46, 2.45, respectively), than children of parents with either that specific level of education or unhealthy roles only.

Table 7.17. Estimates for the moderating effect of roles in the association between family SEP and ECOHIS total score (n=714)

	Roles		**Measure of interaction**	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	RR[a] **[95% CI]**	**RR**[a] **[95% CI]**	**RR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	0.53 [0.26-1.10]		
A-levels	0.78 [0.37-1.64]	1.83 [0.78-4.31]	4.44 [1.40-14.02]*	1.52 [0.10, 2.95]*
Secondary school	0.34 [0.15-0.75]*	1.32 [0.58-3.02]	7.34 [2.25-23.96]*	1.45 [0.46, 2.45]*
None	0.57 [0.16-2.05]	0.84 [0.31-2.30]	2.77 [0.59-13.06]	0.74 [-0.25, 1.73]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	2.01 [0.96-4.24]		
Intermediate	2.96 [1.03-8.51]*	2.79 [1.15-6.78]*	0.47 [0.11-1.96]	-1.18 [-5.03, 2.67]
Routine/manual	1.59 [0.66-3.83]	2.56 [0.92-7.15]	0.80 [0.21-3.01]	-0.05 [-2.82, 2.72]
Not working	2.21 [0.96-5.11]	2.00 [0.77-5.15]	0.45 [0.13-1.53]	-1.23 [-3.80, 1.34]

[a] Negative binominal regression was fitted and rate ratios (RR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of roles with parent's education (p=0.005) and roles with parent's socioeconomic classification (p=0.541).

For the affective involvement domain, there was evidence of a positive multiplicative positive additive interaction limited to one stratum of parental education (Table 7.18). Children whose parents had secondary education and unhealthy affective involvement reported higher ECOHIS total scores, on the multiplicative (RR: 6.16, 95% CI: 1.62-23.36) and additive scales (RERI: 1.48, 95% CI: 0.20, 2.75), than those whose parents had either secondary school education or unhealthy affective involvement.

Table 7.18. Estimates for the moderating role of affective involvement in the association between family SEP and ECOHIS total score (n=714)

	Affective involvement		**Measure of interaction**	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	RR[a] **[95% CI]**	**RR**[a] **[95% CI]**	**RR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	0.64 [0.29-1.40]		
A-levels	1.00 [0.43-2.33]	1.08 [0.47-2.52]	1.69 [0.49-5.81]	0.44 [-0.65, 1.54]
Secondary school	0.38 [0.16-0.91]*	1.49 [0.60-3.71]	6.16 [1.62-23.36]*	1.48 [0.20, 2.75]*
None	1.39 [0.34-5.71]	0.46 [0.18-1.19]	0.52 [0.10-2.68]	-0.57 [-2.59, 1.44]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	1.35 [0.61-2.99]		
Intermediate	2.15 [0.78-5.93]	2.69 [1.03-7.06]*	0.93 [0.21-4.01]	0.19 [-2.99, 3.37]
Routine/manual	1.80 [0.67-4.81]	1.60 [0.64-3.99]	0.66 [0.17-2.58]	-0.55 [-2.74, 1.65]
Not working	2.10 [0.85-5.15]	1.64 [0.68-3.95]	0.58 [0.16-2.06]	-0.80 [-3.04, 1.43]

[a] Negative binominal regression was fitted and rate ratios (RR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of affective involvement with parent's education (p=0.013) and affective involvement with parent's socioeconomic classification (p=0.840).

Table 7.19. Estimates for the moderating role of behaviour control in the association between family SEP and ECOHIS total score (n=714)

	Behaviour control		**Measure of interaction**	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	RR[a] **[95% CI]**	**RR**[a] **[95% CI]**	**RR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	0.81 [0.36-1.82]		
A-levels	0.90 [0.34-2.34]	1.46 [0.63-3.34]	1.99 [0.58-6.91]	0.74 [-0.42, 1.91]
Secondary school	0.56 [0.20-2.34]	1.37 [0.85-3.29]	3.00 [0.76-11.89]	1.00 [-0.17, 2.17]
None	2.78 [0.92-8.35]	0.40 [0.14-1.11]	0.18 [0.04-0.72]*	-2.20 [-5.39, 1.00]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	1.62 [0.77-3.41]		
Intermediate	1.93 [0.64-5.80]	3.41 [1.47-7.95]*	1.09 [0.25-4.88]	0.87 [-2.56, 4.29]
Routine/manual	1.88 [0.62-5.69]	1.79 [0.79-4.03]	0.59 [0.14-2.39]	-0.71 [-3.22, 1.80]
Not working	3.34 [1.23-9.04]*	1.37 [0.63-2.99]	0.25 [0.08-0.86]*	-2.58 [-6.04, 0.88]

[a] Negative binominal regression was fitted and rate ratios (RR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of behaviour control with parent's education (p=0.001) and behaviour control with parent's socioeconomic classification (p=0.140).

For the behaviour control domain, there was evidence of a negative multiplicate zero additive interaction with parental education, although limited to a single stratum (Table 7.19). Children whose parents had no qualifications and unhealthy behaviour control reported lower ECOHIS scores, on the multiplicative scale (RR: 0.18, 95% CI: 0.04-0.72), than those whose parents had only one of those conditions (either no qualifications or unhealthy behaviour control).

Table 7.20. Estimates for the moderating role of general family functioning in the association between family SEP and CIS score (n=714)

	General functioning		**Measure of interaction**	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	RR[a] **[95% CI]**	**RR**[a] **[95% CI]**	**RR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	0.88 [0.37-2.10]		
A-levels	0.79 [0.33-1.85]	1.36 [0.60-3.06]	1.96 [0.58-6.67]	0.69 [-0.45, 1.83]
Secondary school	0.63 [0.22-1.77]	1.31 [0.59-2.92]	2.36 [0.60-9.24]	0.80 [-0.36, 1.95]
None	1.24 [0.23-6.61]	0.51 [0.19-1.33]	0.47 [0.07-2.93]	-0.61 [-2.78, 1.56]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	2.33 [1.04-5.20]*		
Intermediate	2.76 [0.99-7.74]	3.41 [1.34-8.69]*	0.53 [0.13-2.23]	-0.68 [-4.72, 3.36]
Routine/manual	0.79 [0.25-2.48]	2.46 [1.13-5.34]*	1.34 [0.34-5.32]	0.34 [-1.82, 2.50]
Not working	4.25 [1.74-10.36]*	1.47 [0.56-3.85]	0.15 [0.04-0.53]*	-4.10 [-8.49, 0.28]

[a] Negative binominal regression was fitted and rate ratios (RR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of general functioning with parent's education (p=0.283) and general functioning with parent's socioeconomic classification (p=0.014).

7.3.2. Child Impacts Section (CIS) score

Table 7.20 presents the RRs for each stratum of family SEP (either education or socioeconomic classification) and general family functioning as well as the measures of interaction. There was evidence of a negative multiplicative zero additive interaction between parental socioeconomic classification and general family functioning, although limited to a single stratum. Children whose parents were not working and had

unhealthy general family functioning reported lower CIS scores, on the multiplicative scale (RR: 0.15, 95% CI: 0.04-0.53), than those whose parents had one of the two conditions (were either not working or had unhealthy general functioning).

Three of the six domains of family functioning evaluated (problem solving, roles and affective involvement) showed evidence of interaction with family SEP indicators. For the problem solving domain, there was evidence of an inverted interaction as well as a negative multiplicative zero additive interaction with different strata of parental socioeconomic classification (Table 7.21). On one hand, children whose parents had intermediate occupation and unhealthy problem solving reported lower CIS scores, on both the multiplicative (RR: 0.07, 95% CI: 0.01-0.54) and additive scales (RERI: -3.65, 95% CI: -7.14, -0.16), than those whose parents only had one of those conditions (intermediate occupations or unhealthy problem solving). On the other hand, children whose parents were not working and had unhealthy problem solving reported lower CIS scores, on the multiplicative scale (RR: 0.14, 95% CI: 0.02-0.89), than those whose parents had one of those circumstances only (either were not working or had unhealthy problem solving).

For the roles domain, there was evidence of a positive multiplicative positive additive interaction as well as positive multiplicative zero additive interaction with different strata of parental education (Table 7.22). Children whose parents had A-level education and unhealthy roles functioning reported greater CIS score on the multiplicative scale (RR: 3.88, 95% CI: 1.10-13.71), children whose parents had secondary school education and unhealthy roles functioning reported greater CIS scores on the multiplicative (RR: 7.13, 95% CI: 2.14-23.79) and additive scales (RERI: 1.40, 95% CI: 0.50, 2.31), and children whose parents had no qualification and unhealthy roles functioning reported greater CIS scores on the multiplicative (RR: 8.63, 95% CI: 1.61-

46.40) and additive scales (RERI: 1.25, 95% CI: 0.33, 2.18) than children whose parents only had either that specific level of education or unhealthy roles functioning.

Table 7.21. Estimates for the moderating role of problem solving in the association between family SEP and CIS score (n=714)

	Problem solving		**Measure of interaction**	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	RR[a] **[95% CI]**	**RR**[a] **[95% CI]**	**RR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	1.39 [0.38-5.03]		
A-levels	1.06 [0.53-2.15]	2.06 [0.61-6.92]	1.39 [0.25-7.65]	0.61 [-2.15, 3.36]
Secondary school/None	1.09 [0.55-2.18]	0.61 [0.19-1.93]	0.40 [0.08-2.10]	-0.87 [-2.85, 1.10]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	2.33 [0.81-6.69]		
Intermediate	2.76 [1.32-5.76]*	0.44 [0.07-2.62]	0.07 [0.01-0.54]*	-3.65 [-7.14, -0.16]*
Routine/manual	1.53 [0.70-3.32]	1.89 [0.71-5.02]	0.53 [0.12-2.26]	-0.97 [-3.92, 1.97]
Not working	2.16 [1.01-4.61]*	0.71 [0.15-3.31]	0.14 [0.02-0.89]*	-2.78 [-6.07, 0.50]

[a] Negative binominal regression was fitted and rate ratios (RR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of problem solving with parent's education (p= 0.311) and problem solving with parent's socioeconomic classification (p=0.032).

Table 7.22. Estimates for the moderating effect of roles in the association between family SEP and CIS score (n=714)

	Roles		**Measure of interaction**	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	RR[a] **[95% CI]**	**RR**[a] **[95% CI]**	**RR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	0.43 [0.19-0.96]*		
A-levels	0.76 [0.36-1.64]	1.26 [0.50-3.18]	3.88 [1.10-13.71]*	1.07 [-0.05, 2.20]
Secondary school	0.41 [0.18-0.92]*	1.24 [0.56-2.76]	7.13 [2.14-23.79]*	1.40 [0.50, 2.31]*
None	0.25 [0.06-0.99]*	0.93 [0.34-2.59]	8.63 [1.61-46.40]*	1.25 [0.33, 2.18]*
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	1.61 [0.75-3.46]		
Intermediate	3.58 [1.31-9.80]*	2.20 [0.84-5.78]	0.38 [0.09-1.59]	-1.99 [-6.04, 2.05]
Routine/manual	1.38 [0.60-3.15]	2.42 [0.91-6.46]	1.09 [0.30-3.97]	0.43 [-1.98, 2.84]
Not working	2.04 [0.85-4.89]	2.14 [0.78-5.83]	0.65 [0.18-2.36]	-0.52 [-3.03, 1.98]

[a] Negative binominal regression was fitted and rate ratios (RR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of roles with parent's education (p=0.005) and roles with parent's socioeconomic classification (p=0.516).

For the affective involvement domain, there was evidence of a positive multiplicative positive additive interaction with parental education, although it was limited to one stratum (Table 7.23). Children whose parents had secondary school education and unhealthy affective involvement reported greater CIS scores, on the multiplicative (RR: 4.85, 95% CI: 1.30-18.17) and additive scales (RERI: 1.30, 95% CI: 0.16, 2.44), than those whose parents only had one of those conditions (either secondary school education or unhealthy affective involvement).

Table 7.23. Estimates for the moderating role of affective involvement functioning in the association between family SEP and CIS score (n=714)

	Affective involvement		**Measure of interaction**	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	RR[a] **[95% CI]**	**RR**[a] **[95% CI]**	**RR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	0.61 [0.27-1.39]		
A-levels	0.99 [0.41-2.37]	0.86 [0.35-2.11]	1.42 [0.39-5.20]	0.26 [-0.82, 1.34]
Secondary school	0.46 [0.19-1.14]	1.37 [0.56- 3.39]	4.85 [1.30-18.17]*	1.30 [0.16, 2.44]|*
None	1.33 [0.28- 6.23]	0.36 [0.14-0.97]*	0.45 [0.08-2.55]	-0.58 [-2.67, 1.52]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	0.95 [0.42-2.15]		
Intermediate	2.24 [0.77- 6.54]	2.22 [0.86-5.71]	1.04 [0.23-4.65]	0.03 [-2.93, 2.99]
Routine/manual	1.30 [0.52-3.25]	1.54 [0.63-3.74]	1.24 [0.33-4.66]	0.28 [-1.34, 1.91]
Not working	2.03 [0.81-5.06]	1.54 [0.62-3.79]	0.80 [0.22-2.92]	-0.44 [-2.49, 1.62]

[a] Negative binominal regression was fitted and rate ratios (RR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of affective involvement with parent's education (p= 0.028) and affective involvement with parent's socioeconomic classification (p= 0.946).

7.3.3. Family Impacts Section (FIS) score

Table 7.24 reports the RRs for each stratum of family SEP and general family functioning as well as measures of interaction in the multiplicative and additive scales. There was evidence of a negative multiplicative zero additive interaction between parental socioeconomic classification and general family functioning, which was

limited to a single stratum. Children whose parents were not working and had unhealthy general functioning reported lower FIS scores, on the multiplicative scale (RR: 0.07, 95% CI:0.01-0.30), than those whose parents had only one of those factors (either were not working or had unhealthy general functioning).

Table 7.24. Estimates for the moderating role of general family functioning in the association between family SEP and FIS score (n=714)

	General functioning		**Measure of interaction**	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	RR[a] **[95% CI]**	**RR**[a] **[95% CI]**	**RR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	0.97 [0.38-2.46]		
A-levels	0.66 [0.22-1.92]	2.27 [0.83-6.18]	3.56 [0.82-15.52]	1.64 [0.33, 3.62]
Secondary school	0.31 [0.11-0.89]*	1.71 [0.59-4.97]	5.63 [1.20-26.38]*	1.43 [-0.30, 3.16]
None	1.50 [0.25-9.05]	0.94 [0.24-3.72]	0.65 [0.07-5.64]	-0.53 [-3.41, 2.36]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	5.56 [2.10-14.75]*		
Intermediate	2.51 [0.83-7.63]	6.53 [2.02-21.09]*	0.47 [0.09-2.48]	-0.54 [-8.65, 7.56]
Routine/manual	2.01 [0.48-8.40]	3.88 [1.25-12.00]*	0.35 [0.06-2.14]	-2.69 [-9.24, 3.85]
Not working	4.26 [1.36-13.32]*	1.58 [0.60-4.15]	0.07 [0.01-0.30]*	-7.24 [-15.31, 0.83]

[a] Negative binominal regression was fitted and rate ratios (RR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of general functioning with parent's education (p= 0.066) and general functioning with parent's socioeconomic classification (p=0.006).

In further analysis by specific domains of family functioning, interactions with family SEP indicators were found for all domains but problem solving. For the communication domain, there was evidence of a negative multiplicative zero additive interaction with parental education and socioeconomic classification (Table 7.25). On one hand, children of parents with no qualifications and unhealthy communication reported lower FIS scores, on the multiplicative scale (RR: 0.02, 95% CI: 0.00-0.14), than children of parents with either no qualifications or unhealthy communication. On the other hand, children of parents with intermediate occupations and unhealthy communication and

children of parents with no work and unhealthy communication reported lower FIS scores, on the multiplicative scale (RR: 0.08, 95% CI: 0.01-0.58 and RR: 0.05, 95% CI: 0.01-0.23, respectively) than children of parents with either that specific occupational status or unhealthy communication.

Table 7.25. Estimates for the moderating role of communication in the association between family SEP and FIS score (n=714)

	Communication		**Measure of interaction**	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	RR[a] **[95% CI]**	**RR**[a] **[95% CI]**	**RR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	1.11 [0.39-3.13]		
A-levels	0.94 [0.37-2.43]	2.57 [0.88-7.51]	2.47 [0.53-11.56]	1.53 [-1.03, 4.08]
Secondary school	0.42 [0.14-1.29]	2.10 [0.67-6.57]	4.51 [0.78-26.16]	1.57 [-0.82, 3.98]
None	4.55 [1.47-14.09]*	0.10 [0.02-0.49]	0.02 [0.00-0.14]*	-4.56 [-10.03, 0.91]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	6.05 [2.29-15.95]*		
Intermediate	4.59 [1.64-12.85]*	2.31 [0.47-11.38]	0.08 [0.01-0.58]*	-7.32 [-15.66, 1.01]
Routine/manual	2.95 [0.76-11.37]	3.26 [0.98-10.82]	0.18 [0.03-1.07]	-4.74 [-12.01, 2.54]
Not working	4.21 [1.52-11.68]*	1.26 [0.41-3.93]	0.05 [0.01-0.23]*	-7.99 [-7.98, 0.12]

[a] Negative binominal regression was fitted and rate ratios (RR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of communication with parent's education (p= <0.001) and communication with parent's socioeconomic classification (p=0.001).

For the roles domain, there was evidence of a positive multiplicative positive additive interaction with parental education, which was limited to one stratum (Table 7.26). Children of parents with secondary education and unhealthy roles reported greater FIS scores, on the multiplicative (RR: 16.12, 95% CI: 2.24-67.14) and additive scales (RERI: 1.76, 95% CI: 0.13, 3.38) than children of parents with only one of those factors (either secondary education or unhealthy roles).

Table 7.26. Estimates for the moderating effect of roles in the association between family SEP and FIS score (n=714)

	Roles		**Measure of interaction**	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	RR[a] **[95% CI]**	**RR**[a] **[95% CI]**	**RR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	0.73 [0.28-1.92]		
A-levels	0.88 [0.36-2.16]	2.24 [0.69-7.28]	3.49 [0.75-16.13]	1.63 [-0.78, 4.05]
Secondary school	0.19 [0.05-0.69]*	1.68 [0.58-4.84]	16.12 [2.24-67.14]*	1.76 [0.13-3.38]*
None	1.64 [0.32-8.41]	0.65 [0.18-2.38]	0.54 [0.07-4.08]	-0.73 [-3.51, 2.04]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	2.98 [1.15-7.70]*		
Intermediate	1.80 [0.44-7.34]	4.17 [1.53-11.37]*	0.78 [0.13-4.75]	0.39 [-4.49, 5.27]
Routine/manual	2.00 [0.55-7.23]	3.36 [0.90-12.46]	0.56 [0.09-3.65]	-0.63 [-5.78, 4.52]
Not working	2.40 [0.85-6.78]	1.19 [0.42-3.37]	0.17 [0.04-0.75]*	-3.19 [-7.20, 0.81]

[a] Negative binominal regression was fitted and rate ratios (RR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of roles with parent's education (p=0.008) and roles with parent's socioeconomic classification (p=0.114).

For the affective responsiveness domain, there was evidence of a negative multiplicative zero additive interaction with parental socioeconomic classification, although it was restricted to a single stratum (Table 7.27). Children whose parents were not working and had unhealthy affective responsiveness reported lower FIS scores, on the multiplicative scale (RR: 0.10, 95% CI: 0.02-0.55), than children whose parents only had one of those circumstances (either were not working or had unhealthy affective responsiveness).

For the affective involvement domain, there was evidence of a positive multiplicative zero additive interaction with parental education, which was limited to one stratum (Table 7.28). Children of parents with secondary school education and unhealthy affective involvement reported higher FIS scores, on the multiplicative scale (RR: 9.82, 95% CI: 1.83-52.68), than children of parents with only one of those conditions (either secondary school education or unhealthy affective involvement).

Table 7.27. Estimates for the moderating role of affective responsiveness in the association between family SEP and FIS score (n=714)

	Affective responsiveness		**Measure of interaction**	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	RR[a] **[95% CI]**	**RR**[a] **[95% CI]**	**RR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	1.21 [0.35-4.25]		
A-levels	1.02 [0.42-2.53]	3.14 [0.97-10.16]	2.53 [0.42-15.20]	1.90 [-1.75, 5.55]
Secondary school	1.35 [0.50-3.66]	0.62 [0.16-2.39]	0.38 [0.06-2.39]	-0.94 [-3.03, 1.15]
None	2.36 [0.63-8.83]	0.37 [0.08-1.57]	0.13 [0.01-1.10]	-2.21 [-5.73, 1.31]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	3.29 [1.08-9.98]*		
Intermediate	2.31 [0.88-6.03]	2.68 [0.51-13.97]	0.35 [0.05-2.59]	-1.91 [-7.43, 3.60]
Routine/manual	2.22 [0.66-7.41]	1.52 [0.37-6.27]	0.21 [0.03-1.58]	-2.98 [-7.95, 1.98]
Not working	1.73 [0.66-4.52]	0.56 [0.16-1.93]	0.10 [0.02-0.55]*	-3.46 [-7.75, 0.83]

[a] Negative binominal regression was fitted and rate ratios (RR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of affective responsiveness with parent's education (p=0.027) and affective responsiveness with parent's socioeconomic classification (p=0.065).

Table 7.28. Estimates for the moderating role of affective involvement in the association between family SEP and FIS score (n=714)

	Affective involvement		**Measure of interaction**	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	RR[a] **[95% CI]**	**RR**[a] **[95% CI]**	**RR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	0.84 [0.30-2.34]		
A-levels	1.03 [0.40-2.65]	1.64 [0.53-5.10]	1.90 [0.42-8.60]	0.77 [-1.03, 2.57]
Secondary school	0.25 [0.07-0.83]*	2.04 [0.68-6.14]	9.82 [1.83-52.68]*	1.95 [-0.15, 4.06]
None	1.93 [0.39-9.48]	0.85 [0.22-3.32]	0.52 [0.06-4.27]	-0.92 [-4.14, 2.30]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	2.86 [1.07-7.64]*		
Intermediate	1.77 [0.57-5.47]	4.81 [1.54-15.01]*	0.95 [0.18-5.10]	1.18 [-4.33, 6.69]
Routine/manual	3.77 [0.95-14.97]	2.07 [0.67-6.45]	0.19 [0.03-1.12]	-3.56 [-9.52, 2.40]
Not working	1.73 [0.61-4.92]	1.85 [0.65-5.28]	0.37 [0.09-1.57]	-1.74 [-5.02, 1.55]

[a] Negative binominal regression was fitted and rate ratios (RR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of affective involvement with parent's education (p=0.031) and affective involvement with parent's socioeconomic classification (p=0.204).

For the behaviour control domain, there was evidence of a positive multiplicative positive additive interaction and a negative multiplicative zero additive interaction with parental education as well as evidence of a negative multiplicative zero additive interaction with parental socioeconomic classification (Table 7.29). On one hand, children of parents with secondary school education and unhealthy behaviour control reported greater FIS scores, on the multiplicative (RR: 12.41, 95% CI: 2.24-68.84) and additive scales (RERI: 1.83, 95% CI: 0.25, 3.42) whereas children of parents with no qualifications and unhealthy behaviour control reported lower FIS scores, albeit only on the multiplicative scale (RR: 0.05, 95% CI: 0.01-0.29), than those with either that specific level of education or unhealthy behaviour control. On the other hand, children whose parents were not working and had unhealthy behaviour control reported lower FIS scores, on the multiplicative scale (RR: 0.13, 95% CI: 0.03-0.65), than children whose parents either were not working or had unhealthy behaviour control.

Table 7. 29. Estimates for the moderating role of behaviour control in the association between family SEP and FIS score (n=714)

	Behaviour control		**Measure of interaction**	
	Healthy	**Unhealthy**	**Multiplicative**[b]	**Additive**
	RR[a] **[95% CI]**	**RR**[a] **[95% CI]**	**RR [95% CI]**	**RERI [95% CI]**
Parent's education				
Degree or higher	1.00 [reference]	0.63 [0.22-1.78]		
A-levels	0.90 [0.28-2.96]	1.38 [0.46-4.18]	2.43 [0.50-11.83]	0.85 [-0.56, 2.26]
Secondary school	0.22 [0.06-0.82]*	1.68 [0.57-4.97]	12.41 [2.24-68.84]*	1.83 [0.25, 3.42]*
None	6.50 [1.80-23.43]*	0.18 [0.04-0.80]*	0.05 [0.01-0.29]*	-5.94 [-14.46, 2.59]
Parent's socioeconomic classification				
Managerial/professional	1.00 [reference]	2.14 [0.80-5.73]		
Intermediate	1.60 [0.48-5.31]	4.13 [1.34-12.73]*	1.21 [0.21-6.97]	1.39 [-3.27, 6.05]
Routine/manual	3.47 [0.89-13.62]	1.78 [0.54-5.84]	0.24 [0.04-1.44]	-2.83 [-8.10, 2.45]
Not working	3.73 [0.98-14.24]	1.02 [0.40-2.59]	0.13 [0.03-0.65]*	-3.85 [-9.44, 1.75]

[a] Negative binominal regression was fitted and rate ratios (RR) reported. Models were adjusted for parental and child demographic factors (parental age, sex, ethnicity, marital status, child age and sex) and the other socioeconomic indicator in the table.
[b] Joint test for the interactions of behaviour control with parent's education (p=<0.001) and behaviour control with parent's socioeconomic classification (p=0.044).

7.4. Summary of the chapter

This chapter reported findings testing whether family functioning moderated the association between family SEP and child oral health. Various shapes and sizes of interactions between family SEP indicators and family functioning were seen across the assessed oral health outcomes. Only those interactions found consistently across both indicators and multiple categories of SEP as well as with general and specific domains of family functioning were considered meaningful.

First, there was no strong evidence for an interaction between family functioning and family SEP in relation child dental behaviours. Second, general family functioning, problem solving and behaviour control moderated the association of family SEP with untreated caries. In all these cases, having an unhealthy functioning in the family worsened the association between low family SEP and child untreated caries. Finally, there was no strong evidence for an interaction between family functioning and family SEP in relation to child and family quality of life.

Chapter 8

Discussion

This chapter discusses the findings presented in chapters 4 through 8, their implications for future research, the strengths and limitation of the present research, and finally present the conclusions of the study.

8.1. Summary of key findings

This research project aimed to examine the interrelationship of family functioning, parental SEP and child oral health among pre-school children. This aim was addressed through three complementary objectives:

The findings on *the independent association of family functioning with child oral health* (objective 1) were presented in chapter 5. Children from families with unhealthy general functioning had high sugars intake, more caries experience and untreated caries and poorer family quality of life. In analysis by domains, unhealthy roles was associated with high sugars intake, infrequent toothbrushing, less treated caries and poorer family quality of life.; unhealthy behaviour control was associated with high sugars intake and less treated caries; unhealthy affective involvement with high sugars intake and poorer family quality of life; unhealthy affective responsiveness with less treated caries; and unhealthy problem solving with poorer family quality of life.

The findings of *testing the mediating role of family functioning in the association between parental SEP and child oral health* (objective 2) were presented in chapter 6. There was evidence that general family functioning may partially mediate the

associations of parental SEP with high sugars intake, dental caries experience and untreated caries. In analysis by domains, roles, affective responsiveness, affective involvement and behaviour control showed the strongest evidence of mediation, particularly for the association of low parental SEP with high sugars intake and less treated caries.

The findings of *testing whether family functioning modified the association between parental SEP and child oral health* (objective 3) were presented in chapter 7. Unhealthy general family functioning strengthened the associations of low parental SEP with more untreated caries. By domains, unhealthy problem solving and behaviour control worsened the association of low parental SEP with higher levels of untreated caries.

8.2. Description of the study sample

This study analysed data from the ELOHI survey which targeted the general population of 16-65-year-olds and 3-4-year-olds living in Outer North East London (Barking and Dagenham, Redbridge, and Waltham Forest boroughs). The area is largely deprived (the three boroughs were in the most deprived decile in England) and hosts a multi-ethnic population of over 600,000 residents (Office for National Statistics, 2011).

When comparing the sociodemographic characteristics of the study sample with data from the 2011 UK Census, it was noted that the proportion of ethnic minorities in the study sample (44%) was very similar to the 42% of non-White groups residing in the area (Office for National Statistics, 2011). However, higher proportions of parents who were more educated and in managerial and professional jobs was noted in this study than the study population. The proportions with degree or higher education (40.7%) and in managerial and professional jobs (44.6%) were higher in the study sample than

in the study population (31.6% and 27.3%, respectively) (Office for National Statistics, 2011). These differences can generally be attributed to higher participation rates in surveys and research among more educated groups (Galea and Tracy, 2007).

Although the proportion of cohabiting parents in the study sample (82%) was higher than in the study population (67%) (Office for National Statistics, 2011), this difference can be attributed to the targeted selection of participants in this study. ELOHI recruited families with young children (3-4-year-olds) whereas the census data included a wider range of age for dependent children (0-15-year-olds), which might account for greater variability in family structure and living arrangements in the census data. The difference could also reflect that lone-parents tend to participate less in surveys (i.e., underrepresentation) than cohabiting parents due to increased care responsibilities and time-constraints (Campbell et al., 2016, Arnold et al., 2008).

In terms oral health outcomes, the child caries experience in this study (dmft: 0.99) was similar to the latest dental caries data from the three boroughs, which ranged from 0.5 to 0.6 for 3-year-olds and from 0.9 to 1.6 for 5-year-olds (Public Health England, 2021a). Studying populations where there are social and ethnic differences (adversity and disadvantage), such as in the ELOHI study, is important because it allows assessment of populations that are most in need where there is higher disease prevalence/incidence, more behavioural risks, poorer outcomes, lower access/provision of care and resources (i.e., health inequalities) (Lee and Divaris, 2014).

Furthermore, half of the sample reported unhealthy general family functioning, which was much higher than the 15.6% of parents reporting problematic family functioning in the Mental Health of Children and Young People Survey in England follow-up wave 2020 (NHS Digital, 2020). Although not directly comparable given differences in methodology where only 4 questions from the FAD 12-items general functioning scale

were used in the 2020 study and where the age of children was 5-16-year-olds, it is likely that the high prevalence of unhealthy family functioning in our sample could be attributed to the high deprivation level in the targeted population, that might put families under stress (Conger et al., 2010).

Clear differences in family functioning were noted according to parental SEP, ethnicity and family structure. Living in poverty is associated with poorer family outcomes including poorer family functioning (Emerson and Hatton, 2009). Various pathways of how family SEP could affect family functioning have been previously suggested. One of those pathways is through family stress whereby lower social and financial standing put parents in distress because of their inability to provide optimal living conditions for their families (Mansfield et al., 2013). That can result in maladaptive coping mechanisms which can reflect in the ways in which family members interact with and relate to each other (Banovcinova et al., 2014, Botha et al., 2018). Another potential pathway is through parental beliefs, practices and attitudes towards best familial practices and how to deal with day-to-day challenges. Lower educational attainment, access to information and socioeconomic standing affect how parents define and assign family roles and responsibilities, how they express affection and support for each other, how they negotiate and respond in times of problems and crises, and how they discipline children and control behaviours (Mansfield et al., 2013). Certainly, parental beliefs, practices and attitudes are culturally shaped which could explain the ethnic differences in unhealthy general family functioning seen in this study. Family dynamics vary across cultures in aspects such as the mothering role of women, gendered family roles, and discipline of children (Bornstein and Lansford, 2019). This study also found differences in roles functioning between single-parents and those who were living with a partner, which can be explained by the increased everyday responsibilities and challenges,

whether financial, physical or emotional, faced by single-parents versus those with a partner to help care for a child. Evidence from a UK population sample has suggested that single-parenthood constituted another layer of social disadvantage that hindered access, participation and benefit from support services (Belsky et al., 2006).

To sum up, the sample was not entirely representative of the study population in terms of sociodemographic factors. Some differences in sociodemographic characteristics and family functioning noted in this study were likely related to disadvantage (low SEP, ethnic minority and single parenthood).

8.3. The association between family functioning and child oral health

Children from families with unhealthy general functioning were more likely to have high sugars intake and less likely to brush frequently than their counterparts. Although similar findings have been previously reported (Renzaho et al., 2014, Nanjappa et al., 2015, Duijster et al., 2014), the present study provides further evidence on which domains of family life were relevant to child dental behaviours. Families with well-defined roles, good involvement and responsiveness, and appropriate behaviour control provide their children with an environment that is more conducive to the adoption of favourable behaviours including limiting the child's sugars intake. Furthermore, well-defined and fulfilled roles seemed to support frequent toothbrushing. These findings emphasise parental responsibility in care and support for children including commitment to perform frequent brushing for their 3-4-year-olds' teeth as young children do not yet have the necessary skills to do this unaided. Although unhealthy family functioning was also associated with irregular child dental attendance, this association was fully attenuated after adjustment for family SEP. Previous studies have

reported mixed findings (de Moura et al., 2021b, Neves et al., 2021b, Finlayson et al., 2018). The use of dental services is somewhat different to sugars intake and toothbrushing as families may face external barriers that fall outside their perceived direct control. That said, child dental services are free and comprehensive in England, which suggests there might be factors beyond affordability affecting child attendance pattern. Data from the latest national oral health survey of children showed an increasing proportion of parents reporting difficulties finding an NHS dentist over the past decade (Holmes et al., 2016). The fact that ELOHI families were recruited from a deprived, ethnically diverse area suggests issues of geographical accessibility, availability and accommodation (language and cultural barriers) could be relevant. Other barriers that might influence dental attendance include dental fear or pain during treatment, past treatment experiences, lack of parental perception of need for child dental treatment or preventive care, issues related to parental health information and knowledge, although these factors need further exploration.

In terms of child dental caries, unhealthy general family functioning was associated with higher levels of child caries experience and untreated caries. The magnitude of these associations was such that children living in families with unhealthy general functioning had around 49% greater caries experience and 84% more teeth with untreated caries than children living in families with healthy general functioning. These findings confirmed previous studies (de Jong-Lenters et al., 2018, Duijster et al., 2014, Neves et al., 2020, Dutra et al., 2020) but also contradict others (Duijster et al., 2015, de Moura et al., 2021c). The association between family functioning and child dental caries could be explained through the behavioural pathway positing that poor family functioning leads to unhealthy behaviours which ultimately led to poor health outcomes, such as childhood obesity and eating disorders (Holtom-Viesel and Allan,

2014, Halliday et al., 2014, Booysen et al., 2021). As for the relevant domains, good functioning in behaviour control, roles and affective responsiveness could explain why some children had more caries treatment experience (fillings and extractions). The findings underscore parental responsibility and role in the care of children, including setting up routines conducive to health, such as curbing sugars intake and supervising daily toothbrushing (behaviour control); seeking and accessing dental services for caries treatment as needed (roles); and providing the emotional support that young children need during episodes of pain or anxiety while visiting the dentist (affective responsiveness).

As for OHRQoL, the associations of general functioning with the ECOHIS total, CIS and FIS scores were all positive (i.e., suggesting that families with unhealthy functioning also reported more oral impacts on quality of life) but only those for the FIS score were significant. The FIS of ECOHIS is comprised of two constructs: family function and parental distress, which might suggest some degree of overlapping with family functioning. However, questions on the family function construct focus on how often family members had taken time-off work and/or felt impacted financially because of their child oral health whereas questions on the parental distress construct focus on how often family members had felt guilty and/or upset because of their child's oral health condition. As such, FIS items focus on outcomes whereas FAD items focus on processes. An alternative explanation is that a healthy level of interaction between family members might provide a psychosocial environment that is conducive to more favourable behaviours, oral health and OHRQoL. Although this explanation is somewhat supported by the direction of the associations between family functioning and CIS, the association with child impacts (CIS) was weaker than that with family impacts (FIS). Another explanation is that child caries experience might influence

family life both in terms of distress and finances (as measured by the FIS) as well as in terms of the amount and quality of interactions among members (family functioning). Although our estimates were adjusted for child dental caries experience, the cross-sectional nature of the data only shows that the three variables were correlated, but it cannot provide clues about their temporal ordering. Moving towards relevant domains, unhealthy roles functioning was associated with greater FIS score. That is, parents who reported improperly assigned and unaccomplished roles among family members also reported more family impacts caused by the child oral condition. Our finding that effective roles functioning could be relevant to child oral health is in line with earlier evidence showing that family organisation (from the 5 domains in the Family Questionnaire, namely communication, organisation, partner-relation, responsiveness and social network) was the only domain associated with childhood dental caries after adjustments (Duijster et al., 2014). This is not to say that other domains of family functioning are not important. Indeed, our findings indicate that other domains could be relevant to explain the impacts of child oral conditions on family life. Family's ability to solve and manage problems (problem solving) as well as their ability to regulate how they get involved in the interest of each other (affective involvement) were associated with oral impacts on the family life.

To summarise, family functioning was found to influence different aspects of child oral health, notably on sugars intake, dental caries and oral impacts on family life. The most relevant domains of the family environment to child oral health were behaviour control and roles as they were consistently associated with various oral health outcomes.

8.4. The mediating role of family functioning in the association of parental socioeconomic position with child oral health

The findings of chapter 6 provided some support to the hypothesised indirect pathway from parental SEP to child oral health outcomes via family functioning. Such a mediating role was clearer with dental behaviours than dental caries and OHRQoL. Family functioning explained up to 13% of the association between parental SEP and child sugars intake, but not the associations of parental SEP with other child behaviours. Parental SEP can have both a direct and an indirect influence over child sugars intake. On one hand, the ability of parents to provide, choose and purchase healthier food options for their children is determined primarily by their resources, such as education (knowledge) and income (Park et al., 2016). Indeed, the consumption of sugars is typically higher among the more deprived groups of the population because foods that have high content of added sugars such as sugar-sweetened beverages are typically cheaper and more accessible (Thompson et al., 2009, Allen et al., 2017, Backholer et al., 2016). This could account for the direct effect of low SEP on child sugars intake. On the other hand, the indirect pathway posits that low socioeconomic circumstances put parents under stress, which has well-known adverse biological and behavioural influence (Peres and Heilmann, 2015) as well as adverse impacts on the functioning of the family (Emerson and Hatton, 2009, Mansfield et al., 2013, Botha et al., 2018). As a result of stress, maladaptive behavioural coping mechanisms often develop including smoking, excessive alcohol consumption, and unhealthy dietary behaviours which are all linked to a wide range of non-communicable diseases, such as dental caries and obesity, the so-called psychosocial pathway to health inequalities (World Health Organization, 2019, Phantumvanit et al., 2018, World Health Organization, 2021, Halliday et al., 2014). Although the evidence testing the mediating role of the family

environment in the association between parental SEP and childhood health is limited, a recent scoping review found that family processes including parent-child relationship, parental rules/descriptive norms, parental own health-related behaviour contributed to health inequalities in children through the pathway of family stress and the consequent maladaptive behavioural coping mechanisms (Hoffmann et al., 2022). Furthermore, van Harmelen et al. (2016) found that a supportive family context mediated the effect of adversities (including financial difficulties) on adolescents' mental health symptoms. Behaviour control, roles and affective involvement were the family functioning domains with supporting evidence of partial mediation of the association between parental SEP and child sugars intake. Low socioeconomic conditions lead to worse control over the child health behaviours, less engagement with parental responsibilities, and less parental involvement in the child's interest as parents cope with the harmful effects of socioeconomic disadvantage including inferior work conditions, long working hours, worse general health, single-parenthood, higher behavioural risks and generally lower social support and capital (Letourneau et al., 2011, Conger et al., 2010).

The fact that family functioning did not mediate the association of parental SEP with other child dental behaviours is puzzling, but it implies that other psychosocial factors and/or family attributes, such as childhood life events and oral health literacy, and language and geographical barriers to dental care can better explain differences in child toothbrushing behaviour and dental attendance pattern across SEP groups (Holmes et al., 2016, Arora et al., 2016, Abdelrahim et al., 2017, Sabbah et al., 2019).

General family functioning was found to partially mediate the association of parental SEP with child caries experience and untreated caries but not with treated caries. Based on the social causation theory, higher SEP groups are exposed to more favourable social determinants of health, resulting in better health behaviours whereas groups from lower

SEP are exposed to more disadvantaged conditions increasing their disease risk, stress and maladaptive coping behaviours which consequently result in health inequalities (psychosocial pathway to oral health inequalities) (Letelier et al., 2022). In that regard, it could be that poor socioeconomic circumstances resulted in unhealthy family functioning which affected dental caries experience through the path of behaviours (especially sugars intake in this sample). The harmful effects of socioeconomic disadvantage on child dental caries (Phantumvanit et al., 2018) and family functioning are well documented (Emerson and Hatton, 2009, Mansfield et al., 2013, Banovcinova et al., 2014, Botha et al., 2018). However, general family functioning explained around 12-16% of the association between parental SEP and dental caries indicating a partial and small role played. Indeed, the evidence suggests that dental behaviours (brushing with fluoride, sugars intake, regular dental attendance and daily smoking) explained about 27% and 49% of the social gradients in 4-year DMFT increment and DT increment among Finish adults (Sabbah et al., 2015). This finding suggests that other factors, such as other parenting and family characteristics, could play a more important role in explaining social gradients in child dental caries. That said, this encouraging finding could not be corroborated in analysis by domains. No family functioning domain met the conditions of the Baron and Kenny approach for mediation.

The opposite pattern was found regarding untreated caries. While there was no evidence supporting the intermediate role of general family functioning, the analysis by domains showed that roles, affective responsiveness and behaviour control could mediate the association between parental SEP and treated caries. Dental care services are free of charge for under 18 years old in England, however, parents and caregivers need to look for an NHS dentist and register the child with the dentist. Socioeconomic disadvantage is often linked to worse work environment for parents including unemployment,

overworking (e.g., working two jobs to provide for the family) or inflexible work schedules, and single parenthood with increased responsibility and lack of support. These unfavourable circumstances can impede the proper assignment and undertaking of parental roles and care responsibilities and limit being responsive to the child's needs and having control over their health behaviours (i.e., looking for a dentist, taking the time to use dental care services, compliance with treatment and appointments, following the advice of the dentist and generally practicing preventive behaviours) (Campbell et al., 2016, Arnold et al., 2008, Conger et al., 2010). Some of these factors were not captured by our measure of regular dental attendance, which is more related to accessing preventive than curative dental services.

This study did not find evidence that general or domain-specific family functioning mediated the association of parental SEP with OHRQoL. It is thus possible that differences in the perceptions of OHRQoL across SEP groups are better explained by other psychological, environmental, cultural and contextual factors such as general health status, happiness, resiliency, fear and anxiety (Faulks et al., 2022, Locker and Allen, 2007). Indeed, previous research has found that physical, emotional and mental well-being as well as previous experiences with disease and treatment predict children's OHRQoL (Sischo and Broder, 2011, Merdad and El-Housseiny, 2017).

In summary, the findings of this chapter were mixed, with stronger evidence that general family functioning could be an intermediate factor in the association of parental SEP with children's sugars intake, and less so with childhood dental caries. There was a consistent pattern in which behaviour control and roles were the domains of family functioning that could act as intermediate factors between parental SEP and sugars intake and treated caries. However, the magnitude to which family functioning could

explain socioeconomic inequalities in child oral health was relatively small, suggesting that other factors could be of key roles in the pathway.

8.5. The moderating role of family functioning in the association between family SEP and child oral health

The findings from chapter 7 provided some evidence of synergism between unhealthy family functioning and low parental SEP to adversely affect childhood oral health, although this was more evident for child untreated caries than dental behaviours or OHRQoL. These findings should be interpreted in the light of multiple testing (63 interactions were tested) and consistency across multiple family functioning domains, parental SEP indicators and child oral health outcomes (Ranganathan et al., 2016).

Unhealthy general and domain-specific family functioning intensified the effect of poor SEP circumstances on child untreated caries. The combined effect of both exposures (low parental SEP and unhealthy general functioning) was stronger than their individual effects, suggesting that they can exacerbate each other to affect childhood dental caries. This finding is in line with two recent reviews emphasising the role of family processes as a determinant of child health. In their review on the environmental mechanisms and pathways to child mental health outcomes, Bush et al. (2020) identified family processes as a malleable mechanism that affected new and sustained health risks. In the second review, Hoffmann et al. (2022) found evidence that family processes, including differential parenting and conflicts in parent-child relationship, modified the association between family SEP and child health. As proposed by Hoffmann et al. (2022), unhealthy family functioning may have intensified the effect of low SEP circumstances on untreated caries through the behavioural pathway. That is, family

functioning might have affected the ability of parents to manage and navigate the health care system (e.g., transport, find an NHS dentist who is available and able to treat children), manage the child if they are fearful or apprehensive about visiting the dentist, and comply with treatment and subsequent appointments. This is supported by the findings of the analysis by domains of family functioning in which unhealthy behaviour control and problem solving acted synergistically with low parental SEP to increase levels of untreated caries. These findings underscore the role of family functioning, which if healthy might provide a psychosocial environment that is conducive to good child oral health even in the face of socioeconomic disadvantage, but if unhealthy might add to the adversity and contribute to unfavourable outcomes. Of course, it is likely that the outcome of these interactions is dependent on other factors and mechanisms that are yet to be explored.

In summary, the findings from this chapter indicated that unhealthy family functioning had in some instances exacerbated the effect of low parental SEP on child oral health with stronger evidence that it intensified the association with child untreated caries in particular. There was a consistent pattern in which behaviour control and problem solving interacted with parental SEP to affect child untreated caries.

8.6. Putting all the study findings on the role of family functioning together

Three hypothesised roles for family functioning were tested in this project, namely independent factor, mediator and moderator (Booysen et al., 2021). Although the findings supported the three roles, the strongest evidence was observed for an independent effect. Indeed, the independent effect of family functioning was consistently seen across most child oral health outcomes (behaviours, dental caries and

OHRQoL) and for general and domain-specific functioning. That said, the independent, mediating and moderating roles are not mutually exclusive and vary depending on the outcome and predictors of interest (Baron and Kenny, 1986, Kraemer et al., 2008, MacKinnon, 2012, VanderWeele, 2015). Therefore, it is also possible that family functioning might be an intermediary factor in the association between parental SEP and child dental behaviours and untreated caries while also having an interaction effect with low parental SEP to affect untreated caries. The evidence on employing the same construct both as a potential mediator and a potential moderator is mixed. Some researchers argue that, based on conceptual and temporal grounds, the same construct cannot serve both functions in the same association of interest at the same time point (Karazsia and Berlin, 2018). That is because a moderator must precede an exposure to modify/change the exposure to outcome path whereas a mediator must follow the exposure to explain part or all the exposure to outcome path (Kraemer et al., 2002). However, other authors have provided empirical (Dakanalis et al., 2014, D'Lima et al., 2012) and mathematical evidence (Valeri and Vanderweele, 2013, Hayes, 2015) in which the same construct was shown to mediate and moderate the same association of interest and they provided explanations as to why this might be plausible. Goldstein et al. (2021) explained that it is possible for the indirect effect of the mediator on the association of interest to differ across levels of the exposure and mediator. Furthermore, Grant et al. (2006) reviewed the evidence on the mediating and moderating factors of the association between stressors and psychopathology in children and adolescents and found family functioning to be a mediator in one study and a moderator in another study for that association. Indeed, this suggests the relevance of moderated mediation and mediated moderation in systems of three or more variables. To that end, Valeri and Vanderweele (2013) suggested that the product method (Baron and Kenny, 1986) that

was utilised in this analysis could be useful to test mediation even if there is exposure-mediator interaction (also known as moderated mediation) because such analysis will provide evidence of mediation if the product of coefficients is non-zero, however, the product of coefficients in this case might not be equivalent to an indirect effect measure. That said, a four-way standard regression techniques can be used to decompose the total effect of an exposure on an outcome into four categories; that due to mediation alone, that due to interaction alone, that due to both mediation and interaction (also known as mediated moderation) and that due to neither of them (VanderWeele, 2014). However, that level of analysis requires complex longitudinal (panel) data that allow for measurement of the effect of prior change on later change (MacKinnon et al., 2007).

With regard to the family functioning domains that were found relevant to multiple child oral health outcomes, it is apparent that roles and behaviour control, and to a lesser extent affective responsiveness and affective involvement, showed the most consistent set of associations with child oral health in the analysis of independent, mediation and moderating effects. These domains of family dynamics could affect child health behaviours, which subsequently impact on child oral health. On one hand, roles functioning is related to how parents plan and fulfil care responsibilities such as, preparing and purchasing of food, supervising toothbrushing, and arranging for dental care service use. On the other hand, behaviour control is related to how parents monitor, reinforce or discourage their child's behaviours and set norms and routines around health and activities, such as curbing sugars, reinforcing twice daily toothbrushing, and time spent watching TV or playing on the streets among others.

The emotional support of parents to their children was highlighted by the findings on affective involvement and responsiveness. The former domain is relevant to how parents understand their child's feelings, symptoms and needs (Miller et al., 2008, Ryan

et al., 2005), including realising when their child is not feeling well due to issues related with their teeth or mouth. The latter domain is then relevant to how parents respond and address those perceived needs (Miller et al., 2008, Ryan et al., 2005), which would inevitably affect their behaviours including use of dental care services.

Furthermore, the domains of problem solving and communication were found irrelevant to child oral health. It could be explained that the focus of the communication domain of the FAD is on measuring how open and direct family conversations are, however, it might be that some important elements of communication could be better captured by other domains of family functioning such as how families perceive, use, and respond to the information they communicate. As for problem solving, 88% of the sample in this study reported healthy functioning in that domain (i.e., homogenous). It is possible that since this sample was drawn from a deprived area, families were more or less adapted, became resilient and have acquired the necessary skills to cope and solve problems.

Finally, the findings of this study can be relevant in explaining and supporting the general propositions of family theories presented earlier, particularly those related to the family system framework. For example, the family system theory identifies a link between dysfunction within the family system and individual disease or pathology since parts/members are interconnected and are affected by each other. This is supported by the findings of this study where unhealthy family functioning was associated with adverse oral health outcomes in children whether in terms of behaviours, disease experience or quality of life. Other family theories could also be relevant in explaining the links between family processes and childhood oral health, however further investigation and empirical testing is needed to support these explanations. For example, one can argue that the principles of the family ecology framework might be

relevant to the findings of this study since participants were recruited from a highly socially deprived area of London and approximately half of them reported unhealthy general family functioning indicating possible ecological links between area deprivation and family processes. Moreover, one can suggest that family conflict can generate stress within the family that provokes maladaptive coping mechanisms and results in adverse health outcomes. Furthermore, the family development theory postulates that family processes develop and change over time and across developmental stages making them amenable to change and improvement by targeted interventions. This could be helpful when setting, designing and evaluating strategies to improve childhood oral health.

8.7. Implications for policy and practice

It is common to misinterpret statistically significant findings as being clinically important or relevant to public health. Whilst this study found evidence that healthy family functioning was associated with more favourable child oral health outcomes, it is important to differentiate between statistical significance and clinical and public health relevance to help set these findings in the broader perspective. Statistical significance determine the probability of obtaining specific results due to chance, whereas clinical importance and public health relevance consider the effect and impact of study findings on the population of interest (Ranganathan et al., 2015). The impact or effect on the population is determined based on the extent and capacity to implement interventions or change the traditional practice in light of many factors, including, how much this change or intervention would make a difference in people's lives, the short, medium, and long-term effects of intervention or change of practice, public acceptance and uptake of intervention, cost-effectiveness, how easily the intervention can be

applied and whether the implementation would require additional training or education of personnel (LeFort, 1993).

The findings of the current study underscore the value of family functioning in relation to oral health. Examining the family context is key when trying to disentangle the roots for common non-communicable diseases during early life and to address health inequalities in childhood and later life. The fact that family functioning has been associated with other child health outcomes, such as obesity (Halliday et al., 2014), asthma (Al Ghriwati et al., 2017), sleep problems (El-Sheikh and Kelly, 2017), and eating disorders (Cerniglia et al., 2017), implies that family functioning could act as a common risk pathway (or at least part of the pathway) for multiple childhood illnesses. Dental caries and childhood obesity share a common behavioural risk factor, that is a diet high in sugars (Chi et al., 2017). Theoretical models of childhood obesity (Halliday et al., 2014) and child oral health (Fisher-Owens et al., 2007, Chi et al., 2017) have identified the family context as an important determinant because dietary habits are shaped within the family and are affected by its resources (Nanjappa et al., 2015). Therefore, the findings of this study support these models in identifying family functioning as a determinant of child oral health. Policy makers could include family functioning when designing and implementing strategies and interventions to improve child oral health. Such interventions could utilise a behavioural approach that engages parents/caregivers by means of training and education, counselling, therapy and skills development (Varghese et al., 2020). These family-based behavioural interventions could focus on family dynamics, rules and routines particularly those around food purchase, preparation, and family meals (Pratt and Skelton, 2018). It could also be beneficial for policy makers to consider the broader social environment in which families are living in when designing such interventions.

The findings of this study suggest that clear allocation and fulfilment of parental responsibilities and tasks between family members (healthy roles functioning) and setting norms, routines and practices that are conducive to oral health (behaviour control) as well as showing interest, empathy and support in each other by for instance, taking the time and effort to care for the child, meet their needs and seek care services when needed (affective involvement and responsiveness) might be possible features of the family life that could be addressed with interventions to improve child oral health and reduce inequalities in childhood oral health. Indeed, the evidence show that family-based interventions including family therapy sessions coupled with traditional treatment approaches targeting physical activity and dietary behaviours were more successful in treatment and prevention of obesity and promoting weight loss in children (Kitzmann et al., 2008, Pratt and Skelton, 2018, Skelton et al., 2020).

It is also worth mentioning here that as our participants were drawn from a population-based ethnically diverse sample of families from a deprived area of London, the present findings suggest that the role of the family might cut across different settings and backgrounds, making it very relevant for wider public health interventions.

8.8. Strengths and limitations of the study

8.8.1. Strengths of the study

This study added new knowledge to current evidence in this area. Perhaps the main strength of this study was in using the full version of the FAD (60 items), which allowed separate analyses of general and domain-specific family functioning. By doing so, this study explored which aspects of family functioning were more relevant to child oral health. In previous research, the assessment of family functioning was carried out using

general measures without further testing on the aspects of family functioning that affect child oral health. Other strengths of this study were the multiple child oral health outcomes evaluated, which included reported and clinical measures; and the comprehensive set of confounders controlled for during analysis, which included parental and child demographic characteristics as well as multiple family SEP indicators (education and socioeconomic classification), thus, overcoming common limitations in previous studies. The large sample of parent-child dyads from a socially deprived and multi-ethnic area in London was another strength as it broadens the applicability of our research framework across cultures and settings.

8.8.2. Limitations of the study

Some limitations of this study relating to the design, selection bias, measurement bias, and confounding need to be addressed.

Limitations related to the study design

This study analysed cross-sectional data. As data collection was carried out at a specific point in time, clear temporal relations (and causal inferences) between the variables cannot be established. This is particularly true in mediation analysis, which requires a clear ordering from exposure (family SEP) to mediator (family functioning) and to outcome (child oral health). That said, cross-sectional designs are useful to identify associations and generate hypotheses for further testing with stronger designs.

Potential for selection bias

The ethnic and sociodemographic structure of the study sample was close, but not fully representative to that observed in the Outer North East London area. As the study population live in a highly disadvantaged and multi-ethnic area, the findings might not be generalisable to the entire population of London or England because the population ethnic and socioeconomic make-up varies across other areas. In addition, the moderate response rate (57%) could have reduced the generalisability of findings. However, survey weights were used during analysis to produce population-level estimates and to compensate for survey non-response.

The proportion of eligible participants who were excluded from the analysis due to missing data was 26%, with most exclusions (15%) due to incomplete FAD responses. This finding is not surprising as the FAD is one of the longest instruments to measure family functioning (60 items) (Epstein et al., 1983b, Ryan et al., 2005), which underscores the typical trade-off between completion rates and gathering detail content (Rolstad et al., 2011, Bowling, 2005). That said, there were no significant differences across sociodemographic, family functioning and oral health outcomes between included and excluded participants except for their marital status. This sample lost some of its representation as the proportion of lone-parents was lower in included participants compared to those excluded, which confirm earlier evidence on under-representation of lone-parents in health surveys (Campbell et al., 2016, Arnold et al., 2008).

Potential for measurement bias

The exposure (family functioning) and some of the oral health outcomes (child behaviours and OHRQoL) assessed in this study were self-reported by parents, and as such some extent of measurement bias (recall and social desirability) is expected.

However, validated instruments to assess family functioning (FAD) (Epstein et al., 1983b) and OHRQoL (ECOHIS) (Pahel et al., 2007) were used in this study. Furthermore, adapted questions from national surveys on child's intake of sugars (National Diet and Nutrition Survey of children aged 1.5- to 4.5-year-olds) (Hinds and Gregory, 1995), dental attendance and toothbrushing frequency (Child Dental Health Survey) (Pitts et al., 2006) were also used. Furthermore, as parents completed the child questionnaire on behalf of their young children, this brings up the methodological challenge of using proxy reports (Culler et al., 2020, Thomson and Broder, 2018a). That said, most oral health status and OHRQoL measures for young children (preschool aged) are based on parental or carer reports (Castilho et al., 2013).

Regarding family functioning, there is an additional issue concerning which parent provided the responses. In this study, most parent-child dyads (70%) had only one parental response (mainly the mother) which was used. However, in 20% of the dyads, both parental responses were available, in which case, maternal responses were used in the analysis, except if they had missing data (n=13 dyads), because mothers were regarded as the primary carer of children. Nevertheless, the evidence suggests mothers' and fathers' responses on various family functioning measures were consistent and similar and showed no noticeable discrepancy (Altiere and Von Kluge, 2009, Delvecchio et al., 2016, Pisula and Porębowicz-Dörsmann, 2017).

This study measured family SEP by assessment of parental education and employment. Although this was an advancement compared to previous studies, some of which did not even attempt to adjust for family SEP, other relevant socioeconomic indicators, such as household disposable income, were not collected as part of the survey. There is also evidence that socioeconomic indicators do not have the same meaning or reflect the same status across ethnic groups (Fischbacher et al., 2013, Delgado-Angulo et al.,

2019). That said, the Outer North East London area was relatively homogenous in terms of social deprivation, which provided further control for area-level SEP differences across ethnic groups.

Potential for confounding bias

As with any project based on existing data, the choice of confounders was limited by data availability. Adjustment for important confounders (family SEP, parental and child demographic factors) of the association between family functioning and child oral health was carried out. However, other important factors, such as early life factors (pre-natal period and infancy) and parental health status and behaviours are associated with both family functioning (Renzaho and de Silva-Sanigorski, 2014) and child oral health (Goettems et al., 2011), and they could confound the association between family functioning and child oral health. These factors are fundamental to our understanding of child oral health and were, therefore, kept in the conceptual model for this study.

Potential impact of multiple testing

Multiple comparisons were carried out in this study across the seven domains of the FAD and multiple child oral health outcomes. Running multiple tests increases the probability of finding a statistically significant association just by chance which does not truly exist (i.e., a false-positive finding, type I error) (Streiner and Norman, 2011). There are generally two approaches to address the issue of multiple testing. One is a conservative approach in which correction or adjustment for the multiplicity of tests is carried out, typically by adjusting the α significance level (*p-value*). Adjustment of the significance level is often carried out using correction techniques, such as the

Bonferroni correction where the α significance level is divided by the number of tests conducted resulting in more stringent level of *p-value*. Although adjustment techniques reduce the chance of false-positive findings, they tend to decrease the study power and increase the chance of not finding statistically significant associations when they truly exist (i.e., false-negative findings, type II error). Missing some true associations because they did not reach the adjusted level of *p-value* is disadvantageous, particularly in exploratory research that aims to identify possible associations (Rothman, 1990). Another approach is to not undertake any adjustment or correction and rely for interpretation on scientific plausibility, supporting evidence from other studies and focusing on actual effect sizes rather than on *p-values* (Ranganathan et al., 2016, Rothman, 1990). The no correction approach was employed in this study as the aim was to examine and explore the interrelationships among family functioning, parental SEP and child oral health; however, cautious interpretation of the significant findings in this study was attempted considering consistency of evidence across the domains of family functioning and the multiple child oral health outcomes that were examined.

8.9. Recommendations for further research

The following recommendations can be made:

Future research could benefit from using longitudinal designs to establish temporal ordering between family functioning and oral health outcomes. This would require at least 2 separate assessments over time. A minimum of three consecutive assessments would be needed if mediating effects are to be tested, to ensure family SEP precedes, family functioning and this precedes child oral health outcomes. Improving study design from cross-sectional to longitudinal would improve the level of evidence for

causality across the hierarchy of observational evidence (VanderWeele et al., 2016). Causal inferences from observational data could potentially be established if time-varying exposures such as family functioning are assessed longitudinally at multiple time points whilst controlling for confounding at baseline and subsequent follow-ups (VanderWeele et al., 2016). It could also be relevant to study the feedback loop from child oral health to family functioning or reverse causation (i.e., whether the presence of a child with chronic condition such as dental caries impacted the functioning of their family). Interventions targeting family functioning using randomised controlled trials have been carried and were reported across several child health outcomes including obesity (Ek et al., 2015, Kelishadi and Azizi-Soleiman, 2014). These interventions seem to result in more favourable outcomes compared to traditional treatment approaches. Therefore, it could be suggested that family-based interventions with elements focusing on improving parental monitoring, empathy, reinforcement and encouragement of healthy behaviours, could be useful for the prevention and treatment of dental caries.

Future research may also benefit from assessment and adjustment of other factors, not assessed in this study, that may confound the association between family functioning and child oral health across time and developmental stages. Adjustment for early life factors such as, infant feeding practises and breastfeeding, as well as adjustment for factors related to parents such as psychological distress, mental health problems, general health status, chronic conditions, social support and capital could be further explored. In addition, the use of other measures of family functioning and alternative indicators of SEP might be useful in clarifying the dimensions and nature of the associations between SEP, family functioning and child oral health.

Finally, one can recommend the use of qualitative approaches to explore mothers/carers perceptions of what, why, and how family attributes and processes might contribute to the development of unhealthy behaviours and chronic diseases in children, specifically dental caries. Using qualitative methodologies would, then, improve our understanding of the family level determinants of child oral health. Interviewing mothers would be particularly informative because they are often the primary carers of young children and are usually involved in setting family routines and practices around health, diet and practices and household activities, such as purchasing and preparing food for the child, supervising toothbrushing, arranging and using dental care services.

Chapter 9

Conclusion

Regarding the three objectives of this study, it is concluded that:

Healthy family functioning was independently associated with more favourable child oral health outcomes including more favourable dental behaviours, lower dental caries experience, and less frequent impacts of child oral conditions on their quality of life and that of their families. How a family functions, particularly in terms of how they define roles and control daily routines might be relevant to improving child dental behaviours, and subsequently, child oral health.

Family functioning partly explained the associations of family socioeconomic position with child sugars intake and dental caries, emphasising the role of the family in reducing socioeconomic inequalities in child oral health. Clearly defined and articulated roles and behaviour control in the family were the most relevant domains.

Finally, family functioning moderated the association of low parental socioeconomic position with child untreated caries. More specifically, unhealthy behaviour control could exacerbate the negative effects of living in poor socioeconomic conditions on child dental status.

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Appendices

Appendix 1: Search strategy

Appendix 2: Adult questionnaire

Appendix 3: Child questionnaire

Appendix 4: Publications

Appendix 1

Literature search strategy

Database	Keywords
Medline	("Dental Caries"[Mesh]) AND "Family"[Mesh]
Medline	("Oral Health"[Mesh]) AND "Family"[Mesh]
Medline	("Oral Health"[Mesh]) AND "Nuclear Family"[Mesh]
Medline	("Dental Health Services"[Mesh]) AND "Family Relations"[Mesh]
Medline	("Oral Health"[Mesh]) AND "Nuclear Family"[Mesh])
Medline	("Dental Health Services"[Mesh]) AND "Family"[Mesh]
Medline	("Family"[Mesh]) AND "Dental Care"[Mesh]
Medline	Family functioning and dental caries
Medline	Family functioning and child oral health
Ovid	Family function* And Oral health Or Periodont* Or Gingivitis Or Dental caries
Google Scholar	Family functioning and oral health
Google Scholar	Family functioning and dental caries
Google Scholar	family function and child dental health
Google Scholar	Family function and oral health
Google Scholar	Family function and dental caries
Google Scholar	Family environment and oral health
Google Scholar	Family environment and dental caries
The Cochrane Central Register of Controlled Trials (CENTRAL)	Dental caries and family

Appendix 2

Adult Questionnaire

Address

.....

.....

.....

Adult Questionnaire

1. **What is your Name :**

The following questions are about your dental attendance

(For each of the following please tick the box next to your response)

2. About how long ago was your last visit to the dentist?

In the middle of treatment	1	More than 3 up to 5 years ago	6
in the last 6 months	2	More than 5 up to 10 years ago	7
in the last 12 months	3	More than 10 up to 20 years ago	8
More than 1 up to 2 years ago	4	Never	9
More than 2 up to 3 years ago	5		

3. **The last time you went to the dentist what made you go? Was it because you were having some trouble with your teeth or for a check-up or for some other reason?**	Trouble with teeth	1
	For a check-up	2
	Other (Specify):	3

4. **Is the dental practice (you went to the last time) nearer to your home or to your work?**	Nearer to home	1
	Nearer to work /school	2
	The same	3

5. **How far is it?**	Up to half a mile	1	More than 10 up to 20 miles	6
	More than half up to one mile	2	More than 20 up to 30 miles	7
	More than 1 up to 2 miles	3	More than 30 miles	8
	More than 2 up to 5 miles	4	Other (Specify):	9
	More than 5 up to 10 miles	5		

6. **Do you usually take time off work when you go to the dentist?**	Yes **(go to 7)**	1	No **(go to 8)**	2

7. **How much work time does a dental visit usually take, including travelling? (in hours)**	Under 1 hour	1	3 hours but less than 4	4
	1 hour but less than 2	2	Or 4 hours or more?	5
	2 hours but less than 3	3		

8. **Was your treatment under the NHS, was it private or was it something else?**	National Health Service (NHS)	1	Dental hospital (hospital)	6
	Private	2	Dentist at your workplace	7
	N.H.S and Private	3	Through insurance	8
	School/Community dental service	4	With a dental plan	9
	Armed forces	5	Something else? Specify:	10

9. **How much did the treatment cost you?**	Specify amount:

10. **Thinking about the dental practice you went to last time had you been there before or was that your first time at that practice?**	Been before **(go to 11)**	1
	First time **(go to 12)**	2

11. **For about how many years have you been going to that dental practice?**	Less than a year	1	5 years or more	4
	One year less than two	2	Don't know	5
	Two years less than five	3		

The following questions are about your oral hygiene habits
(For each of the following please tick the box next to your response)

12. **This question is about cleaning your teeth. How often do you clean your teeth nowadays?**	Never	1	More than twice a day	4
	Once a day	2	Other (Specify):	5
	Twice a day	3		

13. Nowadays there are several things available in chemist shops to help with dental hygiene purpose. Do you use any of them?

Dental floss	1	Dental disclosing tablets	6
Interdens/ toothpicks/ woodsticks	2	Dental chewing gum	7
Mouthwash	3	Sensodyne or smokers' toothpaste	8
Interspace brush	4	Something else (Specify)	9
Electric toothbrush	5		

The following question is about your diet

(For each of the following foods please tick the box next to your response)

14. How often on average do you eat the following foods?

		More than once a day	Once a day	Most days	At least once a week	At least once a month	Less than once a month	Never
A	Chocolate	1	2	3	4	5	6	7
B	Biscuits or cookies- (only sweet varieties)	1	2	3	4	5	6	7
C	Cakes (sweet)	1	2	3	4	5	6	7
D	Ice cream or ice lollies	1	2	3	4	5	6	7
E	Yogurt (Sweet)	1	2	3	4	5	6	7
F	Confectionary or other sweets	1	2	3	4	5	6	7
G	Cheese or cheese spread (not fromage frais)	1	2	3	4	5	6	7
H	Fruit Juice (sweetened)	1	2	3	4	5	6	7
I	Fruit Juice (un-sweetened)	1	2	3	4	5	6	7
J	Frizzy drinks (sweet)	1	2	3	4	5	6	7
K	Frizzy drinks (un-sweetened)	1	2	3	4	5	6	7
L	Meat other than fish or chicken: e.g. beef	1	2	3	4	5	6	7

		More than once a day	Once a day	Most days	At least once a week	At least once a month	Less than once a month	Never
M	Fried food: e.g. fried English breakfast, chips/crisps, savoury, fried chicken	1	2	3	4	5	6	7
N	Spicy food: e.g. most Asian food such madras curry, samosas, bhajis	1	2	3	4	5	6	7
O	Fatty food: e.g. full fat milk, Bacon, cheese	1	2	3	4	5	6	7
P	Unprocessed food: e.g. raw vegetables, cereals (grains)	1	2	3	4	5	6	7

This section includes questions on the impact that dental diseases can have on the quality of your life.

Please tick the box on the right hand side of your response

15. **In the last 12 months have you had trouble PRONOUNCING ANY WORDS because of problems with your teeth, mouth or dentures?**	Never	1	Fairly Often	4
	Hardly Ever	2	Very Often	5
	Occasionally	3		

16. **In the last 12 months have you felt that your SENSE OF TASTE has worsened because of problems with your teeth, mouth or dentures?**	Never	1	Fairly Often	4
	Hardly Ever	2	Very Often	5
	Occasionally	3		

17. **In the last 12 months have you had PAINFUL ACHING in your mouth?**	Never	1	Fairly Often	4
	Hardly Ever	2	Very Often	5
	Occasionally	3		

18. **In the last 12 months have you found it UNCOMFORTABLE TO EAT ANY FOODS because of problems with your teeth, mouth or dentures?**	Never	1	Fairly Often	4
	Hardly Ever	2	Very Often	5
	Occasionally	3		

19. **In the last 12 months have you been SELF-CONSCIOUS because of problems with your teeth, mouth or dentures?**	Never	1	Fairly Often	4
	Hardly Ever	2	Very Often	5
	Occasionally	3		

20. **In the last 12 months have you FELT TENSE because of problems with your teeth, mouth or dentures?**	Never	1	Fairly Often	4
	Hardly Ever	2	Very Often	5
	Occasionally	3		

21. **In the last 12 months has your DIET BEEN UNSATISFACTORY because of problems with your teeth, mouth or dentures?**	Never	1	Fairly Often	4
	Hardly Ever	2	Very Often	5
	Occasionally	3		

22. **In the last 12 months have you had to INTERRUPT MEALS because of problems with your teeth, mouth or dentures?**	Never	1	Fairly Often	4
	Hardly Ever	2	Very Often	5
	Occasionally	3		

23. **In the last 12 months have you found it DIFFICULT TO RELAX because of problems with your teeth, mouth or dentures?**	Never	1	Fairly Often	4
	Hardly Ever	2	Very Often	5
	Occasionally	3		

24. **In the last 12 months have you been a bit EMBARRASSED because of problems with your teeth, mouth or dentures?**	Never	1	Fairly Often	4
	Hardly Ever	2	Very Often	5
	Occasionally	3		

25. **In the last 12 months have you been a bit IRRITABLE WITH OTHER PEOPLE because of problems with your teeth, mouth or dentures?**	Never	1	Fairly Often	4
	Hardly Ever	2	Very Often	5
	Occasionally	3		

26. **In the last 12 months have you had DIFFICULTY DOING YOUR USUAL JOBS because of problems with your teeth, mouth or dentures?**	Never	1	Fairly Often	4
	Hardly Ever	2	Very Often	5
	Occasionally	3		

27. **In the last 12 months have you felt that life in general was LESS SATISFYING because of problems with your teeth, mouth or dentures?**	Never	1	Fairly Often	4
	Hardly Ever	2	Very Often	5
	Occasionally	3		

28. **In the last 12 months have you been TOTALLY UNABLE TO FUNCTION because of problems with your teeth, mouth or dentures?**	Never	1	Fairly Often	4
	Hardly Ever	2	Very Often	5
	Occasionally	3		

The following questions are about your satisfaction with your teeth

29. **(Thinking about both your natural teeth and your dentures) In general, how do you feel about the appearance of your teeth (and/or dentures), are you satisfied or not satisfied with the way they look?**			
Very satisfied	1	Dissatisfied	3
Satisfied	2	Very dissatisfied	4

30. **If you went to the dentist with an aching back tooth would you prefer the dentist to take it out or fill it (supposing it could be filled)?**	Take it out	1
	Fill it	2

31. **If the dentist said a front tooth would have to be extracted (taken out) or crowned, what would you prefer?**	Extracted	1
	Crowned	2

32. **If the dentist said a back tooth would have to be extracted (taken out) or crowned, what would you prefer?**	Extracted	1
	Crowned	2

33. **If you had several missing teeth at the back would you prefer to have a partial denture or manage without?**	Back partial denture	1
	Manage without	2

This section is about toothache, pain or sensitivity from your teeth or gums.

If you have NOT experienced PAIN in the previous ONE MONTH go to question 47.

34. **In the past ONE month have you experienced pain in your … (You may tick more than 1 answer)**	Tooth/ Teeth	1	Floor of mouth	5
	Gums	2	Inside of cheek	6
	Tongue	3	Jaw	
	Palate	4	Jaw joint	

35. **How long did you have the pain for?**	less than 1 week	1	6 months or longer, but less than 1 year	4
	1 week or longer, but less than 1 month	2	1 year or longer	5
	1 month or longer, but less than 6 months	3		

36. **How would you describe the intensity of your pain at its WORST?**	Mild	1	Horrible	4
	Discomforting	2	Excruciating	5
	Distressing	3		

37. **Thinking about the pain you have had in the past one month, how would you describe its pattern of occurrence?**			
Episodic: It comes and goes	1	Continuous: It's constant	2

38. **Please indicate the extent to which your pain radiates to the surrounding area**	Not at all	1	A large extent	4
	A small extent	2	Complete extent	5
	Moderate extent	3		

39. **Please indicate the extent to which it is worse when you chew or eat on the side of your mouth with the pain**	Not at all	1	A large extent	4
	A small extent	2	Complete extent	5
	Moderate extent	3		

40. **Please indicate the effect of eating or drinking something COLD**	Makes it a lot more painful	1	Makes it a little better	4
	Makes it a little more painful	2	Makes it a lot better	5
	No effect	3		

Please indicate the extent to which

	Not at all	A small extent	Moderate extent	A large extent	Complete extent
41. The gums in the area where you experienced the pain had felt swollen	1	2	3	4	5
42. The tooth where you experienced the pain had felt loose	1	2	3	4	5
43. It was difficult to swallow because of the pain	1	2	3	4	5
44. The tooth where you experienced the pain felt like it was sticking out a little	1	2	3	4	5

45. **Please indicate the extent to which you had difficulties with sleeping because of the pain.**	Full extent	1	A small extent	4
	A large extent	2	Not at all	5
	Moderate extent	3		

46. Which of the following words, if any, would you use to describe the pain you experienced in the past ONE month?			
		Yes	No
A	Pulling	1	2
B	Numb	1	2
C	Exhausting	1	2
D	Electric shocks	1	2

The following questions are related to your socio-demographic characteristics

(For each of the following questions please tick the box next to your response)

47. How long have you lived in this country?	All my life	1
	Other: specify number of years:	2

The following questions are related to your occupation (*please tick the box next to your response)*

48. Last week, were you any of the following?	In training/ Student	1	Retired	6
	Casually employed	2	Currently sick/ disabled	7
	Full-time employed	3	I have never worked	8
	Part-time employed	4	None of the options:	9
	Looking after home/ family	5	Specify:	10

If you have never worked go to question 56

The following questions are related to <u>your</u> current or last main job and occupation

49. What is (was) your main job?

Answer the following questions according to your current or last main job and occupation. For example, primary school teacher, state registered nurse, car mechanic, television service engineer, benefits assistant.
Civil Servants, local Government Officers- give job title not grade or pay band.

Please write your answer below

50. Describe what you do (did) in your main job?

Please write your answer below

51. What does (did) the firm/organisation you work for mainly make or do (at the place where you worked)?

For example, making shoes, repairing cars, secondary education, food wholesale, clothing retail, doctor's surgery.

If you are (were) self employed/ freelance or have (had) your own business, what is (was) the nature of your business?

Civil Servants, local Government Officers- please specify your department

Please write your answer below

52. Do (did) you work as an employee or are (were) you self employed? (*please tick the box next to your response*)	Employee	1
	Self employed with employees	2
	Self employed/ freelance without employees	3

53. **If you are (were) an <u>employee</u>: how many people work (worked) for your employer at the place where you work (worked)? (*please tick the box next to your response)***	1 to 9	1
	10 to 24	2
	25 to 499	3
	500 or more	4
If you are (were) <u>self employed</u> with employees: How many people do (did) you employ? (*please tick the box next to your response)*	1 to 9	1
	10 to 24	2
	25 to 499	3
	500 or more	4

54. Do (did) you supervise any other employees?

A supervisor or foreman is responsible for overseeing the work of other employees on a day to day basis.
Please, do not include:

- ***Supervisors of children, for example, teachers, nannies, childminders***
- ***Supervisors of animals***
- ***People who supervise security of buildings only, for example, caretakers, security guards***

(*please tick the box next to your response)*

Yes	1	No	2

55. Which of the following best describes the sort of work you do? If you are not working now, please indicate what you did in your last main job.

Modern professional occupations such as : teacher- nurse-physiotherapist- social worker- welfare officer- artist- musician- police officer (sergeant or above)- software designer	1
Clerical and intermediate occupations such as: secretary- personal assistant- clerical worker- office clerk- call centre agent- nursing auxiliary- nursery nurse	2
Senior managers or administrators (usually responsible for planning, organising and coordinating work) - finance manager- chief executive	3
Technical and craft occupations such as : motor mechanic – fitter- inspector- plumber- printer- tool maker- electrician – gardener- train driver	4
Semi-routine manual and service occupations such as : postal worker- machine operative- security guard- caretaker- farm worker- catering assistant- receptionist- sales assistant	5
Routine manual and service occupations such as: HGV driver- van driver- cleaner- porter- packer- sewing machinist- messenger- labourer- waiter/waitress- bar staff	6
Middle or junior managers such as : office manager- retail manager- bank manager- restaurant manager- warehouse manager- publican	7
Traditional professional occupations such as: accountant – solicitor- medical practitioner- scientist- civil/mechanical engineer	8

Question 56 only applies if you have never worked

56. **If you had a choice, what would you like to be doing next year? (*please tick all boxes that apply next to your response)***	Be unemployed	1
	Doing A levels	2
	Doing some other course at school (6th form) or at College	3
	Getting an apprenticeship/employment training course	4
	Getting a part or full-time job	5

PART –II

This section contains a number of statements about families. Studies have found that family characteristics affect oral health behaviours such as utilisation of dental services and dietary habits. Your answers will help us in identifying family characteristics that improve health.

Different people have different definitions of what a family is. When answering questions in this section, please consider all the people in your family who have played a role, either positive or negative, in your life during the past year.

57. Please tick, from the list provided those you will consider as family when answering the following section.

Mother	1	Brother	6
Father	2	Sister	7
Step/ foster mother	3	Step siblings	8
Step/ foster father	4	Grand parent(s)	9
Partner (Husband/ Wife/ Cohabitant)	5	Children	10
Other Specify:			11

13

Read each statement carefully, and decide how well it describes your own family. You should answer according to how you see your family. Try not to spend too much time thinking about each statement, but respond as quickly and as honestly as you can. If you have difficulty, answer with your first reaction. Please be sure to answer every statement.

		Strongly Agree	Agree	Disagree	Strongly Disagree
58.	**Planning family activities is difficult because we misunderstand each other**	1	2	3	4
59.	**We resolve most everyday problems around the house**	1	2	3	4
60.	**When someone is upset the others know why**	1	2	3	4
61.	**When you ask someone to do something, you have to check that they did it**	1	2	3	4
62.	**If someone is in trouble, the others become too involved.**	1	2	3	4
63.	**In time of crisis we can turn to each other for support.**	1	2	3	4
64.	**We don't know what to do when an emergency comes up.**	1	2	3	4
65.	**We sometimes run out of things that we need**	1	2	3	4
66.	**We are reluctant to show our affection for each other**	1	2	3	4
67.	**We make sure members meet their family responsibilities**	1	2	3	4
68.	**We cannot talk to each other about sadness we feel**	1	2	3	4
69.	**We usually act on our decisions regarding problems.**	1	2	3	4
70.	**You only get the interest of others when something is important to them**	1	2	3	4
71.	**You can't tell how a person is feeling from what they are saying**	1	2	3	4
72.	**Family tasks don't get spread around enough**	1	2	3	4

		Strongly Agree	Agree	Disagree	Strongly Disagree
73.	Individuals are accepted for what they are	1	2	3	4
74.	You can easily get away with breaking the rules	1	2	3	4
75.	People come right out and say things instead of hinting at them	1	2	3	4
76.	Some of us just don't respond emotionally	1	2	3	4
77.	We know what to do in an emergency	1	2	3	4
78.	We avoid discussing our fears and concerns	1	2	3	4
79.	It is difficult to talk to each other about tender feelings	1	2	3	4
80.	We have trouble meeting our bills	1	2	3	4
81.	After our family tries to solve a problem, we usually discuss whether it worked or not	1	2	3	4
82.	We are too self centred	1	2	3	4
83.	We can express feelings to each other	1	2	3	4
84.	We have no clear expectations (rules) about toilet habits (toilet use).	1	2	3	4
85.	We don't show our love for each other	1	2	3	4
86.	We talk to people directly rather than through go –betweens	1	2	3	4
87.	Each of us has particular duties and responsibilities	1	2	3	4
88.	There are lots of bad feelings in the family	1	2	3	4
89.	We have rules about hitting people	1	2	3	4
90.	We get involved with each other only when something interests us	1	2	3	4
91.	There's little time to explore personal interests	1	2	3	4
92.	We often don't say what we mean	1	2	3	4

		Strongly Agree	Agree	Disagree	Strongly Disagree
93.	We feel accepted for what we are	1	2	3	4
94.	We show interest in each other only when we can get something out of it personally	1	2	3	4
95.	We resolve most emotional upsets that come up	1	2	3	4
96.	Tenderness takes second place to other things in our family	1	2	3	4
97.	We discuss who is to do household jobs	1	2	3	4
98.	Making decisions is a problem for our family	1	2	3	4
99.	Our family shows interest in each other only when they can get something out of it	1	2	3	4
100	We are frank with each other	1	2	3	4
101	We don't hold any rules or standards	1	2	3	4
102	If people are asked to do something, they need reminding	1	2	3	4
103	We are able to make decisions about how to solve problems	1	2	3	4
104	If the rules are broken, we don't know what to expect	1	2	3	4
105	Anything goes in our family	1	2	3	4
106	We express tenderness	1	2	3	4
107	We confront problems involving feelings	1	2	3	4
108	We don't get along well together	1	2	3	4
109	We don't talk to each other when we are angry	1	2	3	4
110	We are generally dissatisfied with the family duties assigned to us	1	2	3	4
111	Even though we mean well, we intrude too much into each other's lives	1	2	3	4

		Strongly Agree	Agree	Disagree	Strongly Disagree
112	**There are rules about dangerous situations**	1	2	3	4
113	**We confide in each other**	1	2	3	4
114	**We cry openly**	1	2	3	4
115	**We don't have reasonable transport**	1	2	3	4
116	**When we don't like what someone has done, we tell them**	1	2	3	4
117	**We try to think of different ways to solve problems**	1	2	3	4

The next section applies only if you currently have a partner. If you do not have a partner this is the end of the questionnaire for you. Thank you for your participation

The following questions are about your partner's socio - demographic characteristics

118. Date of birth	_____/_____/_____ date month year	
119. Sex	Male	1
	Female	2
120. Country of Birth		

121. How long has your partner lived in this country?	All his/her life	1
	Other: specify number of years:	2

122. Which category best describes your partner? This is their race or ethnic group.					
Asian British	1	Black British	8	White British	17
Asian Indian	2	Black European	9	White West European	18
Asian Bangladeshi	3	Black African	10	White East European	19
Asian Pakistani	4	Black Caribbean	11	White Mediterranean	20
Asian Middle East/ Arabic	5	Black American	12	White North American	21
Asian Chinese	6	Latino	13	White Latin American	22
Asian Japanese	7	Mixed Asian/White	14	Other (Specify):	23
		Mixed Black/White	15		
		Mixed Asian/Black	16		

The following questions are related to your partner's education
(Please tick the box next to your response)

123. Did your partner ever attend school?		
	No **(Go to question 125)**	1
	No, but he/she can read and write **(Go to question 125)**	2
	Yes	3

124. What was the highest degree or qualification that your partner obtained?			
Elementary/ Primary school	1	A/AS/S levels	5
Secondary school without O level(s)	2	University	6
Secondary school with O level(s)	3	Post-graduate	7
Technical qualification	4		

The following questions are related to your partner's occupation ***(Please tick the box next to your response)***

125. **Last week, was your partner any of the following?**	In training/ Student	1	Retired	6
	Casually employed	2	Currently sick/ disabled	7
	Full-time employed	3	has never worked	8
	Part-time employed	4	None of the options:	9
	Looking after home/ family	5	Specify:	10

If your partner has never worked, this is the end of the questionnaire. Thank you!

The following questions are related to <u>your partner's</u> current or last main job and occupation

126. What is (was) your partner's main job?

For example, primary school teacher, state registered nurse, car mechanic, television service engineer, benefits assistant.

Civil Servants, local Government Officers- give job title not grade or pay band.

Please write your answer below

127. Describe what your partner does (did) in his/her main job?

Please write your answer below

128. What does (did) the firm/ organisation your partner work for mainly make or do ? *For example, making shoes, repairing cars, secondary education, food wholesale, clothing retail, doctor's surgery.* *If your partner is (was) self employed/ freelance or has (had) their own business, what is (was) the nature of the business?* *Civil Servants, local Government Officers- please specify your department* *Please write your answer below*

129. Does (did) your partner work as an employee or is (was) he/she self employed?	Employee	1
	Self employed with employees	2
	Self employed/ freelance without employees	3

130. If your partner is (was) an <u>employee</u>: how many people work (worked) for his/her employer at the place where he/she work (worked)? *(Please tick the box next to your response)*	1 to 9	1
	10 to 24	2
	25 to 499	3
	500 or more	4
If he/she is (was) <u>self employed</u> with employees: How many people do (did) he/she employ?	1 to 9	1
	10 to 24	2
	25 to 499	3
	500 or more	4

131. Do (did) your partner supervise any other employees?

A supervisor or foreman is responsible for overseeing the work of other employees on a day to day basis.

Please, do not include:

- ***Supervisors of children, for example, teachers, nannies, childminders***
- ***Supervisors of animals***
- ***People who supervise security of buildings only, for example, caretakers, security guards***

(Please tick the box next to your response)

Yes	1	No	2

132. Which of the following best describes the sort of work your partner does . If your partner is not working now, please indicate what he/she did in their last main job.
(Please tick the box next to your response)

Modern professional occupations such as : teacher- nurse-physiotherapist- social worker- welfare officer- artist- musician- police officer (sergeant or above)- software designer	1
Clerical and intermediate occupations such as: secretary- personal assistant- clerical worker- office clerk- call centre agent- nursing auxiliary- nursery nurse	2
Senior managers or administrators (usually responsible for planning, organising and coordinating work) - finance manager- chief executive	3
Technical and craft occupations such as : motor mechanic – fitter- inspector- plumber- printer- tool maker- electrician – gardener- train driver	4
Semi-routine manual and service occupations such as : postal worker- machine operative- security guard- caretaker- farm worker- catering assistant- receptionist- sales assistant	5
Routine manual and service occupations such as: HGV driver- van driver- cleaner- porter- packer- sewing machinist- messenger- labourer- waiter/waitress- bar staff	6
Middle or junior managers such as : office manager- retail manager- bank manager- restaurant manager- warehouse manager- publican	7
Traditional professional occupations such as: accountant – solicitor- medical practitioner- scientist- civil/mechanical engineer	8

Thank you for your help!

Appendix 3

Child Questionnaire

Address

.....

.....

.....

Child Questionnaire

The following questions are about the child being examined

1. **What is your name?**

2. **What is the name of the child being examined?**

3. **Are the child's parents…..**					
	Married to each other	1	Mother unmarried	7
	Cohabiting with each other	2	Father a widower	8
	Divorced/ separated	3	Father remarried	9
	Mother a widow	4	Father cohabiting with someone else	10
	Mother remarried	5	Father unmarried	11
	Mother cohabiting with someone else	6		

4. **What is the sex of the child being examined** ***(Please tick the box next to your response)***		
	Male	1
	Female	2

5. **What is the child's date of birth?** _____/_____/_____ date month year

The following questions are about the dental attendance of the child being examined. *(Please tick the box next to your response)*

6. **At what age did the child first visit the dentist?**	At 2 or under	1	Never	4
	Over 2 and under 3 years of age	2	Can't remember	5
	Over 3 and under 4 years of age	3		

7. **How long ago was the child's last visit to the dentist?**	Less than 6 months ago	1	More than 1 year: Specify :	3
	More than 6 months up to 1 year ago	2	Never **(go to question 9)**	4

8. Did the child attend the dentist because:			
You knew a routine check up was due	1	The oral health professional at the pre-school/ day-care advised it	3
The dentist sent you a reminder for a check	2	The child had toothache or some other problem	4

The following questions are about the child's brushing habits *(Please tick the box next to your response)*

9. **How often are the child's teeth brushed/ cleaned?**	Never	1	Twice a day	4
	Less than once a day	2	Three times a day or more	5
	Once a day	3		

10. **What kind of tooth paste does the child use?**	Doesn't use toothpaste	1	Without fluoride	3
	With fluoride	2	Don't know	4

The following questions are about the child's diet *(Please tick the box next to the response that best describes your child's eating habits)*

11. How often on average does the child eat the following foods?

		More than once a day	Once a day	Most days	At least once a week	At least once a month	Less than once a month	Never
A	Chocolate	1	2	3	4	5	6	7
B	Biscuits or cookies- (only sweet varieties)	1	2	3	4	5	6	7
C	Cakes (sweet)	1	2	3	4	5	6	7
D	Ice cream or ice lollies	1	2	3	4	5	6	7
E	Yogurt (Sweet)	1	2	3	4	5	6	7
F	Confectionary or other sweets	1	2	3	4	5	6	7
G	Cheese or cheese spread (not fromage frais)	1	2	3	4	5	6	7
H	Milk (sweetened)	1	2	3	4	5	6	7
I	Milk (unsweetened)	1	2	3	4	5	6	7
J	Fruit Juice (sweetened)	1	2	3	4	5	6	7
K	Fruit Juice (un-sweetened)	1	2	3	4	5	6	7
L	Frizzy drinks (sweet)	1	2	3	4	5	6	7
M	Frizzy drinks (un-sweetened)	1	2	3	4	5	6	7
N	Meat other than fish or	1	2	3	4	5	6	7

	chicken: e.g. beef							
O	Fried food: e.g. fried English breakfast, chips/crisps, savoury, fried chicken	1	2	3	4	5	6	7
P	Spicy food: e.g. most Asian food such madras curry, samosas, bhajis	1	2	3	4	5	6	7
Q	Fatty food: e.g. full fat milk, Bacon, cheese	1	2	3	4	5	6	7
R	Unprocessed food: e.g. raw vegetables, cereals (grains)	1	2	3	4	5	6	7

The next section is about the impact that dental diseases in young children can have on the quality of life of the child and the family

Problems with the teeth, mouth or jaws and their treatment can affect the well-being and everyday lives of children and their families.

For each of the following questions please tick the box next to the response that best describes your child's experiences or your own.

Consider the child's entire life from birth until now when answering each question. If a question does not apply, check 'Never"'

12. **How often has your child had pain in the teeth, mouth or jaws?**	Never	1	Often	4
	Hardly ever	2	Very often	5
	Occasionally	3	Don't know	6

13.	**How often has your child [e.g.:** *Had difficulty drinking hot or cold beverages*] **because of dental problems or dental treatments?**	Never	Hardly Ever	Occasionally	Often	Very Often	Don't Know
A	Had difficulty drinking hot or cold beverages	1	2	3	4	5	6
B	Had difficulty eating some foods	1	2	3	4	5	6
C	Had difficulty pronouncing any words	1	2	3	4	5	6
D	Missed preschool or daycare	1	2	3	4	5	6

14.	**How often has your child [.....] because of dental problems or dental treatments?**	Never	Hardly Ever	Occasionally	Often	Very Often	Don't Know
A	Had trouble sleeping	1	2	3	4	5	6
B	Been irritable or frustrated	1	2	3	4	5	6

15.	**How often has your child [.....] because of dental problems or dental treatments?**	Never	Hardly Ever	Occasionally	Often	Very Often	Don't Know
A	Avoided smiling or laughing when around other children	1	2	3	4	5	6
B	Avoided talking with other children	1	2	3	4	5	6

16.

		Never	Hardly Ever	Occasi onally	Often	Very Often	Don't Know
A	How often have you or another family member been upset because of your child's dental problems or dental treatments?	1	2	3	4	5	6
B	How often have you or another family member felt guilty because of your child's dental problems or dental treatments?	1	2	3	4	5	6

17.

		Never	Hardly Ever	Occasi onally	Often	Very Often	Don't Know
A	How often have you or another family member taken time off from work because of your child's dental problems or dental treatments	1	2	3	4	5	6
B	How often has your child had dental problems or dental treatments that had a financial impact on your family?	1	2	3	4	5	6

Thank you for your help!

6

Appendix 4

Publications

Community Dental Health (2021) **38,** 235–240
Received 3 February 2021; Accepted 20 April 2021

doi:10.1922/CDH_00037Almutairi06

Family Functioning and Dental Behaviours of Pre-school Children

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Objectives: To examine the association of family functioning with child dental behaviours and to identify family functioning domains associated with those behaviours. ***Methods***: Cross-sectional data from the East London Oral Health Inequalities (ELOHI) study were analysed in a subsample of 733 parent-child (3-4-years-olds) dyads. Family functioning was measured with the 60-item Family Assessment Device that yielded a general functioning score and six domain scores (roles, communication, problem solving, affective involvement, affective responsiveness, and behaviour control). Child dental behaviours were sugar intake, dental attendance and toothbrushing frequency. The association of family functioning with each dental behaviour was assessed in logistic regression models adjusted for confounders (parental sociodemographic and child demographic factors). ***Results***: Unhealthy general functioning was associated with greater odds of reporting high child intake of sugars (OR: 1.78, 95%CI: 1.01-3.13) as well as lower odds of reporting frequent child brushing (OR: 0.76, 95%CI: 0.50-1.18) and a child visit for dental check-up in the past year (OR: 0.98; 95%CI: 0.62-1.53), after adjustment for confounders. Unhealthy functioning in roles, affective involvement and behaviour control were associated with high child sugar intake whereas unhealthy functioning in roles was inversely associated with frequent child toothbrushing. No family functioning domain was associated with child dental attendance pattern. ***Conclusions***: Healthy family functioning was associated with more favourable child dental behaviours. How a family φυνχτιονσ; παρτιχυλαρλψ ιν τερμσ οφ ηοω τηεψ δεφινε ρολεσ ανδ συππορτ εαχη οτηερ εμοτιοναλλψ ισ λικελψ το βε ρελεϖαντ το χηιλδ οραλ ηεαλτη.

Keywords: *children, family, dental caries, sugars, toothbrushing*

Introduction

Childhood dental caries is a common chronic disease that adversely impacts children, families and society (Seow, 2018; Tinanoff *et al.*, 2019). It is a multi-factorial, with social, psychosocial, behavioural and biological determinants (Fisher-Owens *et al.*, 2007; Tinanoff *et al.*, 2019). Dental behaviours, such as high sugar intake, infrequent toothbrushing and irregular access to preventive services,χ are considered proximal predictors of caries experience across the life course (Kim Seow, 2012; Leong *et al.*, 2013; Pitts *et al.*, 2017). The family environment, in which children develop and thrive, plays an important role in establishing favourable health behaviours early in life (Chi *et al.*, 2017; Scaglioni *et al.*, 2018), including dental behaviours (Hooley *et al.*, 2012).

Many characteristics of the family environment have been studied in relation to child oral health (Hooley *et al.*, 2012). One factor that has gained recent attention is family functioning; the psychosocial features of family dynamics (i.e. their interactions and relationships) (Halliday *et al.*, 2014; Leeman *et al.*, 2016). Family functioning embraces a variety of themes including emotional attributes (e.g., warmth, tenderness, closeness, support, safety, responsiveness), physical health environment (e.g., health habits, activities and products), family governance (e.g., establishment of expectations and rules), quality of intra-familial relationships (i.e., parent-child, sibling and marital), characteristics of cognitive development and engagement (e.g., interaction and talking with children, spending time in reading and learning), and extra-familial connectedness (i.e., involvement with extended family, neighbourhood, work, school and community service) (Epstein *et al.*, 1978; Ryan *et al.*, 2005). Although several frameworks conceptualise family functioning, the McMaster model (Miller *et al.*, 2008; Ryan *et al.*, 2005), and the Family Assessment Device (FAD) to measure functioning (Epstein *et al.*, 1983; Μανφρεδ *et al.*, 2015; Miller *et al.*, 1985), ωερε ιδεντιφιεδ αμονγ the most relevant for research on childhood caries in a recent systematic review (Duijster *et al.*, 2013).

A few studies have examined the association between φαμιλψ φυνχτιονινγ ανδ χηιλδηοοδ οραλ ηεαλτη, ωιτη χονφλιχτ-ing results. Three Dutch studies found that healthier family functioning was associated with lower caries experience, although only at bivariate level (de Jong-Lenters *et al.*, 2018; Duijster *et al.*, 2015; Duijster *et al.*, 2014). An Australian study associated healthier family functioning with lower odds of carers reporting poor child oral health, even after adjustment for confounders (Renzaho and de Silva-Sanigorski, 2014). Two other studies have focused on dental behaviours among young children, particularly sugar intake. Nanjappa et al. (2015) showed that preschool children in families with unhealthy functioning consumed more sugars, after adjustment for parental sociodemographic factors and child demographic characteristics. Similarly, Renzaho et al. (2014) reported that children were more likely to drink sweet beverages if they lived in families with unhealthy functioning, after adjustment for family and child factors. There is a lack of studies εξαμινινγ φαμιλψ φυνχτιονινγ ινφλυενχεσ ον οτηερ χηιλδ dental behaviours. The aims of this study were to examine the association between family functioning and three child dental behaviours (sugar intake, dental attendance pattern and toothbrushing frequency) and to identify the family functioning domains associated with those behaviours.

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J Public Health Dent . ISSN 0022-4006

ORIGINAL ARTICLE

Family functioning and dental caries among preschool children

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Keywords
children; dental caries; family; socioeconomic factors.

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Received: 2/26/2021; accepted 9/6/2021.

doi: 10.1111/jphd.12475

J Public Health Dent (2021)

Abstract

Objectives: To investigate the relationship of family functioning with dental caries among 3–4-year-olds and the role of family functioning in explaining the relationship of family socioeconomic status (SES) with childhood dental caries.
Methods: Data from 761 parent–child dyads who took part in the East London Oral Health Inequalities study were analyzed. Family functioning was assessed using the 60-item family assessment device that yielded scores on general functioning and six domains (roles, communication, problem-solving, affective involvement, affective responsiveness, and behavior control). Children were clinically examined at home for dental caries. The association of family functioning and family SES (education and socioeconomic classification) with dental caries (dmft and dt scores) was tested using negative binominal regression while adjusting for child and parental demographic factors.
Results: Children from families with unhealthy general functioning had 1.49 (95% CI: 1.01–2.20) and 1.84 (95% CI: 1.20–2.82) times greater dmft and dt, respectively, than those from families with healthy functioning after adjustment for confounders. The estimates for the associations of parental education and socioeconomic classification with dmft and dt were attenuated by around 12%–18% after adjusting for family functioning. Of the six family functioning domains assessed, only unhealthy behavior control in the family was associated with greater numbers of decayed teeth after adjustments.
Conclusions: This study showed that unhealthy family functioning was associated with dental caries among young children. Family functioning partly explained the relationship between family SES and childhood dental caries.

INTRODUCTION

Childhood dental caries is a very common, largely preventable, chronic condition with substantial adverse impacts on child health and well-being [1,2]. Dental caries develops from an array of risk factors interplaying at the individual level (e.g., biology and health behaviors), family level (e.g., family functioning, parenting styles, and practices), and a broader societal level (e.g., level of deprivation, provision/access to care and resources) [2–5]. Further, evidence has shown that dental caries are socially patterned, whereby children from poorer social backgrounds often show more untreated disease and less treatment experience [5]. Understanding the mechanisms by which these factors affect the caries process is key to improve child oral health and reduce social inequalities in childhood oral health [6].

The role that families play as a nurturing environment for young children has a pivotal influence on their health and wellbeing outcomes across the life course [7,8]. A family context that is favorable is more conducive to better health and healthier behaviors [9]. One family-level factor that has been studied in relation to child chronic conditions, like obesity and asthma, is family functioning [10,11]. Family functioning encompasses the psychosocial characteristics of the family dynamics (i.e., the level and quality of interactions between family members and their relationships) [12,13]. It incorporates a variety of domains such as emotional attributes

Received: 29 March 2021 | Revised: 9 July 2021 | Accepted: 25 February 2022

DOI: 10.1111/cdoe.12739

ORIGINAL ARTICLE

Community Dentistry and Oral Epidemiology WILEY

Family functioning and preschool children's oral health-related quality of life

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Abstract

Introduction: Identifying which aspects of how a family functions are relevant to child oral health provides opportunities for interventions targeting the family context. The aim of this study was to investigate the associations of general and domain-specific family functioning with oral health-related quality of life (OHRQoL) of 3–4-year-old children.

Methods: Cross-sectional data from 740 parent-child dyads from East London were analysed. Family functioning was assessed with the 60-item Family Assessment Device that yields scores for general functioning and six domains (roles, behaviour control, communication, affective involvement, affective responsiveness and problem solving). Children's OHRQoL was measured using the Early Childhood Oral Health Impact Scale (ECOHIS), which measures the lifetime impacts of children's oral conditions on the child (child impact section, CIS) and family (family impact section, FIS). The associations of family functioning with the ECOHIS total, CIS and FIS scores were assessed in negative binomial regression models (rate ratios [RR] and 95% confidence intervals [95% CI] were calculated), adjusting for parental sociodemographic factors and child demographic factors and caries experience.

Results: Children in families with unhealthy general functioning had 1.45 (95% CI: 0.87–2.43), 1.24 (95% CI: 0.73–2.13) and 2.19 (95% CI: 1.20–3.99) times greater ECOHIS total, CIS and FIS scores, respectively, than those in families with healthy general functioning after adjustment for confounders. Unhealthy functioning in the roles domain was associated with greater ECOHIS total and FIS scores. Unhealthy functioning in the problem solving, roles and affective involvement domains were also associated with greater FIS scores.

Conclusions: Unhealthy family functioning was associated with worse child OHRQoL, especially in terms of disrupting family life. Effective assignment and undertaking of roles should be further explored as a target for intervention.

KEYWORDS
children, family, oral health, quality of life