Family functioning and frequency of sugar consumption by 3 and 4 year old children in Outer North East London

Sucharita Nanjappa

2012

Barts and the London School of Medicine and Dentistry, Queen Mary University of London

This thesis is submitted to the University of London in fulfilment of the requirements for Doctor of Philosophy under the supervision of Professor Wagner Marcenes and Professor Mark P Hector

Declaration

I, Sucharita Nanjappa confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Abstract

Dental caries is a public health problem affecting over 30% of 3.5 to 4.5 year old children in the UK. One of its most important determinants is frequent consumption of sugary foods, without which plaque bacteria cannot produce sufficient acids to demineralise tooth structure. The aim of this study was to identify the contribution of family functioning in the domains behaviour control, affective responsiveness, affective involvement, communication, problem solving and roles towards the frequent consumption of sugary foods by three and four year old children in Outer North East London. The research questions were explored with data from the Outer North East London Family Study (ONEL-FS), which collected data through home visits, by trained dentists and interviewers, from a representative sample of adults and children living in the London boroughs of Redbridge, Barking and Dagenham and Waltham Forest in 2008-10. This study analysed data (N=698) from three and four year old children and their mothers and included unadjusted and adjusted logistic regression and mediation analysis. The results showed that 17% of the sample consumed sugary foods more than 4/day which was significantly associated with behaviour-control (OR 0.25; 95% CI: 0.11, 0.57), affective-responsiveness (OR 0.29; 95% CI: 0.14, 0.58), affective-involvement (OR 0.32; 95% CI: 0.17, 0.60), communication (OR 0.34; 95% CI: 0.14, 0.85) and roles (OR 0.22; 95% CI: 0.08, 0.62), after adjusting for confounders. The significant association between mother's education and children's sugar consumption (OR 0.35; 95% CI: 0.21, 0.58) was partially mediated through behaviour control, affective responsiveness, affective involvement, communication and roles. The significant association between mother's ethnicity and sugar consumption (OR 3.46; 95% CI: 1.63, 5.25) was also partially mediated through these same five domains. The study findings contribute to the literature on protective influences within the family environment and confirm current knowledge regarding mother's education and ethnicity.

ACKNOWLEDGEMENTS

This thesis would not have been possible without the support, patience, guidance and encouragement of the following people. It is to them, that I owe my deepest gratitude.

Professor Wagner Marcenes, my first supervisor and an invaluable mentor. His expertise in this field, his brilliant insights, his guidance, support and commitment were essential throughout my PhD journey. He taught me the value and importance of having a sound theoretical base and high quality methodology.

My second supervisor Professor Mark P Hector has made available his support in countless ways throughout this process. His encouragement and unwavering support has given me the incentive to keep going and is deeply appreciated. His wisdom and motivation added considerably to my PhD experience.

Professor Allan Pau started me off on my PhD journey and gave me the opportunity to work on different projects and gain skills that have proved invaluable in my journey. Their combined knowledge, and expertise were the basis for this thesis.

Dr. Eduardo Bernabe gave generously of his time and expertise to help me through the minefield that is Statistics.

Waltham Forest, Redbridge, Barking and Dagenham Primary Care Trusts provided practical and financial support for the ONEL –FS and the Queen Mary Overseas Research Students Award granted me a fee waiver.

Sharea, Budi, Sakher, Seddika and Amani, my office mates and fellow students, shared this journey and made it an unforgettable and infinitely sweet memory. My other QMUL friends, Harveen, Manu, Feras, Ana, Vanessa, Amal, Saba, Siddharth, Amrita, Fadil, Lifong, Pete and Tony provided fun times and enriched the experience.

Sowmya Shetty and my other friends in London, who are too many to name, without forgetting someone (unintentionally), were my support network and family away from home.

My friends in Dundee made it easy to settle in a new country and complete this document, a special thank you to Stephanie Chambers who proofread my final draft.

I am forever grateful to my parents who have been unfailing in their belief and incredibly generous in giving me the means to follow my dreams. My family and friends are the most important people in my life and their unconditional love and support have given me the security to enjoy my PhD experience so far away from home. A special thank you to Savi and Binod for proofreading my drafts.

My deepest gratitude to Sri La Sri Sakthevadivel Swamiji for never letting go. His kindness, prayers and blessings have been a source of much needed strength.

The above mentioned deserve all the credit and none of the blame. For any errors or inadequacies that may remain in this work, the responsibility is entirely my own.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 Introduction

Diet refers to the habitual consumption of a selection of food and drink and has a direct effect on oral health, particularly dental caries, by influencing the oral pH and plaque composition; nutrition on the other hand is used to describe the intake and absorption of nutrients from food and drink which have an indirect systemic influence on oral health (Ashcroft et al.,2007). Children's diet, specifically the frequent consumption of sugary foods, is an oral health risk behaviour that has the potential to result in dental caries.

Dental caries is the result of complex interactions between the biological processes in the mouth, individual behaviours and societal influences (Holst et al.,2001) and is a public health problem in the UK affecting over 30% of 3.5 to 4.5 year old children (Moynihan and Holt,1996). One of the most important determinants of caries is non milk extrinsic sugars (NMES) in the diet, without which plaque bacteria cannot produce sufficient acids to demineralise tooth structure (Sheiham,2001). The problem of caries is compounded by the unequal distribution of the disease, with higher proportions of those in lower socioeconomic positions having the disease (Watt and Sheiham,1999; Reisine and Psoter, 2001).

The biological process of caries can be controlled by modifying the diet especially the consumption of NMES more than four times a day, as it is a key risk factor for dental caries (Sheiham,2001; World Health Organisation,2003; Moynihan and Petersen,2004). Pre-school children are wholly dependent on their families for their basic needs which include their dietary needs; ideally families should provide environments that allow for the healthy biological, social and psychological development and maintenance of its individual members (Epstein et al.,2003). Family functioning, which is the manner in which family members interact with each other

and fulfil their roles and responsibilities, shapes this environment that impacts their physical and emotional health (Walsh,2003). It is therefore an important family characteristic to consider when studying children's dietary behaviours that influence their caries risk.

Oral health related behaviours established at the pre-school age influence caries risk in later years (Mattila et al., 2005a; Nicolau et al, 2005), and because behaviour modification in later life is often unsuccessful (Watt,2002), factors that influence development of the behaviours themselves should be explored. Family is in a unique position to influence the development of pre-school children's oral health related behaviours, especially their dietary behaviours (Mattila et al.,2000; Blinkhorn et al.,2001; Benton,2004; Mattila et al.,2005b). Therefore, the emphasis is on limiting the consumption of sugary foods by three and four year old children by identifying protective influences within the family environment that contribute to good dietary behaviours. Previous studies focused on the identification of risk factors within families such as single parents, lack of formal education and poverty. One of the first studies to identify protective influences within the family, identified good marital quality as having a protective influence on oral health outcomes (Marcenes and Sheiham,1996). It is becoming increasingly important to identify other protective family factors that promote healthy development in the midst of adversity. Effective family functioning is one such protective factor and is assessed by the family's ability to face challenges that arise as part of a family's life cycle**,** have clear and direct communication between members, have flexible rules as a way of regulating family behaviour, clearly define the roles and responsibilities of its members and have warm affectionate relationships. Family functioning is studied in many different ways, the most common areas of research are marital quality, parent child interactions and whole family functioning (Hayden et al.,1998). Previous dental research focused on

the first two while this study focuses on whole family functioning as it provides the wider context within with children develop and it is related to the other areas of family functioning (Hayden et al.,1998).

It has often been suggested that dietary differences may explain some of the social inequalities in oral health. As children's diets are so strongly influenced by their family environment, within which the mother's play a pivotal role (North and Emmett,2000; Northstone and Emmett,2005; Savage et al.,2007), we will be exploring an important familial variable, family functioning, from the mother's perspective, to see what contributions it makes to children's sugar consumption behaviours. The family environment is where the various health behaviours are introduced and maintained; exploring the role of family functioning domains on children's frequent sugar consumption will give us a better understanding of these potential influences, and help inform future interventions that could reduce inequalities in oral health.

This study was set in the Outer North East London boroughs of Waltham Forest, Redbridge and Barking and Dagenham, which have a multi ethnic population, allowing the study aims and objectives to be explored in a mixed setting.

2 Literature Review

2.1 Introduction

This review provides a background for the study hypothesis. It describes the epidemiology of caries and caries related sugar consumption behaviours in young children in the UK and summarises the various determinants of caries in young children with a focus on NMES in the diet. It explores the family factors that are associated with development of dietary behaviours in children, with a focus on family functioning as a potential protective influence against the frequent consumption of sugary foods by children.

2.2 Epidemiology of caries in young children in the UK

The three and four year old age group is important because children with caries at this age are more at risk of caries at age five. Dental habits established at this age remain similar over the years, children who eat sweets at this age are more likely to eat sweets at age five and the presence of plaque at this age is significantly associated with plaque at five years (Mattila et al.,1998).

With specific reference to caries in three and four year old children in the UK, the National Diet and Nutrition survey of children (1992/93) found 30% of 3.5 to 4.5 year olds had caries of which 83% was untreated (Moynihan and Holt,1996). Current data is limited as most of the data is about older children (5, 8, 12 and 15 year olds), and comes from the Children's Dental Health surveys conducted every ten years (most recent one in 2003), and the British Association for the Study of Community Dentistry (BASCD) surveys (conducted every other year, involving five year olds). In 2006 the regulatory framework for dentistry and oral health was reformed so that local health

authorities were given the responsibility of undertaking epidemiological surveys. The Primary Care Trusts (PCTs) along with the Strategic Health Authorities (SHAs) and the Department of Health (DH) became responsible for conducting yearly dental surveys as part of the NHS (England) Dental Epidemiology Programme (NHS DEP). The first NHS DEP for five year olds was conducted in 2007/08, the next survey is scheduled for 2011/12 (North West Public Health Observatory and The Dental Observatory,2010).

Table 2.2.1 Mean number of decayed, missing and filled teeth (dmft) and proportion of children aged five years in England with caries experience (dmft>0) in 2005/06 (BASCD survey) and 2007/08 NHS (England) Dental Epidemiology Programme.

	BASCD SURVEY 2005/06		NHS (ENGLAND) DENTAL EPIDEMIOLOGY PROGRAMME 2007/08	
REGION	MEAN DMFT	PROPORTION (%) WITH DMFT >0	MEAN DMFT	PROPORTION (%) WITH DMFT >0
Waltham Forest	1.82	37.2	1.29	33.6
Redbridge	1.11	30.6	0.66	22.7
Barking & Dagenham	1.46	36.9	Did not participate	
London	1.66	40.1	1.30	32.5
England	1.47	38.0	1.11	30.9

2.3 Consumption of NMES by three and four year old children in the UK

The UK recommendations are that not more than 10% of total dietary energy should come from NMES, but the National Diet and Nutrition Survey (NDNS) found that children aged 3½ to 4½ received 20% of their dietary energy from NMES (Hinds and Gregory,1995) and only 12.5% of all the children in the survey had intakes of NMES within the recommended 10% (Watt et al.,2001). A more recent national survey, the NDNS rolling programme (2008/09), found that for toddlers (ages 1.5 to 3) this amount had decreased to 11%, which is close to the recommended amount. Data between the two NDNS programmes are not directly comparable for the younger age groups because of methodological differences. The 1992/93 programme divided young children into sub groups 1 ½ - 2 ½, 2 ½ - 3 ½ and 3 ½ to 4 ½ years, the rolling programme categorised them all as toddlers (1 ½ to 3) and older children (4 -10 years). In addition, the rolling programme reported results based on a four day food diary, whereas the 1992/93 programme, although it used a four day diary, reported a corrected seven day average. The two surveys are going to be made comparable in future (Food Standards Agency and the Department of Health,2008/2009).

Similarly although the guidelines for the UK recommend that sugars should not be consumed more than four times per day (Department of Health and the British Association for the Study of Community Dentistry,2009), the NDNS found that 3½ to 4½ year olds in the UK consumed sugary foods an average of 5.6 times per day, and overall 43% of children consumed sugar confectionary most days of the week or more often (Hinds and Gregory,1995). Data from the NDNS was further analysed and showed that for children with diets high in NMES (>24% of their energy from NMES), consumption of confectionary and soft drinks was about twice the average amount (Gibson,1997). Consumption of sugary foods was also related to the socioeconomic position of the family. Children from manual households consumed sugary foods

more often than children from non-manual households. Manual households also spent a significantly ($p<0.01$) greater amount of money on chocolates and sweets per week compared to children from non-manual households (Hinds and Gregory,1995).

The findings from the NDNS are important because they analyse both a food frequency questionnaire and weighted data, which provides a strong foundation on which to base their findings. It is also one of the few national studies done in the UK which collected information on pre-school children's sugar consumption behaviours in relation to dental caries.

Table 2.3.1 Frequency with which 3½ to 4½ year old children in the UK in 1992/93 were reported to consume various sugary foods (Hinds and Gregory,1995).

VARIABLE	PERCENTAGE
Sugar confectionary	
More than once a day	4
Once a day	16
Most days	28
At least once a week	41
At least once a month	6
Less than once a month	3
Never	3
Chocolate confectionary	
More than once a day	4
Once a day	13
Most days	21
At least once a week	48
At least once a month	9
Less than once a month	3
Never	1

Biscuits	
More than once a day	21
Once a day	20
Most days	39
At least once a week	17
At least once a month	2
Less than once a month	0
Never	0
Cakes	
More than once a day	1
Once a day	4
Most days	10
At least once a week	56
At least once a month	18
Less than once a month	6
Never	5
Ice cream or ice lollies	
More than once a day	1
Once a day	5
Most days	14
At least once a week	41
At least once a month	22
Less than once a month	13
Never	5
Carbonated drinks (including diet versions)	
More than once a day	9
Once a day	9
Most days	12
At least once a week	30
At least once a month	12
Less than once a month	11
Never	17

Blackcurrant juice	
More than once a day	16
Once a day	6
Most days	11
At least once a week	13
At least once a month	13
Less than once a month	9
Never	33
Fruit juice	
More than once a day	9
Once a day	9
Most days	13
At least once a week	23
At least once a month	13
Less than once a month	8
Never	25

Note: percentages may not add up to 100 because of rounding.

2.4 Biological process of dental caries

The development of dental caries is dependent on diet, salivary flow rate and composition, fluoride ion concentration in oral fluids and plaque microbial composition and thickness (Fejerskov and Kidd,2008). Bacteria present in dental plaque metabolises dietary carbohydrates to produce acid, causing a fall in the pH, which promotes demineralisation of tooth structure; although development of a frank cavity happens over a period of time (Tinanoff and Palmer,2000). Dietary behaviour is a key factor in the biological process of caries because it provides fermentable carbohydrates and also aids in the colonisation of plaque bacteria. Other oral health

behaviours that influence the biological process include tooth brushing and dental attendance.

2.4.1 Role of sugars in caries aetiology

Diet plays a fundamental role in the biological process of dental caries with sugar consumption being the most import dietary factor in its aetiology, therefore controlling sugar consumption is considered an important step in preventing dental caries (Sheiham,2001; Moynihan,2005; Li,2011). The type, frequency and timing of sugar consumption are all significantly associated with dental caries in pre-school children (Mattila et al.,1998; Rodrigues and Sheiham,2000; Tinanoff and Palmer,2000; Harris et al.,2004) and consumption of sugary foods more than four times per day is acknowledged as a risk factor for caries experience (World Health Organisation,2003; Moynihan and Petersen,2004; Moynihan,2005; Department of Health and the British Association for the Study of Community Dentistry,2009).

The main types of dietary sugars implicated in caries aetiology are non milk extrinsic sugars (NMES). These are sugars that are not components of milk nor contained within plant cell walls. This term was coined by the committee on medical aspects of food policy (COMA) panel on dietary sugars (1989) to define a type of sugar that should be controlled in the diet in order to control caries without compromising nutrient intake (Gibson,1997). NMES are mainly found in confectionary, biscuits, cakes, table sugar, fruit juice and soft drinks. Cariogenic bacteria present in dental plaque are dependent on a frequent diet of NMES to decalcify tooth structure and produce dental caries. Dietary NMES, particularly sucrose, are considered even more important in caries aetiology than the presence of streptococcus mutans (van

Palenstein Helderman et al.,1996), although there is some evidence for a correlation between sugar consumption levels and s.mutans levels (Litt et al.,1995).

The NDNS found that frequency of consumption of certain sugary foods namely confectionary and sugar sweetened beverages were associated with caries experience in pre-school children. 22% of children with low intakes of confectionery had caries and 40% of children with a high intake had caries; for carbonated drinks it was 25% and 44% respectively (Hinds and Gregory,1995). An international WHO study looked at the individual contribution of different types of sugar consumption behaviours such as eating sweets or chocolates every day or most days, drinking sugary drinks in bed, adding sugar to drinks, drinking sugary drinks every day or most days. The study found that in relation to diet and caries, a combined restriction of all the above mentioned types of sugar consumption behaviours led to the best reduction in the odds of 3 ½ to 4 ½ year olds having caries (Pine et al.,2004a).

In an extensive review of the literature by Sheiham (2001) on diet and dental caries, he explored the often discussed question about whether frequency or quantity of sugar consumption was more important in caries aetiology and concluded that frequency is so highly correlated with quantity that both are equally important, a conclusion shared by other authors reviewing studies on the relationship between caries and sugar (Moynihan,2000; Moynihan,2005).

Though the evidence for the relationship between sugar consumption and caries is strong, there have been mixed results from studies. A recent systematic review on sugar consumption and caries risk found that out of thirty six studies that were included in the final analysis, only two showed strong relationships (OR >=2.5), while 16 showed moderate relationships (OR 1.5 to 2.4) and eight demonstrated weak

(OR< = 1.4, r<0.4) or no relationships (Burt and Pai,2001). This could be because while sugar is necessary for the biological process of caries, a host of different factors cloud the caries sugar relationship. This includes clubbing the various types of sugary foods together resulting in the loss of information. For example, grouping together juice and fizzy drinks could result in loss of any significant associations being observed because of the difference in methods of consumption, such as drinking juice more often with meals and fizzy drinks between meals (Marshall et al.,2003). Other factors include use of fluoride in its various forms, and individual biological variability leading to increased or decreased susceptibility.

A more recent systematic review found reliable evidence of a significant relationship between frequency of sugar consumption and dental caries, but found no reliable evidence of a relationship between quantity of sugar consumed and dental caries (Anderson et al.,2009), indicating that frequency of sugar consumption may be a better predictor of dental caries than quantity of sugar consumed.

Though the linear relationship between sugar and caries has changed in the past decade, sugar consumption still remains the key dietary factor in the aetiology of dental caries (Moynihan,2000; Sheiham,2001; Moynihan,2005), especially in vulnerable populations such as young children and those with low or no fluoride exposure (Karjalainen,2007). Therefore, cutting down on sugar consumption is still considered imperative for caries prevention (World Health Organisation,2003; Department of Health and the British Association for the Study of Community Dentistry,2007).

> "*additional fluoride to that currently available in toothpaste does not appear to be benefiting the teeth of the majority of children, the main strategy to further reduce the levels of caries, is reducing the sugars levels in the diet.*" (Sheiham,2001).

2.4.2 Tooth brushing and dental attendance

The biological process is also influenced by tooth brushing and dental attendance, studies show that tooth brushing less than once a day and more importantly the presence of visible plaque are risk factors for dental caries (Hinds and Gregory,1995; Rodrigues and Sheiham,2000). Tooth brushing efficacy is more important than the number of times per se, as plaque is a better predictor of caries experience (Tanzer et al.,2001). While the mechanical effects of tooth brushing are effective in plaque removal, the concurrent use of fluoride toothpaste is now accepted as a major contributor to caries prevention. The effect of fluoride toothpaste increases with higher fluoride concentration, greater frequency of use and supervised brushing (Marinho et al.,2003).

Another oral health related behaviour associated with caries experience in children is dental attendance. Though there are inconsistencies regarding the benefit of regular dental visits in young children (Wang et al.,1992; Murray,1996; Kay,1999), regular dental attendance allows for the early detection of disease (Levine,2004), makes preventative interventions, such as professionally applied fluorides and fissure sealants possible, gives parents access to professional advice on tooth brushing and diet, and also allows the child to get acclimatised to visiting a dentist. The NICE guidelines (Crawford,1998) recommend that children should visit a dentist at least once a year.

Once developed, health related behaviours become routine and habitual, making them invulnerable to health messages (Hunt and Macleod,1987). Most behaviours are developed early in life and are therefore (to an extent) beyond the control of the individual. Therefore instead of trying to change oral health behaviours after they have developed, it is more beneficial to explore the factors that influence

development of the behaviours themselves, which in the case of three and four year old children are various familial factors (Loe,2000).

The most important determinant of dental caries is the consumption of sugary foods (Sheiham,2001), therefore factors influencing children's diets, specifically the frequent consumption of sugary foods, will be discussed further in the following sections.

2.5 Children's diets

Eating behaviours evolve during the first few years of life, initially children have the inherent ability to regulate their food intake according to their energy requirement, without instructions from adults. Nevertheless they are susceptible to modifying this behaviour and learning new eating behaviours from environmental stimuli, such as repeated offers of food and the eating behaviours of those around them. The frequency of consumption of specific foods by children is chiefly dependent on their food preferences (Sullivan and Birch,1990; Scaglioni et al.,2008); because children have an innate preference for sweet taste, regular exposure to sugary foods could increase children's preference for them, impacting their dietary behaviours and increasing their consumption of these foods (Jamel et al.,1996). Although there is an initial genetic predisposition towards sweet flavours, along with a penchant for high energy density foods, this can be modified, and it is in this context that the family environment plays a very important role (Benton,2004). By pre-school age children show preference for the type of food that they are regularly exposed to and not to sweet foods unless they were regularly exposed to them; demonstrating that by pre-school age repeated exposure alters innate preference for sweet foods (Sullivan and Birch,1990).

The first five years of a child's life are important because it is during this time that eating patterns develop, which then form the foundation for future dietary behaviours. It is also during this time that parents play a central role in shaping the environment in which dietary practices are developed. This environment is determined by family beliefs, attitudes and practices (Savage et al.,2007). Little is known about how health/risk promoting dietary behaviours develop in pre-school children, therefore exploration of the family environment within which children grow up, and how their health related dietary behaviours develop is important. Family functioning which incorporates many aspects of the family environment is especially appropriate for further study.

2.5.1 Family factors influencing children's diet

Family factors are crucial influences in the acquisition and development of children's diets (Blinkhorn,1981). They influence children's dietary preferences in a number of ways. Children have an innate preference for sweet foods and are also biased to reject new foods (Birch and Fisher,1998). Children get over their fear of new foods through regular exposure. Families of young children are responsible for exposing them to different types of foods, thus making these foods familiar to children so that they become more acceptable. By frequently exposing children to sugary foods, families are responsible for strengthening children's preference for these types of foods, thereby influencing the frequency of consumption of sugary foods. In addition to exposing them to sugary foods, families of young children are usually in charge of limiting their sugar consumption by controlling their access to such foods (Mattila et al.,2000). Nevertheless having strict rules which restrict or force children to eat certain

foods can be counter effective (Scaglioni et al.,2008). Another important way in which family influences children's dietary behaviours is by the dietary behaviours of the family members themselves, because children model or copy the behaviours of their parents and siblings (Birch and Fisher,1998). Additionally, there is a very strong social element to the development of children's dietary behaviours: foods accompanied by adult attention also increases preference (Birch et al.,1980). In most societies sugary foods are often used as rewards or to mark special occasions or as a show of affection making children's preference for sugary foods quite wide spread (Drohan,2002; Smith and Freeman,2009). Therefore, for three and four year old children family factors are extremely important in influencing children's sugar consumption behaviours, mainly because it forms the innermost level of influence, where cultural, socioeconomic economic and physical influences are all combined (Kumanyika,2008).

2.5.1.1 Maternal and parental influences

Reviews of parental influences on the development of children's dietary behaviours have identified that most often, in families, it is the women who are responsible for feeding children. Additionally mothers have been identified as spending significantly more time interacting with children than fathers, across a variety of family situations including mealtimes (Savage et al.,2007; Scaglioni et al.,2008). Mothers are also believed to influence children's food preferences before and after birth. Prenatally, flavours of the mother's diet pass into the amniotic fluid, while postnatally, mother's dietary flavours are passed onto the infant during breastfeeding. Later in life mothers shape the environment in which children's dietary behaviours develop, initially by acting as primary socialization agents by selecting the foods that children are

exposed to, and later by acting as models for eating behaviours. Mothers are also responsible for fostering culturally appropriate dietary patterns in their children (Savage et al.,2007).

Just by being responsible for bringing food into the house, parents play the most important role in determining what types of food their children are exposed to (Benton,2004). Parents make available different types of foods in the house and this has an impact on the dietary behaviours of the children because children's food intake is directly linked to its availability in the house. The amount of food that is available to them also impacts their intake, provision of larger quantities have been shown to promote greater intake by children (Savage et al.,2007).

Parents' own dietary practices play a fundamental role in the development of children's eating habits by creating an environment that cultivates children's food preferences, by their own eating behaviours and by family practices such as mealtimes and mealtime rules (Cutting et al.,1999; Tinanoff and Palmer,2000; Spieth et al.,2001; Scaglioni et al.,2008). It has been found that positive parental role models are better for improving children's diet than attempting to control dietary behaviour (Scaglioni et al.,2008). Parents are almost in total control of the development of food preferences and dietary behaviours, and these behaviours become fairly stable for the duration of the child's stay within the family environment, unless outside circumstances force a change (Sallis and Nader,1988). Although both parents influence the development of children's dietary behaviours, it is most often mothers who are intimately associated with children's dietary practices and were therefore the focus of this study.

Even though we consider maternal characteristics important influences in the development of children's diet, in this study our focus is also on family functioning as a whole. Parenting styles and family functioning are variables related to the family environment. Family functioning differs from parenting in that parenting is a characteristic of the parent, whereas family functioning is a broader more systemic evaluation of the whole family environment, which assesses how the whole family interacts in order to attend to the everyday needs of its members. Although parenting and family functioning may be related, they influence children's behaviours in different ways (Kitzman-Ulrich et al.,2010), and in this study we are interested in the broader picture that family functioning provides.

2.5.1.2 Family socioeconomic position

It is well documented that disparities exist in oral health between those from different socioeconomic positions, with those from the lower social classes having a greater burden of the disease (Watt and Sheiham,1999; Reisine and Psoter,2001). Though there is evidence about the association between socioeconomic position and caries experience, there is limited understanding about the mechanism by which it acts (Reisine and Psoter,2001). Dental caries is very closely linked to the diet and therefore disparities may be the result of lifestyle differences. Poor oral health related dietary behaviours of people who are socioeconomically deprived may result from inadequate access to fresh and nutrient dense foods and them having to substitute it for high-energy, low-cost, sugary foods putting them at a higher risk of caries (Mobley et al.,2009). Analysis of the NDNS data by Gibson and Williams (1999) showed that children from manual households got more of their dietary energy from NMES than children from non-manual households. They also consumed more of the sugary foods

that were associated with caries experience (sugar confectionary and soft drinks) than children from non-manual households. A survey of sugar intake among children in Scotland also found similar results. They assessed deprivation based on the Scottish Index of Multiple Deprivation (SIMD) and found that although there was no difference in total sugars consumed between children divided according to quintiles of distribution of the SIMD, those from the most deprived quintile got a larger proportion of their daily energy from NMES. They also found that the more deprived quintile consumed a significantly ($p<0.001$) greater quantity of confectionary (29g/day vs. 19g/day) and non-diet soft drinks (234g/day vs. 123g/day) compared to the least deprived quintile. They also found that non diet soft drinks contributed the most to intake of NMES (17%) followed by confectionary (12%) and biscuits, cakes and pastries (12%) (Sheehy et al.,2008).

Socioeconomic position is usually described based on income, occupation, education or place of residence (Reisine and Psoter,2001). Using place of residence as an indicator of socioeconomic position is advantageous both for its applicability in epidemiological studies and because it provides a broader perspective which includes the neighbourhood in which people live and not just the income earned (Locker and Ford,1994; Locker,2000). This is especially relevant in this study because children's diet is strongly influenced by the environment, especially issues related to food access. Its limitation lies in assuming that all individuals living in the same area have the same socioeconomic position and behave in the same manner (ecological fallacy) (Reisine and Psoter,2001). Therefore, studying both area based measures and individual measures in one study will be more informative, allowing for the exploration of the different mechanisms by which SEP could influence diet. It is also important to select an indicator appropriate to the study aim (Turrell et al.,2003), therefore for his study we will look at area based deprivation assessed using the Index of Multiple

Deprivation (IMD) and mother's education as they are both relevant to children's dietary behaviours.

2.5.1.2.1 Mother's education

Mother's education is highly correlated with dental caries in young children (Verrips et al.,1993; Hinds and Gregory,1995; Mattila et al.,2000; Mattila et al.,2005b), although information on the relationship between mother's education and cariogenic dietary behaviours in young children is limited. Secondary analysis of the NDNS data (1992/93) to explore the socioeconomic determinants of selected dietary indicators in pre-school children living in the UK, found that mother's lower than A levels qualification was associated with poor dietary behaviours including consumption of NMES over the recommended 10%. It was also the most important of all the socioeconomic indicators as it had the largest association (highest OR). Children whose mothers had no qualification were 2.25 times more likely, compared to degree education, to be in the worst category of dietary indicators (Watt et al.,2001).

Studies on dietary patterns found that mother's higher education was associated with a healthy diet in three and four year old children while an unhealthy diet rich in sweets, biscuits, confectionary and fizzy drinks was associated with lower maternal education (North and Emmett,2000; Northstone and Emmett,2005). Educated mothers demonstrate a health conscious pattern when making food choices. A possible pathway by which education could influence diet is through dietary knowledge which influences food purchasing behaviour. A study in Australia found that education was associated with dietary knowledge; dietary knowledge was associated with food purchasing behaviour, education was also associated with food purchasing behaviour but this was attenuated when adjusted for dietary knowledge

(Turrell and Kavanagh,2006), indicating that dietary knowledge could mediate the relationship between education and food purchasing behaviour. This was demonstrated by statistical modelling of data from a cross sectional study, and therefore was indicative of a possible pathway not demonstrative. Nevertheless it is a possible pathway by which children's diet could be influenced by maternal education. Giving children sugary foods is complicated by its association as a symbolic gesture to convey affection or as a reward; therefore it cannot be viewed purely in terms of intellectual knowledge driving this particular behaviour.

2.5.1.3 Ethnicity

Ethnicity can be studied in relation to health as a possible biologic pathway but in this study we look at it in the cultural context, as diet is closely linked to cultural practices and ethnic backgrounds. Cultural practices influence how parents feed their children and how children are socialised to make food choices (Kumanyika,2008). For example Pine et al. (2004a) in an international collaborative study for the WHO found that adding sugar to drinks varied greatly by ethnicity. For example 91% of Asian Pakistani families added sugar to their children's drinks while only 4% of white Belgian families reported doing so. Different feeding practices provide some explanation for differences in caries experience between ethnic groups (Skeie et al.,2006). Dietary differences associated with ethnicity may arise from differences in food related beliefs, preferences, behaviours and cultural influences as well as by interaction with the environment (Kumanyika,2008).

2.5.1.4 Family composition

Children from single parent families are more likely to have caries (Crall et al.,1990; Hinds and Gregory,1995; Mattila et al.,2000) and are more prone to take up high-risk behaviours, often as a result of the socioeconomic disadvantage associated with single parent families (Schor,2003). Although there is limited information on the association between family composition and children's sugar consumption behaviour, Fisher- Owens et al. (2007) on reviewing the literature found that social support (as indicated by two parent families) was associated with positive health outcomes, largely as a result of less risk taking and more health promoting behaviours. Although nowadays there is an increasing recognition and focus on the importance of family functioning and the quality of family relationships for the healthy development of children and adolescents, rather than on family structure per se (Sweeting and West,1995; Schor,2003; World Health Organisation,2004).

2.5.1.5 Importance of Family functioning

Regardless of the structure of the family, it is the functioning of the family that is important to children's healthy development (World Health Organisation,2004). Although there is limited literature on family functioning and cariogenic dietary behaviours of young children, there is more literature on family functioning and diet in relation to general health. Because diet is a common risk factor for oral and general diseases we assume that family functioning plays a similar role in caries related dietary behaviour of children as it does in general health related dietary behaviours.

A review of the literature aimed at exploring the importance of including family factors into dietary programmes for children, identified positive family functioning as being

positively associated with healthy dietary behaviours in children; this was seen in multiple studies. The studies suggest that good family functioning could influence healthy dietary behaviours through provision of healthy food, modelling of good behaviours and providing a supportive environment. The family functioning domains identified as positively influencing healthy dietary behaviours were emotional bonding between family members (affective responsiveness and affective involvement), cohesion (behaviour control and roles) and conflict resolution (problem solving, communication) (Kitzman-Ulrich et al.,2010), theoretically similar domains assessed by the Family Assessment Device (FAD), the measure used in this study, are in parenthesis. Studies using the FAD to assess general family functioning found that a healthier diet in adolescents (Ambrosini et al.,2009) and children (Renzaho et al.,2011) was associated with more efficient general family functioning.

Traditionally studies investigating the relationship between family and diet in children fell into two broad categories; they focused either on 'structural' or 'interactional' variables. Structural variables were the socio-demographic variables and 'interactional' variables included family decision making, parental interaction, parent child interaction and marital quality. Findings from the interaction studies found that family stability, unity and communication were important factors related to dietary behaviours and that effective family functioning in these areas were associated with good dietary behaviours (Kintner et al.,1981). Assessing family functioning using the FAD takes into consideration the above mentioned aspects of family interaction, where the dimensions of problem solving, roles and behaviour control are related to family stability; affective responsiveness and affective involvement relate to family unity, and the communication domain assesses intra familial communication; therefore, these domains were considered important to explore in this study.

Family functioning is a boarder dimension than parenting styles and parental modelling of behaviour, two important family variables that impact children's eating behaviours (Rhee,2008). Family functioning was found to have a greater influence than family composition on children's health (Sweeting and West,1995; Schor,2003), and effective family functioning seems to act as a buffer against the development of oral health problems (Fisher-Owens et al.,2007). Since diet is so strongly influenced by a person's environment, and for children this is the family environment, exploring the influence of this component of the family environment in promoting positive eating behaviours to protect against the development of dental caries, is important. Understanding the roles of each of the domains of family functioning could equip us with better tools for effective interventions aimed at improving dietary behaviours in children.

Christensen (2004) in her paper proposing a conceptual framework for health promoting families explored the family psychology and sociology literature and found that in addition to social and demographic variables, family transactional processes such as roles, behaviour control, problem solving and communication patterns, are important in determining how families promote the health of their members. The importance of these domains of family functioning are recognised in relation to general health but no studies have been done to explore how these domains are related to children's oral health related dietary behaviours.

Rhee (2008) reviewed the literature on family variables and dietary behaviours in children and proposed that family functioning could influence good dietary behaviours in children by creating an environment within the family that facilitates healthy eating. This study proposes a similar pathway whereby the manner in which families function, that is the way in which they solve problems in order to fulfil daily goals, the roles they

undertake, communication, emotional connection with each other, and the rules they have in place to control behaviours, provides the context within which parenting practices (such as rules about sugar consumption frequency) are understood and accepted by the child and this could influence children's sugar consumption behaviours.

Though previous studies have not studied the relationship between children's frequency of sugar consumption and family functioning, they have explored related dietary dimensions. It was found that effective family functioning was associated with healthy calorie intake, eating breakfast and consuming more fruit and vegetables (Kitzman-Ulrich et al.,2010; Renzaho et al.,2011). On the other hand, ineffective family functioning was linked to eating disorders (Emanuelli et al.,2003) and obesity in children (Chen and Kennedy,2005). Effective family functioning is thought to act as a safeguard against the development of health problems in children by influencing the amount of support available to facilitate the development of a healthy lifestyle (Fisher-Owens et al.,2007).

The family is possibly the most important environment within which children's dietary behaviours develop. It is not a rigid system but a complex and dynamic one influenced by the wider environment. The manner in which families function in order to attend to the needs of their members is an important perspective, more so than other family variables, from which to explore this environment within which children's behaviours develop (World Health Organisation,2004).

2.6 Family functioning

Family functioning is the term used to assign a value or a normative judgment (as opposed to describing a fact) to the daily workings and behaviours of a family, as a means of characterising the family process. It describes the different ways in which family members interact with each other, includes the rules they have to control behaviour, the roles fulfilled by individual members and the level of emotional involvement and interest family members have in each other's welfare (Miller et al.,1985). It is a sharing of family responsibility that benefits both the individual members and the whole family unit (Gruber and Haldeman ,2009). Family functioning is the dynamic interaction between family members that ensures attainment of family goals. It is also the context within which sociocultural influences emerge (Rew and Horner,2003). Family functioning influences children's physical and emotional health, and is therefore a good indicator to study families rather than the other family factors per se (Schor,2003).

2.6.1 Models of family functioning

A review of the literature identified three main approaches to describing and measuring family functioning based on self-report. They are summarised in the following sections, along with a more detailed discussion on the model used in this study, which is the McMaster model of Family Functioning (MMFF) (Epstein et al.,1978) and the instrument used to assess it, the Family Assessment Device (FAD) Version 3 (Epstein et al.,1981; Epstein et al.,2005).

In general, functional families are described as having the following attributes: (Bloch et al.,1994)

- The ability to face challenges, both predictable and accidental, that arise as part of a family's life cycle
- Clear and direct communication between members, tolerance with conflict, readiness to deal with differences when they occur and a mutual respect for privacy
- Clear description of roles, functions and responsibilities of family members which is flexible so that members feel comfortable in their roles and also feel a sense of security
- An appreciation for rules as a way of regulating family behaviour
- Warm affectionate relationship between members, with a mutual respect of individuality
- Ability to relate with its social environment, such as extended family, friends, neighbours, colleagues and with other influences such as family ethnicity, poverty, racism, sexism and unemployment

2.6.1.1 The Family Environment approach

The Family Environment Scale (FES) comprises 10 sub scales grouped into 3 dimensions (Bloch et al.,1994)

- The relationship dimension has three subscales which deal with interrelationships
- The personal growth dimension has five subscales which cover aspects of personal growth
- The system maintenance dimension includes two subscales which cover the organisational characteristics of families

The FES measures the perception of family members along the 3 dimensions. The strength of this scale is that it has a family incongruence score that shows the level of agreement between family members. The scale can also be used to elicit family expectations. Although its validity and reliability has been demonstrated by its authors, Moos and Moos (1981), its internal consistency was found to be low and its validity was questioned by students (Bloch et al.,1994). Although its dimensions appear to be relevant, especially as it includes a dimension on social relationships, questions about its validity preclude its use in this study.

2.6.1.2 The Circumplex model

The main hypothesis of the Circumplex Model is that balanced levels of cohesion (emotional bond between members) and adaptability (ability of the family to respond to life's stresses) are most conducive to healthy family functioning. Conversely, unbalanced levels of cohesion and adaptability (very low or very high levels) are associated with problematic family functioning (Bloch et al.,1994).

The instrument used to assess levels of family functioning is called FACES (IV is the most recent) and is a self-report questionnaire having 6 scales with seven items in each scale. The authors, Olsen et al. (1983), claim good psychometric properties but the validity of both the model itself and older versions of the scale have been questioned and studies using FACES IV have mainly been presented in non peer-reviewed journals (Alderfer et al.,2008), thus precluding its use in this study.

2.6.1.3 McMaster model of family functioning (MMFF)

The inventory used for this study is The Family Assessment Device (FAD) and is described in detail in the methodology (5.8.1.2). It is based on the McMaster Model of Family Functioning (Epstein et al.,1978). This model is a multidimensional model based on the general systems theory that views the family as a single unit (system), consisting of subsystems (individual members, dyads) interacting with each other and with other larger systems (extended family, school, community). The family system is unique in that it cannot be described based only on the characteristics of its members or the interaction between them, but also involves the explicit and implicit rules and actions that govern members' behaviours (Epstein et al.,2003).

The MMFF includes domains that are considered to have the most impact on the emotional and physical health of family members and which contribute to creating a foundation for family behaviour. The authors believe that the main function of families today is to provide an environment that allows for the social, psychological and biological development and maintenance of its members whilst fulfilling the tasks it encounters during the course of the family's life cycle. The three main types of tasks are basic, developmental, and hazardous. Basic tasks involve the provision of basic necessities such as food, shelter and money. Developmental tasks involve handling problems that arise during individual development (infancy, childhood, adolescence, middle age, old age) and during the different family stages (marriage, pregnancy, birth of child, children leaving home). Hazardous tasks involve handling crises that arise as a result of illness, loss of job and death. Families have different types of resources that allow them to cope with different types of tasks encountered during the course of the family's life cycle (Hamilton et al.,1980). In order to understand families and how they successfully handle various tasks, their structure, organization, and

transactional processes are described using the following six dimensions (Epstein et al.,2003):

1. **Problem solving** is defined as a family's ability to resolve problems to a level that maintains effective family functioning. Problems that a family face are divided into two types: instrumental and affective. Instrumental problems are those relating to basic issues such as provision of money, food, clothing, shelter etc., while affective problems relate to issues that cause anger or depression. Effective problem solving involves the following steps:
    1) Identifying the problem
    2) Communicating it to appropriate people
    3) Developing a set of possible solutions
    4) Deciding on one of them
    5) Carrying out the required action
    6) Monitoring to ensure that the action is carried out
    7) Evaluating its effectiveness

Families may not consciously run through each of these steps, but functional families resolve most problems effectively and easily. Families have a range of problem solving abilities; the most effective families are those that have few, or no, unresolved problems and where the unresolved problems are not of sufficient importance or duration to cause any major disruption in the family. Less effective problem solving is usually a consequence of not approaching it in a systematic manner, and the least effective type is when families are unable to even identify the problem (i.e. stop before step 1).

2. **Communication** is defined as the exchange of verbal information within a family (the focus is on verbal, rather than other forms of communication, because it is easy to measure). Communication, like problem solving, is divided into instrumental and affective; in addition, it can be clear or masked (vague) and direct or indirect *(*involving a third person*).*

Importance is given to clear, unambiguous communication between members; preferably directly between sender and receiver without involvement of a third party. Communication becomes less effective as it moves towards masked and indirect.

3. **Roles** are the repetitive patterns of behaviour by which family members fulfil family duties. There are certain duties that have to be dealt with continuously by family members, in order to maintain a healthy family system. Roles are divided into instrumental, affective and mixed types. Instrumental roles include provision of material resources such as money, food, clothing and housing. Affective roles include nurturance and support, which is the provision of comfort, warmth, reassurance, and support for family members. Mixed roles include development of personal skills; maintenance and management of the family system involving functions such as decision making, maintaining discipline and family standards; finance functions such as payment of bills; and health related functions such setting up and keeping appointments and adhering to health practices.

Roles are mutually agreed upon and suitably allocated with room for reassignment if necessary; though most often they are not formally allocated, sometimes families get together to decide who does what. Roles are important for support, decision making,

control and personal development of members, including inculcating health promoting behaviours. Role functioning is assessed by looking at how family's allocate responsibility and handle accountability. Family members should have well defined roles which contribute to different areas of family functioning, without causing overburdening of any member; the most effective functioning is seen when role allocation is appropriate and accountability is made clear.

4. **Affective responsiveness** is the ability to respond to a given stimulus with an appropriate quality and quantity of feelings. There are two categories of emotions: welfare emotions (affection, warmth, tenderness, support, love, consolation, joy, happiness) and emergency emotions (fear, anger, disappointment, depression, sadness). This dimension is closely linked to the next dimension affective involvement.

It is most effective when the response is of appropriate amount and quality in relation to the stimulus and least effective when the emotions are inappropriate or of greater/ lesser intensity than warranted by the context.

5. **Affective involvement** is the extent to which family members show an interest in and value the activities and interests of other family members; the amount of interest and how they show it are important aspects. The following six types of involvement have been identified;
    1) Total lack of involvement
    2) Involvement devoid of feeling, out of duty or curiosity and usually intellectual in nature
    3) Narcissistic involvement, interested in how the behaviour reflects on the self, involvement to booster self-worth

4) Empathetic involvement, real understanding of the others needs along with the ability to meet them.
5) Over involvement, excessive interest in each other
6) Symbiotic involvement, extreme or pathological involvement in each other, where there is difficulty in differentiating one person from another.

Empathetic involvement is seen as the best type for effective family functioning; it decreases as families move away in either direction, with symbiotic and absence of involvement being the worst types.

6. **Behaviour control** is the pattern that families adopt for handling behaviour in three areas, physically dangerous situations, situations that involve meeting and expressing psychobiological needs and drives and situations involving interpersonal socialising behaviour (between members and with people outside the family). In order to fulfil this function, families set standards or rules that may be of the following varieties:
    1) Rigid, where rules are specific and allow very little negotiation in different situations. This type is usually linked to cultural or religious beliefs and works well to maintain regular day-to-day tasks and roles, but is not successful in managing developmental or crisis tasks. It encourages subversion, passive aggressive behaviour, power struggles and displacement of anger outside the family
    2) Flexible, here rules are reasonable and there is opportunity for negotiation, depending on the situation

3) Laissez-faire, here there are no set rules, task accomplishment is poor, there are problems with role allocation and communication and children are often insecure and impulsive
4) Chaotic, rules are unpredictable and shift randomly between all of the above types, resulting in poor family functioning

Flexible behaviour control is the most effective, and chaotic is the least effective style for optimal family functioning. Effective family functioning can occur even when families behave in an 'inappropriate' manner, as long as the behaviour is not prolonged and does not cause conflict.

Effective family functioning in the different domains facilitates the family's ability to deal successfully with various life tasks (Epstein et al.,2003). This study defines what we mean by effectively functioning families so that we have a standard against which to compare different types of families and accurately assess good outcomes (Leon and Armantrout,2007). The term 'normal' will not be used because of the negative connotations attached to not confirming to the norm. Instead the term effective will be used to describe a family environment that supports optimal physical health of its members and ineffective will refer to family patterns that lead to problems with everyday living (Ryan et al.,2005). Whether the family process is effective or not is specific to the family and is dependent upon what the family perceives as being normal, as well as life cycle demands, resources and sociocultural influences (Walsh,2003). Family functioning is strongly influenced by family composition, sexual orientation, family ethnicity and race, immigration, religion and spirituality, community interaction, geographic influences, family experiences, family resilience and financial resources (Schor,2003; Walsh,2003). Family functioning can range from most effective to most ineffective. Most effective family functioning in the different domains

contributes to optimal physical and emotional health of family members (Ryan et al.,2005).

2.7 Summary

Dental caries is one of the most common chronic diseases in childhood and if untreated could affect the growth and quality of life of preschool children. These children have a higher risk of hospitalization and emergency dental visits, are prone to increased absence from school and restricted activity, in addition it has an unfavourable effect on the economy caused by parents taking time off work (Reisine,1985; Majewski et al.,1988; Gift et al.,1992; Low et al.,1999; Filstrup et al.,2003; Sheiham,2006). Although dental caries is the result of complex interactions between the biological processes in the mouth, individual behaviours and societal influences (Holst et al.,2001), at the tooth level diet, bacteria and host susceptibility are the most immediate influences, of which diet is the most easily modifiable. Consumption of foods rich in NMES is the most important aetiological factor for dental caries (Harris et al.,2004). Consequently the focus is on an area which is modifiable, the reduction of sugar in children's diets, which will lead to the inhibition of the biological process of caries, reducing caries levels in the population and its consequential social, developmental, psychological and economic disadvantages.

Dietary patterns become established during childhood, influencing oral health outcomes in later years (Mattila et al.,2005; Nicolau et al.,2005). Influences on development of children's dietary behaviours, specifically sugar consumption behaviours, are therefore of particular interest as a main strategy for reducing the levels of dental caries in children.

The most important influence on children's dietary behaviour is the family environment. Important familial factors influencing children's diets include, socioeconomic position of the family, maternal education, ethnic minority status, familial behaviours and attitudes and family functioning. Of these factors, family functioning, which is a global characteristic that integrates the various aspects of the family environment, was found to be positively associated with healthy dietary behaviours in children (Kitzman-Ulrich et al.,2010). How a family functions includes how family members manage their daily routines, fulfil parenting roles, communicate with each other and connect emotionally; this forms the framework within which children's own dietary practices develop. Efficient family functioning could provide a favourable environment through the provision of healthy food and modelling of good behaviours thus leading to the development of health promoting dietary behaviours in children (Rhee,2008; Kitzman-Ulrich et al.,2010). Currently most of the information on family factors influencing diet in young children is in relation to overall dietary patterns and within this, the focus is mainly on parental influences. There is a growing recognition of the importance of family functioning as a more global family characteristic, influencing children's diet, but once again the focus is on broad dietary patterns not specifically sugar consumption behaviours.

The important domains of family functioning related to development of children's dietary behaviours are emotional connection between family members, conflict resolution, family unity and stability, communication and roles (Kintner et al.,1981; Kitzman-Ulrich et al.,2010). Therefore, the focus of this study is family functioning in the related domains of affective responsiveness, affective involvement, communication, problem solving, behaviour control and roles, assessed using the FAD, in order to better understand children's sugar consumption behaviours and

ultimately reduce the consequences of one of the most common childhood chronic diseases, dental caries.

The instrument FAD based on the MMFF is used in this study because of the potential relevance of the domains measured to the study outcome, its good psychometric properties (Epstein et al.,1983; Miller et al.,1985; Tiffin et al.,2007), its use in many peer reviewed studies (Ridenour et al.,1999; Alderfer et al.,2008) and because it is considered one of the most widely researched tools for self-reporting family functioning (Ridenour et al.,1999). Being a self-report questionnaire it allows judgments to be based on the beliefs and norms of the family members themselves, which is preferable to clinical observations where the investigator needs to be aware of relevant cultural norms before making judgments about 'appropriate' behaviours (Walsh,2003). In addition, the instrument is designed so that members are not asked directly how the family functions; instead questions are designed to reveal this indirectly, removing potential for bias caused by provision of responses deemed politically correct. The FAD has also been used in culturally diverse populations and has been translated into more than 20 languages (Herzer et al.,2010).

Some authors recommend using only the general functioning subscale (Byles et al.,1988) as it has a linear relationship to family functioning (Epstein et al.,1983) and it is able to assess unique variation in family functioning (Ridenour et al.,1999). The authors of the instrument, Epstein, Baldwin, and Bishop (1983) recommend looking at each scale. In this study we prefer to look at each individual dimension separately as we are interested in the contribution of each dimension, and in exploring possible mechanisms by which effective family functioning in these domains influences sugar consumption frequency. Exploring each dimension separately provides a clearer picture and is a way of disentangling this complex process.

An overlapping of the subscales has been reported as a limitation by Ridenour et al. (1999) but the authors of the instrument do not perceive it as such. They provide a reasonable argument that dimensions of family functioning are unlikely to be totally independent of each other, as effective functioning in one area may facilitate or impede functioning in another. For example, effective problem solving skills may be useful in resolving issues of behaviour control. Another limitation is that discrepancies have been reported between child and parent reports of family functioning (Bihun et al.,2002). This is not relevant to this study because for the three and four year age group we are only interested in the mother's perspective.

The FAD being a self-report tool, the perception of family functioning is based on underlying assumptions built on cultural values and norms, goals, needs and practices of the family; therefore a judgement of effective or ineffective is relative to the culture of the family and not to the wider perception of what is normal (Ryan et al.,2005).

3 Theoretical framework

3.1 Introduction

It is important to have a theoretical framework because it guides the understanding of children's sugar consumption behaviours by telling us in broad terms what factors are important to study, it helps us to identify appropriate methods, and also helps us understand how different aspects fit together. Each of these reasons advocated by McQueen (1996) promote a theoretical perspective in health behaviour and health promotion research. Theoretical frameworks also guide us in selecting and using various analytic techniques and aid in the intepretation of the results (Victora et al.,1997).

Various theories have been proposed to explain social inequalities; a recent paper by Sisson (2007) has provided an overview of the theories relevant to oral health. One of the theories is the behavioural explanation, which proposes that people from lower socioeconomic positions make unhealthy behavioural choices which lead to poor oral health outcomes. The limitation of this theory lies in the complex processes that underpin human behaviour, whereby varied influences (social, economic and environmental) combine to influence behaviour (Sisson ,2007). For young children, the social, economic and environmental influences are all encompassed within the family environment, which provides a setting within which children's behaviours develop. Therefore, in this study we focus on family functioning, an integral part of the family environment, where effective functioning leads to the healthy social, psychological and biological development of its members and ineffective functioning leads to problems including adoption of unhealthy behaviours (Ryan et al.,2005). Trying to change behaviour without understanding the factors influencing them could widen inequalities rather than bridge the gap, by better equipping those in the higher

social classes who already have the material and educational advantage make appropriate changes to their health behaviours.

As with other behaviours, the relative importance of the various determinants of diet change over time, but for three and four year old children family influences are paramount. Children are wholly dependent on their families for an extended duration, with the family acting as a facilitator between children and their environment (Schor,2003). Exposure of children to cariogenic foods because of easy access to foods rich in NMES, increasing the frequency of consumption by facilitating snacking between meals, and offering sugary foods as a reward are all factors influenced directly by the family. In a similar manner, the family is also responsible for inculcating health promoting dietary behaviours in the child, making the family an important determinant of child oral health outcomes. Family influences become even more important when we consider that the eating habits established in childhood persist into adult life (Fisk et al.,2011).

As Blinkhorn (1981) summarised from the literature, families are responsible for instilling the initial values, attitudes, beliefs and behaviours in young children which forms the backbone on which rests their ability to behave in a health promoting manner in later years. Effective family functioning could provide a background within which specific rules are made regarding sugar consumption frequency, and because positive social interactions enhance the adoption of healthy dietary habits (Benton,2004; Rhee,2008), the favourable atmosphere created by effective family functioning may facilitate better acceptance of these rules by children and enhance their ability to behave in a health promoting manner.

Human behaviour is a complex product of processes that are individual, society and biologically based (McQueen,1996). Behaviours such as eating are essential, but specific dietary behaviours such as frequent consumption of sugary foods is developed within social, cultural and environmental contexts which for children are inherent within the family environment. Family functioning offers a global framework within which the various processes interact to shape children's dietary behaviour. Therefore, studying the association between family functioning domains and children's cariogenic sugar consumption behaviour is important for understanding the context within which children's risk and protective dietary behaviours develop.

3.2 Proposed pathway by which effective family functioning acts

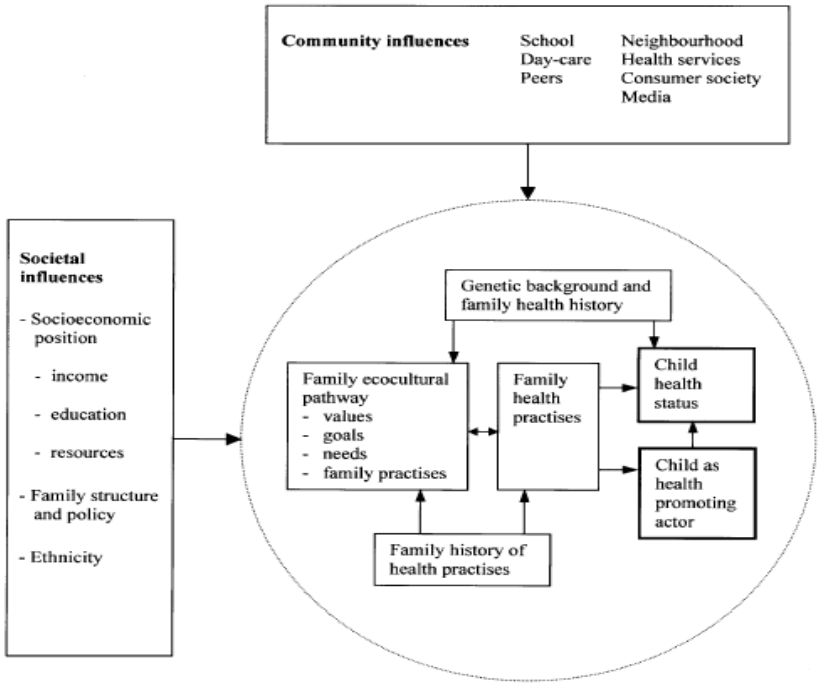


Figure 3.2.1 Model of the health-promoting family (Christensen,2004)

There is an increasing recognition of the importance of cultural pathways in the development of human behaviour (Weisner,2002; Ryan et al.,2005). *"Cultural pathways are made up of everyday routines of life, and routines are made up of cultural activity (bedtime, playing videogames, homework, watching TV, cooking dinner, soccer practice, visiting grandma) "*, these everyday routines are considered the most important influences in the development of human behaviours (Weisner,2002). Christiansen (2004) expanded on this and proposed a model 'the family ecocultural pathway' (Figure 3.2.1) which suggests that family health practices are within the remit of everyday activities that families engage in. All families have tasks or duties that need to be fulfilled as part of daily living. They do this through their everyday routine activities or family functioning in the different domains. Families have different levels of success in fulfilling these goals, which may or may not be health related. However, these routines have implications for the health of each family member as it forms the broader picture within which health related practices take place. Families integrate their health related goals within this broader framework of the family goals.

This study draws from this concept and proposes that family functioning which encompasses the everyday activities that families engage in and which are built upon family values, goals, needs and family practices, is 'the ecocultural pathway' that influences family health practices, which in turn enables a child to behave as a health promoting actor. For example, members fulfil their roles to ensure provision of food for its members, making sure that this food is nutritious and healthy (low sugar) integrates health related goals within the everyday goals. In a similar way, when a family perceives effective behaviour control, demonstrated by having flexible rules within the family governing a range of different situations which are open to negotiation and change, rules preventing frequent sugar consumption are better

understood and adhered to. Clear and direct communication in everyday life equips family members to have the skills to communicate healthy diet related goals to their children, which have the potential to be well received. In a similar manner emotional bonding between members demonstrated by the capability to respond with appropriate emotion to any given stimulus and having a real emotional interest in the needs of members (effective functioning in the domains affective involvement and affective responsiveness) could ensure that the family has the appropriate emotional skills to provide a positive emotional context within which family interactions occur, helping to shape dietary behaviour and prevent unhealthy dietary practices often caused by emotional upsets. Having a family system that allows effective problem solving assists the family in breaking down any barriers that may prevent the acquisition of healthy dietary behaviours and ensure a healthy diet even under difficult circumstances. Therefore, effective family functioning is postulated as having the ability to inculcate good oral health related dietary behaviours, or more appropriately, because this is a cross-sectional study, we propose a positive association between effective family functioning in each of the domains and children's restricted consumption of sugary foods.

The family does not act in isolation, rather the family is surrounded by external forces which influence the family, its functioning and its health practices, including diet. Christiansen (2004) in her model (Figure 3.2.1) differentiates the external factors into societal and community influences. The societal influences include factors that provide the material base for the family and include family socioeconomic position, education, ethnicity, family structure and housing. The community influences include the social networks available to the family. Although these external forces contribute to the resources available to the family, the manner in which the family makes use of these resources is dependent on the functioning of the family, which ultimately

influences their health related goals (children's diet low in NMES). We therefore propose that family functioning in each of the domains, behaviour control, affective responsiveness, affective involvement, communication, problem solving and roles acts as a mediator between the societal influences on the family and the family's health practices (children's diet low in NMES). Reviewing the literature identified family socioeconomic position, maternal education and maternal ethnicity as being important influences on children's diets, and were therefore included as covariates in this study. In this this manner, family functioning is considered as being an independent contributor to children's sugar consumption behaviours as well as working with the other factors in the wider family enviornment to influence childrens diet.

This study does not propose to infer causality; rather we hope to gain a better insight into the development of cariogenic dietary behaviours in children by identifying and exploring factors associated with frequent sugar consumption.

Effective family functioning is being able to fulfil family goals, such as controlling frequent consumption of sugary foods by children, even in the face of life's challenges. In today's world where sweets are all pervasive, implementing healthy dietary behaviours is often very challenging, for a variety of reasons. Even when parents are knowledgeable about the harmful effects of sweets, cultural and social norms, and the ambiguity of the sugar content of popular foods and drinks make controlling their children's sugar consumption difficult. In addition, daily life stresses and unexpected life events often overwhelm parents making it difficult to implement healthy dietary goals (Smith and Freeman,2009). Effective family functioning becomes important because it contributes to the development of a favourable environment, which provides a stable backbone that enables families to fulfil their

family goal of ensuring the healthy development and maintenance of its members, even in the face of everyday life challenges and other adversity.

4 Aim and Hypotheses

4.1 Aim

The aim of this study is to assess the relative contribution of each of the family functioning domains behaviour control, affective responsiveness, affective involvement, communication, problem solving and roles towards the frequent consumption of sugary foods by three and four year old children in Outer North East London. In addition, we will confirm whether deprivation and mother's lack of higher education are risk factors for frequent consumption of sugary foods by three and four year old children in Outer North East London. We will also test the ability of efficient family functioning in each of the six domains to mediate the effect of these factors. Frequent consumption of sugary foods in this study refers to consumption of more than four sugary items per day, which is based on the frequency associated with caries prevalence (World Health Organisation,2003; Moynihan,2005) and sugary foods refers to foods containing sugar which are potentially damaging to children's teeth (Hinds and Gregory,1995).

4.2 Hypotheses

1. We hypothesise that effective functioning in the domain behaviour control demonstrated by family rules that are reasonable and flexible with an opportunity for negotiation depending on the situation, provides a favourable environment that protects against the consumption of sugary foods more than four times per day by three and four year old children; independent of demographic, socioeconomic and environmental influences.

2. We hypothesise that effective functioning in the domain affective responsiveness demonstrated by the ability of family members to respond to a given stimulus with an appropriate quality and quantity of feelings, provides a favourable environment that protects against the consumption of sugary foods more than four times per day by three and four year old children; independent of demographic, socioeconomic and environmental influences.

3. We hypothesise that effective functioning in the domain affective involvement demonstrated by a real understanding of the needs of family members along with the ability to meet them, provides a favourable environment that protects against the consumption of sugary foods more than four times per day by three and four year old children; independent of demographic, socioeconomic and environmental influences.

4. We hypothesise that effective functioning in the domain problem solving demonstrated by the ability to resolve problems, provides a favourable environment that protects against the consumption of sugary foods more than four times per day by three and four year old children; independent of demographic, socioeconomic and environmental influences.

5. We hypothesise that effective functioning in the domain communication demonstrated by clear, open and direct communication between members, provides a favourable environment that protects against the consumption of sugary foods more than four times per day by three and four year old children; independent of demographic, socioeconomic and environmental influences.

6. We hypothesise that effective functioning in the domain roles demonstrated by having clearly defined roles and responsibilities for family members, provides a favourable environment that protects against the consumption of sugary foods more than four times per day by three and four year old children; independent of demographic, socioeconomic and environmental influences.

7. We hypothesise that three and four year old children living in more deprived areas are more likely to consume sugary foods more than four times per day compared to children who live in less deprived areas.

8. We hypothesise that three and four year old children whose mothers have a higher level of education (A levels or higher) are less likely to consume sugary foods more than four times per day compared to children whose mothers have lower educational qualifications.

9. We hypothesise that mother's higher education will improve the family's ability to regulate family behaviour (effective behaviour control), resulting in children being less likely to consume sugary foods more than four times per day.

10. We hypothesise that mother's higher education will improve the family's ability to respond to any given stimulus with the appropriate quality and quantity of feelings (effective affective responsiveness), resulting in emotional stability making children less likely to consume sugary foods more than four times per day.

11. We hypothesise that mother's higher education will improve the family's ability to gain a real understanding of the needs of family members along with

improving the ability to meet these needs (effective affective involvement); therefore creating emotional bonds that will result in children being less likely to consume sugary foods more than four times per day.

12. We hypothesise that mother's higher education will enable the family to deal with any problems they encounter in an effective manner (effective problem solving), resulting in children being less likely to consume sugary foods more than four times per day.

13. We hypothesise that mother's higher education will foster clear, open and direct communication between family members (effective communication) resulting in children being less likely to consume sugary foods more than four times per day.

14. We hypothesise that mother's higher education will enable the family to have clearly defined roles and responsibilities for its members (effective roles), resulting in children being less likely to consume sugary foods more than four times per day.

15. We hypothesise that mothers of children living in more deprived areas characterised by higher IMD scores will perceive less efficient family functioning in each of the six domains, behaviour control, affective responsiveness, affective involvement, communication, problem solving and roles; resulting in children in these areas being more likely to consume sugary foods more than four times per day compared to children living in less deprived areas.

5 Methods

5.1 Introduction

The research questions were explored with data from the Outer North East London Family Study (ONEL-FS) (Marcenes et al.,2011; Marcenes et al.,2011) carried out by the Institute of Dentistry, Barts and The London School of Medicine and Dentistry, Queen Mary, University of London, in collaboration with the Barking and Dagenham, Redbridge and Waltham Forest PCTs. Data was collected from a representative sample of 2,343 adults aged 16 - 65 years and 1,174 children aged three and four years in 2008-10. The researcher (SN) was involved in the planning (obtaining ethical approval, identifying and preparing adult and child questionnaires, patient information sheets, consent forms and training the interviewers) and conducting (administering the questionnaires, co-ordinating data collection, co-ordinating and doing data entry and data cleaning and quality assessment) of the study. The clinical examinations were carried out by dentists registered with the General Dental Council (GDC) and SN acted as one of the scribes.

The first part of the methodology is a general description of the ONEL-FS protocol (Marcenes et al.,2011; Marcenes et al.,2011) with details provided when directly relevant to this study, section 5.10 onwards is specific to this study.

5.2 Ethical conduct of the study

This study was approved by the Outer North East London Research Ethics Committee (REC Reference Number: 08/H0701/93) and the joint R&D office of Barts and The London NHS Trust and Queen Mary, University of London (ReDA Reference: 006190).

Written consent was obtained from all participants prior to carrying out any clinical exam or interview. The adult questionnaire (Appendix 8) was divided into two parts. The interviewer explained to participants that they could withdraw from the study at any point without any consequences. Therefore, they could answer questions in part one but not in part two if they felt uncomfortable about providing information about their family. The interviewer was available to clarify any issues related to answering the questionnaire.

All information collected during the course of this study was treated with the utmost confidence. Clinical and questionnaire data was coded, names were removed and numbers assigned and only this coded data was used in the study. In addition, all the data sheets were stored in the research supervisor's locked office.

5.3 Setting of the study

The ONEL-FS took part in the Outer North East London boroughs of Barking and Dagenham, Redbridge and Waltham Forest. Barking and Dagenham was the most deprived of the three boroughs and was ranked 22 out of 354 local authorities in England, where rank 1 was given to the most deprived area; the ethnic majority here were White (87%). Waltham Forest was relatively less deprived and was ranked 27, it had the lowest proportion of Whites (55%) compared to the other two boroughs and also had the second largest population of Pakistanis in London. Redbridge was the most affluent of the three, ranked 143 in terms of average deprivation, with a mixed population consisting of 37% ethnic minorities (25% Asian (mostly Indian) and 8% Black) (Department of Communities and Local Government,2007).

5.4 Sample recruitment

A two-stage stratified random probability sampling procedure was adopted to obtain a representative sample of adults aged 16 to 65 years and children aged three and four years living in Barking and Dagenham, Redbridge and Waltham Forest, in Outer North East London (ONEL). The sampling frame comprised all addresses in Barking and Dagenham, Redbridge and Waltham Forest stratified by the 58 wards (strata). The sampling frame excluded businesses, institutions and empty addresses. A maximum of three adults aged 16 to 65 and all children aged three and four years living in each selected household were invited to undergo a clinical examination. The adults were invited to complete an initial screening questionnaire and a 132-item self-complete questionnaire. Parents/ carers of selected children were asked to complete a child questionnaire. The exclusion criteria were adults and children with special needs.

5.5 Contacting potential participants

All sampled potential participants were contacted in advance, an invitation letter (Appendix 1 and 3), a pre-paid envelope, an opt-in card (Appendix 2 and 4) and information sheet (Appendix 5) were sent to all sampled addresses. The information sheet explained that participation was voluntary, detailed the purpose of the survey and asked for their co-operation. The participants were asked to complete and return the opt-in card detailing their telephone number, their availability, choice of venue and gender preference relating to the dentist. The invitation letter informed potential participants that they could either opt-in by returning the opt-in card by post or by default as the invitation letter stated that “if we do not hear from you within two weeks from the date of this letter then an appointment will be sent by default”. An

appointment was arranged with those who replied in accordance with their preferences of time, venue, and gender of the dentist. The dentist and interviewer also visited addresses that accepted the appointment by default.

5.6 Training and calibration exercise

The data collection teams comprised a qualified dentist registered with the GDC who conducted the clinical examinations and an interviewer who acted as a scribe to record the information from the clinical examination and also administered the survey questionnaires. The training exercise was set to assure intra- and inter-examiner agreement during the data collection, and also comparability with data collected in other Dental Health Surveys in the UK. The data collection team were trained regarding clinical procedures, protocol, criteria and codes to be used in the clinical examinations and interviews prior to starting the data collection. The criteria and examination forms were distributed to dental examiners and interviewers prior to the first training session and all members of the data collection team were asked to study the criteria and memorise the codes. The questionnaires were distributed to the interviewers who then underwent a training session in obtaining general and personal details of participants and applying the questionnaire.

5.7 Cross infection control

Each data collection team carried sufficient sets of sterile disposable instruments to ensure that there were sterile instruments for every examination. Examiners wore a clean pair of vinyl gloves for the examination of each participant and used an alcohol hand-rub before and after putting the gloves on. The gloves and instruments were

disposed of in a standard bag and returned to the Institute of Dentistry for incineration.

5.8 Data collection

Signed consent (Appendix 6 and 7) was obtained at the time of the visit from all adults before conducting any assessment. The data collection team included a dentist and a formally trained interviewer. The dentist carried out all clinical oral examinations and the interviewer acted as a scribe to record the clinical information, and applied the questionnaires. The dentist also provided information for participants who wished to know about preventing oral diseases, but only after they completed the survey questionnaire as the questionnaire included questions on health behaviours, and providing this information before participants completed the questionnaire could lead to potential bias.

5.8.1 Conducting the interview

After the clinical examination the interviewer asked adult participants and at least one parent/ carer of each child participant, to answer the survey questionnaires (Appendix 8 and 9). Interviewers explained to participants that they were free to withdraw from the study at any point; they could answer questions in one part of the questionnaire but not in another, if they felt uncomfortable about providing personal information on their background. Interviewers distributed the questionnaire to participants and were available to clarify any issues related to the questionnaire.

In part one of the adult questionnaire, all participants were asked to answer questions on demographic, socioeconomic and cultural factors, risk and protective oral health behaviours, experience of dental pain and oral health related impact on quality of life. In part two of the questionnaire, information on family functioning and partner's current socioeconomic characteristics were collected.

In the child questionnaire, the parent/ carer was asked to answer questions about the child's demographics (age and sex), brushing habits, dental attendance patterns, diet and the impact that the child's dental health had on the quality of life of the child and family.

5.8.1.1 Child questionnaire

In the child questionnaire, information on oral health related behaviours of children including dental attendance and oral hygiene habits were collected using questions adapted from the Child Dental Health Survey (2003). The instrument used to collect information about three and four year old children's sugar consumption frequency was adapted from the food frequency interview questionnaire used in the National Diet and Nutrition Survey (NDNS) of children aged 1 ½ to 4 ½ years (Hinds and Gregory,1995). This survey was deemed the most comprehensive assessment of national nutrition and diet by the National Obesity Observatory (Roberts,2010). One reason for using a food frequency questionnaire over weighted methods was because it was more likely to reflect a person's usual diet, as it covered a longer reference period, compared to weighted methods which provide data on current intake (Hinds and Gregory,1995). It was also relatively inexpensive, could focus on foods of interest such as commonly consumed sugary foods and could be used to screen children with

high and low sugar intakes (Ziegler et al.,2006) which was a key interest of this study. Data from the food frequency questionnaire of the NDNS was used to inform the dental report which assessed the relationship between frequency of consumption of sugary foods and caries experience in the same age groups as this study (Hinds and Gregory,1995).

5.8.1.2 Adult questionnaire

In the adult questionnaire, socioeconomic classification and ethnic group information were collected according to questions included in the census (National Statistics,2005) and used in the Adult Dental Health Survey (1998). Questions on oral health related behaviours including dental attendance and oral hygiene habits were adapted from the Adult Dental Health Survey (1998). Questions about diet were adapted from the Diet and Nutrition Survey (1992-1993). Data on family functioning was collected using the validated questionnaire Family Assessment Device (FAD) (Epstein et al.,1981; Epstein et al.,2005).

The FAD assessed the six domains of family functioning considered most important for the emotional and physical health of family members (Epstein et al.,2003). The FAD took 15–20 minutes to complete and required a reading age of around 10 years. It had good psychometric properties, its concurrent validity was assessed by comparing it with other measures of family functioning and it was found to be significantly correlated (Miller et al.,1985). Reliability was good: 0.83 for affective responsiveness, 0.78 for affective involvement, 0.75 communication, 0.74 problem solving and 0.72 for roles and behaviour control (Epstein et al.,1983). Social desirability response bias was low, it was assessed by correlating the FAD with the

Marlowe-Crowne Social Desirability Scale (Miller et al.,1985), this ensured that responses motivated by the desire to provide socially acceptable answers were minimised. The FAD also has cross cultural applicability as it has been translated into over 20 languages and been applied across cultures (Ryan et al.,2005; Herzer et al.,2010).

5.9 Referral for treatment

The data collection team had referral forms available (Appendix 10) which were filled in if considered necessary by the dentist and handed over to the project coordinator who organised an appointment for further assessment and dental treatment. If participants needed treatment the project coordinator liaised with PCTs to identify a dentist available to provide the necessary treatment. If the examining dentist identified participants with any suspicious pre-cancer lesions, the project coordinator organised referrals for further examination and treatment with a consultant at the Institute of Dentistry, Barts and The London School of Medicine and Dentistry.

5.10 Statistical power to test study hypotheses

The minimum required sample size, to have 90% statistical power and a significance level of 5% was 644, for estimating a significant unadjusted association between any family functioning domain score and children's frequent consumption of sugary foods.

The sample size was estimated using the formula developed by Hsieh et al. (1998)

$$N = \frac{(Z_{1-\alpha/2} + Z_{1-\beta})^2}{[P\,(1-P)\,\Omega^2]}$$

Where

- $Z_{1-\alpha/2}$ is the Z score for an alpha of 0.05 (Type 1 error) = 1.960
- $Z_{1-\beta}$ is the Z score for a statistical power of 0.90 = 1.282
- P is the proportion of children with frequent sugar consumption at the mean value of the explanatory variable (family functioning domains) = 0.15
- Ω is the natural logarithm of the unadjusted odds ratio (0.70) for the association between one unit change in any family functioning domain score and children's frequent sugar consumption = 0.358

5.11 Data analysis

Mother-child dyads were selected for analysis based on criteria described in section 5.11.3. The variables included were children's age, sex and frequency of consumption of sugary foods; mother's marital status, education, ethnicity and perception of family functioning, and the Index of Multiple Deprivation derived from the postcode. Variables were re-coded to facilitate statistical analysis. Complex sample analysis using survey software was used to analyse the data. The analysis took into account the complex survey design (stratification and clustering) to adjust standard errors and confidence intervals accordingly, as ignoring the complex design can lead to biased estimates and overstated significance levels. The data was analysed using survey commands in STATA 11.0 and SPSS 16.0.

5.11.1 Data entry

Initially a spreadsheet was developed using SPSS 16.0 statistical package. Data was coded, names removed and numbers assigned. A common family number was assigned to child participants and their parents. The data was first screened to check for data entry errors such as out of range variables and then 10% of the data was re-entered to assess data entry quality. Child questionnaire data and clinical data were then merged with relevant parental data and then analysed using SPSS 16.0 and STATA 11.0 software. SPSS was used for data entry, to check for entry errors, to select the subsample and for doing simple analysis using survey analysis commands. STATA was used to double check selection of sub sample, results of simple analysis and for modelling of data.

5.11.2 Weighting

Data was weighted to adjust for the unequal probability of selection, to correct for the effect of non-response and to represent the distribution of the population in the three Outer North East London boroughs by key demographic factors age, sex and ethnicity.

Survey weights were calculated using the following steps (adapted from an intra departmental seminar):

1. Calculate sampling weights
2. Adjust sampling weights for non-response and post stratification
3. Rescale weights so that sum of survey weights is equal to actual sample number

1) ***Calculating sampling weights***: Sample weights which is the inverse of the probability of selection was calculated using the following steps:

A = total number in the population

B = number sampled

C = B/A = the probability of selection in the first stage

D = total number of eligible children per household

E = actual number of children sampled in the household

F = E/D = the probability of selection in the second stage

G = C*F = the total probability of selection

Sample weight (**SW**) = 1/G = the inverse of the probability of selection

Table 5.11.2.1 Calculating sampling weights

strata	borough	ward	total hh (A)	sampled hh (B)	pos1 hh (C=B/A)	f. no	total ind (D)	sampled ind (E)	pos 2 ind (F=E/D)	total pos (G=C*F)	weights (H=1/G)
1	Barking	Abbey	4090	86	0.02	1	4	1	0.25	0.01	190.2
						2	5	2	0.40	0.01	118.9
						....					
2	Barking	Alibon	3830	66	0.02	4					

2) ***Adjust sampling weights for non-response and post stratification***

1. Adjusting for non-response

$$\text{Response rate} = \frac{\text{Number responding:}}{\text{Number invited}}$$

$$\text{Non response weight (NRW)} = \frac{1}{\text{Response rate (section 6.2)}}$$

2. Adjusting for post stratification: this step makes the weighted frequencies in the sample equal to the population frequencies.

A= proportion of children by age, sex and ethnicity in the population

B= proportion of children by age, sex and ethnicity in the sample

Post stratification weight (**PSW**) = A/B

3. ***Calculation of survey weights***:

Survey weights = SW*NRW* PSW

The weights were then rescaled to reflect the actual sample number.

5.11.3 Selection of the study sub sample

A study sub sample was selected from the ONEL-FS children's data set. In step 1 mother-child dyads were selected from the ONEL-FS children's data set. In step 2 the study sub sample comprising mother–child dyads with complete data on the study variables were selected for data analysis (figure 5.11.3.1).

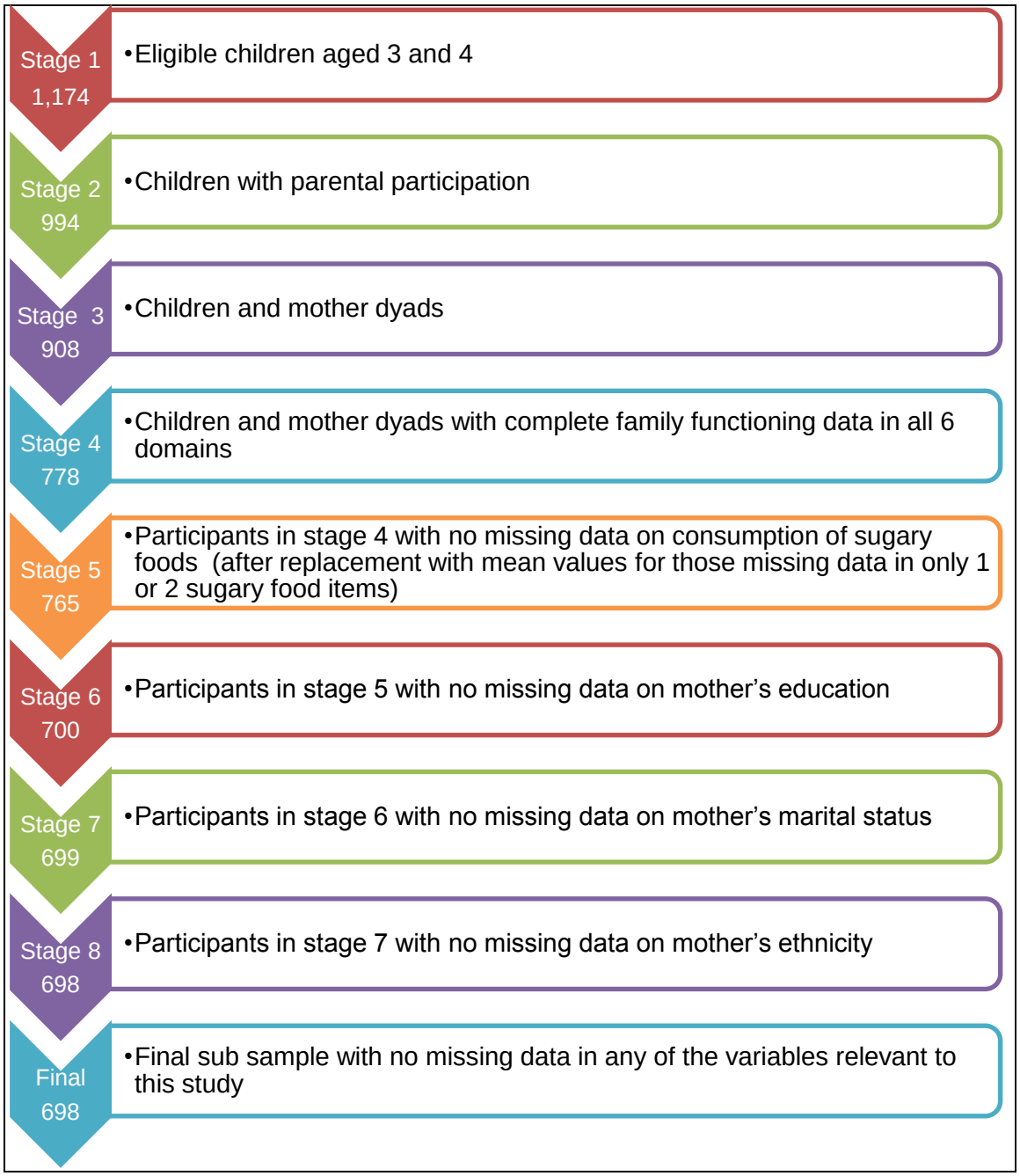


Figure 5.11.3.1 Flow chart of final sub sample selection

The study sub sample had complete data on variables needed to explore the study aims. The variables included children's age and sex; maternal variables, mother's marital status, education and ethnicity; the Index of Multiple Deprivation which was based on the postcode and all six family functioning domains.

5.11.4 Handling missing data

Replacement of missing data was done for the variables assessing frequency of consumption of sugary foods. Out of the 698 participants included in the analysis, 648 had complete data on all seven sugar variables (chocolates, biscuits, cakes, sweet confectionary, sweetened milk, sweetened juice and sweetened fizzy drinks), 42 had missing information on only one sugar variable and nine had missing information on only two sugar variables, these missing values were replaced by the mean sugar consumption frequency.

Mean family functioning domain scores were calculated for each of the six domains only if a minimum of 60% of the questions relating to that domain were answered, if more than 40% of the items for a domain were missing that domain score was designated as missing and the subject was not included in the analysis.

5.11.5 Construction of study variables

5.11.5.1 Mother's ethnicity

Ethnicity was collected in 26 categories Asian British, Asian Indian, Asian Bangladeshi, Asian Pakistani, Asian Middle East/Arabic, Asian Chinese, Asian Japanese, Black British, Black European, Black African, Black Caribbean, Black American, Latino, Mixed Asian/Black, Mixed Asian/White, Mixed Black/White, White British, White West European, White East European, White Mediterranean, White North American, White Latin American, Asian other, Black other, White other, other.

It was then recoded into four main categories White, Asian, Black and Mixed/Others. White included all the white ethnic groups (White British, White West European, White

East European, White Mediterranean, White North American, White Latin American, White others), Asian Included Asian British, Asian Indian, Asian Bangladeshi, Asian Pakistani, Asian Middle East/Arabic, Asian Chinese and Asian others. The Black category included Black British, Black European, Black African, Black Caribbean, Black American and Black Others. The Mixed/Other category included Latino, mixed Asian/Black, mixed Asian/White, mixed Black/White and Other.

5.11.5.2 Mother's marital status

Information on mother's marital status was collected in 7 categories, single (never married), married (first marriage), re-married, cohabiting, separated, divorced and widowed. The data was re-categorised into 'single', 'in a relationship' (married, re-married, cohabiting) and 'previously married' (separated, divorced, widowed).

5.11.5.3 Mother's education

Information on mother's education was collected in six categories: no qualification, secondary school (GCSE, O levels), A levels, technical qualifications, first degree (university) and higher degree (post graduate). They were re-categorised into two groups, a lower qualification group that included no qualification, secondary school, and technical qualifications; maternal qualifications found more often in manual households. The second group, the higher educational group included A levels, first degree and higher degree, maternal qualifications found more often in non-manual households (Hinds and Gregory,1995) . Therefore, households classified as manual in the NDNS would equate with the lower educational group in this study and the non-manual with the higher educational group. A similar categorisation as used by North

and Emmett (2000) in a study on the diet of three year old children and its associations with socio-demographic factors.

5.11.5.4 Family Functioning

Information on family functioning was assessed from the information provided in the FAD portion of part 2 of the adult questionnaire. The FAD had seven subscales, one subscale for each of the six domains and one general functioning scale which assessed overall functioning of the family. The FAD was made up of 60 questions and participants had to select a response from a four-point Likert type scale (strongly agree/ agree/ disagree/ strongly disagree). Each item (question) on the FAD belonged to one of the 7 domains (behaviour control, affective responsiveness, affective involvement, communication, problem solving, roles and general functioning). The questions were designed so that some were worded in a positive manner, where agreement denoted effective family functioning, while others were worded in a negative manner where agreement was indicative of ineffective family functioning. The items were scored so that strongly agree was 1, agree 2, disagree 3 and strongly disagree 4. The first step was to transform all the responses so that higher scores were indicative of more effective functioning. In order to accomplish this, questions that were positively worded were re-coded by subtracting the response score from 5; this ensured that higher scores reflected more effective functioning for all the questions. Next, each item was grouped into its respective domain and scores for each domain were calculated by averaging the scores of the items. The scores for each domain ranged from 1.00 to 4.00, higher scores denoted more effective family functioning. If more than 40% of the items in a domain were missing, it was nominated as missing and the score was not calculated for that domain. The

minimum number of responses required for calculating the score for the domain behaviour control was six, affective responsiveness was four, affective involvement was five, communication was six, problem solving was four and roles was seven.

5.11.5.5 Level of deprivation

This study elected to use a composite measure of deprivation, derived from the postcode and based on neighbourhood characteristics, for a number of reasons. Firstly, as well argued and demonstrated by Turrell et al. (2007), an area based composite index which is based on characteristics of the environment that includes its physical and social infrastructure and health services has a direct effect on oral health. The oral health related behaviour, sugar consumption frequency, is also similarly subject to the influence of these neighbourhood characteristics and therefore IMD was included in the study analysis. In addition, the socioeconomic position of immigrants cannot be accurately assessed using the same criteria as for the local population owing to differences in occupation in own country versus host country, therefore an area based measure, the IMD, was considered more suitable in Outer North East London which has a relatively large immigrant population.

The IMD was constructed by the Social Disadvantage Research Centre at the University of Oxford to be used as a composite measure of area based deprivation. The IMD is part of the English Index of Deprivation (ID) and is the government's official measure of multiple deprivations for geographic areas known as lower super output areas (LSOA's). LSOA's have an average population of about 1,500 people, there are 32,482 LSOA's in England with IMD rank 1 given to the most deprived area in England and rank 32,842 given to the least deprived. The IMD is based on 37

different indicators covering aspects of income, employment, health and disability, education, skills and training, barriers to housing and services, living environment and crime (Department of Communities and Local Government,2007).

For the purposes of this study the IMD has been separated into quintiles based on the quintiles for England, and each case has been assigned a quintile based on the residential postcode. Therefore, those whose postcodes correspond to the fifth quintile are said to live in the 20% most deprived areas in England. For the purpose of analysis, the sample was further dichotomised into less deprived (the first three divisions) and more deprived (the last two divisions).

5.11.5.6 Children's daily consumption of sugary foods

A food frequency questionnaire (FFQ) was used to collect data on nine sugary food items: chocolate, biscuits or cookies, cakes, ice cream or ice lollies, sweetened yogurt, confectionary or other sweets, sweetened milk, sweetened fruit juice and sweetened fizzy drinks; using a 7 point ordinal scales (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). Two items were dropped for this study analysis, ice cream (because of seasonal variation in its consumption) and sweetened yoghurt, which is not considered a high sugar food (Hinds and Gregory,1995). A summative variable was created, based on the reported consumption of the remaining seven sugary food items, to indicate the number of times sugary foods were eaten per day by children. The information available did not permit the calculation of actual amounts, but allowed us to get a picture of the daily frequency that would enable us to differentiate between those with low or high daily sugar consumption rates.

The responses for each sugary food item were transformed into a daily equivalent and the daily equivalents were summed to give an estimate of the daily frequency of consumption of sugary foods. First the response categories for each of the sugary food variables were re-coded to reflect frequency of consumption of that sugary food item per day. A response of more than once a day was conservatively estimated to mean twice a day and given a value of two per day, once a day was given a value of one per day, most days was estimated as consumption of that sugary food item at least four days out of seven and was given a value of 0.57(4÷7) per day, a response of once a week was estimated as consumption of that item once in seven days and given a value of 0.14 (1÷7) per day and responses indicating consumption of the sugary food once a month or less was given a value of zero. If up to two responses for sugary foods were missing then the mean value of the other items was imputed. The daily frequency was then calculated as number of times chocolates were eaten per day + number of times biscuits were eaten per day + number of times cakes were eaten per day + number of times sweets were eaten per day + number of times sweet milk was consumed per day + number of times sweet juice was consumed per day + number of times sweet fizzy drinks were consumed per day. Children were then dichotomised as those consuming four or more sugary foods per day and those consuming less than four sugary foods a day.

5.11.6 Description of the sample

Descriptive analysis was undertaken to assess the frequency distribution of the study variables. This data was presented as frequencies and weighted percentages, the totals of which may not add up to 100% because of rounding. Family functioning scores in the domains behaviour control, affective responsiveness, affective involvement, communication, problem solving and roles as perceived by the mothers, was assessed as mean scores and 95% confidence intervals. Sample distribution by consumption of sugary foods more than four times per day was also assessed.

5.11.7 Agreement between mothers and fathers FAD scores

Intraclass Correlation Coefficient (ICC) was used to check the degree of agreement between mothers and fathers of the children in the sample, regarding perception of family functioning in each of the six domains. SPSS 16 was used to calculate the average measures ICC of absolute agreement, which gives us the degree of relationship between the average scores of mothers and fathers for each family functioning domain, in terms of absolute agreement. Absolute agreement ICC views measures that differ in absolute value as disagreements (McGraw and Wong,1996).

5.11.8 Unadjusted analysis

In the first step univariable logistic regression analyses was carried out to assess the unadjusted association between each of the explanatory variables (children's age and sex; mother's ethnicity, marital status, education; IMD and family functioning scores in the six domains) and children's consumption of sugary foods more than four times per day. Logistic regression was selected as the appropriate method because it is used to

predict a binary outcome (Field,2009). The odds ratios and 95% confidence intervals were assessed within two decimal places.

The Wald statistic is commonly used to calculate the P value, which tells us whether the explanatory variable is making a significant contribution to the prediction of the outcome. It is calculated by dividing the regression coefficient by its standard error. The limitation of the Wald's statistic is that there is the likelihood of making a Type II error (rejecting the contribution of the explanatory variable when in fact there is a significant contribution). This can occur when the regression coefficient is large, which tends to inflate the standard error resulting in underestimation of the Wald's statistic (Field,2009). A relationship was considered statistically significant if $p \leq 0.05$.

Bonferroni correction is often applied in studies involving multiple testing, to decrease the chance of making a Type I error, it is done by dividing the chosen level of significance by the number of tests so that the cumulative type I error remains below 5% (Field,2009). Recent schools of thought argue that Bonferroni correction 'overcorrects' resulting in too many Type II errors, which is especially detrimental in studies that are aimed at generating hypotheses, by discarding potentially useful observations. Therefore, it has been suggested that such observational studies do not correct for multiple testing but instead be conservative in their inference of the findings such that they are viewed as hypothesis generating rather than definitive findings (Streiner and Norman,2011). Therefore, because of the observational nature of this study and its aim of contributing to the development of theory it was deemed appropriate not to apply Bonferroni correction for hypothesis tests involving each of the family functioning domains.

5.11.9 Construction of the conceptual model

In the next step of the analysis hierarchical modelling was done, which is a type of multiple regression analysis in which the predictor variables are entered into the model according to a hierarchy guided by a theoretical framework (Victora et al.,1997). The hierarchical model was used to assess the independent contributions of each of the family functioning domains and each of the relevant socio-demographic and socioeconomic variables. The results of the univariable analysis guided the selection of the variables into the model. Statistically significant associations at the 20% level ($p<0.20$) between the explanatory variable and the outcome of interest were selected.

The selected variables were then entered in blocks guided by theory. Initially age, sex and mother's ethnicity were entered (model 1), next mother's education and IMD were entered (model 2) and any changes in the odds ratios and p-values noted. Finally one domain of family functioning was entered (model 3) and changes to the results noted. This was repeated for each of the six domains of family functioning.

In the first step of the analysis the independent associations of children's age and sex and mother's ethnicity, with frequent consumption of sugary foods by children was assessed (model1). In the second step of the analysis (model 2) mother's education and IMD were added, and their independent associations assessed in the presence of the potential confounding factors. The magnitude of the remaining effects of age, sex and ethnicity reflects the part not mediated through education and IMD. Similarly in the next step (model 3) one domain of family function was added and its effect on children's frequent sugar consumption assessed in the presence of all potential confounders. Any residual relationship between mother's ethnicity, mother's education or IMD and sugar consumption, is that part of the relationship that is not

potentially mediated through that family functioning domain. Here the attenuation in the odds ratios reflects the magnitude of the association accounted for by that domain of family functioning. Relative attenuation of the OR was calculated using the formula $(OR_U – OR_A)÷(OR_U -1)$ (Birkmeyer et al.,2003), where OR_U represents the unadjusted odds ratio (model 2) and OR_A reflects the odds ratio after including a family functioning domain in the model (model 3).

5.11.10 Family functioning domains as effect modifiers

The final step of the analysis was to assess the manner in which family functioning in each of the six domains could potentially work with the other protective/ risk factors in the family environment, to influence the outcome. Variables can work together in a variety of different ways (Kraemer et al.,2001). Three possible ways for the risk/protective factors to work together in this study were (1) they could work together as overlapping protective/risk factors, (2) each domain of family functioning could mediate the relationship between the risk/protective factors in the family environment and sugar consumption frequency by children or, (3) each domain of family functioning could moderate the relationship between risk/protective factors in the family environment and sugar consumption frequency by children.

5.11.10.1 Overlapping protective/risk factors

Overlapping factors are those that ‘tap into the same construct’ whereby adding both the variables into the model improves the fit compared to when the variables are entered individually. In addition none of the factors should be co-related or have temporal precedence (Kraemer et al.,2001). Mother’s ethnicity precedes family

function, and it is reasonable to assume that in most cases mother's education also precedes the birth of her children and establishment of family functioning of this family unit; therefore this concept of overlapping factors was ruled out and not assessed further.

5.11.10.2 Family functioning domains as mediators

Mediation is defined as *"a relation such that an independent variable causes a mediating variable, which then causes a dependent variable"* (MacKinnon and Luecken,2008). *"A variable M is a mediator of the relationship between T and O if M helps explains how or why T is related to O*" (Kraemer et al.,2008).

There are a number of approaches to testing mediation, MacKinnon et al. (2002) reviewed 14 of the most commonly used methods and grouped them into three main approaches: causal steps tests of the intervening variable effect, difference in coefficient tests of the intervening variable effect, and product of coefficient tests of the intervening variable effect. The causal steps approach is the most commonly used and is based on the work of Baron and Kenny (1986) and Judd and Kenny (1981). In this study we followed the Baron and Kenny (1986) approach because it suits this study as it takes into account partial mediation often observed in complex causal pathways, which rarely have one main variable that mediates the effect of the independent variable on the dependent variable. It differs from the Judd and Kenny (1981) approach where only complete mediation is supported (MacKinnon et al.,2002).

Baron and Kenny's (1986) approach requires that:

- The independent variable should be *significantly* associated with the mediator
- The mediator should be *significantly* associated with the dependent variable
- The independent variable should be *significantly* associated with the dependent variable AND this association should be attenuated after controlling for the mediator

This approach specifies demonstration of a relationship between the independent variable (X) and the outcome (Y) referred to as the total effect (path c), which should change when the mediator (M) is controlled for (path c'), which is the direct effect (Baron and Kenny,1986); demonstrated in Figures 5.11.10.2.1 and 5.11.10.2.2

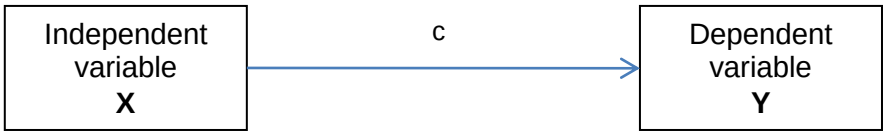


Figure.5.11.10.2.1 Total effect

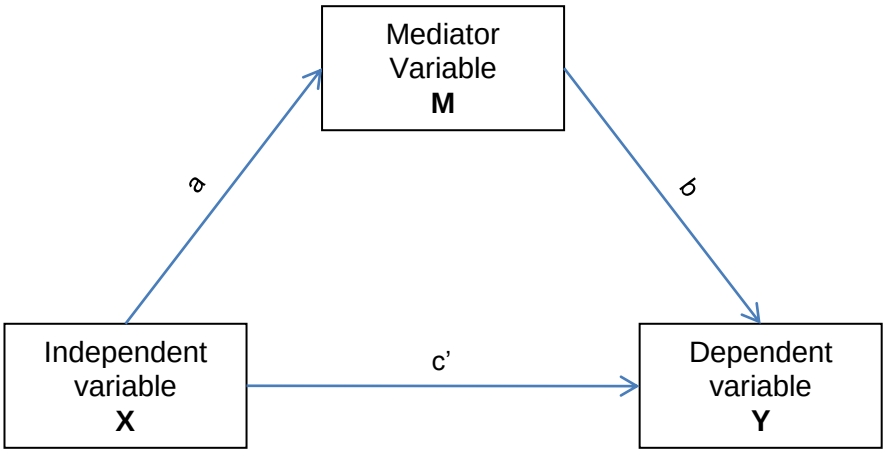


Figure 5.11.10.2.2 Direct (c') and mediation effect (ab)

Path c is the association between X and Y, path a is the association between X and M, path b is the association between M and Y controlling for X and path c' is the association between X and Y controlling for M (Figure 5.11.10.2.2). Full mediation is supported if path b is significant and path c' is not significant after controlling for M, whereas if both path c' and path b are significant then partial mediation is indicated.

In this study the mediating role of family functioning domains in the relationship between mother's education and frequent consumption of sugary foods by children was assessed using logistic regression analysis. Step 1 was assessment of *path c*, which was the association between mother's education and frequent consumption of sugary foods by children. Step 2 assessed *path a,* which was the association between mother's education and a family functioning domain. Step 3 was the assessment of *path b* which is the association between the family functioning domain and frequent consumption of sugary foods by children, after controlling for mother's education. Step 4 was the assessment of *path c'* which was the relationship between mother's education and frequent consumption of sugary foods by children after controlling for the family functioning domain; level of significance and any attenuation was noted. Mediation was indicated if path a and b were statistically significantly different from zero and complete mediation was indicated if path c' was not significantly different from zero after controlling for the mediator. This analysis was then repeated with mother's ethnicity as the independent variable. Keeping in mind that this is a cross sectional study, causation was not inferred from this analysis; rather it was used to build theory and direct future research.

5.11.10.3 Family functioning domains as moderators

A moderator is a qualitative or quantitative variable that affects the direction and/or strength of the relation between an independent variable and a dependent variable (Baron and Kenny,1986). This means that "*a variable M is a moderator of the relationship between a target variable T and an outcome O in a particular population, if M explains under what conditions T is related to O*" (Kraemer et al.,2008). In order to test statistically that a moderator actually functions as one there must be a statistically significant interaction between the moderator and independent variable (Kraemer et al.,2008).

For a variable to be considered a moderator it has to fulfil the following criteria, (1) it should not be correlated with the independent variable, (2) both the factors should be independently associated with the outcome, and (3) it should have temporal precedence over the independent and dependent variables. This last one is considered the minimal criterion to be met, for a variable to be considered a moderator (Kraemer et al.,2001; Wu and Zumbo,2008).

In this study family functioning did not precede mother's ethnicity, nor was it likely to precede mother's education. In the words of Kraemer et al. (2001) *"....the same factor cannot be both a moderator and a mediator for a target risk factor for a particular outcome in a population"* because the criteria for the variable to be considered either a mediator or moderator is unambiguous in reference to temporal precedence and correlation between variables (Kraemer et al.,2001). In addition, the relationship between mother's education/ethnicity and sugar consumption frequency by children should vary as a function of family functioning without education or ethnicity influencing family functioning itself in any way, which was not possible in this study

because the variables were related. Therefore, family functioning was not tested as a moderator in this study.

5.11.11 Summary

A final sub sample of 698 mother child dyads was included in the data analysis. The variables analysed were children's age and sex; mother's ethnicity, education and marital status; area based deprivation assessed using IMD; family functioning domains behaviour control, affective responsiveness, affective involvement, communication, problem solving and roles and frequency of consumption of sugary foods by the children in the sample.

Hierarchical logistic regression analysis was done to assess the independent relationship of each of the socio-demographic variables and each family functioning domain with the consumption of sugary foods more than four times a day by the three and four year old children in the study sub sample. The mediating role of each of the six family functioning domains, in the relationship between mother's education, mother's ethnicity and IMD and frequent consumption of sugary foods by children in the sample, were assessed using Baron and Kenny's (1986) steps.

6 Results

6.1 Introduction

The ONEL Family Study (ONEL-FS) response rate and representativeness of the study sample are presented first, followed by a description of the study sample. Finally results of univariable, hierarchical modelling and mediation analysis are presented.

6.2 Response rate

Table 6.2.1 Response rates for the ONEL-FS sample of three and four year old children, by the boroughs in Outer North East London (ONEL).

Borough	**Response rate**
Waltham Forest	
Number of addresses sampled	700
Number of valid addresses (final sampling frame)	676
Number of addresses refusing to participate	152
Number of addresses agreed to participate	524
Household response rate (%)	***77.5%***
Redbridge	
Number of addresses sampled	651
Number of valid addresses (final sampling frame)	392
Number of addresses refusing to participate	146
Number of addresses agreed to participate	246
Household response rate (%)	***62.8%***
Barking and Dagenham	
Number of addresses sampled	579
Number of valid addresses (final sampling frame)	503
Number of addresses refusing to participate	206
Number of addresses agreed to participate	297
Household response rate (%)	***59%***
All boroughs response rate (%)	***67.9%***

A total of 1,930 households with three and four year old children were selected from the 58 wards in the ONEL boroughs. From these 359 were excluded as invalid addresses (e.g. business premises) and 504 households refused to participate, leaving 1,067 participating households making the overall response rate 67.9% (Table 6.2.1).

6.3 Representativeness of study sample

Table 6.3.1 Representativeness of three and four year old children in the study sub sample compared to the ONEL census population and ONEL-FS children sample, by age, sex and ethnicity

Variable	Proportion in ONEL census population (N)	Proportion in un-weighted ONEL–FS children sample (N)	Proportion in un-weighted study sub-sample (N)	Proportion in weighted study sub sample
Age				
3 years	50% (9062)	52% (513)	51% (359)	49%
4 years	50% (9124)	48% (481)	49% (339)	51%
Gender				
Male	51% (9269)	52% (517)	51% (356)	47%
Female	49% (8904)	48% (477)	49% (342)	53%
Children's ethnicity				
White	57% (10375)	31% (311)	33% (229)	53%
Asian	21% (3772)	34% (339)	34% (236)	27%
Black	14% (2478)	31% (310)	30% (212)	12%
Mixed/Other	8% (1548)	4% (34)	3% (21)	8%

Table 6.3.1 shows that the distribution of children by age and gender was similar in the ONEL census population and the ONEL-FS children's sample. Although this study analysed a sub sample of the ONEL-FS children's sample, the distribution of children by age and gender remained the same, showing that the impact of the response rate and completeness of data did not affect the representativeness of the data. Weighting accounted for the non- representation of the ethnic distribution within the study sub sample.

Table 6.3.2 Deprivation profile of three and four year old children in the study sub sample compared to the ONEL population and ONEL-FS children sample

Borough	**ONEL census Population Mean IMD score**	**ONEL–FS Mean IMD score**	**Study sub sample Mean IMD score**
Barking and Dagenham	34.37	35.02	34.92
Redbridge	20.16	20.56	20.58
Waltham Forest	33.07	33.21	33.69

Table 6.3.2 confirms that the study sub sample reflects the deprivation profile of children living in Outer North East London (ONEL).

6.4 Agreement between mothers and fathers FAD scores

Table 6.4.1 Intraclass correlation coefficient statistics assessing the agreement between mothers and fathers of children in the ONEL-FS sample, in each of the six domains of family functioning measured using the FAD.

Family functioning domain (n)	**Intraclass correlation coefficient (95% CI)**	**P value**
Behaviour Control (193)	0.72 (0.63, 0.79)	<0.001
Affective Responsiveness (192)	0.69 (0.59, 0.77)	<0.001
Affective Involvement (191)	0.72 (0.63, 0.79)	<0.001
Problem Solving (194)	0.62 (0.49, 0.71)	<0.001
Communication (192)	0.74 (0.66, 0.81)	<0.001
Roles (194)	0.73 (0.65, 0.80)	<0.001

Table 6.4.1 shows that there was good absolute agreement in the perception of family functioning in all the six domains, between mothers and fathers of children in the ONEL-FS sample.

6.5 Study sub sample description

Table 6.5.1 Frequency distribution of children's age, sex, mother's marital status and mother's education in the study sub sample

Variables (N=698)	***Frequency***	***Weighted Proportion***
Age		
3 years	359	49%
4 years	339	51%
Gender		
Male	356	47%
Female	342	53%
Mother's marital status		
Single	88	14%
Married	482	65%
Re-married	6	3%
Cohabiting	69	12%
Separated	32	4%
Divorced	9	2%
Widowed	2	
----------	----------	----------
Mother's marital status: re-categorised		
Living alone	88	14%
Living with a partner	567	80%
Previously married	43	06%
Mother's Education		
No qualification	61	10%
Secondary school GCSE, O levels	174	25%
A levels	109	16%
Technical qualifications	68	9%
First degree (university)	192	25%
Higher degree (postgraduate)	94	15%
----------	----------	----------
Mother's Education: re-categorised		
Lower qualification (No, Secondary school, technical)	303	45%
Higher qualification (A levels, university, postgraduate)	395	55%

Table 6.5.1 shows that children were equally distributed by age and gender within the study sub sample. Mother's marital status describes the family structure of the study sample. A majority (65%) of the mothers were married, followed by 14% who were single and 12% who were cohabiting; smaller proportions were remarried (3%),

separated (4%) or divorced (2%). A quarter (25%) of the mothers had secondary school education and the same proportion had a university qualification; smaller but similar proportions had A levels (16%) and postgraduate (15%) qualifications and even smaller but similar proportions reported technical qualifications (9%) and no education (10%). Mother's education variable was dichotomised so that qualifications more often reflecting manual households were grouped together and qualifications more often reflecting non manual households were grouped together (Hinds and Gregory,1995). Based on the above, a slightly higher proportion (55%) reported having a higher qualification.

With regard to mother's ethnicity, a majority (57%) of mothers belonged to the White ethnic group, 26% to the Asian ethnic group, 11% to the Black ethnic group and 6% to mixed or other ethnicities. The sample distribution within each ethnic group is represented in pie charts (Figures 6.5.1 to 6.5.4).

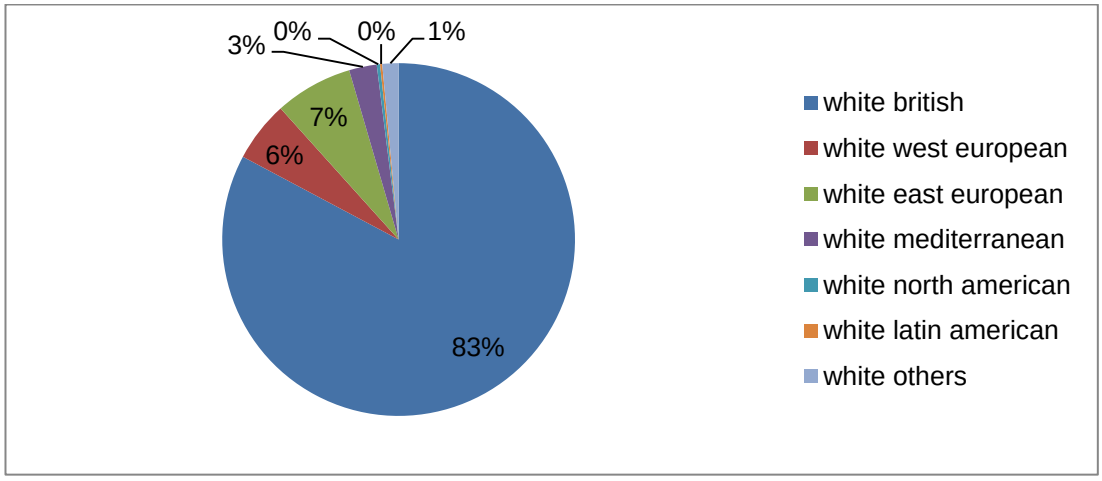


Figure 6.5.1 Pie chart showing frequency distribution within the White ethnic group

Figure 6.5.1 shows that the White ethnic group was made up largely of mothers who reported their ethnicity as White British (83%), followed by White East European (7%) and White West European (6%).

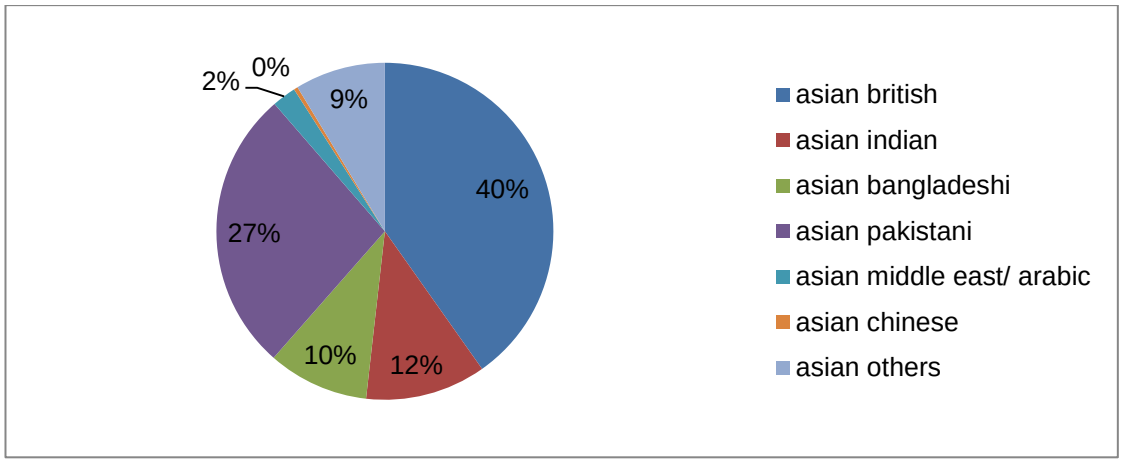


Figure 6.5.2 Pie chart showing frequency distribution within the Asian ethnic group

Figure 6.5.2 shows that in the Asian group 40% reported their ethnicity as Asian British, 27% Pakistani, 12% Indian and 10% Bangladeshi.

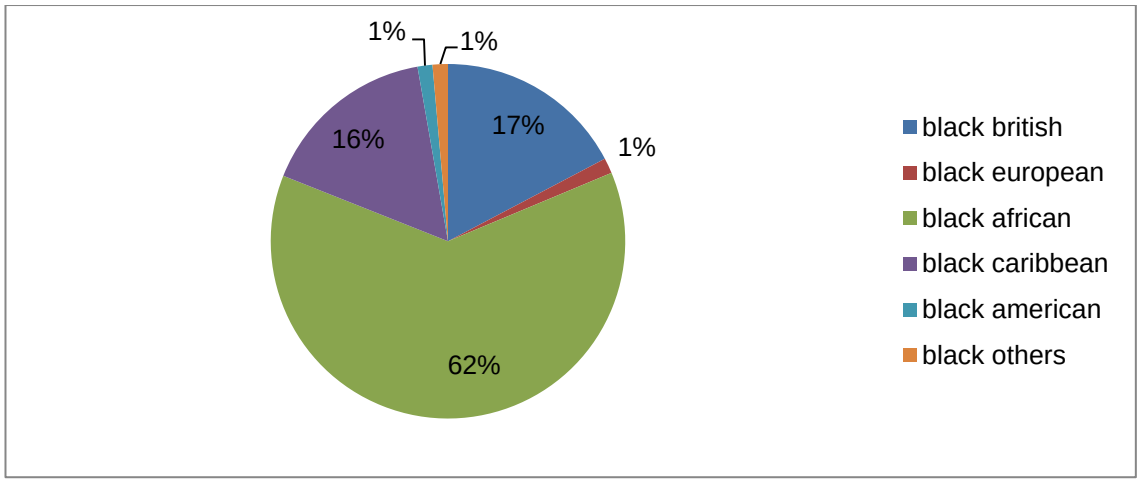


Figure 6.5.3 Pie chart showing frequency distribution within the Black ethnic group

Figure 6.5.3 shows that in the black ethnic group, the majority (62%) reported their ethnicity as Black African, 17% as Black British and 16% as Black Caribbean.

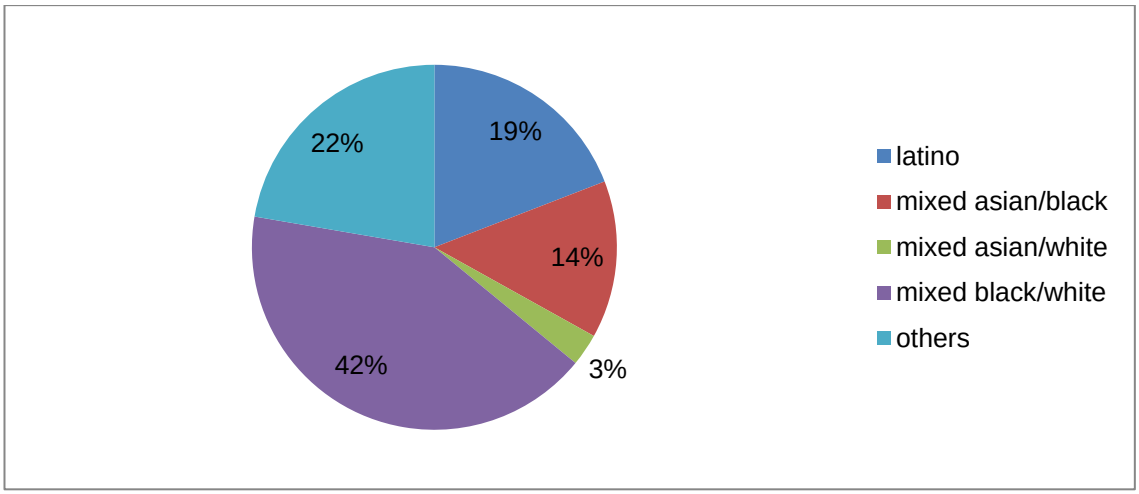


Figure 6.5.4 Pie chart showing frequency distribution within the Mixed/Other ethnic group

Figure 6.5.4 shows that in the Mixed/Other group the majority (42%) reported ethnicity as Black and White mixed, followed by 'Others' (22%) and Latino (19%), the lowest proportion reported Asian and White Mixed ethnicity (3%).

Table 6.5.2 Frequency distribution of Index of Multiple Deprivation scores in the study sub sample, by quintiles of distribution in England

IMD quintiles	Range of scores of IMD in England	Frequency in sample	Weighted proportion in sample
1st quintile (least deprived)	0.00 - 8.32	7	2%
2nd quintile	8.33-13.74	37	10%
3rd quintile	13.75-21.22	83	16%
4th quintile	21.23-34.42	285	40%
5th quintile (most deprived)	34.43-highest	286	32%
Dichotomised IMD Less deprived (1st, 2nd, 3rd) More deprived (4th, 5th)	 0.0 - 21.22 21.23-highest	 127 571	 28% 72%

The mean IMD score for the study sub sample was 28.46 (95% CI 27.49, 29.44) and ranged from 5.36 to 58.28, with higher scores indicating greater levels of deprivation.

A great majority (72%) of the sample lived in the two most deprived quintiles, based on the quintiles of distribution for England (Table 6.5.2).

Table 6.5.3 Mean family functioning score, by domains, in the study sub sample

Family functioning domains (N=698)	***Mean (95% CI)***
Behaviour Control	3.10 (3.05, 3.14)
Affective Responsiveness	3.01 (2.97,3.05)
Affective Involvement	2.93 (2.88, 2.98)
Communication	2.93 (2.89, 2.96)
Roles	2.76 (2.73, 2.80)
Problem Solving	3.08 (3.04, 3.12)

Family functioning domain scores ranged from 1 to 4, with higher scores reflecting better family functioning. Table 6.5.3 shows that the family functioning domain roles had the lowest mean score (2.76) followed by affective involvement and communication, both having mean scores of 2.93; the remaining three domains all had mean scores above 3.

Table 6.5.4 Proportion of children in the study sub sample consuming sugary foods more than four times per day by age, sex, mother's ethnicity, mother's marital status, mother's education and Index of Multiple Deprivation

Variables (n)	**Frequency (%) consuming sugary foods more than 4 times per day**	**P value**
Age		
3 years (359)	59 (13%)	0.06
4 years (339)	63 (20%)	
Gender		
Male (356)	67 (19%)	0.17
Female (342)	55 (14%)	
Mother's ethnicity		
White (253)	29 (12%)	0.01
Asian (225)	62 (27%)	
Black (200)	28 (15%)	
Mixed/Other (20)	3 (17%)	
Mother's marital status		
Living alone (88)	16 (16%)	0.70
Living with a partner (567)	100 (17%)	
Previously married (43)	6 (11%)	
Mother's Education		
Lower (None, Secondary school, technical)(303)	74 (23%)	<0.001
Higher (A levels, university, postgraduate) (395)	48 (11%)	
Index of Multiple Deprivation		
Less deprived (1st, 2nd, 3rd quintile) (127)	16 (11%)	0.09
More deprived (4th and 5th quintile) (571)	106 (18%)	
All	122 (17%)	

The children in the sample consumed sugary foods an average of 2.4 times per day (95% CI: 2.23, 2.56), while 17% consumed sugary foods more than four times per day. Table 6.5.4 shows that in general the direction of the results were in line with what was expected from reviewing the literature. Although not significant, a higher proportion (20%) of four year olds consumed sugar compared to the younger age group (13%); similarly a higher proportion of males (19%) consumed sugar frequently

compared to females (14%). The proportion of children consuming sugar frequently differed significantly (p=0.01) between ethnic groups: the highest proportion were children with mothers of Asian ethnicity (27%), followed by mixed (17%) and Black (15%) ethnicities, the lowest proportion were children with White mothers (12%).

Regarding mother's marital status, there was no noticeable trend. The highest proportion of frequent sugar consumers were children whose mothers were married (19%), followed by single (16%), cohabiting, separated and divorced were similar (11%) and remarried was the least (8%); because only two children had mothers who were widowed this proportion was not considered. When re-categorised, similar proportions of children consumed sugary foods frequently when mothers were living alone (16%) or with a partner (17%), the lowest proportion of frequent sugar consumers (11%) had mothers who were previously married.

With reference to mother's education, higher proportions of children whose mothers had no qualification (24%), secondary school (21%) or technical qualification (29%) consumed sugar frequently compared to children whose mothers reported A level (12%), degree (15%) or postgraduate (4%) qualification: this difference in the proportions was significant (p=0.004). Dichotomising mother's education showed there was a significant (p<0.001) difference between the two groups, a higher proportion (23%) were frequent consumers when mothers had lower educational qualifications compared to when mothers reported a higher qualification (11%).

Regarding levels of deprivation, a lower proportion (11%) of children living in the less deprived areas (1st, 2nd and 3rd quintiles) consumed sugar frequently compared to 18% of children living in more deprived areas (4th and 5th quintiles), this difference was not statistically significant.

6.6 Unadjusted analysis

Table 6.6.1 Simple logistic regression models for the relationship between children's age, sex, mother's ethnicity, mother's marital status, mother's education and Index of Multiple Deprivation, and consumption of sugary foods more than four times per day by three and four year old children in the study sub sample

Variables (N=698)	***Odds Ratio (95% CI)***	***P value***
Age		
3 years	1	
4 years	1.58 (0.97,2.58)	0.07
Gender		
Male	1	
Female	0.70 (0.42,1.17)	0.17
Mother's Ethnicity		
White	1	
Asian	2.69 (1.53,4.74)	0.001
Black	1.29 (0.68,2.45)	0.43
Mixed/Other	1.43 (0.34,6.04)	0.63
Mother's marital status		
Living alone	1	
Living with a partner	1.09 (0.48,2.48)	0.83
Previously married	0.67 (0.19,2.36)	0.54
Mother's Education		
Lower (No, Secondary school, technical)	1	
Higher (A levels, university, postgraduate)	0.41 (0.25, 0.68)	0.001
IMD		
Less deprived (1^{st}, 2^{nd}, 3^{rd} quintile)	1	
More deprived (4^{th}, 5^{th} quintile)	1.87 (0.89, 3.90)	0.10

Table 6.6.1 shows although not significant, the trends for age, sex and IMD were in expected directions, with boys, older children (4 year olds) and children living in more deprived areas more likely to consume sugary foods frequently compared to girls, younger children (3 year olds) and children living in less deprived areas. Children with Asian mothers were significantly 2.69 times (95% CI: 1.53, 4.74) more likely to consume sugary foods frequently compared to children with White mothers. Children whose mothers were Black or Mixed/Other were 1.29 times (95% CI: 0.68, 2.45) and

1.43 times (95% CI: 0.34, 6.04) respectively, more likely than children with White mothers to consume sugary foods frequently, although this was not statistically significant. Regarding mother's education, children whose mothers reported higher education were significantly (p=0.001) 0.41 times (95% CI: 0.25,0.68) less likely to consume sugary foods frequently compared to children whose mothers reported lower qualifications.

Table 6.6.2 Simple logistic regression models for the association between family functioning in each of the six domains and consumption of sugary foods more than four times per day by children in the study sub sample

Family functioning domains (N=698)	***OR (95% CI)***	***P value***
Behaviour Control	0.20 (0.10,0.37)	<0.001
Affective Responsiveness	0.21 (0.11,0.38)	<0.001
Affective Involvement	0.27 (0.15,0.48)	<0.001
Problem Solving	0.28 (0.12,0.63)	0.002
Communication	0.24 (0.10,0.55)	0.001
Roles	0.19 (0.09,0.41)	<0.001

Table 6.6.2 shows that all six domains of family functioning, behaviour control, affective responsiveness, affective involvement, problem solving, communication and roles were highly significantly associated with frequent consumption of sugary foods by children, when not adjusted for any confounders. For each of these six domains of family functioning, the chances of frequent consumption of sugary foods by children decreased, as perceived family functioning scores increased or became more

effective. The domain roles assesses the repetitive patterns of behaviour by which family members fulfil their family duties. This was associated with the greatest reduction in children's chances of frequent sugar consumption, an 81% reduction, for every one unit increase in the roles score. This shows that children were less likely to consume sugary foods frequently when their mothers perceived effective role functioning characterised by high a domain score representing adequately fulfilled duties that were fairly allocated, compared to children whose mothers scored low in this domain indicating unfair role allocation and no accountability.

This was followed closely by an 80% reduction in children's chances of frequent consumption of sugary foods for every unit increase in the behaviour control score. This domain assesses the rules and standards in place for handling family members' behaviours. The analysis indicated that when mothers perceived effective behaviour control characterised by high scores, signifying flexible and reasonable family rules and standards, their children were less likely to consume sugary foods frequently compared to children whose mothers perceived rigid or chaotic family rules represented by low scores in this domain.

Similarly there was a 79% reduction in children's chances of frequent consumption of sugary foods for every unit increase in the affective responsiveness score, which assesses the ability of family members to respond emotionally. Thus indicating that when mothers reported more effective affective responsiveness, characterised by high scores showing that family members had the capacity to show appropriate emotional responses, their children were less likely to consume sugary foods frequently compared to children whose mothers reported absence of emotional response or over responsiveness represented by low scores in this domain.

Similarly when mothers reported more effective affective involvement, characterised by a real understanding of the needs of family members along with the ability to meet them, demonstrated by high scores in this domain, their children were less likely to consume sugary foods frequently compared to children whose mothers scored low demonstrating lack of involvement or over involvement.

Regarding the domain communication, when mothers scored high signifying effective communication characterised by clear and direct communication between family members, their children were less likely to consume sugary foods frequently compared to when communication was unclear and indirect, represented by low scores in this domain.

The domain problem solving, which assesses the ability of the family to resolve everyday problems, was associated with a 72% reduction in the chances of frequent sugar consumption for every unit increase in this score. Although the lowest of all the domains assessed, children were less likely to consume sugary foods frequently when mothers reported efficient functioning in this domain too, demonstrated by high scores signifying few unresolved family problems, compared to children whose mothers reported less systematic problem solving ability represented by low domain scores.

6.7 Hierarchical modelling

Hierarchical modelling using binary logistic regression analysis was done to assess the independent associations of the relevant variables with frequent consumption of sugary foods by three and four year old children. Variables were chosen based on results of the univariable analysis; variables significant at the 20% level (P≤0.2) were included in the modelling. Hierarchical modelling was used to test hypotheses 1 to 8.

6.7.1 Models with family functioning domain behaviour control

Table 6.7.1.1 Hierarchical logistic regression models for the association between socio-demographic variables and behaviour control, and the consumption of sugary foods more than four times per day by three and four year old children in the study sub sample

Variables	**Model 1** **OR (95% CI)**	**Model 2** **OR (95% CI)**	**Model 3** **OR (95% CI)**
Age: 3 years 4 years	1 1.49 (0.90, 2.49)	1 1.46 (0.87, 2.46)	1 1.52 (0.90,2.57)
Sex: Male Female	1 0.70 (0.41,1.18)	1 0.72 (0.42,1.23)	1 0.67 (0.38, 1.17)
Mother's Ethnicity: White Asian Black Mixed/Other	1 2.61 (1.48,4.61)*** 1.28 (0.68, 2.41) 1.43 (0.35, 5.86)	1 3.46 (1.63,5.25)*** 1.24 (0.73,2.66) 1.70 (0.42,6.12)	1 2.54 (1.30, 4.97)** 1.06 (0.54, 2.10) 1.44 (0.36,5.74)
IMD Less deprived More deprived		1 1.92 (0.89,4.14)	1 1.83 (0.87, 3.87)
Mother's Education: Lower education Higher education		1 0.35 (0.21,0.58)***	1 0.39 (0.23, 0.67)***
Behaviour Control			0.25 (0.11,0.57)***

* p≤0.05, **p≤0.01, ***p≤0.001

Model 1: Adjusted for age, sex and mother's ethnicity

Model 2: Adjusted for variables in Model 1 plus mother's education and IMD

Model 3: Adjusted for variables in Model 2 plus family behaviour control

Table 6.6.1 showed the unadjusted associations between the explanatory socio-demographic variables and the outcome. We can see from the adjusted models (1, 2 and 3) in table 6.7.1.1 that 4 year olds, males and children living in more deprived areas were still more likely than 3 year olds, females and children living in comparatively more affluent areas respectively, to consume sugary foods more than four times per day; although this difference was not significant in any of the models. Interestingly, when the domain behaviour control was added to the model (model 3), the OR for IMD decreased by 10%, hinting that the rules that families have in place to handle behaviour, where flexible behaviour control is the most effective, may account for a small part of this difference. Although $p>0.05$, because the real effect is likely to lie around the point estimate rather than at the ends of the confidence interval, we consider such results meaningful, especially for theory building, but are cautious in their interpretation (Hackshaw and Kirkwood,2011).

With regard to mother's ethnicity, similar to the unadjusted model (table 6.6.1) there were differences in sugar consumption frequency between the ethnic groups, although only the difference between children with Asian mothers and White mothers was significant ($p<0.001$). When adjusted for age and sex (model 1) the ORs remained similar. The Asian group were more than twice as likely (OR 2.61; 95% CI: 1.48, 4.61) to consume sugary foods frequently compared to children with White mothers. This association increased to over three times (OR 3.46; 95% CI: 1.63, 5.25) and remained significant ($p<0.001$) after mother's education and IMD were added to the model (model 2), indicating that mother's education may be a suppressor in this

relationship. On the other hand, adjusting for behaviour control (model 3) partially attenuated this ethnic difference by 37% (OR 2.54; 95%CI: 1.30, 4.97). This demonstrated that family behaviour control, which is the manner in which a family handles different types of behaviour and where effective functioning is demonstrated by family rules that are reasonable and flexible, may mediate the relationship between mother's ethnicity and children's sugar consumption frequency. Mediation is tested in the next section. An attenuation in the OR was also seen in relation to the Black and Mixed/Other ethnic groups, although these differences were not statistically significant in any of the models.

It is apparent from the unadjusted analysis in the previous section (Table 6.6.1) that mother's education had a protective effect on children's frequent consumption of sugary foods. Table 6.7.1.1 shows that this association became even more protective when age, sex, ethnicity and IMD were adjusted for (model 2). Children whose mothers had a higher qualification were significantly 0.35 times (95% CI: 0.21, 0.58) less likely to consume sugary foods frequently compared to children whose mothers reported lower qualifications, thus supporting hypothesis 8. This protective association decreased by 6% when family behaviour control was added to the model (Table 6.7.1.1). This indicates that some part of this association between mother's education and children's sugar consumption is potentially mediated through family behaviour control. This is the manner in which the family handles different types of behaviour and where effective functioning is demonstrated by family rules that are reasonable and flexible. Mediation is tested in the next section.

The previous unadjusted model (Table 6.6.2) showed that children were least likely to consume sugary foods more than four times per day when mothers reported effective behaviour control characterised by high scores signifying flexible and reasonable

family rules and standards, compared to children whose mothers reported rigid or chaotic family rules represented by low scores in this domain. This relationship remained after controlling for potential confounders (Table 6.7.1.1, model 3) and was highly significant in both unadjusted and adjusted models. Thus showing that family rules that are reasonable and flexible provides a more favourable environment that protects against the consumption of sugary foods more than four times per day by three and four year old children, compared to a less favourable environment created when family rules are rigid or chaotic. This relationship was independent of demographic, socioeconomic and environmental influences, thereby supporting hypothesis 1.

6.7.2 Models with family functioning domain affective responsiveness

Table 6.7.2.1 Hierarchical logistic regression models for the association between socio-demographic variables and affective responsiveness, and the consumption of sugary foods more than four times per day by three and four year old children in the study sub sample

Variables	**Model 1** **OR (95% CI)**	**Model 2** **OR (95% CI)**	**Model 3** **OR (95% CI)**
Age: 3 years 4 years	1 1.49 (0.90, 2.49)	1 1.46 (0.87, 2.46)	1 1.55 (0.91,2.63)
Sex: Male Female	1 0.70 (0.41,1.18)	1 0.72 (0.42,1.23)	1 0.69 (0.40, 1.20)
Mother's Ethnicity: White Asian Black Other	1 2.61(1.48,4.61)*** 1.28 (0.68, 2.41) 1.43 (0.35, 5.86)	1 3.46 (1.63,5.25)*** 1.24 (0.73,2.66) 1.70 (0.42,6.12)	1 2.68 (1.40, 5.13)** 1.03 (0.52, 2.06) 1.51 (0.37,6.21)
IMD Less deprived More deprived		1 1.92 (0.89,4.14)	1 1.85 (0.86,3.99)
Mother's Education: Lower education Higher education		1 0.35 (0.21,0.58)***	1 0.43 (0.24,0.74)**
Affective responsiveness			0.29 (0.14,0.58)***

* p≤0.05, **p≤0.01, ***p≤0.001

Model 1: Adjusted for age, sex and mother's ethnicity

Model 2: Adjusted for variables in Model 1 plus mother's education and IMD

Model 3: Adjusted for variables in Model 2 plus family affective responsiveness

Table 6.7.2.1 shows that addition of the domain affective responsiveness to the model (model 3) resulted in an 8% decrease in the OR for IMD, indicating that the

manner in which family members respond to emotional stimuli may account for a small part of the difference between levels of deprivation, although this difference was not statistically significant in any of the models.

Table 6.7.2.1 shows that the nearly three and a half times (OR 3.46; 95%CI: 1.63, 5.25) increased likelihood of frequent sugary food consumption by children with Asian mothers compared to children with White mothers (model 2), was reduced by 32% (OR 2.68; 95% CI: 1.40, 5.13) after adjusting for the manner in which family members respond to emotional stimuli, where effective affective responsiveness is demonstrated by the capacity of members to respond with the appropriate quantity and quality of emotion. This was a slightly smaller degree of attenuation than was seen after controlling for the manner in which the family handles different types of behaviour (Table 6.7.1.1). This attenuation in the OR was also seen in relation to the Black and Mixed/Other ethnic groups, although these differences were not statistically significant in any of the models. Therefore, family affective responsiveness may also explain a part of the difference between the White and Asian ethnicities, by mediating the effect of mother's ethnicity on children's sugar consumption frequency and is assessed in the next section.

Regarding mother's education, Table 6.7.2.1 shows that the significant protective relationship between mother's higher education and decreased chances of consumption of sugary foods more than four times per day by children, compared to mothers with lower qualifications (OR 0.35; 95% CI: 0.21, 0.58; model 2), was attenuated by 12% (OR 0.43; 95% CI: 0.24, 0.74) when adjusted for family affective responsiveness (model 3). This was the largest degree of attenuation compared to the other five domains, indicating that the manner in which family members respond to emotional stimuli, where effective affective responsiveness is demonstrated by the

capacity of family members to respond with the appropriate quantity and quality of feeling, may mediate the relationship between mother's education and children's sugar consumption frequency. Mediation is assessed in the next section.

The unadjusted model in Table 6.6.2 showed that children's chances of consuming sugary foods more than four times per day decreased by 79% for every unit increase in the affective responsiveness score demonstrating that when mothers perceived more effective affective responsiveness, characterised by high scores, showing that family members had the capacity to show appropriate emotional responses, their children were less likely to consume sugary foods frequently compared to children whose mothers reported absence of emotional response or over responsiveness represented by low scores in this domain. Similarly, Table 6.7.2.1 shows that children's chances of consuming sugary foods more than four times per day decreased by 71% for every unit increase in the affective responsiveness score after controlling for potential confounders, this association remained highly significant ($p<0.001$). Thus showing that the ability of family members to respond emotionally to a given stimulus with an appropriate quality and quantity of feelings, provides a more favourable environment that protects against the consumption of sugary foods more than four times per day by three and four year old children compared to when mothers report absence of emotional response or over responsiveness. This relationship was independent of demographic, socioeconomic and environmental influences, providing support for hypothesis 2.

6.7.3 Models with family functioning domain affective involvement

Table 6.7.3.1 Hierarchical logistic regression models for the association between socio-demographic variables and affective involvement, and the consumption of sugary foods more than four times per day by three and four year old children in the study sub sample

Variables	**Model 1** **OR (95% CI)**	**Model 2** **OR (95% CI)**	**Model 3** **OR (95% CI)**
Age: 3 years 4 years	1 1.49 (0.90, 2.49)	1 1.46 (0.87, 2.46)	1 1.49 (0.88,2.53)
Sex: Male Female	1 0.70 (0.41,1.18)	1 0.72 (0.42,1.23)	1 0.69 (0.39, 1.21)
Mother's Ethnicity: White Asian Black Other	1 2.61(1.48,4.61)*** 1.28 (0.68, 2.41) 1.43 (0.35, 5.86)	1 3.46 (1.63,5.25)*** 1.24 (0.73,2.66) 1.70 (0.42,6.12)	1 3.04 (1.61, 5.73)*** 1.19 (0.61, 2.35) 1.86 (0.48, 7.20)
IMD Less deprived More deprived		1 1.92 (0.89,4.14)	1 1.90 (0.89, 4.05)
Mother's Education: Lower education Higher education		1 0.35 (0.21,0.58)***	1 0.39 (0.22, 0.67)***
Affective involvement			0.32 (0.17,0.60)***

* p≤0.05, **p≤0.01, ***p≤0.001

Model 1: Adjusted for age, sex and mother's ethnicity

Model 2: Adjusted for variables in Model 1 plus mother's education and IMD

Model 3: Adjusted for variables in Model 2 plus family affective involvement

Table 6.7.3.1 shows that controlling for the emotional connection between family members assessed by the domain affective involvement, decreased the OR for IMD by 2%; less than that seen after controlling for the previous two domains, behaviour control and affective responsiveness (Table 6.7.1.1 and 6.7.2.1, model 3).

With reference to mother's ethnicity, Table 6.7.3.1 shows that the nearly three and a half times (OR 3.46; 95%CI: 1.63,5.25) increased likelihood of frequent sugary food consumption by children with Asian mothers compared to children with White mothers (model 2), was reduced by 17% (OR 3.04; 95% CI: 1.61, 5.73) after adjusting for the emotional involvement between family members assessed by the domain affective involvement (model 3), where effective functioning is demonstrated by a real understanding of the needs of family members along with the ability to meet these needs. This was a smaller degree of attenuation than was observed after controlling for behaviour control and affective responsiveness (Table 6.7.1.1 and 6.7.2.1, model 3) but greater than the attenuation seen after controlling for the domains problem solving, communication and roles (Tables 6.7.4.1, 6.7.5.1 and 6.7.6.1, model 3). This attenuation in the OR was also seen in relation to the Black and Mixed/Other ethnic groups, although these differences were not statistically significant in any of the models. This Indicates that family affective involvement may explain part of the difference between the White and Asian ethnicities, by mediating the effect of mother's ethnicity on children's sugar consumption frequency and is assessed in the next section.

Table 6.7.3.1 also shows in reference to mother's education, that the significant protective relationship between mother's higher education and decreased chances of frequent consumption of sugary foods by children, compared to mothers with lower qualifications (OR 0.35; 95% CI: 0.21, 0.58; model 2), was attenuated by 6% (OR

0.39; 95% CI: 0.22, 0.67) when adjusted for the emotional involvement between family members assessed by the domain affective involvement, where effective functioning is demonstrated by a real understanding of the needs of family members along with the ability to meet them (model 3); the same degree of attenuation as seen in Table 6.7.1.1 after adjusting for the domain behaviour control. This suggests that family affective involvement may mediate the association between mother's education and children's consumption of sugary foods more than four times per day. This is assessed in the next section.

Similar to the domains behaviour control and affective responsiveness, when mothers reported more effective affective involvement characterised by empathetic involvement demonstrated by high scores in this domain, children were less likely to consume sugary foods frequently compared to when mothers scored low demonstrating lack of involvement or over involvement. Children's chances of consuming four or more sugary foods per day decreased by 68% (95% CI: 0.17, 0.60) for every unit increase in the affective involvement score, after controlling for potential confounders (Table 6.7.3.1); in the unadjusted model it was 73% (Table 6.6.2). Demonstrating that a real understanding of the needs of family members along with the ability to meet them creates a more favourable environment that protects against the consumption of sugary foods more than four times per day by three and four year old children, compared to when family members respond inappropriately. This relationship was independent of demographic, socioeconomic and environmental influences, thus supporting hypothesis 3.

6.7.4 Models with family functioning domain problem solving

Table 6.7.4.1 Hierarchical logistic regression models for the association between socio-demographic variables and problem solving, and the consumption of sugary foods more than four times per day by three and four year old children in the study sub sample

Variables	**Model 1** **OR (95% CI)**	**Model 2** **OR (95% CI)**	**Model 3** **OR (95% CI)**
Age: 3 years 4 years	1 1.49 (0.90, 2.49)	1 1.46 (0.87, 2.46)	1 1.49 (0.89,2.49)
Sex: Male Female	1 0.70 (0.41,1.18)	1 0.72 (0.42,1.23)	1 0.72 (0.42, 1.22)
Mother's Ethnicity: White Asian Black Other	1 2.61(1.48,4.61)*** 1.28 (0.68, 2.41) 1.43 (0.35, 5.86)	1 3.46 (1.63,5.25)*** 1.24 (0.73,2.66) 1.70 (0.42,6.12)	1 3.15 (1.67, 5.93)*** 1.21 (0.63, 2.36) 1.47 (0.40, 5.37)
IMD Less deprived More deprived		1 1.92 (0.89,4.14)	1 1.88 (0.88,4.02)
Mother's Education: Lower education Higher education		1 0.35 (0.21,0.58)***	1 0.38 (0.22,0.66)***
Problem solving			0.44 (0.18,1.09)

* p≤0.05, **p≤0.01, ***p≤0.001

Model 1: Adjusted for age, sex and mother's ethnicity

Model 2: Adjusted for variables in Model 1 plus mother's education and IMD

Model 3: Adjusted for variables in Model 2 plus family problem solving

Table 6.7.4.1 shows that addition of the domain problem solving, which assesses the manner in which families resolve problems, to the model resulted in an attenuation in the OR for IMD by 4%. A smaller degree of attenuation than was observed for the models with the domains behaviour control and affective responsiveness (Tables 6.7.1.1 and 6.7.2.1), similar to the other models this relationship was not statistically significant.

Table 6.7.4.1 shows that with reference to mother's ethnicity, the nearly three and a half times (OR 3.46; 95%CI: 1.63, 5.25) increased likelihood of frequent sugary food consumption by children with Asian mothers compared to children with White mothers (model 2), was reduced by 13% (OR 3.15; 95% CI: 1.67, 5.93) after adjusting for the domain problem solving which assesses the ability of the family to resolve their problems (model 3). A smaller degree of attenuation than was observed with the domains behaviour control, affective responsiveness and affective involvement (Table 6.7.1.1, 6.7.2.1 and 6.7.3.1 model 3). This attenuation in the OR was also seen in relation to the Black and Mixed/Other ethnic groups, although these differences were not statistically significant in any of the models. Problem solving, like the previous three domains, may explain part of the difference between the White and Asian ethnicities, by mediating the effect of mother's ethnicity on children's sugar consumption frequency, and is assessed in the next section.

Table 6.7.4.1 also shows that the significant protective relationship between mother's with higher education and decreased chances of frequent consumption of sugary foods by children, compared to mothers with lower qualifications (OR 0.35; 95% CI: 0.21, 0.58; model 2), was attenuated by 5% (OR 0.38; 95% CI: 0.22, 0.66) when adjusted for the domain problem solving (model 3). This was less attenuation than seen with the other domains suggesting that problem solving, which is the manner in

which families resolve their problems and where effective functioning is demonstrated by few or no unresolved problems within the family, may play a smaller role in this relationship than the other five domains. The potential mediating effect of family problem solving ability in the relationship between mother's education and children's sugar consumption frequency is assessed in the next section.

Table 6.7.4.1 shows that after adjusting for potential confounders, the manner in which a family resolves its problems was not significantly associated with frequent sugar consumption by children, although the direction of the relationship was the same as the previous three domains and this association (OR 0.28; 95% CI: 0.12, 0.63) was significant in the unadjusted model (Table 6.6.2). This suggests that after controlling for demographic, socioeconomic and environmental influences, a family's ability to resolve problems may not independently influence the consumption of sugary foods more than four times per day by three and four year old children. This finding refutes hypothesis 4.

6.7.5 Models with family functioning domain communication

Table 6.7.5.1 Hierarchical logistic regression models for the association between socio-demographic variables and communication, and the consumption of sugary foods more than four times per day by three and four year old children in the study sub sample

Variables	**Model 1** **OR (95% CI)**	**Model 2** **OR (95% CI)**	**Model 3** **OR (95% CI)**
Age: 3 years 4 years	1 1.49 (0.90, 2.49)	1 1.46 (0.87, 2.46)	1 1.53 (0.92,2.57)
Sex: Male Female	1 0.70 (0.41,1.18)	1 0.72 (0.42,1.23)	1 0.70 (0.40, 1.21)
Mother's Ethnicity: White Asian Black Other	1 2.61(1.48,4.61)*** 1.28 (0.68, 2.41) 1.43 (0.35, 5.86)	1 3.46 (1.63,5.25)*** 1.24 (0.73,2.66) 1.70 (0.42,6.12)	1 3.08 (1.64, 5.80)*** 1.27 (0.66, 2.45) 1.58 (0.42, 5.95)
IMD Less deprived More deprived		1 1.92 (0.89,4.14)	1 1.93 (0.92, 4.05)
Mother's Education: Lower education Higher education		1 0.35 (0.21,0.58)***	1 0.39 (0.23, 0.67)***
Communication			0.34 (0.14,0.85)*

* p≤0.05, **p≤0.01, ***p≤0.001

Model 1: Adjusted for age, sex and mother's ethnicity

Model 2: Adjusted for variables in Model 1 plus mother's education and IMD

Model 3: Adjusted for variables in Model 2 plus family communication

Table 6.7.5.1 shows that addition of the domain communication, which assesses the verbal exchange of information between family members, to the model resulted in a very minor (1%) attenuation in the OR for IMD, the smallest degree of attenuation seen with any of the family functioning domains.

With reference to mother's ethnicity, Table 6.7.5.1 shows that the nearly three and a half times (OR 3.46; 95%CI: 1.63,5.25) increased likelihood of frequent sugary food consumption by children with Asian mothers compared to children with White mothers (model 2), was reduced by 15% (OR 3.08; 95% CI: 1.64, 5.80) after adjusting for the domain communication (model 3) which assesses the verbal exchange of information between family members, where effective communication is demonstrated by clear and direct exchange of information between family members. A smaller degree of attenuation than was observed in the models incorporating the domains behaviour control, affective responsiveness and affective involvement (Table 6.7.1.1, 6.7.2.1, 6.7.3.1, model 3). This attenuation in the OR was also seen in relation to the Mixed/Other ethnic groups but not the Black group (slight increase in the OR), although these differences were not statistically significant in any of the models. This domain, like the previous four, may partially mediate the association between mother's ethnicity and children's consumption of sugary foods more than four times per day and is tested in the next section.

Table 6.7.5.1 also shows that the significant protective relationship between mother's with higher education and decreased chances of frequent consumption of sugary foods by children, compared to mothers with lower qualifications (OR 0.35; 95% CI: 0.21, 0.58; model 2), was attenuated by 6% (OR 0.39; 95% CI: 0.23, 0.67) when adjusted for the domain communication which assesses the verbal exchange of information between family members, where effective communication is demonstrated

by clear and direct exchange of information between family members (model 3). The same degree of attenuation as was seen in the models with behaviour control and affective involvement (Table 6.7.1.1 and 6.7.3.1). Indicative of the mediating role of family communication in the association between mother's education and children's sugar consumption frequency. This is assessed in the next section.

In the previous section Table 6.6.2 showed that children's chances of consuming sugary foods more than four times per day decreased by 76% for every unit increase in the communication score and this was highly significant (p=0.001). Table 6.7.5.1 shows that in the fully adjusted model (model 3), children's chances of frequent sugar consumption decreased by 66% (95% CI: 0.14, 0.85) for every unit increase in the communication score and the level of significance reduced to 0.02. Thus showing that when mothers scored high in this domain signifying effective communication, characterised by clear and direct communication between family members, their children were least likely to consume sugary foods frequently compared to when communication was unclear and indirect represented by low scores in this domain. Therefore, clear, open and direct communication between members, provides a favourable environment that protects against the consumption of sugary foods more than four times per day by three and four year old children, compared to a less favourable environment created when communication between family members is masked and indirect. This relationship was independent of demographic, socioeconomic and environmental influences, thus supporting hypothesis 5.

6.7.6 Models with family functioning domain roles

Table 6.7.6.1 Hierarchical logistic regression models for the association between socio-demographic variables and roles, and the consumption of sugary foods more than four times per day by three and four year old children in the study sub sample

Variables	**Model 1 OR (95% CI)**	**Model 2 OR (95% CI)**	**Model 3 OR (95% CI)**
Age: 3 years 4 years	1 1.49 (0.90, 2.49)	1 1.46 (0.87, 2.46)	1 1.52 (0.90,2.56)
Sex: Male Female	1 0.70 (0.41,1.18)	1 0.72 (0.42,1.23)	1 0.68 (0.40, 1.18)
Mother's Ethnicity: White Asian Black Other	1 2.61(1.48,4.61)*** 1.28 (0.68, 2.41) 1.43 (0.35, 5.86)	1 3.46 (1.63,5.25)*** 1.24 (0.73,2.66) 1.70 (0.42,6.12)	1 3.33 (1.83, 6.04)*** 1.25 (0.64, 2.43) 1.69 (0.38, 7.60)
IMD Less deprived More deprived		1 1.92 (0.89,4.14)	1 1.82 (0.85,3.89)
Mother's education: Lower education Higher education		1 0.35 (0.21,0.58)***	1 0.40 (0.23,0.68)***
Roles			0.22 (0.08,0.62)**

* p≤0.05, **p≤0.01, ***p≤0.001

Model 1: Adjusted for age, sex and mother's ethnicity

Model 2: Adjusted for variables in Model 1 plus mother's education and IMD

Model 3: Adjusted for variables in Model 2 plus family roles

Table 6.7.6.1 shows that addition of the domain roles, which assesses the repetitive patterns of behaviour by which family members fulfil their family obligations, to the model (model 3) resulted in a 11% decrease in the OR for IMD, more than the

reduction seen with any of the other five domains. Therefore, roles may account for part of the difference between levels of deprivation, although this difference was not statistically significant in any of the models.

Table 6.7.6.1 shows that with reference to mother's ethnicity, the nearly three and a half times (OR 3.46; 95%CI: 1.63,5.25) increased likelihood of frequent sugary food consumption by children with Asian mothers compared to children with White mothers (model 2), was reduced by 5% (OR 3.33; 95% CI: 1.83, 6.04) after adjusting for the domain roles (model 3), a much smaller degree of attenuation than was seen with each of the other five domains. This domain assesses the repetitive patterns of behaviour by which family members fulfil their family obligations and effective role functioning is characterised by adequately fulfilled duties that are fairly allocated. This domain, like the previous five, may partially mediate the association between mother's ethnicity and children's consumption of sugary foods more than four times per day and is tested in the next section.

Regarding mother's education, table 6.7.6.1 shows that the significant protective relationship between mother's higher education and decreased chances of frequent consumption of sugary foods by children compared to mothers with lower education, secondary school or technical qualifications (OR 0.35; 95% CI: 0.21, 0.58; model 2) was attenuated by 8% (OR 0.40; 95% CI: 0.23, 0.68) when adjusted for the domain roles (model 3) which assesses the repetitive patterns of behaviour by which family members fulfil their family duties. Effective role functioning is characterised by adequately fulfilled duties that are fairly allocated. Again indicative of a possible mediating effect of family roles in the relationship between mother's education and children's consumption of sugary foods more than four times per day, which is assessed in the next section.

In the fully adjusted model, children's chances of consuming sugary foods frequently decreased by 78% (95% CI: 0.08, 0.62) for every unit increase in the roles score, in the unadjusted model it was 81% (Table 6.6.1). This shows that when mothers perceived effective role functioning characterised by high scores representing adequately fulfilled duties that were fairly allocated, children were less likely to consume sugary foods frequently compared to children whose mothers reported unfair role allocation and no accountability represented by low scores in this domain. The odds ratio for the domain roles, in the fully adjusted model, was lower than for any of the other family function domains tested, making family environments with clearly defined roles and responsibilities for family members highly protective against the consumption of sugary foods more than four times per day by three and four year old children, independent of demographic, socioeconomic and environmental influences. Thereby supporting hypothesis 6.

6.8 Mediation analysis

One of the assumptions for mediation analysis is that there is temporal precedence; the independent variable must precede the mediation variable, else it is difficult to establish whether X leads to M or M to X, to influence Y. Owing to the cross-sectional design of this study we can only infer temporality based on theory. In the majority of instances education precedes motherhood and starting a family, therefore we propose that family functioning could mediate the relationship between mother's education and sugar consumption by children. On the other hand, it is straightforward to infer temporal precedence with reference to mother's ethnicity.

Mediation analysis was used to test hypotheses 9 to 14. Mediation analysis was not conducted with reference to deprivation (hypothesis 15) because there was no significant association between IMD and consumption of sugary foods by children in the study sample.

6.8.1 Family functioning domains as mediators in the relationship between mother's education and frequent consumption of sugary foods by children

Mediation was assessed according to the four steps proposed by Baron and Kenny (1986). Partial mediation was supported if steps 1 to 3 were fulfilled and complete mediation was indicated if step 4 was also supported. The steps were as follows:

Step 1: Significant association between mother's education and frequent consumption of sugary foods by children, path c

Step 2: Significant association between mother's education and the family functioning domain, path a

Step 3: Significant association between the family functioning domain and frequent consumption of sugary foods by children, adjusting for mother's education, path b

Step 4: Non significant association between mother's education and frequent consumption of sugary foods by children, after controlling for the family functioning domain, path c'

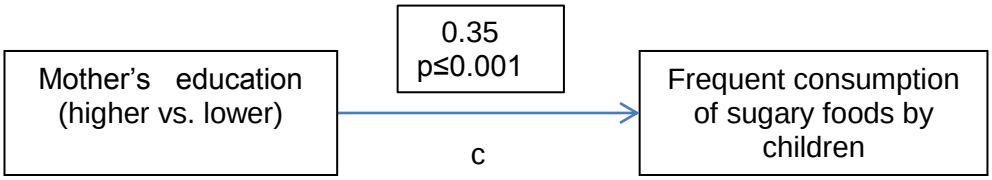


Figure 6.8.1.1 Total effects (Step 1, path c)

Figure 6.8.1.1 shows the total effect, which is the association between mother's education and frequent consumption of sugary foods by children without controlling for the proposed mediator family functioning, it corresponds to step 1, path c. Path c is common for all of the six domains tested. This study shows that children whose mothers have a higher level of education are significantly 0.35 times less likely to consume sugary foods frequently compared to children whose mothers have a lower educational qualification. The following sections will assess whether mother's higher education improves family functioning in each of the six domains and if this in turn makes children less likely to consume sugary foods more than four times per day.

6.8.1.1 Behaviour control

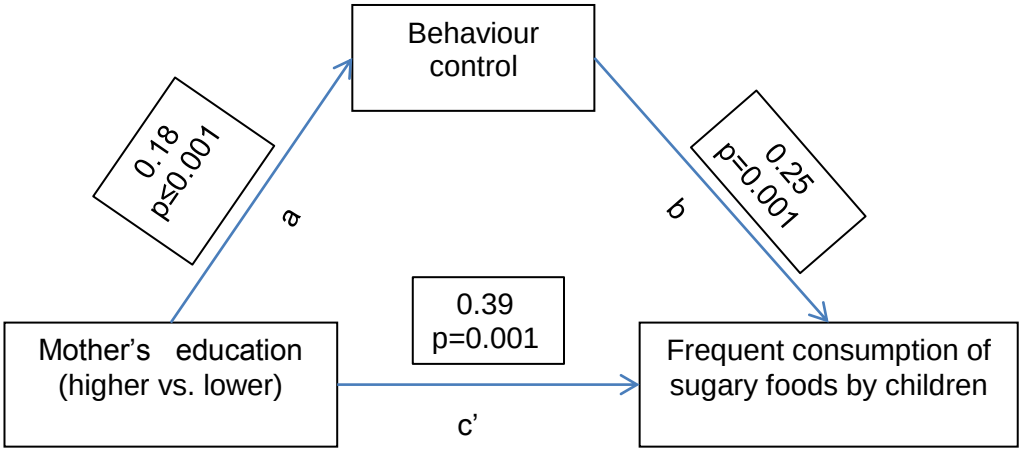


Figure 6.8.1.1.1 Behaviour control as a mediator in the relationship between mother's education and frequent consumption of sugary foods by children

Figures 6.8.1.1 and 6.8.1.1.1 show that steps 1 (path c), 2 (path a) and 3 (path b) were supported in this study sample but step 4 (path c') was not supported as the association between mother's education and children's sugar consumption frequency remained significant even after controlling for the domain behaviour control, although a 6% attenuation in the relationship was observed. This indicates that the family functioning domain behaviour control, which assesses the rules and standards that the family adopts to control the behaviour of its members, partially mediates the relationship between mother's education and the frequent consumption of sugary foods by children. Figure 6.8.1.1.1 shows that mother's higher education compared to a lower level of education, improves the family's ability to have flexible family rules to regulate family behaviour, resulting in children being less likely to consume sugary foods more than four times per day. Thereby supporting hypothesis 9.

6.8.1.2 *Affective responsiveness*

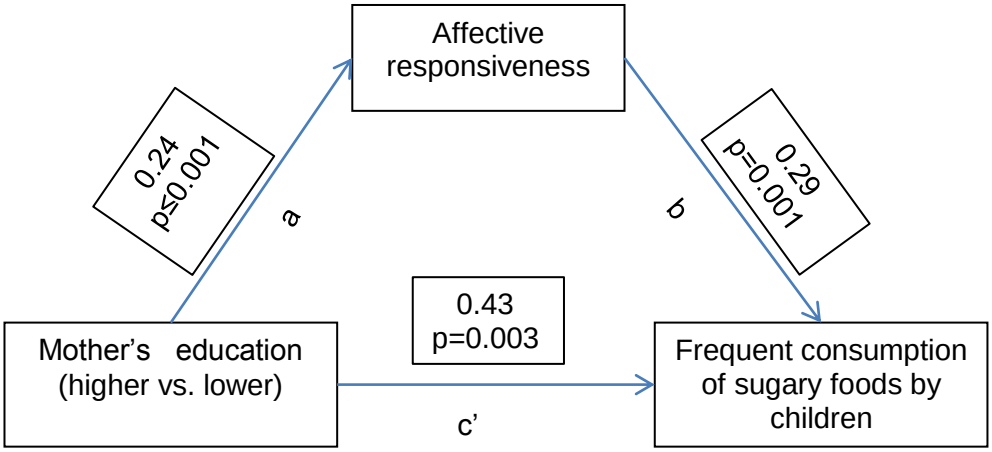


Figure 6.8.1.2.1 Affective responsiveness as a mediator in the relationship between mother's education and frequent consumption of sugary foods by children

Figures 6.8.1.1 and 6.8.1.2.1 show that steps 1 (path c), 2 (path a) and 3 (path b) were supported in this study sample but step 4 (path c') was not supported as the association between mother's education and children's sugar consumption frequency remained significant, even after controlling for the domain affective responsiveness, although a 12% attenuation in the relationship was observed. This indicates that the family functioning domain affective responsiveness, which assesses the family's potential to respond emotionally, partially mediates the relationship between mother's education and the frequent consumption of sugary foods by children. Figure 6.8.1.2.1 shows that mother's higher education compared to a lower level of education, improves the family's ability to respond to a given stimulus with the appropriate quality and quantity of feelings, resulting in emotional stability in the family environment making children less likely to consume sugary foods more than four times per day. Thus supporting hypothesis 10.

6.8.1.3 Affective involvement

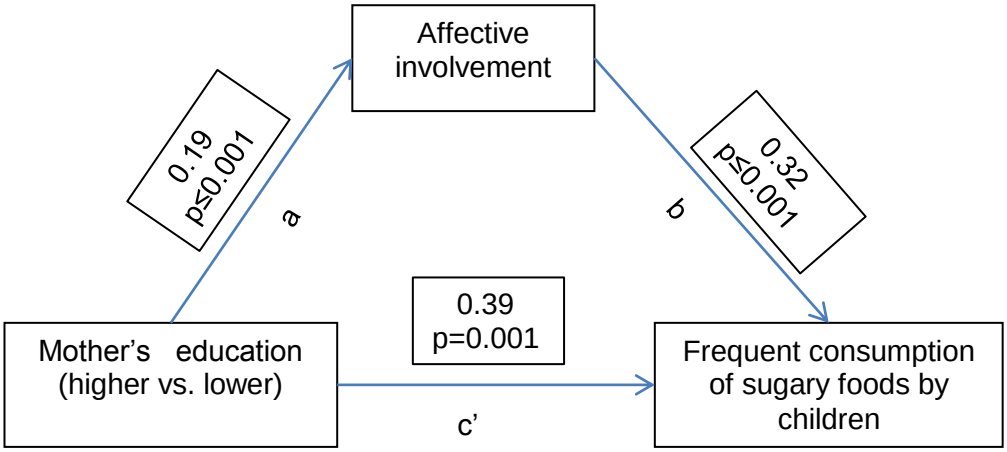


Figure 6.8.1.3.1 Affective involvement as a mediator in the relationship between mother's education and frequent consumption of sugary foods by children

Figures 6.8.1.1 and 6.8.1.3.1 show that steps 1 (path c), 2 (path a) and 3 (path b) were supported in this study sample but step 4 (path c') was not supported as the significant association between mother's education and children's sugar consumption frequency remained even after controlling for the domain affective involvement, although a 6% attenuation in the relationship was observed. This indicates that the family functioning domain affective involvement, which assesses the family's ability to understand and value the needs and interests of its members, partially mediates the relationship between mother's education and the frequent consumption of sugary foods by children. This points towards mother's higher education compared to a lower level of education, improving the family's ability to gain a real understanding of the needs of family members along with improving the ability to meet these needs. This thereby creates favourable emotional bonds that will result in children being less likely to consume sugary foods more than four times per day, thus supporting hypothesis 11.

6.8.1.4 Problem solving

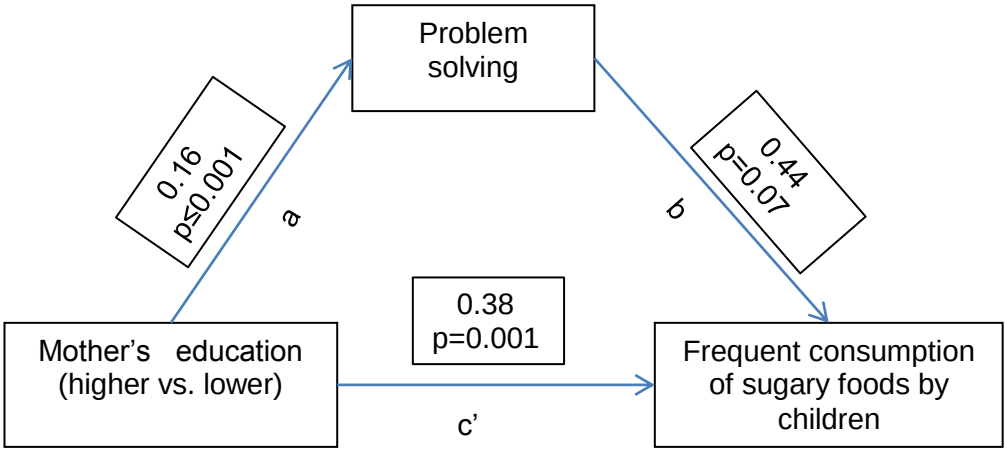


Figure 6.8.1.4.1 Problem solving as a mediator in the relationship between mother's education and frequent consumption of sugary foods by children

Figures 6.8.1.1 and 6.8.1.4.1 show that steps 1 (path c) and 2 (path a) were supported in this study sample, but steps 3 (path b) and 4 (path c') were not supported as there was no significant relationship between the domain problem solving and the frequent consumption of sugary foods by children once mother's education was controlled for (path b), and the association between mother's education and children's sugar consumption frequency remained significant even after controlling for the domain problem solving (path c'), although a 5% attenuation in the relationship was observed. This indicates that the family functioning domain problem solving which assesses the family's ability to resolve problems, does not mediate the relationship between mother's education and the frequent consumption of sugary foods by children. Figure 6.8.1.4.1shows that although mother's higher education improves the family's ability to resolve problems encountered as part of the family's life cycle, we are unable to make inferences about the mediating role of this domain because it is not statistically significantly associated with children's sugar consumption, after controlling for mother's education. Thus refuting hypothesis 12.

6.8.1.5 Communication

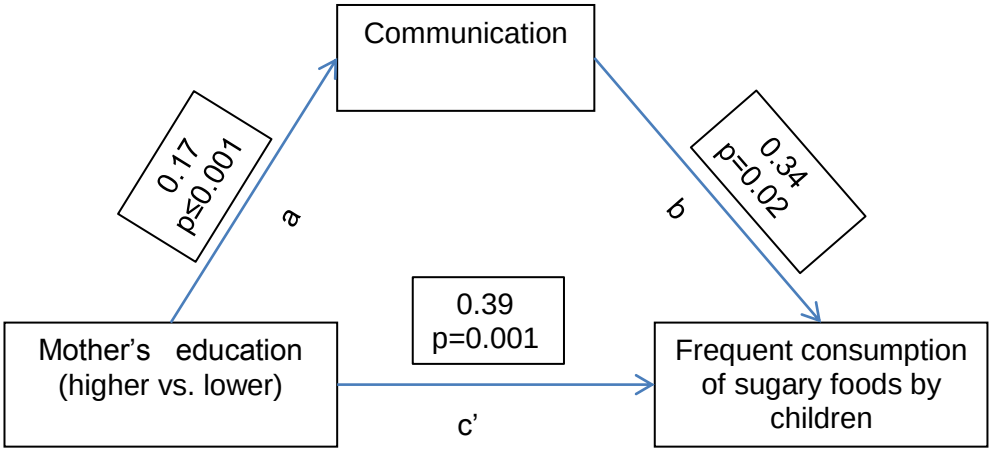


Figure 6.8.1.5.1 Communication as a mediator in the relationship between mother's education and frequent consumption of sugary foods by children

Figures 6.8.1.1 and 6.8.1.5.1 show that steps 1 (path c), 2 (path a) and 3 (path b) were supported in this study sample but step 4 (path c') was not supported as the significant association between mother's education and children's sugar consumption frequency remained even after controlling for the domain communication, although a 6% attenuation in the relationship was observed. Therefore, the family functioning domain communication, which assesses the verbal exchange of information between family members, partially mediates the relationship between mother's education and the frequent consumption of sugary foods by children. Figure 6.8.1.5.1 shows that mother's higher education compared to a lower level of education, fosters clear, open and direct communication between family members resulting in children being less likely to consume sugary foods more than four times per day, thereby supporting hypothesis 13.

6.8.1.6 Roles

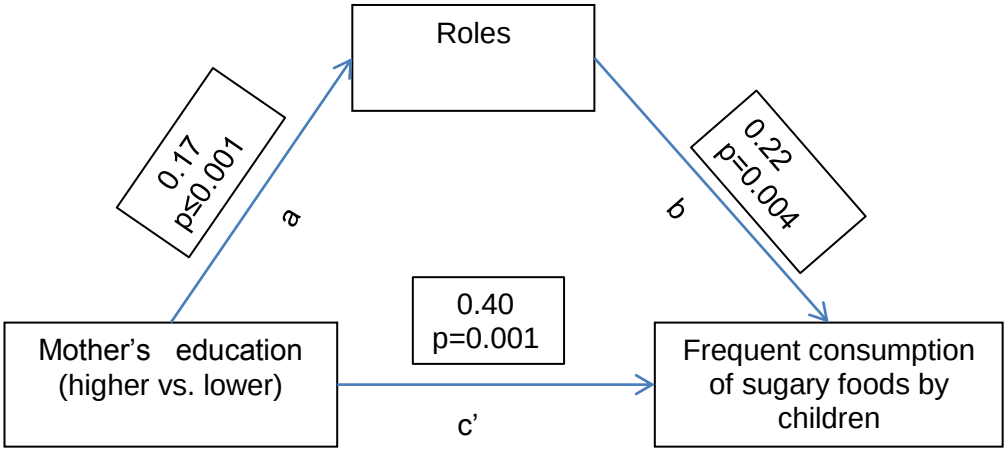


Figure 6.8.1.6.1 Roles as a mediator in the relationship between mother's education and frequent consumption of sugary foods by children

Figures 6.8.1.1 and 6.8.1.6.1 show that steps 1 (path c), 2 (path a) and 3 (path b) were supported in this study sample but step 4 (path c') was not supported as the significant association between mother's education and children's sugar consumption frequency remained even after controlling for the domain roles, although an 8% attenuation in the relationship was observed. This indicates that the family functioning domain roles, which assess the repetitive patterns of behaviour by which family members fulfil their family duties, partially mediates the relationship between mother's education and the frequent consumption of sugary foods by children. Figure 6.8.1.6.1 shows that mother's higher education compared to a lower level of education enables the family to have clearly defined roles and responsibilities for its members resulting in children being less likely to consume sugary foods more than four times per day. Thus supporting hypothesis 14.

6.8.2 Family functioning domains as mediators of the relationship between mother's ethnicity and frequent consumption of sugary foods by children

Mediation was assessed according to the four steps proposed by Baron and Kenny (1986). Partial mediation was supported if steps 1 to 3 were fulfilled and complete mediation was indicated if step 4 was also supported. The steps were as follows:

Step 1: Significant association between mother's ethnicity and frequent consumption of sugary foods by children, path c

Step 2: Significant association between mother's ethnicity and the family functioning domain, path a

Step 3: Significant association between the family functioning domain and frequent consumption of sugary foods by children, adjusting for mother's ethnicity, path b

Step 4: Non significant association between mother's ethnicity and frequent consumption of sugary foods by children, after controlling for the family functioning domain, path c'

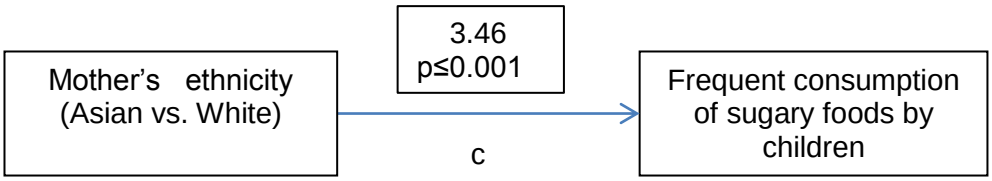


Figure 6.8.2.1 Total effects (Step 1, path c)

Figure 6.8.2.1 shows the total effect which is the association between mother's ethnicity and frequent consumption of sugary foods by children, without controlling for the proposed mediator family functioning, it corresponds to step 1, path c and is common for all the six domains tested. This shows that children whose mothers were of Asian ethnicity were nearly three and a half times more likely to consume sugary foods frequently compared to children whose mothers belonged to the White ethnic

group. The following sections will assess whether mother's ethnicity influences family functioning in each of the six domains and if this in turn makes children more or less likely to consume sugary foods more than four times per day.

6.8.2.1 Behaviour control

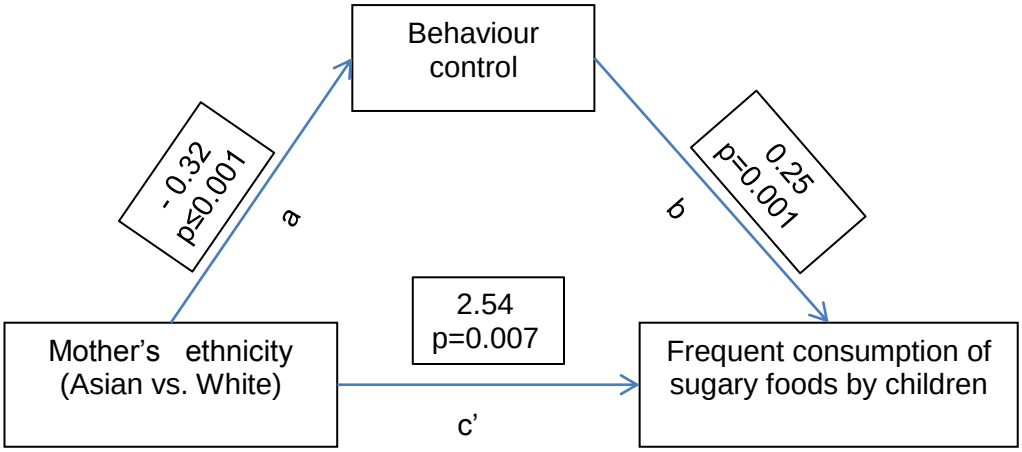


Figure 6.8.2.1.1 Behaviour control as a mediator in the relationship between mother's ethnicity and frequent consumption of sugary foods by children

Figures 6.8.2.1 and 6.8.2.1.1 show that steps 1 (path c), 2 (path a) and 3 (path b) were supported in this study sample but step 4 (path c') was not supported as the significant association between mother's ethnicity and children's sugar consumption frequency remained even after controlling for the domain behaviour control, although a 37% attenuation in the relationship was observed. This indicates that the family functioning domain behaviour control, which assesses the rules in place to control family members' behaviours, partially mediates the relationship between mother's ethnicity and the frequent consumption of sugary foods by children. Figure 6.8.2.1.1 shows that mothers of Asian ethnicity are more likely compared to White mothers to perceive less effective forms of behaviour control such as chaotic, rigid or laissez-

faire, demonstrated by lower scores in this domain, resulting in children being more likely to consume sugary foods frequently.

6.8.2.2 Affective responsiveness

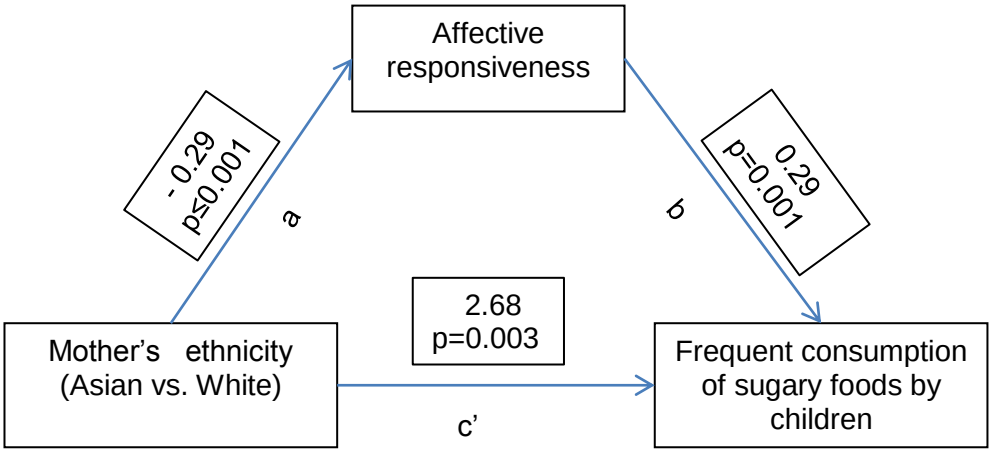


Figure 6.8.2.2.1 Affective responsiveness as a mediator in the relationship between mother's ethnicity and frequent consumption of sugary foods by children

Figures 6.8.2.1 and 6.8.2.2.1 show that steps 1 (path c), 2 (path a) and 3 (path b) were supported in this study sample but step 4 (path c') was not supported as the significant association between mother's ethnicity and children's sugar consumption frequency remained even after controlling for the domain affective responsiveness, although a 32% attenuation in the relationship was observed. This indicates that the family functioning domain affective responsiveness, which assesses the capacity of family members to respond emotionally, partially mediates the relationship between mother's ethnicity and the frequent consumption of sugary foods by children. Figure 6.8.2.2.1 shows that mothers of Asian ethnicity are more likely, compared to White mothers, to perceive a diminished capacity to respond emotionally, demonstrated by

lower domain scores, making children more likely to consume sugary foods more than four times per day.

6.8.2.3 Affective involvement

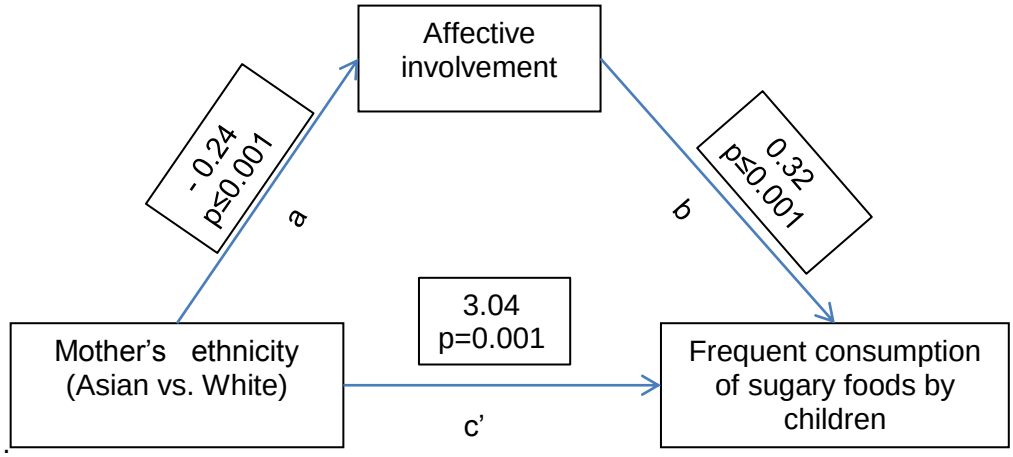


Figure 6.8.2.3.1 Affective involvement as a mediator in the relationship between mother's ethnicity and frequent consumption of sugary foods by children

Figures 6.8.2.1 and 6.8.2.3.1 show that steps 1 (path c), 2 (path a) and 3 (path b) were supported in this study sample but step 4 (path c') was not supported as the significant association between mothers ethnicity and children's sugar consumption frequency remained even after controlling for the domain affective involvement, although a 17% attenuation in the relationship was observed. This indicates that the family functioning domain affective involvement, which assesses the ability of family members to understand the emotional needs of its members, partially mediates the relationship between mother's ethnicity and the frequent consumption of sugary foods by children. These results indicate that mothers of Asian ethnicity, compared to White ethnicity, perceive a limited ability within the family to meet the emotional needs of its

members, demonstrated by lower domain scores, resulting in children being more likely to consume sugary foods more than four times per day.

6.8.2.4 Problem solving

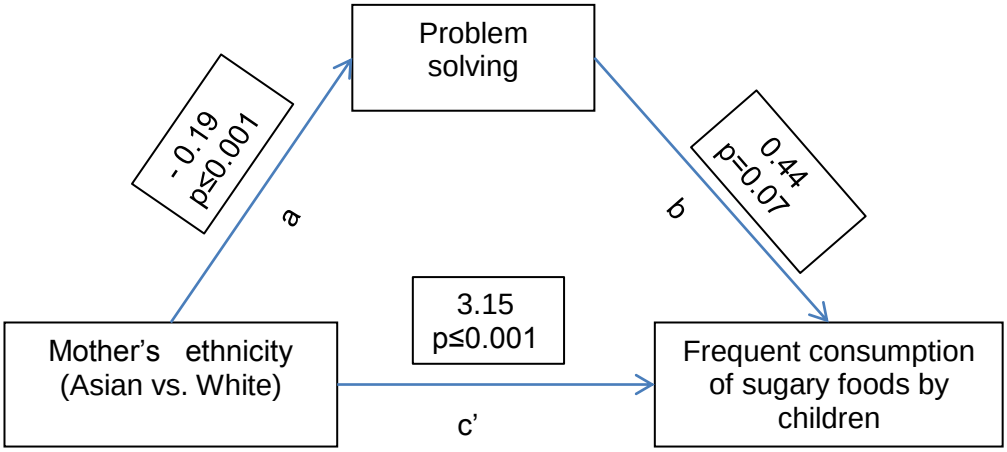


Figure 6.8.2.4.1 Problem solving as a mediator in the relationship between mother's ethnicity and frequent consumption of sugary foods by children

Figures 6.8.2.1 and 6.8.2.4.1 show that steps 1 (path c) and 2 (path a) were supported in this study sample, but steps 3 (path b) and 4 (path c') were not supported as there was no significant relationship between the domain problem solving and the frequent consumption of sugary foods by children once mother's ethnicity was controlled for (path b), and the significant association between mother's ethnicity and children's sugar consumption frequency remained even after controlling for the domain problem solving (path c'), although a 13% attenuation in the relationship was observed. This indicates that the family functioning domain problem solving which assesses the ability of family members to resolve problem, does not mediate the relationship between mother's ethnicity and the frequent consumption of sugary foods by children. Figure 6.8.2.4.1 shows that although mothers of Asian

ethnicity, compared to White mothers, perceive difficulty in resolving family problems demonstrated by lower scores in this domain, we are unable to make inferences about the mediating role of the domain problem solving because it is not statistically significantly associated with children's sugar consumption after controlling for mother's ethnicity.

6.8.2.5 Communication

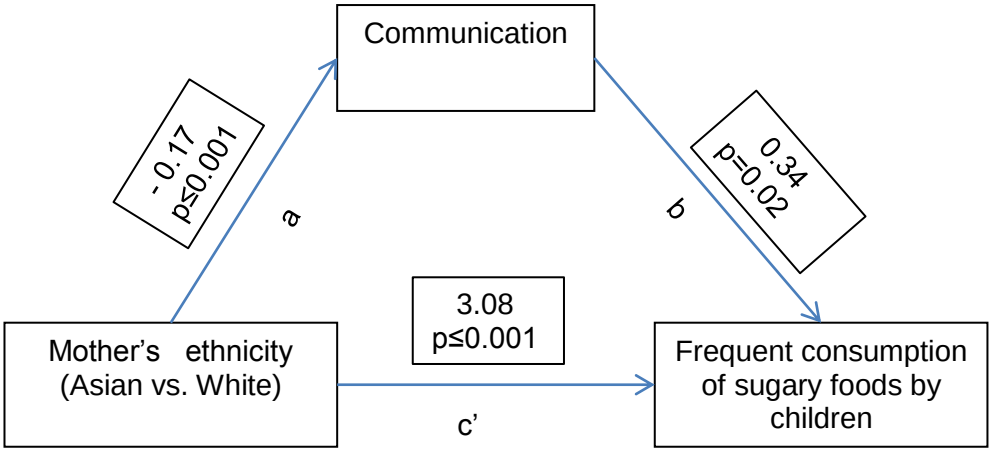


Figure 6.8.2.5.1 Communication as a mediator in the relationship between mother's ethnicity and frequent consumption of sugary foods by children

Figures 6.8.2.1 and 6.8.2.5.1 show that steps 1 (path c), 2 (path a) and 3 (path b) were supported in this study sample but step 4 (path c') was not supported as the significant association between mother's ethnicity and children's sugar consumption frequency remained even after controlling for the domain communication, although a 15% attenuation in the relationship was observed. Therefore, the family functioning domain communication, which assesses the verbal communication patterns of family members, partially mediates the relationship between mother's ethnicity and the frequent consumption of sugary foods by children. Asian mothers were more likely,

compared to White mothers, to perceive unclear and indirect communication between family members demonstrated by lower domain scores, leading to children being more likely to consume sugary foods more than four times per day.

6.8.2.6 Roles

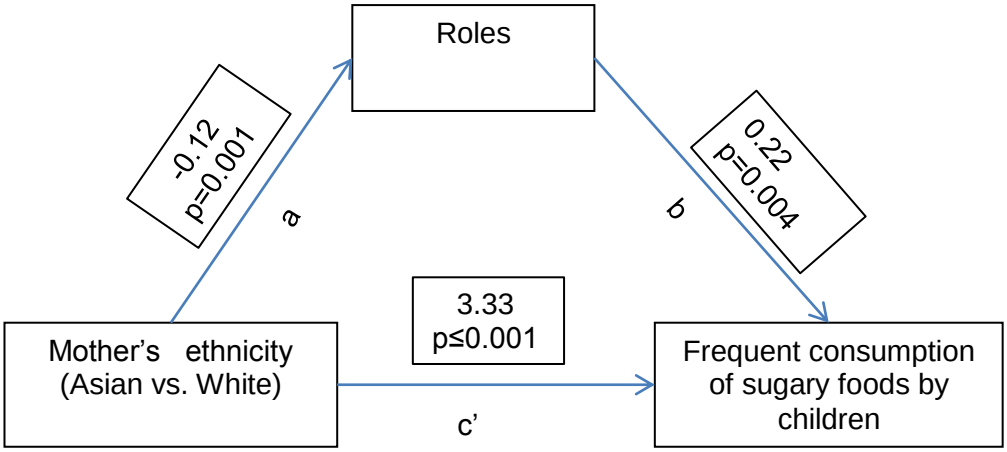


Figure 6.8.2.6.1 Roles as a mediator in the relationship between mother's ethnicity and frequent consumption of sugary foods by children

Figures 6.8.2.1 and 6.8.2.6.1 show that steps 1 (path c), 2 (path a) and 3 (path b) were supported in this study sample but step 4 (path c') was not supported as the significant association between mother's ethnicity and children's sugar consumption frequency remained even after controlling for the domain roles, although a 5% attenuation in the relationship was observed. This indicates that the family functioning domain roles, which assesses the repetitive patterns of behaviour by which family members fulfil their family duties, partially mediates the relationship between mother's ethnicity and the frequent consumption of sugary foods by children. Asian mothers are more likely than White mothers to perceive unclear or unfair allocation of family

roles demonstrated by lower domain scores, which can lead to children being more likely to consume sugary foods more than four times per day.

6.9 Summary

The results show that there were no statistically significant differences between three and four year old children or boys and girls regarding the frequent consumption of sugary foods, although the trends of these associations were in expected directions as informed by the literature, lending credibility to the study.

Nearly three quarters (72%) of the children in the study sub sample lived in the two most deprived quintiles in England. This study population was mainly deprived and therefore statistically significant differences in sugar consumption behaviour of children based on the Index of Multiple Deprivation could not be detected, thus hypothesis 7 could not be conclusively supported. Nevertheless the direction of the results were in the expected direction, with deprived children being more likely to consume sugary foods frequently compared to children in more affluent areas. Regarding mother's education, study hypothesis 8 was supported as the results showed that mother's A levels or university or higher education was protective against the frequent consumption of sugary foods by children. On the other hand, mother's Asian ethnicity, compared to White ethnicity, was a risk indicator for consumption of sugary foods more than four times per day by children.

The findings also provided support for hypotheses 1, 2, 3, 5 and 6 which proposed that effective family functioning demonstrated by reasonable and flexible family rules (effective behaviour control); the capacity to respond to a given stimulus with an appropriate quality and quantity of feelings (effective affective responsiveness); a real

understanding of the needs of family members, along with the ability to meet them (effective affective involvement); clear, open and direct communication between members (effective communication) and having clearly defined roles and responsibilities for its members (effective roles) provides a favourable environment that protects against the consumption of sugary foods more than four times a day by three and four year old children. This association was independent of mother's education, mother's ethnicity, level of deprivation, children's age or sex. On the other hand hypothesis 4, regarding the domain problem solving, was not supported by the results of this study.

The differences in frequency of sugar consumption between children whose mothers had higher versus lower education, wherein mother's higher education was protective against the frequent sugar consumption by children, was partially attenuated when behaviour control (6%), affective responsiveness (12%), affective involvement (6%), problem solving (5%), communication (6%) and roles (8%) were added to the model. This attenuation could be attributed to the intervening role of each of these domains. When tested further for mediation, using the four steps proposed by Baron and Kenny (1986), it was found that this relationship was partially mediated through the family functioning domains behaviour control, affective responsiveness, affective involvement, communication and roles. These findings support hypotheses 9, 10,11, 13 and 14, indicating that mother's education facilitates more effective family functioning in each of the domains demonstrated by flexible family rules, capacity of family members to respond emotionally, emotional connection between members, clear and direct communication patterns and clearly defined rules and responsibilities of members. This creates a favourable environment that decreases the likelihood of children consuming sugary foods more than four times per day.

An additional finding was with reference to mother's ethnicity. The study found that children whose mothers were of Asian ethnicity were significantly more likely than children with White mothers to consume sugary foods frequently. This difference between children with Asian mothers and children with White mothers was partially attenuated by behaviour control (37%), affective responsiveness (32%), affective involvement (17%), problem solving (13%), communication (15%) and roles (5%). Once again this attenuation could be attributed to the intervening role of each of these domains. When tested further for mediation, using the four steps proposed by Baron and Kenny (1986), it was found that this relationship was partially mediated through the family functioning domains behaviour control, affective responsiveness, affective involvement, communication and roles. White mothers were more likely than Asian mothers to score higher in each of the domains indicating more flexible family rules, more effective emotional response, appropriate levels of emotional involvement, clear and direct communication between members and more clearly defined roles and responsibilities, leading to a decrease in the chances of their children consuming sugary foods more than four times per day.

7 Discussion

7.1 Main findings

The aim of this study was to assess the relative contribution of each of the family functioning domains, behaviour control, affective responsiveness, affective involvement, communication, problem solving and roles towards the frequent consumption of sugary foods by three and four year old children in Outer North East London; to confirm whether deprivation and mother's lack of higher education were risk factors for children's consumption of sugary foods more than three times per day, and to test the ability of efficient family functioning in each of the six domains to mediate the effect of these factors.

The domain behaviour control assessed the rules and standards that a family adopted to handle different kinds of behaviour. Effective functioning suggested that the family had flexible rules to control the behaviours of its members, while less effective functioning was indicative of family rules that were rigid or unpredictable or that there were no rules at all. The domain affective responsiveness assessed the capacity of family members to respond emotionally to a given stimuli. Effective functioning suggested that family members had the capacity to respond with the appropriate quantity and quality of emotion, while less effective functioning was suggestive of a reduced capacity to respond emotionally. The domain affective involvement assessed the level and type of interest that family members showed in each other's activities. Effective functioning implied true concern by family members for the needs of each other, while less effective functioning implied a total lack of involvement or over involvement with each other. The domain communication assessed the verbal exchange of information within the family. Effective functioning pointed towards family members communicating with each other in a clear and direct

manner while less effective communication implied masked and indirect communication between family members. The domain problem solving assessed the family's ability to resolve problems. Effective functioning was indicative of families having resolved most of their problems easily and systematically, while less effective functioning implied not approaching problems in a systematic manner and as a result having many unresolved issues. The final domain roles assessed the repetitive patterns of behaviour by which family members fulfilled family duties. Effective functioning implied role allocation that was appropriate and where accountability was made clear, while less effective functioning was indicative of members feeling overburdened by their duties or that members did not fulfil their duties adequately.

To our knowledge this is the first study to examine the relationship between frequent consumption of sugary foods by three and four year old children and family functioning in the domains behaviour control, affective responsiveness, affective involvement, communication, problem solving and roles, as assessed by the McMaster Model using the Family Assessment Device. A complex web of factors influence children's sugar consumption behaviours, the most proximal influence for children is their family, of which family functioning is most intimately linked with behaviours. Additionally the importance of including in the study any potential covariates that may influence the outcome was carefully considered. It is essential to choose socioeconomic position indicators appropriate to the aims of a study, because different measures involve different pathways and have varying degrees of association with different health behaviours (Singh-Manoux et al.,2002). Education is one of the most commonly used measures of SEP when studying diet (Turrell and Kavanagh,2006) and is a relevant variable for measuring variation in SEP across ethnic groups (Kelaher et al.,2009). Level of maternal education has also been

validated as a proxy for international comparisions of SEP (Pine et al.,2004a; Pine et al.,2004b).

In the current study mother's education was selected because of its close association with children's sugar consumption behaviours (Watt et al.,2001) and also because it is a relevant indicator of socioeconomic position when studying mixed populations (Pine et al.,2004a; Pine et al.,2004b; Kelaher et al.,2009). This study found that mother's higher education protected against the frequent consumption of sugary foods by children, which is in keeping with previous study findings. Studies have shown that children whose mothers had lower education had poor quality diets, while children whose mothers had higher education had better quality diets, which were more in keeping with dietary guidelines (North and Emmett,2000; Watt et al.,2001; Northstone and Emmett,2005). A possible explanation for this is that mothers' education guides their knowledge about different foods, which in turn determines the types of foods that they buy (Northstone and Emmett,2005; Turrell and Kavanagh,2006), which then influences children's exposure to these foods, affecting their preference and ultimately sugar consumption habits. On the whole, even in the largely deprived population in outer North East London, mother's higher education was found to be protective against frequent sugar consumption by children. The NDNS (1992/93) found that children from manual households consumed sugary foods more often than children from non-manual households. They also found that manual households more often had lower levels of maternal educational attainment and mothers in non-manual households often had higher educational qualifications (Hinds and Gregory,1995). Therefore, extrapolating from this and previous studies that found a positive association between mother's education and children's more healthy diet, it is possible that some of the differences in children's diets, attributed to SEP, may be explained by mother's educational qualifications.

When each of the family functioning domains, behaviour control, affective responsiveness, affective involvement, problem solving, communication and roles were added to the model, there was a partial attenuation of the relationship between mother's education and sugar consumption, although education was still strongly associated with sugar consumption frequency. This indicates that a part of the association between mother's education and children's sugar consumption frequency could be attributed to family functioning in each of these domains. Therefore, the roles of each of these domains of family functioning were investigated further by testing for mediation, and will be discussed later.

With regard to ethnicity, this study explored the associations of children's sugar consumption with mother's ethnicity and not child's ethnicity because diet is more closely linked with cultural factors than inherent biological characteristics. This study found that Mother's Asian ethnicity was a risk indicator for consumption of sugary foods more than four times per day by three and four year old children. Interestingly the results showed that controlling for mother's education widened the difference between the Asian and White groups, pointing to the likely suppressor effect of this variable clouding the link between mother's ethnicity and children's diet. Suppression implies a 'surprise' relationship between a predictor and a criterion when controlling for a third variable, given the bivariate correlation between the predictor and outcome (Kline,2005). Indicating that maybe, mother's influence on their children's diet is more intimately linked to certain cultural norms than education, especially since cultural practices and values often shape food preferences and perceptions on what is healthy or not (Larson and Story,2009). For example, it is the norm for certain cultures to add sugar to children's drinks (African, Pakistani, Mexican) while it is not common to do so in white Belgian families (Pine et al.,2004a). We need to keep in mind that

intracultural variations exist and that globalisation and acculturation can affect cultural norms (Larson and Story,2009). On the other hand, this study found that the relationship between mother's ethnicity and children's sugar consumption frequency was partially attenuated after controlling for each of the six domains of family functioning. This indicates that part of the association between mother's ethnicity and children's sugar consumption is attributable to the intervening effect of these six domains, although to different degrees, with behaviour control contributing the most and roles the least. The attenuation seen with behaviour control can be related to a previous study which suggested that ethnic minority parents had a more 'indulgent' attitude towards their children's' diet. This study reported that a much higher proportion (45.1% vs.7.8%) of ethnic minority parents reported finding it stressful to say no when their children wanted sweets (Skeie et al.,2006). Therefore, some of the differences between the ethnicities could be attributed to the way children are disciplined within families, or the emotional interactions between members, or the way that members take on and fulfil various roles, or the way they communicate with each other. The remaining differences could be credited to practices within the ethnic groups, whereby cultural practices may make consumption of sugary foods by children the norm, which is not related to how they function on a daily basis.

There has been some critisisms about research on ethnic diffrences in health not taking into consideration the socioeconomic differences within the groups; because *"studies that inadequately account for socioeconomic circumstances when examining ethnic-group differences in health can reify ethnicity"* (Smith,2000). The selection of an appropriate SEP indicator reduces the chance of residual confounding, which occurs when an inappropriate measure of the confounding variable is used, resulting in the incomplete removal of the effect of the confounder (Kelaher et al.,2009). In other words, because a confounder variable is capable of making it seem that there is

a relationship between the explanatory variable and the outcome, when in actual fact the relationship is because of the confounding variable; only by controlling for an appropriate SEP can we say with any degree of authority that any remaining association between ethnicity and the outcome is linked mainly to ethnicity and not to SEP. Selecting mother's education as a SEP indicator for this study is relevant because, as mentioned in the previous section, it is suitable for accounting for variations in SEP across ethnic groups (Kelaher et al.,2009). Therefore, controlling for mother's education effectively removes the effect of socioeconomic position as a confounder, allowing any remaining association between mother's ethnicity and children's sugar consumption to be attributed mainly to factors more intimately linked to ethnicity. The factors intimately linked to ethnicity are usually described as 'cultural' or 'genetic'. Cultural characteristics may be more relevant when studying dietary behaviours, but we need to keep in mind that certain behaviours may be linked more to SEP and shared across ethnic groups (Smith,2000), bringing us back to the importance of controlling for appropriate SEP indicators. Although ethnicity and SEP are often interrelated (Verrips et al.,1993; Smith,2000), ethnicity on its own has an association with oral health behaviours as demonstrated by the current study and in the literature (Gao et al.,2010) and therefore, especially with reference to diet, to be a more proximal influence than SEP.

Additionally, we also need to keep in mind that educated parents and White parents may be more aware of the social norms and dietary guidelines in this country relating to sugar consumption and as such could have provided socially acceptable answers in response to the food frequency questionnaire. As mentioned earlier FFQ have been validated against food diaries and 24 hour recalls minimising the potential for bias.

Contrary to expectations, this study did not find a statistically significant difference in children's sugary food consumption frequency based on levels of deprivation, assessed using the IMD, although the trend for the association was in the expected direction (OR 1.87, 95% CI: 0.89, 3.90). This could be because only 2% of this population lived in affluent areas, 10% in less deprived areas and the rest in areas of increasing deprivation, with 32% in the most deprived quintile for England, with a mean sample IMD score of 28.46 (95% CI: 27.49, 29.44). This population on the whole was considered deprived and therefore significant differences in sugar consumption frequency could not be identified based on IMD, because of the relatively homogenious nature of this population. It must be made clear that although the neighbourhoods as a whole were considered deprived, the people living here belonged to a range of socioeconomic circumstances. Therefore, although this study did not find an association between area based deprivation and sugar consumption frequency of children, there was an association with mother's education, supporting the literature which idetified mother's education as being an appropriate indicator of SEP when studying mixed populations and in relation to childrens diet.

The findings from this study in relation to IMD are similar to findings from a survey of sugar intake among children in Scotland, which found small associations between intake of NMES and the Scottish Index of Multiple Deprivation (SIMD). Although they also found that in the more deprived quintiles NMES made up a greater proportion of the total energy from food, and in terms of actual amounts of sugar consumption (g/day) the total sugars consumed by children in the most deprived quintile was significantly higher (Sheehy et al.,2008). A reanalysis of this data identified dietary patterns were very strongly related to deprivation, leading to the conclusion that area based measures were good indicators for broader dietary patterns rather than in relation to specific nutrients such as NMES (McNeill et al.,2009).

Although it has often been demonstrated that unhealthy dietary patterns are associated with lower SEP, the consumption of sugary foods is slightly more complicated, especially in the case of young children, where sugary treats are often an expression of affection across social classes and cultures, and not just the result of the underlying influences of deprivation. Therefore, in this particular study, IMD may not be a very good predictor of frequent sugar consumption, not because it is not related to it, but because it may be a more distal influence for young children compared to other indicators such as mothers education. One of the ways that neighbourhood deprivation is thought to influence poor dietary habits is through issues of access, related to availability and affordability of healthy food options. For young children this is mediated through their parents, therefore in this instance mother's education, which has the ability to influence her purchasing behaviour, is a more proximal influence than IMD. Proximal factors are better discriminators because they reflect the present circumstances of the child more accurately (Singh-Manoux et al.,2002).

The report on the development of the IMD (2007) makes a distinction between poverty and deprivation, the former is not having enough financial resources to meet needs while the latter refers to unmet need caused by a lack of all kinds of resources. The IMD is an indicator of the various forms of deprivation experienced by individuals living in the same small area. "*In other words, the experience of the people in an area give the area its deprivation characteristics"*. The IMD is based on deprivation in seven domains, income, employment, health and disability, education, skills and training, barriers to housing and services, living environment and crime (Noble et al.,2007). All domains that are very relevant to health outcomes but not directly related to children's sugar consumption, as the influences of all these factors is

mediated through parents/family; reiterating the relevance of the more proximal SEP indicators like mother's education. We also have to keep in mind that even when areas share the same IMD score, the relative contribution of the different domains and indicators making up that score will vary between areas (Pickett and Pearl,2001). For example, two areas with similar scores could be deprived in two very different domains, one area may have lots of unemployed people but with good housing while another may have low levels of unemployment but poor quality housing. In addition different forms of deprivation may interact and have a greater impact when found in certain combinations (Noble et al.,2007). It is also possible that certain characteristics of the neighbourhood have more influence on health related outcomes compared to other neighbourhood characteristics (although they are often highly correlated) (Pickett and Pearl,2001). Therefore, areas with similar scores may have different underlying influences acting in different pathways making the IMD not particularly discriminatory, which may be another reason why we did not find significant associations in this study. Therefore, areas that score high (more deprived) or low (less deprived) could both overlap in relevant domains, such as education deprivation, which has the most impact on dietary behaviour and therefore mask the influence of deprivation on diet.

The justification for using both individual and area based indicators of SEP is that omitting either one could lead to bias; without individual measures the area based measure may act as proxies for individual attributes, similarly the impact of individual factors may vary based on the area (Pickett and Pearl,2001). For example, greater stress may be experienced by individuals with higher education living in poor neighbourhoods, compared to people with similar level of education living in more affluent areas. It is import, therefore, to study individual attributes within the context of the wider environment. On the whole, all SEP indicators could be argued as being

proxies for more complex concepts that are difficult to measure, such as health related attitudes and social standing (Pickett and Pearl,2001).

With respect to family functioning, this study found a statistically significant association between each of the six family functioning domains and children's sugar consumption frequency, prior to adjustment for potential confounders. When children's age, sex, mother's ethnicity, mother's education and IMD were added to the model, an independent association was seen with the domains behaviour control, affective responsiveness, affective involvement, communication and roles. Indicating that children were less likely to consume sugary foods frequently, when families had rules and standards that were reasonable and flexible; when family members had the capacity to respond emotionally; when there was real understanding in the family of the emotional needs of its members; when the communication between members was clear, open and direct and when members had roles and duties that were fairly assigned and members were accountable. In comparison, children were more likely to consume sugary foods frequently when the family had no rules to govern family behaviour; when family members did not have the capacity to respond emotionally; when family members were too self-centred or over involved in the affairs of each other; when members were indirect and unclear when communicating verbally with each other and when members were unhappy with or failed to fulfil the family duties assigned to them.

In contrast, there was complete attenuation of the association between the domain problem solving and children's sugar consumption frequency when mother's education and IMD were added to the model. A possible explanation for this is that mother's education influences the skills that are at the disposal of the family to effectively resolve their problems, as problem solving requires a very structured

logical approach to effectively deal with problems that may arise, and involves the following steps:

1) Identifying the problem
2) Communicating it to appropriate people
3) Developing a set of possible solutions
4) Deciding to act on one of them
5) Carrying out the required action
6) Monitoring to ensure that the action is carried out
7) Evaluating its effectiveness

It is reasonable to assume that higher education may equip a person to tackle problems in the above manner and therefore once education is controlled for, the association between the problem solving domain and children's sugar consumption frequency loses its significance, as they both tap into a related construct.

On the whole, the study findings were consistent with the study hypotheses (1, 2,3,5 and 6) that effective family functioning in the domains behaviour control, affective responsiveness, affective involvement, communication and roles provides a favourable environment which protects against the consumption of sugary foods more than four times per day by children. Flexible and reasonable rules in the family that effectively control family behaviour; the capacity of members to respond with appropriate emotions; family members having a real understanding of the emotional needs of each other; clear and direct communication between family members and members having fairly defined roles and responsibilities suggests a favourable ecocultural pathway, one that forms the backbone of a health promoting family environment, supporting the acquisition of healthy diets low in NMES , as proposed in the theoretical framework.

It was also proposed that family functioning in the different domains acts with the other factors in the wider family enviornment to influence childrens diet. After consideration of the different ways that factors in the family environment could act together to influence children's sugar consumption frequency (section 5.11.10), the role of family functioning as a mediator in the relationship between mother's education and mother's ethnicity and children's sugar consumption frequency was considered the most relevant for this study and was therefore tested. This study followed the Baron and Kenny (1986) method to test for mediation; this causal steps method has the lowest type 1 error rates and the highest type 2 error rates (MacKinnon et al.,2002). Therefore, any mediating influences of the family functioning domains are probably unlikely to be a chance finding; keeping in mind that this is a cross-sectional study any study findings only contribute to theory building and do not suggest causation.

With respect to mother's education, the mediation analysis showed that family functioning domains behaviour control, affective responsiveness, affective involvement, communication and roles partially mediated the association between mother's education and children's sugar consumption frequency. This shows that mother's higher education improves the family's ability to have a more effective approach to regulate family behaviour by having flexible rules. It also influences the family's ability to respond emotionally with the appropriate quality and quantity of feelings; it develops the family's ability to understand the emotional needs of its members; helps cultivate the communication patterns between family members enabling clear and direct verbal communication; and expands the skills in the family to clearly define the roles and responsibilities of its members. This in turn creates a

favourable family environment that protects children against the frequent consumption of sugary foods.

Partial mediation rather than total mediation was expected because the domains of family functioning although potentially important in this relationship, cannot realistically be considered the only factors in this complex pathway, but just important contributors to this pathway. Previous studies trying to explain how and why higher education is linked to better dietary behaviours in children, attributed it to the ability of those with higher education to better understand and assimilate dietary guidelines and to education influencing purchasing behaviour (Turrell et al.,2003; Turrell and Kavanagh,2006). This study adds family functioning in the domains, behaviour control, affective responsiveness, affective involvement, communication and roles to the list of social processes by which higher education could influence children's diet. Higher education has been associated with better family functioning in both the literature (Georgiades et al.,2008) and this study, therefore we can postulate that mother's higher education enhances the skills that contribute to efficient family functioning, which spills over into influencing health related behaviours by creating a health promoting environment.

With regard to mother's ethnicity, although there will be variations in the extent to which cultural beliefs and activities are shared by those within each ethnic group, what we have ascertained in this study is the amount of shared practice within each ethnic group with specific reference to children's sugar consumption habits. When tested further for the mediating effects of family functioning domains, which included assessing whether mother's ethnicity influenced each of the family functioning domains (the mediator) which in turn influenced the outcome. The analysis showed that Asian mothers were more likely than White mothers to score low in the domain

behaviour control, indicating that they were more likely to perceive that the rules within the family were laissez-faire or rigid or chaotic, which in turn was more likely to result in children consuming sugary foods more than four times per day. Asian mothers were also more likely than White mother's to perceive limited ability within the family to respond emotionally, demonstrated by lower scores in the affective responsiveness domain, which increases the likelihood of children consuming sugary foods more than four times per day. With regard to the domain affective involvement, Asian mothers were once again more likely to perceive ineffective functioning compared to White mothers, demonstrated by low scores, indicating that family members were often either too self-involved or over-involved in each other's lives, leading to an increased likelihood of frequent sugar consumption by children in these families. Asian mothers were also more likely than White mothers to perceive more indirect and unclear communication patterns between family members, demonstrated by low scores in the domain communication, resulting in their children being more likely to consume sugary foods more frequently. Similarly, with regard to the domain roles, Asian mothers were more likely to get lower scores compared to white mothers, indicating that the duties within their families were not fairly allocated and often unfulfilled, resulting in children in these families being more likely to consume sugary foods more than four times per day.

Each of these family functioning domains were found to act as partial mediators, therefore the relationship between mother's ethnicity and children's sugar consumption frequency could be a consequence of mother's ethnic minority status and its associated cultural norms, as well as inefficient functioning in each of these family functioning domains. Disentangling the contributions of these different aspects of the family environment is quite challenging. One possible explanation is that certain types of dietary behaviours, including giving children sugary food and drinks daily

may be the cultural norm, and therefore not entirely linked to other family behaviours and not completely amenable to the family ecocultural process, which links everyday behaviours with health behaviours. An example of this was seen in the WHO study mentioned earlier, which found that most parents in certain countries (e.g. White Germans 88%) reported giving their children sweets or chocolates everyday or most days while a smaller proportion in other countries (e.g. Tanzanian African, 18%) reported doing so (Pine et al.,2004a). Here giving children sweet treats daily can be viewed as a cultural norm and not an indication of other behaviours within the family environment. Therefore, although health practices are often integrated into the everyday activities of families, sometimes other factors may influence this. In addition, cultural practices and beliefs may influence choice of foods so that even though families function efficiently in their everyday activities, efficient in certain cultural contexts could mean the provision of high energy density food which is considered appropriate for growing children. Therefore, it may be appropriate to conclude that the association between ethnicity and sugar consumption in children could be attributed to a combination of cultural norms and family functioning in the domains behaviour control, affective responsiveness, affective involvement, communication and roles.

Lastly, we also hypothesised that mothers of children living in more deprived areas, characterised by higher IMD scores, would perceive less efficient family functioning in each of the six domains, behaviour control, affective responsiveness, affective involvement, communication, problem solving and roles; resulting in children in these areas being more likely to consume sugary foods more than four times per day compared to children living in less deprived areas. We were unable to test this because of the homogenously deprived nature of the study sample, precluding the ability to detect any significant differences in sugar consumption behaviours of children based on deprivation.

7.2 Strengths and limitations of the study

It is important that the findings from this study are interpreted keeping in mind the strengths and limitations of the study methodology. This study analysed data from the ONEL-FS which is a cross sectional survey where participants were identified using a stratified random sampling procedure. This ensured that there was a good representation of the various sub groups that made up the population of Outer North East London. Cross-sectional studies, in spite of the limitation of not being able to make causal inferences because of the difficulty in establishing temporal relations, are often used to explore associations between the risk/protective factors and the outcome of interest. Because there is limited information, but a growing recognition of the importance of psychosocial factors within the family environment influencing children's health related behaviours (Finlayson et al.,2007), a cross sectional design was considered appropriate to explore the study aims as a step in understanding the complex process that underpins development of children's sugar consumption behaviours. Another limitation of a cross sectional design is that it is possible to get different results at different points in time, but children's diets at three and four years of age are very dependent on their family environment at that point in time, therefore a 'snapshot' of this particular point in the life of children was deemed appropriate for the purpose of this study. Although this study analysed a sub population of the ONEL-FS, weighting of the data ensured that it was representative of the ONEL population in terms of children's age, sex and ethnicity, allowing the results to be extrapolated to the population with some caution.

With regard to assessment of family functioning, an often asked question is "*Do self-reports from individuals regarding the entire family represent the whole family or do they simply represent the perceptions of that individual? Is it necessary to have complete family assessments from all family members to evaluate family functioning*

or is it sufficient to have individual perspectives from only part of the family? Answers to these questions depend on the purpose of the analysis and answers may vary for different circumstances." (Bray,1995). We know that individual members affect family functioning in different ways, so it is important to take these differences into consideration when deciding how to assess family functioning (Akister and Stevensonhinde,1991). Family functioning is a very broad construct covering many aspects of the family environment. In this study we are interested in family transactional processes, which are the everyday activities that family members routinely engage in, as these are the most relevant to the health behaviours and outcomes of its members. These processes can be studied in relation to different sub groups of the family such as parent-child, siblings, parents, or to the family as a whole; because young children's diets are influenced by the whole family, the FAD was chosen to assess whole family functioning. Family functioning using the FAD is assessed either by averaging the scores for all the members (family mean) or by assessing the perception of the member most relevant to the study outcome. For the purpose of this study, perception of family functioning from the mother's perspective was deemed most relevant because mothers are most often the primary carers and in charge of children's diets (Savage et al.,2007). Therefore, we were interested in exploring how mother's perception of how her family functions, relates to her child's sugar consumption behaviour. The validity of using only the mother's perception is strengthened by the good levels of agreement between mothers and fathers in this sample, on perception of family functioning in the different domains. Although perception of family functioning can vary between family members (Bray,1995; Georgiades et al.,2008), the domains assessed by the FAD are areas that concern the day-to-day running of the family and are therefore more likely to be discussed by family members, resulting in shared views (Akister and Stevensonhinde,1991).

The FAD was chosen because of its good psychometric properties, extensive use in peer reviewed studies, its cross cultural application and because the domains assessed have the most impact on the health outcomes of its members. In addition, the FAD covers a wide range of concepts under one umbrella, which is especially relevant when studying families. Four main categories have been proposed in the literature for studying families, family composition factors, family process factors (communication, problem solving), family affect factors (affective responsiveness and involvement) and family organisational factors (roles and behaviour control) (Bray,1995); the related FAD domains are in parenthesis, demonstrating its suitability for studying families and the manner in which they function.

With regard to the method used to assess children's sugar consumption frequency, it is important that the method used for assessing dietary intake is appropriate to the purpose of the study. Food frequency questionnaires (FFQ) are often used in epidemiological surveys owing to its cost effectiveness, appropriateness for assessing habitual long-term diet and relative ease of data entry and analysis (Cade et al.,2002; Sheehy et al.,2008), all factors considered relevant to this study. On the other hand, FFQ are prone to recall bias and to underreporting of frequency of consumption of foods that project an unhealthy image (Gibson and Williams,1999). This has been addressed by validating FFQs by comparing them with dietary diaries and weighted intakes (Sheehy et al.,2008 ; McNeill et al.,2009). Another limitation of the FFQ especially relevant to the current study is the inability to discriminate whether the foods were eaten at mealtimes, as snacks between meals, whether drinks were sipped through the course of the day or drunk at bedtime; all factors that affect the cariogenic nature of sugary foods. An international study by the WHO found that with reference to sugar consumption behaviours, collectively restricting all types of sugar consumption patterns increased the chances of being caries free (Pine et al.,2004). In

addition, sugar consumption of more than four times per day has been acknowledged as a risk factor for dental caries (Sheiham,2001; World Health Organisation,2003; Moynihan,2005). Therefore for the purpose of the present study, the frequency of consumption was considered relevant even without added information on consumption patterns. In addition, giving children sugary foods is complicated by its intimate association as a symbolic gesture to convey affection or as a reward; because the FFQ provide details of habitual consumption and not consumption on a particular day, it allows us to differentiate between eating sugary foods as occasional rewards and its habitual consumption at a rate that is potentially cariogenic.

A conservative approach was used to calculate daily frequency, wherein lies the possibility of misclassification of frequent consumers into the low frequency group, but the results were in theoretically expected directions which validates this measure to a certain extent. Additionally it is always better to err on the conservative side and risk a Type II error rather than wrongly reject the null hypothesis.

Additionally, data based on self-report is subject to non-sampling errors such as misunderstanding the questions, this was minimised in the current study by use of validated questionnaires and training of the interviewers.

With reference to the modelling of family function domains as mediators in the pathway between mother's education/ethnicity and sugar consumption frequency of children, because of the cross sectional nature of the study we cannot infer causation, nor can we rule out the possibility of omitted variables, therefore the relationships observed could be confounded or spurious (Gelfand et al.,2009). It can only be inferred from the observed associations in the sample that the findings were consistent with what would be expected if there was an actual causal pathway from

mother's education/ethnicity, to family functioning in relevant domains, to children's sugar consumption frequency.

The limitations of the causal steps approach used in this study to assess mediation is that it does not test the significance of the indirect pathway, *"a reduction in significance from c to c' fails to demonstrate that a difference between c and c' is significant"* (Gelfand et al.,2009). It requires a very large sample size (21,000) to detect mediation when paths a and b are small and it requires a statistically significant relation between the independent (X) and dependent (Y) variables. It is argued that statistical significance though important is not absolutely necessary to infer mediation, because path c will not be significant if the power of the test is insufficient (small sample size) or when there is inconsistent mediation where the mediator acts as a suppressor, therefore some authors advocate dropping this first step (Mackinnon and Fairchild,2009). Also if there is collinearity between X and M it is possible that the statistical test of c' will not be significant whereas c is significant, making it appear as if there is complete mediation when in there is no mediation at all (Kenny,2009). In spite of the limitations of the Baron and Kenny approach, because this approach "*uses data analysis as a tool to examine whether a mediation effect is in place*", it is suitable for use in observational studies (Wu and Zumbo,2008) and is therefore the method used here to show that family functioning domains behaviour control, affective responsiveness, affective involvement, communication and roles act as partial mediators in the pathway between mother's education/ ethnicity and children's sugar consumption frequency.

The current study tested for mediation using regression models, which makes the assumption that there were no measurement errors in the measured variables. Usually there are some inherent errors in most measured variables resulting in an

overestimation of the effect of the independent variable and an underestimation of the effect of the mediator variable, on the dependent variable. This is usually addressed by creating latent variables and using SEM (Wu and Zumbo,2008). In this study we did not use SEM because we did not have multiple measured variables indicative of latent measures. It has been proposed that ideally there should be at least three measured variables for each latent variable, so that a confirmatory factor analysis can be done to test that the measured variables are in fact measurable manifestations of the latent variable (Streiner,2006).

Once again the results from the mediation analysis should be interpreted with caution and is meant to build and refine theory, not infer causation.

Finally, the study questionnaires were all in English, requiring a reasonable level of English language ability to complete the adult and child questionnaires. As the ONEL population were of mixed ethnicities, it is possible that the responses of some participants for who English is not their everyday language, may be of lesser quality because of differential understanding or differences in cultural perception on certain questions, making it seem as if ethnic minority families function ineffectively. This bias was minimised by using a measure that has been validated across different cultures (Ryan et al.,2005; Herzer et al.,2010) and by having interviewers of different ethnicities who were there to provide any assistance if required.

7.3 Integrating study findings into existing knowledge and theories

Findings from this study support the shift from studying risk factors to focussing on protective factors in relation to oral health, a direction initially led by Marcenes and Sheiham in 1996. Fifteen years on there is a shift in the paradigm with more oral health related research adopting positive notions of health with concepts such as self efficacy (Litt et al.,1995; Adair et al.,2003; Pine et al.,2004) and salutogenesis (Silva et al.,2008). Studies have found that parental self efficacy which is self belief in the ability to behave in a certain manner, has an important influence on children's sugar consumption behaviour (Litt et al.,1995; Adair et al.,2003; Pine et al.,2004). In the literature there is a positive association between family functioning and individual well being, which is a composite measure of well being in areas that include control of emotions, state of morale, interest in life, perceived stress, perceived health status, satisfaction with relationships and energy (Georgiades et al.,2008). Therefore, the notion of self efficacy could tie in with the perception of efficient family functioning in the various domains, where a perception of the ability to function effectively in fulfilling the various life tasks could spill over into the self confidence to promote good dietary behaviour. These findings further support the ecocultural theory that was discussed in the theoretical framework, which proposes that the everyday practices that families take part in influences their health behaviours. Therefore, when there is confidence (self efficacy) in the ability to successfully handle the day-to-day family processes (effective family functioning) it enhances the family's ability to foster health promoting dietary behaviours in children leading to less frequent sugar consumption.

In addition, Benton (2004) reviewed the literature and suggested that healthy eating behaviour in children could be encouraged by a positive emotional atmosphere at mealtimes, parents and older siblings acting as role models to encourage the tasting of new foods, exposing children to a range of different foods, repeatedly exposing

children to foods that they may dislike at first, offering various low energy density foods which allow the child to balance their own energy intake, neither restricting nor forcing children as this usually increases and decreases, respectively, their consumption of that food, and not using high energy density foods (NMES) as rewards and treats. It is reasonable to hypothesise that these conditions are likely to occur when there is effective functioning in all of the family functioning domains making the family environment favourable to the development of positive dietary behaviours in children. In other words, when effective family functioning in the different domains forms the context within which everyday family activities take place, this favourable background fosters the integration of health practices into everyday family routines.

7.4 Conclusions of the study

With reference to the study aim and hypotheses, it can be concluded that:

1. Effective functioning in the domain behaviour control, indicative of family rules that are reasonable and flexible provides a favourable environment that protects against the consumption of sugary foods more than four times per day by three and four year old children; independent of demographic, socioeconomic and environmental influences.

2. Effective functioning in the domain affective responsiveness indicative of the ability of family members to respond to a given stimulus with an appropriate quality and quantity of feelings, provides a favourable environment that protects against the consumption of sugary foods more than four times per day by three and four year old children; independent of demographic, socioeconomic and environmental influences.

3. Effective functioning in the domain affective involvement indicative of a real understanding of the needs of family members along with the ability to meet them, provides a favourable environment that protects against the consumption of sugary foods more than four times per day by three and four year old children; independent of demographic, socioeconomic and environmental influences.

4. Effective functioning in the domain communication indicative of clear, open and direct communication between members, provides a favourable environment that protects against the consumption of sugary foods more than four times per day by three and four year old children; independent of demographic, socioeconomic and environmental influences.

5. Effective functioning in the domain roles indicative of the family having clearly defined roles and responsibilities for its members, provides a favourable environment that protects against the consumption of sugary foods more than four times per day by three and four year old children; independent of demographic, socioeconomic and environmental influences.

6. Three and four year old children whose mothers have a higher level of education (A levels or higher) are less likely to consume sugary foods more than four times per day compared to children whose mothers have lower educational qualifications.

7. Mother's higher education improves the family's ability to regulate family behaviour (effective behaviour control), resulting in children being less likely to consume sugary foods more than four times per day.

8. Mother's higher education improves the family's ability to respond to any given stimulus with the appropriate quality and quantity of feelings (effective affective responsiveness), resulting in emotional stability making children less likely to consume sugary foods more than four times per day.

9. Mother's higher education improves the family's ability to gain a real understanding of the needs of family members along with the ability to meet these needs (effective affective involvement); creating emotional bonds that result in children being less likely to consume sugary foods more than four times per day.

10. Mother's higher education fosters clear, open and direct communication between family members (effective communication), resulting in children being less likely to consume sugary foods more than four times per day.

11. Mother's higher education enables the family to have clearly defined roles and responsibilities for its members (effective roles), resulting in children being less likely to consume sugary foods more than four times per day.

In addition, we found that:

1. Three and four year old children whose mothers were of Asian ethnicity were more likely to consume sugary foods more than four times per day compared to children whose mothers are of White ethnicity.

2. Asian mothers were more likely than White mothers to perceive inefficient family functioning in the domains, behaviour control, affective responsiveness, affective involvement, communication, and roles; resulting in their children being more likely to consume sugary foods more than four times per day compared to children of White mothers.

The findings of the current study are consistent with the literature (Kitzman-Ulrich et al.,2010) that family factors contribute to healthy dietary behaviours through parental monitoring (rules, roles, communication, problem solving), creation of a healthy eating environment (rules, roles, problem solving, communication, affective responsiveness and affective involvement), setting boundaries (rules, roles, communication, problem solving), parental warmth (affective responsiveness and affective involvement) and shared decision making (roles, communication, problem solving). The family functioning domains assessed by the FAD which are related to these areas of the

family environment, are given in parentheses and effective functioning in these domains has been demonstrated in this study as contributing to restricting children's sugar consumption frequency. Problem solving has been retained in this list of domains because although its association lost significance when mother's education and IMD were added to the model, this could have resulted because a major portion of the effect of problem solving could have been captured by mother's education (as discussed in section 7.1) and not because the effect was confounded by mother's education.

7.5 Implications for future research

There is an increasing appreciation of the need to understand how social, cultural, environmental and psychosocial factors within the family environment influence oral health outcomes in children, as a way of decreasing disparities (Litt et al.,1995; Finlayson et al.,2007; Fisher-Owens et al.,2007; Mouradian et al.,2007). This study provides an added understanding of how family functioning, an important force within the family environment combining psychosocial, cultural and environmental influences under one broad umbrella, could contribute to decreasing health inequalities by supporting the development of a child as a health promoting actor. Families that perceive efficient functioning in each domain clearly have an enhanced perception of their ability to carry out the day-to-day family duties, and consequently the family environment as a whole may be more receptive to adopting and maintaining a healthy diet.

Family functioning is a more visible and tangible construct than self efficacy and may therefore lend itself more easily to any interventions. As pointed out by Baron and Kenny (1986), in research involving social factors, the relationship between a dependent variable and an independent variable cannot usually be explained by one single mediator alone, therefore family functioning in the relevant domains can be regarded as contributing to the theory base and findings from this study add a new dimension to the study of protective factors related to children's diets. Efficient family functioning in each of the domains may improve the acquisition of health promoting dietary behaviours in children by assisting families in breaking down any barriers that may interfere with this process and by creating a health promoting and health sustaining family environment.

Overall this study makes an important contribution to our understanding of how psychosocial forces within the family environment could contribute to oral health related dietary behaviours and ultimately influence oral health outcomes, although further research utilising longitudinal study designs is required to actually establish the causative role of family functioning in relation to children's diets high in NMES. Longitudinal studies will establish temporal relations of the study variables allowing us to make causal assumptions and can determine if family functioning changes over time and how this influences dietary acquisition and maintenance of this behaviour in children.

Although family functioning in the different domains was able to account for some of the protective effect of mother's education, it was unable to fully explain the association between mother's education and children's sugar consumption, indicating that there are other factors influencing this pathway that need to be explored. It has been proposed that general education of the population will positively influence the oral health of the population as a whole, as it is linked to multiple risk factors (Sheiham,2000), this study shows that mother's higher education will improve family functioning in all of the domains, therefore efforts to improve general education will also improve family functioning which will benefit the population as a whole as it is a way of positively influencing acquisition of dietary behaviour which is intimately linked to dental caries.

Similarly, family functioning in the domains behaviour control, affective responsiveness, affective involvement, communication and roles only partially explained the association between mother's ethnicity and children's sugar consumption frequency. Research in relation to oral health disparities between ethnic groups have indicated that social status may be responsible for the difference;

therefore future studies should include multiple SEP indicators and also further explore the influence of mother's education as it acted as a suppressor in this study. Overall the direct effect of ethnicity may be attributed to factors that are culturally rooted within the ethnic groups. However, findings from the current study indicate that family functioning in the relevant domains mediate some of this influence and is therefore an important and relevant area to focus on in future.

Findings from this study imply that interventions to reduce oral health inequalities by focusing on dietary behaviours, may benefit from including family therapy to improve family functioning in the domains behaviour control, affective responsiveness, affective involvement, problem solving, communication and roles. Effective functioning in these domains, demonstrated by flexible family rules, appropriate emotional response and involvement, clear and direct verbal communication between members and fairly allocated family duties with members assuming accountability; creates a favourable family environment that allows families to integrate their health related goals within the remit of everyday activities and goals, making them part of the daily workings of the family and hence more sustainable, even in the midst of adversity, as it becomes part of daily life.

Family functioning falls within the remit of The Common Risk/Health Factor Approach (CRHFA) made prominent as a tool for addressing oral health inequalities (Sheiham and Watt,2000). Efficient family functioning creates a favourable environment that enables and encourages acquisition and maintenance of health promoting behaviours, relating to both oral and general health and therefore can be considered an additional tool in the arsenal to tackle health disparities. This study therefore contributes to literature on the upstream factors, those that shape the environment that contributes to the development of dietary behaviours in children. The Scottish

Dental Clinical Effectiveness Programme (SDCEP) (2010) recommends that in order to keep the child free from oral disease the first step is to *"to encourage the child's parent/carer to take responsibility for their child's oral health, implement preventive advice at home and meet their obligations to bring their child for dental care";* effectively functioning families may be able to more readily accept and incorporate such messages and therefore a multidisciplinary approach incorporating family therapy may be more effective in oral health promotion interventions.

References

Adair, P. M., Pine, C. M., Burnside, G., Nicoll, A. D., Gillett, A., Anwar, S., Broukal, Z., Chestnutt, I. G., Declerck, D., Feng, X. P., Ferro, R., Freeman, R., Gibbons, D., Grant-Mills, D., Gugushe, T., Hunsrisakhun, J., Irigoyen-Camacho, M., Lo, E. C. M., Moola, M. H., Naidoo, S., Nyandindi, U., Poulsen, V. J., Ramos-Gomez, F., Razanamihaja, N., Shahid, S., Skeie, M. S., Skur, P., Splieth, C., Teo, C. S., Whelton, H. and Young, D. W. (2003). Familial and Cultural Perceptions and Beliefs of Oral Hygiene and Dietary Practices among Ethnically and Socioeconomically Diverse Groups. Journal of Dental Research **82**: B66-B66.

Akister, J. and Stevensonhinde, J. (1991). Identifying Families at Risk - Exploring the Potential of the McMaster Family Assessment Device. Journal of Family Therapy **13**(4): 411-421.

Alderfer, M. A., Fiese, B. H., Gold, J. I., Cutuli, J. J., Holmbeck, G. N., Goldbeck, L., Chambers, C. T., Abad, M., Spetter, D. and Patterson, J. (2008). Evidence-Based Assessment in Pediatric Psychology: Family Measures. Journal Pediatric Psychology **33**(9): 1046-1061; discussion 1062-1044.

Ambrosini, G. L., Oddy, W. H., Robinson, M., O'Sullivan, T. A., Hands, B. P., De Klerk, N. H., Silburn, S. R., Zubrick, S. R., Kendall, G. E., Stanley, F. J. and Beilin, L. J. (2009). Adolescent Dietary Patterns Are Associated with Lifestyle and Family Psycho-Social Factors. Public Health Nutrition **12**(10): 1807-1815.

Anderson, C. A., Curzon, M. E. J., Van Loveren, C., Tatsi, C. and Duggal, M. S. (2009). Sucrose and Dental Caries: A Review of the Evidence. Obesity Reviews **10**: 41-54.

Ashcroft, A., Harris, R. and Dailey, Y. (2007) One-to-One Dietary Interventions Undertaken in a Dental Setting for a Change in Dietary Behaviour and the Prevention of Dental Caries and Erosion. Cochrane Database of Systematic Reviews. http://www.mrw.interscience.wiley.com/cochrane/clsysrev/articles/CD006540/frame.html

Baron, R. M. and Kenny, D. A. (1986). The Moderator-Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations. Journal of Personality and Social Psychology **51**(6): 1173-1182.

Benton, D. (2004). Role of Parents in the Determination of the Food Preferences of Children and the Development of Obesity. International Journal of Obesity **28**(7): 858-869.

Bihun, J. T., Wamboldt, M. Z., Gavin, L. A. and Wamboldt, F. S. (2002). Can the Family Assessment Device (FAD) Be Used with School Aged Children? Family Process **41**(4): 723-731.

Birch, L. L. and Fisher, J. O. (1998). Development of Eating Behaviors among Children and Adolescents. Pediatrics **101**(3): 539-549.

Birch, L. L., Zimmerman, S. I. and Hind, H. (1980). The Influence of Social-Affective Context on the Formation of Childrens Food Preferences. Child Development **51**(3): 856-861.

Birkmeyer, J. D., Stukel, T. A., Siewers, A. E., Goodney, P. P., Wennberg, D. E. and Lucas, F. L. (2003). Surgeon Volume and Operative Mortality in the United States. New England Journal of Medicine **349**(22): 2117-2127.

Blinkhorn, A. S. (1981). Dental Preventive Advice for Pregnant and Nursing Mothers-Sociological Implications. International Dental Journal **31**(1): 14-22.

Blinkhorn, A. S., Wainwright-Stringer, Y. M. and Holloway, P. J. (2001). Dental Health Knowledge and Attitudes of Regularly Attending Mothers of High-Risk, Pre-School Children. International Dental Journal **51**(6): 435-438.

Bloch, S., Hafner, J., Harari, E. and Szmukler, G. I. (1994). The Family in Clinical Psychiatry. New York, Oxford University Press.

Bray, J. H. (1995). Family Assessment: Current Issues in Evaluating Families. Family Relations **44**(4): 469-477.

British Association for the Study of Community Dentistry (2005-2006). Dental Caries Experience of 5-Year-Old Children in Great Britain. http://www.dundee.ac.uk/tuith/search/tables/tab2005_6.htm

Burt, B. A. and Pai, S. (2001). Sugar Consumption and Caries Risk: A Systematic Review. Journal of Dental Education **65**(10): 1017-1023.

Byles, J., Byrne, C., Boyle, M. H. and Offord, D. R. (1988). Ontario Child Health Study: Reliability and Validity of the General Functioning Subscale of the McMaster Family Assessment Device. Family Process **27**(1): 97-104.

Cade, J., Thompson, R., Burley, V. and Warm, D. (2002). Development, Validation and Utilisation of Food-Frequency Questionnaires - A Review. Public Health Nutrition **5**(4): 567-587.

Chen, J. L. and Kennedy, C. (2005). Factors Associated with Obesity in Chinese-American Children. Pediatric Nursing **31**(2): 110-115.

Christensen, P. (2004). The Health-Promoting Family: A Conceptual Framework for Future Research. Social Science and Medicine **59**(2): 377-387.

Crall, J. J., Edelstein, B. and Tinanoff, N. (1990). Relationship of Microbiological, Social, and Environmental Variables to Caries Status in Young Children. Pediatric Dentistry **12**(4): 233-236.

Crawford, P. J. (1998). UK National Clinical Guidelines in Paediatric Dentistry. Continuing Oral Care: Review and Recall. International Journal of Paediatric Dentistry **8**(3): 227-228.

Cutting, T. M., Fisher, J. O., Grimm-Thomas, K. and Birch, L. L. (1999). Like Mother, Like Daughter: Familial Patterns of Overweight Are Mediated by Mothers' Dietary Disinhibition. American Journal of Clinical Nutrition **69**(4): 608-613.

Department of Communities and Local Government (2007). Indices of Deprivation 2007. http://www.imd.communities.gov.uk/

Department of Health and the British Association for the Study of Community Dentistry (2009). Delivering Better Oral Health:An Evidence-Based Toolkit for Prevention. Department of Health. London.

http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/documents/digitalasset/dh_102982.pdf

Drohan, S. H. (2002). Managing Early Childhood Obesity in the Primary Care Setting: A Behavior Modification Approach. Pediatric Nursing **28**(6): 599-610.

Emanuelli, F., Ostuzzi, R., Cuzzolaro, M., Watkins, B., Lask, B. and Waller, G. (2003). Family Functioning in Anorexia Nervosa: British and Italian Mothers' Perceptions. Eating Behaviour **4**(1): 27-39.

Epstein, N. B., Baldwin, L. M. and Bishop, D. S. (1981). The McMaster Family Assessment Device, Version 3, Copyright Registration Number 82-315.

Epstein, N. B., Baldwin, L. M. and Bishop, D. S. (1983). The McMaster Family Assessment Device. Journal of Marital and Family Therapy **9**(2): 171-180.

Epstein, N. B., Baldwin, L. M. and Bishop, D. S., Eds. (2005). Family Assessment Device. Evaluating and Treating Families: The McMaster Approach. New York, Routledge.

Epstein, N. B., Bishop, D. S. and Levin, S. (1978). The McMaster Model of Family Functioning. Journal of Marital and Family Therapy **4**(4): 19-31.

Epstein, N. B., Ryan, C. E., Bishop, D. S., Miller, I. W. and Keitner, G. I., Eds. (2003). The McMaster Model a View of Healthy Family Functioning. Normal Family Process: Growing Diversity and Complexity.Third Edition. New York, Guilford Publications.

Fejerskov, O. and Kidd, E., Eds. (2008). Dental Caries the Disease and Its Clinical Management.Second Edition. Blackwell Munksgaard.

Field, A. (2009). Discovering Statistics Using SPSS. London, Sage Publications Ltd.

Filstrup, S. L., Briskie, D., Da Fonseca, M., Lawrence, L., Wandera, A. and Inglehart, M. R. (2003). Early Childhood Caries and Quality of Life: Child and Parent Perspectives. Pediatric Dentistry **25**: 431 - 440.

Finlayson, T. L., Siefert, K., Ismail, A. I. and Sohn, W. (2007). Psychosocial Factors and Early Childhood Caries among Low-Income African-American Children in Detroit. Community Dentistry and Oral Epidemiology **35**(6): 439-448.

Fisher-Owens, S. A., Gansky, S. A., Platt, L. J., Weintraub, J. A., Soobader, M.-J., Bramlett, M. D. and Newacheck, P. W. (2007). Influences on Children's Oral Health: A Conceptual Model. Pediatrics **120**(3): e510-520.

Fisk, C. M., Crozier, S. R., Inskip, H. M., Godfrey, K. M., Cooper, C. and Robinson, S. M. (2011). Influences on the Quality of Young Children's Diets: The Importance of Maternal Food Choices. British Journal of Nutrition **105**(2): 287-296.

Food Standards Agency and the Department of Health (2008/2009).National Diet and Nutrition Survey. Headline Results from Year 1 of the Rolling Programme. Edited By: Beverley Bates, Alison Lennox, Gillian Swan.

Gao, X.-L., Hsu, C.-Y. S., Xu, Y. C., Loh, T., Koh, D. and Hwarng, H. B. (2010). Behavioral Pathways Explaining Oral Health Disparity in Children. Journal of Dental Research **89**(9): 985-990.

Gelfand, L. A., Mensinger, J. L. and Tenhave, T. (2009). Mediation Analysis: A Retrospective Snapshot of Practice and More Recent Directions. Journal of General Psychology **136**(2): 153-176.

Georgiades, K., Boyle, M. H., Jenkins, J. M., Sanford, M. and Lipman, E. (2008). A Multilevel Analysis of Whole Family Functioning Using the McMaster Family Assessment Device. Journal of Family Psychology **22**(3): 344-354.

Gibson, S. and Williams, S. (1999). Dental Caries in Pre-School Children: Associations with Social Class, Toothbrushing Habit and Consumption of Sugars and Sugar-Containing Foods. Further Analysis of Data from the National Diet and Nutrition Survey of Children Aged 1.5-4.5 Years. Caries Research **33**(2): 101-113.

Gibson, S. A. (1997). Non-Milk Extrinsic Sugars in the Diets of Pre-School Children: Association with Intakes of Micronutrients, Energy, Fat and NSP. British Journal of Nutrition **78**(3): 367-378.

Gift, H. C., Reisine, S. T. and Larach, D. C. (1992). The Social Impact of Dental Problems and Visits. American Journal of Public Health **82**(12): 1663-1668.

Gruber K J and Haldeman L A (2009) Using the Family to Combat Childhood and Adult Obesity. Preventing Chronic Disease **6 (**3**)**.

Hackshaw, A. and Kirkwood, A. (2011). Interpreting and Reporting Clinical Trials with Results of Borderline Significance. British Medical Journal **343**: d3340.

Hamilton, I. M., Joy, C. B., Cauble, A. E., Comeau, J. K., Patterson, J. M. and Needle, R. H. (1980). Family Stress and Coping: A Decade Review. Journal of Marriage and Family **42**(4): 855-871.

Harris, R., Nicoll, A., Adair, P. and Pine, C. (2004). Risk Factors for Dental Caries in Young Children: A Systematic Review of the Literature. Community Dental Health **21**: 71 - 85.

Hayden, L. C., Schiller, M., Dickstein, S., Seifer, R., Sameroff, A. J., Miller, I., Keitner, G. and Rasmussen, S. (1998). Levels of Family Assessment: I. Family, Marital, and Parent-Child Interaction. Journal of Family Psychology **12**(1): 7-22.

Herzer, M., Godiwala, N., Hommel, K. A., Driscoll, K., Mitchell, M., Crosby, L. E., Piazza-Waggoner, C., Zeller, M. H. and Modi, A. C. (2010). Family Functioning in the Context of Pediatric Chronic Conditions. Journal of Development and Behavioural Pediatrics **31**(1): 26-34.

Hinds, K. and Gregory, J. R. (1995).National Diet and Nutrition Survey: Children Aged 1/2 to 41/2 Years: GB 1992-3. Volume 2:Report of the Dental Survey. London: HMSO.

Holst, D., Schuller, A. A., Aleksejuniene, J. and Eriksen, H. M. (2001). Caries in Populations-A Theoretical, Causal Approach. European Journal of Oral Sciences **109**(3): 143-148.

Hunt, S. M. and Macleod, M. (1987). Health and Behavioural Change: Some Lay Perspectives. Community Medicine **9**(1): 68-76.

Jamel, H. A., Sheiham, A., Cowell, C. R. and Watt, R. G. (1996). Taste Preference for Sweetness in Urban and Rural Populations in Iraq. Journal of Dental Research **75**(11): 1879-1884.

Karjalainen, S. (2007). Eating Patterns, Diet and Dental Caries. Dental Update **34**(5): 295-298, 300.

Kay, E. J. (1999). How Often Should We Go to the Dentist? Regulations Are Needed to Govern Their Composition and Advertising. British Medical Journal **319**(7204): 204-205.

Kelaher, M., Paul, S., Lambert, H., Ahmad, W. and Smith, G. D. (2009). The Applicability of Measures of Socioeconomic Position to Different Ethnic Groups within the UK. International Journal for Equity in Health **8**:4

Kenny, D. A. (2009). Online resourse. http://davidakenny.net/cm/mediate.htm#SE

Kintner, M., Boss, P. G. and Johnson, N. (1981). The Relationship between Dysfunctional Family Environments and Family Member Food-Intake. Journal of Marriage and the Family **43**(3): 633-641.

Kitzman-Ulrich, H., Wilson, D., St. George, S., Lawman, H., Segal, M. and Fairchild, A. (2010). The Integration of a Family Systems Approach for Understanding Youth Obesity, Physical Activity, and Dietary Programs. Clinical Child and Family Psychology Review **13**(3): 231-253.

Kline, R. B. (2005). Principles and Practice of Structural Equation Modelling. New York, The Guildford Press.

Kraemer, H. C., Kiernan, M., Essex, M. and Kupfer, D. J. (2008). How and Why Criteria Defining Moderators and Mediators Differ between the Baron & Kenny and Macarthur Approaches. Health Psychology **27**(2): S101-S108.

Kraemer, H. C., Stice, E., Kazdin, A., Offord, D. and Kupfer, D. (2001). How Do Risk Factors Work Together? Mediators, Moderators, and Independent, Overlapping, and Proxy Risk Factors. American Journal of Psychiatry **158**(6): 848-856.

Kumanyika, S. K. (2008). Environmental Influences on Childhood Obesity: Ethnic and Cultural Influences in Context. Physiology & Behavior **94**(1): 61-70.

Larson, N. and Story, M. (2009). A Review of Environmental Influences on Food Choices. Annals of Behavioral Medicine **38**(Suppl 1): S56–S73.

Leon, A. M. and Armantrout, E. M. (2007). Assessing Families and Other Client Systems in Community-Based Programmes: Development of the CALF. Child & Family Social Work **12** (2) : 123-132.

Levine, R. (2004). The Scientific Basis of Oral Health Education. Community Dental Health **21**(2): 131-133.

Li, Y. (2011). Controlling Sugar Consumption Still Has a Role to Play in the Prevention of Dental Caries. Journal of Evidence Based Dental Practice **11**(1): 24-26.

Litt, M. D., Reisine, S. and Tinanoff, N. (1995). Multidimensional Causal Model of Dental Caries Development in Low-Income Preschool Children. Public Health Reports **110**(5): 607-617.

Locker, D. (2000). Deprivation and Oral Health: A Review. Community Dentistry and Oral Epidemiology **28**(3): 161-169.

Locker, D. and Ford, J. (1994). Evaluation of an Area-Based Measure as an Indicator of Inequalities in Oral Health. Community Dentistry and Oral Epidemiology **22**(2): 80-85.

Loe, H. (2000). Oral Hygiene in the Prevention of Caries and Periodontal Disease. International Dental Journal **50**(3): 129-139.

Low, W., Tan, S. and Schwartz, S. (1999). The Effect of Severe Caries on the Quality of Life in Young Children. Pediatric Dentistry **21**(6): 325-326.

Mackinnon, D. P. and Fairchild, A. J. (2009). Current Directions in Mediation Analysis. Current Direction in Psychological Science **18**(1): 16.

Mackinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G. and Sheets, V. (2002). A Comparison of Methods to Test Mediation and Other Intervening Variable Effects. Psychological Methods **7**(1): 83-104.

Mackinnon, D. P. and Luecken, L. J. (2008). How and for Whom? Mediation and Moderation in Health Psychology. Health Psychology **27**(2, Suppl): S99-S100.

Majewski, R. F., Snyder, C. W. and Bernat, J. E. (1988). Dental Emergencies Presenting to a Children's Hospital. ASDC Journal of Dentistry for Children **55**(5): 339-342.

Marcenes, W. and Sheiham, A. (1996). The Relationship between Marital Quality and Oral Health Status. Psychology & Health **11**(3): 357-369.

Marcenes, W., Muirhead, V. and Fortune, F. (2011a). Adult Dental Health Survey:Oral Health in Outer North East London 2008-2010. http://www.dentistry.qmul.ac.uk/research/Population%20Based%20Patient%20Studies/Oral%20Needs%20Assessment/index.html

Marcenes, W., Muirhead, V. and Fortune, F. (2011b). The Oral Health of Three-Four-Year Old Children in Outer North East London 2008-2010. http://www.dentistry.qmul.ac.uk/research/Population%20Based%20Patient%20Studies/Oral%20Needs%20Assessment/index.html

Marinho, V. C., Higgins, J. P., Sheiham, A. and Logan, S. (2003). Fluoride Toothpastes for Preventing Dental Caries in Children and Adolescents. Cochrane Database Syst Rev(1): CD002278.

Marshall, T. A., Levy, S. M., Broffitt, B., Warren, J. J., Eichenberger-Gilmore, J. M., Burns, T. L. and Stumbo, P. J. (2003). Dental Caries and Beverage Consumption in Young Children. Pediatrics **112**(3 Pt 1): E184-191.

Mattila, M. L., Paunio, P., Rautava, P., Ojanlatva, A. and Sillanpaa, M. (1998). Changes in Dental Health and Dental Health Habits from 3 to 5 Years of Age. Journal of Public Health Dentistry **58**(4): 270-274.

Mattila, M. L., Rautava, P., Aromaa, M., Ojanlatva, A., Paunio, P., Hyssala, L., Helenius, H. and Sillanpaa, M. (2005a). Behavioural and Demographic Factors During Early Childhood and Poor Dental Health at 10 Years of Age. Caries Research **39**(2): 85-91.

Mattila, M.L., Rautava, P., Ojanlatva, A., Paunio, P., Hyssala, L., Helenius, H. and Sillanpaa, M. (2005b). Will the Role of Family Influence Dental Caries among Seven-Year-Old Children? Acta Odontologica Scandinavica **63**: 73-84.

Mattila, M. L., Rautava, P., Sillanpaa, M. and Paunio, P. (2000). Caries in Five-Year-Old Children and Associations with Family-Related Factors. Journal of Dental Research **79**(3): 875-881.

McGraw, K. O. and Wong, S. P. (1996). Forming Inferences About Some Intraclass Correlation Coefficients. Psychological Methods **1**(1): 30-46.

McNeill, G., Macdiarmid, J., Craig, L., Holmes, B., Loe, J., Nelson, M. and Masson, L. (2009).Secondary Analysis of the Survey of Sugar Intake among Children in Scotland. Food Standards Agency Scotland Research Project S14039.

McQueen, D. V. (1996). The Search for Theory in Health Behaviour and Health Promotion. Health Promotion International **11**(1): 27-32.

Miller, I. W., Bishop, D. S., Epstein, N. B. and Keitner, G. I. (1985). The McMaster Family Assessment Device - Reliability and Validity. Journal of Marital and Family Therapy **11**(4): 345-356.

Mobley, C., Marshall, T. A., Milgrom, P. and Coldwell, S. E. (2009). The Contribution of Dietary Factors to Dental Caries and Disparities in Caries. Academic Pediatrics **9**(6): 410-414.

Mouradian, W. E., Huebner, C. E., Ramos-Gomez, F. and Slavkin, H. C. (2007). Beyond Access: The Role of Family and Community in Children's Oral Health. Journal of Dental Education. **71**(5): 619-631.

Moynihan, P. (2000). The British Nutrition Foundation Oral Task Force Report -Issues Relevant to Dental Health Professionals. British Dental Journal **188**(06): 308-312.

Moynihan, P. and Petersen, P. E. (2004). Diet, Nutrition and the Prevention of Dental Diseases. Public Health Nutrition **7**(1A): 201-226.

Moynihan, P. J. (2005). The Role of Diet and Nutrition in the Etiology and Prevention of Oral Diseases. Bulletin of the World Health Organization **83**: 694 - 699.

Moynihan, P. J. and Holt, R. D. (1996). The National Diet and Nutrition Survey of 1.5 to 4.5 Year Old Children: Summary of the Findings of the Dental Survey. British Dental Journal **181**(9): 328-332.

Murray, J. J. (1996). Attendance Patterns and Oral Health. British Dental Journal **181**(9): 339-342.

National Statistics (1998). Adult Dental Health Survey: Oral Health in the United Kingdom 1998. Office for National Statistics, HMSO.

National Statistics (2005). The National Statistics Socio-Economic Classification. User Manual. N. S. P. MacMillan.

Nicolau, B., Marcenes, W., Bartley, M. and Sheiham, A. (2005). Associations between Socio-Economic Circumstances at Two Stages of Life and Adolescents' Oral Health Status. Journal of Public Health Dentistry **65**(1): 14-20.

Noble, M., Mclennan, D., Wilkinson, K., Whitworth, A., Barnes, H. and Dibben, C. (2007).The English Indices of Deprivation 2007. Communities and Local Government, London Http://Www.Communities.Gov.Uk/Documents/Communities/Pdf/733520.Pdf

North, K. and Emmett, P. (2000). Multivariate Analysis of Diet among Three-Year-Old Children and Associations with Socio-Demographic Characteristics. The Avon

Longitudinal Study of Pregnancy and Childhood (ALSPAC) Study Team. European Journal of Clinical Nutrition **54**(1): 73-80.

North West Public Health Observatory and the Dental Observatory (2010).NHS Dental Epidemiology Programme for England Report June 2010. http://www.nwph.net/dentalhealth/reports/NHS_Dental_Epidemiology_Programme_for_England_Report_June_2010.pdf

Northstone, K. and Emmett, P. (2005). Multivariate Analysis of Diet in Children at Four and Seven Years of Age and Associations with Socio-Demographic Characteristics. European Journal of Clinical Nutrition **59**(6): 751-760.

Pickett, K. E. and Pearl, M. (2001). Multilevel Analyses of Neighbourhood Socioeconomic Context and Health Outcomes: A Critical Review. Journal of Epidemiology and Community Health **55**(2): 111-122.

Pine, C. M., Adair, P. M., Nicoll, A. D., Burnside, G., Petersen, P. E., Beighton, D., Gillett, A., Anderson, R., Anwar, S., Brailsford, S., Broukal, Z., Chestnutt, I. G., Declerck, D., Ping, F. X., Ferro, R., Freeman, R., Gugushe, T., Harris, R., Lin, B., Lo, E. C., Maupome, G., Moola, M. H., Naidoo, S., Ramos-Gomez, F., Samaranayake, L. P., Shahid, S., Skeie, M. S., Splieth, C., Sutton, B. K., Soo, T. C. and Whelton, H. (2004a). International Comparisons of Health Inequalities in Childhood Dental Caries. Community Dental Health **21**(1 Suppl): 121-130.

Pine, C. M., Adair, P. M., Petersen, P. E., Douglass, C., Burnside, G., Nicoll, A. D., Gillett, A., Anderson, R., Beighton, D., Jin-You, B., Broukal, Z., Brown, J. P., Chestnutt, I. G., Declerck, D., Devine, D., Espelid, I., Falcolini, G., Ping, F. X., Freeman, R., Gibbons, D., Gugushe, T., Harris, R., Kirkham, J., Lo, E. C., Marsh, P., Maupome, G., Naidoo, S., Ramos-Gomez, F., Sutton, B. K. and Williams, S. (2004b). Developing Explanatory Models of Health Inequalities in Childhood Dental Caries. Community Dental Health **21**(1 Suppl): 86 - 95.

Reisine, S. (1985). Dental Health and Public Policy; the Social Impact of Dental Disease. American Journal of Public Health **75**: 27 - 30.

Reisine, S. T. and Psoter, W. (2001). Socioeconomic Status and Selected Behavioral Determinants as Risk Factors for Dental Caries. Journal of Dental Education **65**(10): 1009-1016.

Renzaho, A. M. N., Kumanyika, S. and Tucker, K. L. (2011). Family Functioning, Parental Psychological Distress, Child Behavioural Problems, Socio-Economic Disadvantage and Fruit and Vegetable Consumption among 4–12 Year-Old Victorians, Australia. Health Promotion International **26**(3): 263-275.

Rew, L. and Horner, S. D. (2003). Youth Resilience Framework for Reducing Health-Risk Behaviors in Adolescents. Journal of Pediatric Nursing **18**(6): 379-388.

Rhee, K. (2008). Childhood Overweight and the Relationship between Parent Behaviors, Parenting Style, and Family Functioning. The Annals of the American Academy of Political and Social Science **615**(1): 11-37.

Ridenour, T. A., Daley, J. G. and Reich, W. (1999). Factor Analyses of the Family Assessment Device. Family Process **38**(4): 497-510.

Roberts K (2010). Dietary Surveillance and Nutritional Assessemnet in England: What Is Measured and Where Are the Gaps? National Obesity Observatory. Oxford.

Rodrigues, C. S. and Sheiham, A. (2000). The Relationships between Dietary Guidelines, Sugar Intake and Caries in Primary Teeth in Low Income Brazilian 3-Year-Olds: A Longitudinal Study. International Journal of Paediatric Dentistry **10**(1): 47-55.

Ryan, C. E., Epstein, N. B., Keitner, G. I., Miller, I. W. and Bishop, D. S. (2005). Evaluating and Treating Families: The McMaster Approach. New York, Routledge.

Sallis, J. F. and Nader, P. H. (1988). Family Determinants of Health Behaviors. New York, Plenum Press. Health Behavior. Emerging Research Perspectives 107–126.

Savage, J. S., Fisher, J. O. and Birch, L. L. (2007). Parental Influence on Eating Behavior: Conception to Adolescence. The Journal of Law, Medicine & Ethics **35**(1): 22-34.

Scaglioni, S., Salvioni, M. and Galimberti, C. (2008). Influence of Parental Attitudes in the Development of Children Eating Behaviour. British Journal of Nutrition **99** (Suppl 1): S22-25.

Schor, E. L. (2003). Family Pediatrics: Report of the Task Force on the Family. Pediatrics **111**(6 Pt 2): 1541-1571.

Scottish Dental Clinical Effectiveness Programme (2010) Prevention and Management of Dental Caries in Children.Guidance in Brief. http://www.sdcep.org.uk/index.aspx?o=2858

Sheehy, C., McNeill, G., Masson, L., Craig, L., Macdiarmid, J., Holmes, B. and Nelson, M. (2008).Survey of Sugar Intake among Children in Scotland. http://www.food.gov.uk/multimedia/pdfs/sugarintakescot2008rep.pdf

Sheiham, A. (2000). Improving Oral Health for All: Focusing on Determinants and Conditions. Health Education Journal **59**(4): 351-363.

Sheiham, A. (2001). Dietary Effects on Dental Diseases. Public Health Nutrition **4**(2b): 569-591.

Sheiham, A. (2006). Dental Caries Affects Body Weight, Growth and Quality of Life in Pre-School Children. British Dental Journal **201**(10): 625-626.

Sheiham, A. and Watt, R. G. (2000). The Common Risk Factor Approach: A Rational Basis for Promoting Oral Health. Community Dentistry and Oral Epidemiology **28**(6): 399-406.

Silva, A. N., Mendonca, M. H. and Vettore, M. V. (2008). A Salutogenic Approach to Oral Health Promotion. Cad Saude Publica **24 Suppl 4**: s521-530.

Singh-Manoux, A., Clarke, P. and Marmot, M. (2002). Multiple Measures of Socio-Economic Position and Psychosocial Health: Proximal and Distal Measures. International Journal of Epidemiology **31**(6): 1192-1199; Discussion 1199-1200.

Sisson, K. L. (2007). Theoretical Explanations for Social Inequalities in Oral Health. Community Dentistry and Oral Epidemiology **35**(2): 81-88.

Skeie, M. S., Riordan, P. J., Klock, K. S. and Espelid, I. (2006). Parental Risk Attitudes and Caries-Related Behaviours among Immigrant and Western Native Children in Oslo. Community Dentistry and Oral Epidemiology **34**(2): 103-113.

Smith, G. D. (2000). Learning to Live with Complexity: Ethnicity, Socioeconomic Position, and Health in Britain and the United States. American Journal of Public Health **90**(11): 1694-1698.

Smith, P. A. and Freeman, R. (2009). Living in a Sweetie Culture: Scottish Parents' Difficulties in Maintaining Their Children's Oral Health. Health Education Journal **68**(4): 255-265.

Spieth, L. E., Stark, L. J., Mitchell, M. J., Schiller, M., Cohen, L. L., Mulvihill, M. and Hovell, M. F. (2001). Observational Assessment of Family Functioning at Mealtime in Preschool Children with Cystic Fibrosis. Journal of Pediatric Psychology **26**: 215-224.

Streiner, D. L. (2006). Building a Better Model: An Introduction to Structural Equation Modelling. Canadian Journal Of Psychiatry **51**(5): 317-324.

Streiner, D. L. and Norman, G. R. (2011). Correction for Multiple Testing Is There a Resolution? Chest **140**(1): 16-18.

Sullivan, S. A. and Birch, L. L. (1990). Pass the Sugar, Pass the Salt - Experience Dictates Preference. Developmental Psychology **26**(4): 546-551.

Sweeting, H. and West, P. (1995). Family Life and Health in Adolescence: A Role for Culture in the Health Inequalities Debate? Social Science and Medicine **40**(2): 163-175.

Tanzer, J. M., Livingston, J. and Thompson, A. M. (2001). The Microbiology of Primary Dental Caries in Humans. Journal of Dental Education **65**(10): 1028-1037.

Tiffin, P. A., Pearce, M., Kaplan, C., Fundudis, T. and Parker, L. (2007). The Impact of Socio-Economic Status and Mobility on Perceived Family Functioning. Journal of Family and Economic Issues **28**(4): 653–667

Tinanoff, N. and Palmer, C. A. (2000). Dietary Determinants of Dental Caries and Dietary Recommendations for Preschool Children. Journal of Public Health Dentistry **60**(3): 197-206.

Turrell, G., Hewitt, B., Patterson, C. and Oldenburg, B. (2003). Measuring Socio-Economic Position in Dietary Research: Is Choice of Socio-Economic Indicator Important? Public Health Nutrition **6**(2): 191-200.

Turrell, G. and Kavanagh, A. M. (2006). Socio-Economic Pathways to Diet: Modelling the Association between Socio-Economic Position and Food Purchasing Behaviour. Public Health Nutrition **9**(03): 375-383.

Turrell, G., Sanders, A. E., Slade, G. D., Spencer, A. J. and Marcenes, W. (2007). The Independent Contribution of Neighborhood Disadvantage and Individual-Level Socioeconomic Position to Self-Reported Oral Health: A Multilevel Analysis. Community Dentistry and Oral Epidemiology **35**(3): 195-206.

Van Palenstein Helderman, W. H., Matee, M. I., Van Der Hoeven, J. S. and Mikx, F. H. (1996). Cariogenicity Depends More on Diet Than the Prevailing Mutans Streptococcal Species. Journal of Dental Research **75**(1): 535-545.

Verrips, G. H., Kalsbeek, H. and Eijkman, M. A. (1993). Ethnicity and Maternal Education as Risk Indicators for Dental Caries, and the Role of Dental Behavior. Community Dentistry and Oral Epidemiology **21**(4): 209-214.

Victora, C. G., Huttly, S. R., Fuchs, S. C. and Olinto, M. T. (1997). The Role of Conceptual Frameworks in Epidemiological Analysis: A Hierarchical Approach. International Journal of Epidemiology **26**(1): 224-227.

Walsh, F. (2003). Family Resilience: A Framework for Clinical Practice. Family Process **42**(1): 1-18.

Wang, N., Marstrander, P., Holst, D., Ovrum, L. and Dahle, T. (1992). Extending Recall Intervals- Effect on Resource Consumption and Dental Health. Community Dentistry and Oral Epidemiology **20**(3): 122-124.

Watt, R. and Sheiham, A. (1999). Health Policy: Inequalities in Oral Health: A Review of the Evidence and Recommendations for Action. British Dental Journal **187**(1): 6-12.

Watt, R. G. (2002). Emerging Theories into the Social Determinants of Health: Implications for Oral Health Promotion. Community Dentistry and Oral Epidemiology **30**(4): 241-247.

Watt, R. G., Dykes, J. and Sheiham, A. (2001). Socio-Economic Determinants of Selected Dietary Indicators in British Pre-School Children. Public Health Nutrition **4**(06): 1229-1233.

Weisner, T. S. (2002). Ecocultural Understanding of Children's Developmental Pathways. Human Development **45**(4): 275-281.

World Health Organisation (2003). Diet, Nutrition and the Prevention of Chronic Diseases WHO Technical Report Series. Geneva, World Health Organization 105-128.

World Health Organisation (2004).Young People's Health in Context.Health Behaviour in School-Aged Children (HBSC) Study: International Report from the 2001/2002 Survey/ Edited by Candice Curie et al. http://www.euro.who.int/__data/assets/pdf_file/0008/110231/e82923.pdf

Wu, A. D. and Zumbo, B. D. (2008). Understanding and Using Mediators and Moderators. Social Indicators Research **87**(3): 367-392.

Ziegler, P., Briefel, R., Clusen, N. and Devaney, B. (2006). Feeding Infants and Toddlers Study (Fits): Development of the Fits Survey in Comparison to Other Dietary Survey Methods. Journal of the American Dietetic Association **106**(1, Supplement 1): 12.e11-12.e50.

Apendix 1- Adult invitation letter

Version 3 Dated 21/01/09

Barts and The London
School of Medicine and Dentistry

INVITATION LETTER - Adults

RE: Oral Health in Outer North East London

Your address has been randomly sampled to be included in a survey commissioned by Waltham Forest, Redbridge, Barking and Dagenham PCTs to assess the dental health needs of the local community.

Barts & The London School of Medicine & Dentistry, Queen Mary University of London (QMUL), have been asked to carry out a survey of local residents to understand their dental health needs. The outcome of the survey will enable the Primary Care Trust to ensure they provide appropriate levels of dental care in the future.

If you agree to take part, you will be offered an appointment in your own home, at a local PCT venue or at the Barts & The London School of Medicine & Dentistry at a time to suit you. Also, please let us know if you have any preference to be examined by a male or female dentist. There will be a simple check-up and a short interview to collect information on such things as whether you have ever been to the dentist and if so, what your experience was at that visit.

If you are found to be in need of dental treatment, we will arrange for you to attend an appropriate dental practitioner.

Please read the attached information sheet carefully before you decide to take part; this will tell you why the research is being done and what you will be asked to do if

you take part. Please ask me if there is anything that is not clear or if you would like more information. If you have any questions about this survey please contact Professor Wagner Marcenes (QMUL) on 020 7882 2608.

Please complete the attached slip and return it in the prepaid envelope provided to confirm your availability, however, if we do not hear from you within one-week from the date of this letter then an appointment will be sent by default.

Yours sincerely

Wagner Marcenes
Professor of Oral Epidemiology
Project leader

Appendix 2 – Adult opt-in Card

Opt-in Card Version 2 Dated 21/01/09

Barts and The London
School of Medicine and Dentistry

Oral Health in Outer North East London

Name(s) of adults aged 18-65 years or more living in this address:

Name	Age	Name	Age
1		3	
2		4	

Contact telephone numbers if you prefer to be contacted by phone:

Home: _____ Mobile: _____ Work: _____

Please tick to indicate availability and enter the choice of venue

	Morning	**Afternoon**		**Evening**	**Choice of Venue**
Day	**8:00-12 noon**	**12 noon-14:00**	**14:00-18:00**	**After 18:00**	Please indicate Home, PCT or Barts & The London
Monday					
Tuesday					
Wednesday					
Thursday					
Friday					
Saturday					
Sunday					

Please tick to indicate you want to be clinically examined by a female dentist or to indicate you do not want to be clinically examined

I want to be clinically examined by a female Dentist	
I do not want to be clinically examined	

Address_____

_____

Postcode_____

Signed by Patient: _____ Dated: _____

Please return this form in the prepaid envelope provided to Professor Wagner Marcenes at the Institute of Dentistry, Barts and The London School of Medicine and Dentistry.

Thank you

Apendix 3 - Child invitation letter

Version 3 Dated 21/01/09

Barts and The London
School of Medicine and Dentistry

INVITATION LETTER- Children aged 3-4 years

RE: Oral Health in Outer North East London

Your address has been randomly sampled to be included in a survey commissioned by Waltham Forest, Redbridge, Barking and Dagenham PCTs to assess the dental health needs of children aged 3-4 years.

Barts & The London School of Medicine & Dentistry, Queen Mary University of London (QMUL), have been asked to carry out a survey of 3-4 year-olds and adults to understand their dental health needs. The outcome of the survey will enable the Primary Care Trust to ensure they provide appropriate levels of dental care in the future.

If you agree that your child(ren) may take part, you will be offered an appointment in your own home, at a local PCT venue or at the Barts & The London School of Medicine & Dentistry at a time to suit you. Also, please let us know if you have any preference for your child to be examined by a male or female dentist. There will be a simple check-up and a short interview to collect information on such things as whether your child(ren) has ever been to the dentist and if so, what their experience was at that visit.

If your child(ren) is found to be in need of dental treatment, we will arrange for you to attend an appropriate dental practitioner.

Please read the attached information sheet carefully before you decide to take part; this will tell you why the research is being done and what you will be asked to do if you take part. Please ask me if there is anything that is not clear or if you would like more information. If you have any questions about this survey please contact Professor Wagner Marcenes (QMUL) on 020 7882 2608.

Please complete the attached slip and return it in the prepaid envelope provided to confirm your availability, however, if we do not hear from you within one-week from the date of this letter then an appointment will be sent by default.

Yours sincerely

Wagner Marcenes
Professor of Oral Epidemiology
Project leader

Appendix 4 – Child opt-in Card

Opt-in Card Version 2 Dated 21/01/09

Barts and The London
School of Medicine and Dentistry

Oral Health in Outer North East London

Name(s) of child(ren) aged 3 – 4 years

1._____

2._____

3._____

Contact telephone numbers if you prefer to be contacted by phone:

Home: _____ Mobile: _____ Work: _____

Please tick to indicate availability and enter the choice of venue

	Morning	**Afternoon**		**Evening**	**Choice of Venue**
Day	**8:00-12 noon**	**12 noon-14:00**	**14:00-18:00**	**After 18:00**	Please indicate Home, PCT or Barts & The London
Monday					
Tuesday					
Wednesday					
Thursday					
Friday					
Saturday					
Sunday					

Please tick to indicate you want your child(ren) to be clinically examined by a female dentist

I want my child(ren) to be clinically examined by a female Dentist	**Yes / No**

Please tick to indicate you do not want your chil(ren) to be clinically examined

I do not want my child(ren) to be clinically examined	**Yes / No**

Address_____

Postcode_____

Signed by Parents or Carer: _____Dated: _____

Print name: _____

Please return this form in the prepaid envelope provided to Professor Wagner Marcenes.

Thank you

Apendix 5- Participant information sheet

Participant Information Sheet (Version: 3 Dated: 21-01- 2009)

Title of project: Oral Health in Outer North East London

Chief Investigator: Professor Wagner Marcenes

Participant Identification Number for this study:

We would like to invite you to participate in an academic research project, which we think is important. Before you decide if you want to participate please read the following information carefully. It will tell you why the research is being done and what it would involve for you. Please ask if there is anything that is not clear or if you would like more information. Talk to others about the study if you want to.

What is the purpose of the study?

Barts & The London School of Medicine & Dentistry, Queen Mary University of London (QMUL), have been asked to carry out a survey of local residents to understand their dental health needs. The outcome of the survey will enable the Primary Care Trust to ensure they provide appropriate levels of dental care in the future. Oral diseases are a common problem in the UK; they are also preventable and treatable. Prevention of oral diseases reduces the burden on PCTs to provide dental treatment. Information on oral health status and behaviour are crucial for planning dental care. Also we want to further understand why some families living in certain areas have less disease than others. By carrying out this research we hope to identify the factors that have a beneficial effect on the dental health of your family. This study will also contribute to the education of researcher students and their research skills development.

Why have I been invited?

You have been invited to take part in this study because your address has been randomly sampled to be included in a survey commissioned by Waltham Forest, Redbridge, Barking and Dagenham PCTs and conducted by Barts and the London School of Medicine and Dentistry, Queen Mary University of London.

Do I have to take part?

You should only agree to take part if you want to; choosing not to take part will not disadvantage you in anyway, it will not affect your access to treatment or services. You are still free to withdraw at any time and without giving a reason.

What will happen to me if I take part?

If you decide to take part there will be a simple routine check-up which will take 5-10 minutes and a short interview using a questionnaire. The interview should take approximately 15 minutes to complete. You will be asked to sign a consent form before undergoing the examination and answering the questionnaire. You can stop part way through if you do not want to continue. The first part of this questionnaire will collect information on things such as whether you have ever been to the dentist, the second part contains questions on some key features of your family such as the structure of your family and how your family functions on a day to day basis. For each question you will be asked to select a response that best reflects your situation.There are no right or wrong answers.

What are the possible disadvantages or risks of taking part?

There are no risks or disadvantages to taking part in this study. The only additional commitment will be the time required to complete the examination and interview. The opt-in card allows you to tell us when it's convenient to contact you and you have the option to stop part way through if you do not wish to continue.

What are the possible benefits of taking part?

If you are found to be in need of dental treatment, we will arrange for you to attend an appropriate dental practitioner. Some of the information from this study will be used by the Waltham Forest, Redbridge and Barking & Dagenham health authorities in planning service provision and formulating policies that would translate to improved quality of service for you and to develop health promotion strategies for your local community.

What if something goes wrong or there is a problem?

If there is a problem or you have any concerns you may get in touch with Professor Wagner Marcenes on 020 7882 2608 or E-mail: w.marcenes@qmul.ac.uk .If you remain unhappy and wish to complain formally, you can do this through the NHS complaints procedure. Details can be obtained from any hospital, clinic or surgery.

Queen Mary University of London has agreed that if you are harmed as a result of your participation in the study, you will be compensated, provided that, on the balance of probabilities, an injury was caused as a direct result of the intervention or procedures you received during the course of the study. These special compensation arrangements apply where an injury is caused to you that would not have occurred if you were not in the study. These arrangements do not affect your right to pursue a claim through legal action.

Will my details be kept confidential?

All personal identifiable data will be destroyed at the end of the study. All data collected in this study will be anonymised and held securely and confidentially. Your name and any identifiable data will be removed from the questionnaire and it will be assigned a code number. This code will be used to link the questionnaire data with the clinical data. This coded data will be entered into a computer and researchers at Queen Mary University of London will analyse this anonymous database. Data generated in the course of this study is the property of the college and will be kept securely in paper or electronic format for a minimum of 10 years. This will assure that proper practice was adopted and any subsequent questions asked about either the conduct of the research or the results obtained can be addressed.

What will happen to the results of the study?

The results of this study will be published in service reports, in peer reviewed scientific journals and as conference presentations. Any service report or academic publication will present only aggregated data, such as average levels of dental decay in outer north east London. No individual data/ information can be identified from any reports both published and unpublished. These reports will enable the PCTs to asses the dental needs of their communities and to commission appropriate services.

Who has reviewed the study?

The scientific quality of this study has been assessed within the chief investigators institution (Barts & The London School of Medicine & Dentistry, Queen Mary University of London (QMUL). In addition it is looked at by an independent group of people called a Research Ethics Committee. They make sure that your safety, rights, wellbeing and dignity are protected. This study has been reviewed and given a favourable opinion by Redbridge and Waltham Forest Research Ethics Committee. Project reference No: 08/H07071/93.

Apendix 6 - Adult consent form

CONSENT FORM (Version: 3 Dated : 21-01- 2009)

Title of project: Oral Health in Outer North East London

Chief Investigator: Professor Wagner Marcenes

Participant Identification Number for this study:

Please initial box to indicate agreement

1.	I confirm that I have read and understand the information sheet dated 21-01-2009 (version 3) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.	
2.	I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected.	
3	I understand that data collected in the clinical examination will be linked through a coding system to data collected using the questionnaire. This anonymous data will be used for academic purposes by researchers from The Barts and the London/ Queen Mary University of London. I give permission for these individuals to have confidential access to my records. I understand that data generated in the course of this research is the property of the college and will be kept securely in paper or electronic format for a minimum of 10 years, while personal identifiable data will be destroyed at the end of the study.	
4.	I understand that relevant data collected during the study, may be looked at by responsible individuals from regulatory authorities or from the Barts and the London School of Medicine and Dentistry/ Queen Mary University of London, where it is relevant to my taking part in this research. I give permission for these individuals to have access to the data collected in this study	
5.	I agree to take part in the above study.	

_____ _____

Name of Participant Date Signature

_____ _____

Name of Person taking consent Date Signature

Apendix 7 - Child consent form

CONSENT FORM (Version: 3 Dated : 21-01- 2009)

Title of project: Oral Health in Outer North East London

Chief Investigator: Professor Wagner Marcenes

Participant Identification Number for this study:

Please initial box to indicate agreement

1.	I confirm that I have read and understand the information sheet dated 21-01-2009 (version 3) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.	
2.	I understand that my child's participation is voluntary and that I am free to withdraw their participation at any time, without giving any reason, without their medical care or legal rights being affected.	
3	I understand that data collected in the clinical examination will be linked through a coding system to data collected using the questionnaire. This anonymous data will be used for academic purposes by researchers from The Barts and the London/ Queen Mary University of London. I give permission for these individuals to have confidential access to my records. I understand that data generated in the course of this research is the property of the college and will be kept securely in paper or electronic format for a minimum of 10 years, while personal identifiable data will be destroyed at the end of the study.	
4.	I understand that relevant data collected during the study, may be looked at by responsible individuals from regulatory authorities or from the Barts and the London School of Medicine and Dentistry/ Queen Mary University of London, where it is relevant to my taking part in this research. I give permission for these individuals to have access to the data collected in this study	
5.	I agree to allow my child to take part in the above study.	

_____ _____

Name of child Your relationship to the child

_____ _____ _____

Name of person giving consent Date Signature

_____ _____ _____

Name of person taking consent Date Signature

Appendix 8 – Adult questionnaire

Barts and The London
School of Medicine and Dentistry

Welcome,

You are invited to answer this questionnaire. Your responses will help us to understand your oral health needs and help us plan your local oral health services in a more cost effective and efficient way.

Instructions for completion of the questionnaire

Each of the following questions has a list of options from which you can choose the response that best reflects your situation.

Please remember:

There are no right or wrong answers
Give only one answer for each question
All the questions are mandatory

Data Protection

All data collected in this survey will be held securely and confidentially. No personal or identifiable data is retained. Researchers at Queen Mary University of London will analyse the anonymous database. Only aggregated data will be included in any report and it will not be possible to identify a particular person or family from the questionnaire responses.

The questionnaire should take approximately 15 - 20 minutes to complete.

Thank You!

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
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

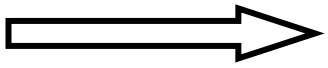
The following questions are related to your socio-demographic characteristics

(***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. Different people have different definition 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 consider family.

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

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

		Strongly Agree	Agree	Disagree	Strongly Disagree
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
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

		Strongly Agree	Agree	Disagree	Strongly Disagree
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 about toilet habits**	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
93.	**We feel accepted for what we are**	1	2	3	4

		Strongly Agree	Agree	Disagree	Strongly Disagree
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

		Strongly Agree	Agree	Disagree	Strongly Disagree
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
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 9 - Child questionnaire

Barts and The London
School of Medicine and Dentistry

Welcome,

You are invited to answer this questionnaire about your child. Your responses will help us to understand your child's oral health needs and help us plan our local oral health services in a more cost effective and efficient way.

Instructions for completion of the questionnaire

Each of the following questions has a list of options from which you can choose the response that best reflects your situation.

Please remember:

- There are no right or wrong answers
- Give only one answer for each question
- All the questions are mandatory

Data Protection

All data collected in this survey will be held securely and confidentially. No personal or identifiable data is retained. Researchers at Queen Mary University of London will analyse the anonymous database. Only aggregated data will be included in any report and it will not be possible to identify a particular person or family from the questionnaire responses.

The questionnaire should take approximately 10 minutes to complete.

Thank You!

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

		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
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 chicken: e.g. beef	1	2	3	4	5	6	7
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

1	**How often has your child [e.g.:** *Had difficulty drinking hot or cold beverages*] **because of dental problems or dental treatments?**	Never	Hardly Ever	Occasion-ally	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.	How often have you or another family member.....	Never	Hardly Ever	Occasionally	Often	Very Often	Don't Know
A	been upset because of your child's dental problems or dental treatments?	1	2	3	4	5	6
B	felt guilty because of your child's dental problems or dental treatments?	1	2	3	4	5	6

17.							
		Never	Hardly Ever	Occasionally	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!

Appendix 10- Referral form

Referral – 3-4 year old children

Dear Parent/Guardian,

Having seen your child as part of this Oral Health Needs Assessment we believe s/he would benefit from a more detailed examination.

Please complete **ONE** of the following sections:

A. My child's dentist is
(name of dentist)……

I will arrange an appointment as soon as possible.

Signed……..……..Date……

Name……

Address……..……

Postcode…….. Tel……

B. My child does not go to the dentist. Please arrange an appointment at a dentist near to me.

Signed……..……..Date……

Name……

Address……..……

Postcode…….. Tel……

C. My child does not go to the dentist. I would like him/her to be seen by the Salaried Dental Service.

Signed……..……..Date……

Name……

Address……

Postcode…….. Tel……

PLEASE NOTE - Treatment is free of charge under the National Health Service, whether provided by a General Practitioner or the Salaried Dental Service.