Mother's perception of general family functioning and sugar consumption of 3- and 4-year-old children

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Mother's perception of general family functioning and sugar consumption of 3 and 4 year old children: the ELF study.

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Abstract

Frequent consumption of sugary foods is a common risk factor for chronic diseases such as dental caries and obesity. Dietary patterns are acquired at home during early life and form a blueprint for dietary behaviours in later life. A favourable family environment can provide a supportive context that enhances the adoption of healthy dietary habits. The aim of this study was to identify the contribution of general family functioning towards the frequent consumption of sugary foods by three and four year old children in Outer North East London. The research question was explored with data from the ELF study, which collected data through home visits from a representative sample of adults and children living in Outer North East London in 2008-10. This study analysed data from 698 three and four year old children and their mothers and included logistic regression, conceptual hierarchical modelling and mediation analysis. The results showed that 17% of the sample consumed sugary foods more than four times day; and that effective general family functioning may help reducing frequent consumption of sugary foods. There was a 67% reduction in children's frequent consumption of sugary foods with every unit increase in the general family functioning score. Mother's higher education may also help reducing frequent consumption of sugary foods by children. The negative impact of mother's lower education was buffered by the effect of effective general family functioning. The study findings underscore the prospect of identifying factors that contribute to the acquisition of good dietary behaviours.

Introduction

The WHO has long advocated the common risk factor approach. This enables a large number of chronic diseases to be targeted by focusing on a small number of risk factors. This improves efficiency and effectiveness and lowers the costs involved in promoting health [Grabauskas, 1987; Sheiham and Watt, 2000; World Health Organisation, 1980].The high consumption of sugary foods is one such risk factor and is common to chronic diseases such as dental caries and obesity, including its associated comorbidities of heart disease, hypertension, stroke, and diabetes [Brynes et al., 2003; Ebbeling et al., 2002; Moynihan, 2005; World Health Organisation, 2003]. Furthermore, a focus on diet is relevant because it is a modifiable behaviour.

Socio-economic position (SEP) influences multiple outcomes, including oral health, and impacts negatively on disease outcomes in a number of ways. Furthermore it involves access to resources to avoid risk and minimise the consequences of disease, and this socio-economic disadvantage repeats over time because higher socio-economic groups are better equipped to benefit from new knowledge [Phelan et al., 2010]. 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 a good proxy for SEP because it is associated with occupation and income [Galobardes et al., 2006]. In addition, education is a relevant variable for measuring variation in SEP across ethnic groups [Kelaher et al., 2008]. It is well established that a poor dietary pattern in children, including diets rich in sugar, is highly correlated with parents' low level of education [North and Emmett, 2000; Northstone and Emmett, 2005]. Turrell and Kavanagh [2006] demonstrated that mothers' education guides their knowledge about different foods. This determines the types of foods that they buy, which influences children's exposure to these foods, affecting their preference; and, ultimately, their sugar consumption habits.

Dietary patterns are acquired at home during early life [Benton, 2004] which, in accordance with the life course theory, forms a blueprint for dietary behaviours in later adolescent and adult life [Fisher-Owens et al., 2007; Mattila et al., 2005; Nicolau et al., 2003]. Families are in a unique position as they are responsible for instilling the initial values, attitudes, beliefs and behaviours in young children. This forms the backbone on which rests their ability to behave in a health-promoting manner in later years [Benton, 2004; Blinkhorn et al., 2001]. Furthermore, a favourable family environment may provide a supportive context in which to

enhance the adoption of healthy dietary habits [Benton, 2004; Rhee, 2008; Ryan et al., 2005].

Previous studies have focused on the importance of parental psychosocial factors, including cognitive aspects such as knowledge, attitudes and parental self-efficacy, to instil healthy behaviours and establish healthy routines [Adair et al., 2004; Finlayson et al., 2007; Lencova and Duskova, 2013]. In recent years, the shift towards positive medicine has seen the identification of health "protective" factors gain prominence. Therefore, further understanding of the role of family functioning on diet offers opportunities to identify factors, within the family environment, that contribute to the acquisition of good dietary behaviours.

Family functioning can be studied in many different ways. This study focuses on whole family functioning as it is more inclusive than focusing solely on parenting styles or parental modelling of behaviour [Renzaho et al., 2011]. Current definitions of 'effective family functioning' include the family's ability to face challenges that arise as part of a family's life cycle; to have clear and direct communication between members; to have flexible rules in order to regulate family behaviour; to define clearly the roles and responsibilities of its members; and to have warm, affectionate relationships [Ryan et al., 2005]. The aim of this study was to assess whether effective general family functioning contribute to the acquisition of good dietary behaviour among three and four year old children living in a deprived area of London. Also, the study sought to assess whether effective family functioning can act as a buffer against the detrimental effects of having lower education and belonging to minority groups.

Methods

This study is part of the East London Family (ELF) study, which is a two generation cross-sectional family study including a representative sample of children aged 3 and 4 (n=1,174) and adults 16-65 years old (n=2,343) living in Waltham Forest, Redbridge, and Barking and Dagenham in 2009-10, in order to investigate the importance of family functioning for oral health [http://www.dentistry.qmul.ac.uk/research-listing/32-patient-and-population-orientated-research/294-onel-family-study]. The Outer North East London Research Ethics Committee approved the ELF study protocol (REC Reference Number: 08/H0701/93).

A sub-sample of participants was drawn from the ELF study for this study on mother's perception of family functioning and sugar consumption by their three and four year old

children. The ELF study conceptualized families according to the Family System Theory as dynamic systems of family members who interact with one another, aiming to adjust to the developmental needs and maintenance of their members. The family system comprises dyadic subsystems, such as parent-child, partner-partner and sibling-sibling relationships [Whitchurch and Constantine, 1993]. This study focused on the mother-child dyadic.

The minimum sample size for this sub-study was estimated to be 644. This sample size provided 90% statistical power to identify an odds ratio of 0.70 for the association between one unit change in general family functioning score and children's high frequency of consumption of sugary foods. The calculation assumed that 15% of children consume sugary foods more than four times per day at the mean value of the explanatory variable (general family functioning), α equal to 0.05, and β equal to 0.10.

The ELF study adopted a stratified random sampling approach to select a representative sample of the general non-institutionalised population. The sampling frames were lists of all addresses in each of the wards (n=58) in Waltham Forest, Redbridge, and Barking and Dagenham. A minimum of 55 addresses were randomly selected from each ward to yield 3,193 addresses. Residents in these addresses were then contacted by post, and invited to participate in the study. Vacant addresses, commercial premises, and households with ineligible residents (e.g.: outside the age range of interest) were excluded. The maximum number of adults and children invited to participate per household were two and one respectively.

Adult participants completed two structured questionnaires in their own homes, and provided information about themselves and their children. Trained interviewers administered the questionnaires. The child questionnaire included questions about the child's demographics (age and sex) and diet. The frequency of children's sugar consumption was assessed using a modified version of the food frequency questionnaire (FFQ), used in the National Diet and Nutrition Survey for children aged 1 ½ to 4 ½ years [Hinds and Gregory, 1995]. The adult questionnaire included socio-demographic characteristics (age, gender, marital status, education and ethnicity) and family functioning. Family functioning was measured using the Family Assessment Device [Epstein et al., 1983]. The Family Assessment Device was chosen because it was a validated instrument with cross cultural applicability (Miller et al.,1985; Byles et. al., 1988), as it has been translated into over 20 languages and been applied across cultures (Ryan et al.,2005; Herzer et al.,2010). The address postcode was

used to derive the Index of Multiple Deprivation (IMD), which was used as an indicator of a family's levels of social and material deprivation.

Data analysis

ELF data was weighted to adjust for the unequal probability of selection and non-response, in order to produce a representative sample with respect to age, gender and ethnicity based on the UK Census of 2001 [Office for National Statistics, 2001]. A sub sample of 698 mother-child dyads was included in this data analysis. The criterion for entry into this sub-study was mother-child dyads (n=908) with complete data (n=698) on variables needed to explore the study's aims. Data were analysed using STATA/IC 11 [StataCorp, 2009] to take into account the complex survey design (stratification and clustering); and to produce corrected standard errors and confidence intervals.

Mean family functioning domain scores were calculated for each of the six domains only when 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. General family functioning was treated as a continuous variable.

The variable relating to mother's education was divided into two categories: 'higher education' and 'less than higher education'. Information on mother's ethnicity was categorised into four main groups: White, Asian, Black and Mixed/Others. Information on mother's marital status was divided into the following categories: 'living alone' (single, separated, widowed, and divorced); and 'living with a partner' (married, re-married, cohabiting) [Office for National Statistics, 2005]. The IMD was categorised into quintiles based on the distribution for England; and each family was assigned to a quintile based on the residential postcode. For the purpose of analysis, the sample was further divided into 'less deprived' and 'more deprived', based on relative deprivation for the whole of England. The first three quintiles were relatively 'less deprived' areas while the last two quintiles were relatively 'more deprived' areas.

'Sugar consumption frequency' refers to how often a child eats/drinks commonly available sugary foods which are potentially damaging to children's teeth (such as chocolate, biscuits

or cookies, cakes, confectionary or other sweets, sweetened milk, sweetened fruit juice and sweetened fizzy drinks) [Hinds and Gregory, 1995]. Responses were collected using 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'). The responses for each sugary food item were transformed into a daily equivalent and the daily equivalents were added up to give an estimate of the daily frequency of consumption of sugary foods. 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; '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. Children were then divided into two groups: those consuming four or more sugary foods per day; and those consuming less than four sugary foods a day. This threshold was established based on international dietary guidelines for the reduction of the risk of developing dental caries [Department of Health/British Association for the Study of Community Dentistry, 2009; Moynihan and Petersen, 2004; Moynihan, 2005; Sheiham, 2001; World Health Organisation, 2003].

Simple logistic regression analyses were carried out to assess the unadjusted association between each of the study variables (children's age and sex; mother's ethnicity, marital status, education; IMD; and general family functioning) and children's consumption of sugary foods more than four times per day. In accordance with the lax criterion [Altman, 1994], explanatory variables that were not statistically significant related to the outcome at the level of 0.20 were excluded at this stage. Thereafter, conceptual hierarchical modelling [Victora et al., 1997] was carried out. Age, gender and socio-economic variables were entered in the regression equation due to their well-known strong association with sugar consumption. Variables were included sequentially as follows: (1) age, gender and mother's ethnicity; (2) age, gender, mother's ethnicity plus IMD and mother's education; (3) age, gender, mother's ethnicity, IMD, mother's education plus general family functioning. Odds Ratios (OR) were reported and the 95% confidence interval was considered. Attenuation of the OR was calculated using the formula:- (ORU – ORA)÷(ORU -1) [Birkmeyer et al., 2003], where ORU represents the odds ratio before including the family functioning score; and ORA reflects the odds ratio after including family functioning in the model. Finally, mediation analysis was carried out following the Baron and Kenny (1986) approach.

Results

The ELF study response rate was 67.9% for children and 56.8% for adults. The average number of adults and children recruited per household was 1.3 and 1.1 respectively. The mother-child dyads study sub-sample comprised 698. The characteristics of the study sub-sample (Table 1) shows that 3 and 4 year old children were fairly equally distributed by age and sex. Only 2% of the sample were categorised into the 'least deprived' quintile reflecting the population distribution reported in the last Census [Office for National Statistics, 2001], which conveys the relative high levels of deprivation of this area. Fifty seven per cent of the mothers were White; 26% were Asian; 11% were Black; and 6% were mixed or other ethnicities. The majority of the mothers (80%) lived with a partner. Forty five per cent of the mothers reported a lower educational qualification. Seventeen per cent of the children in the sub-sample consumed sugary foods more than four times per day. The mean score for general family functioning in the sub-sample was 3.16. General family functioning scores can range from 1 to 4, with higher scores reflecting better family functioning.

The results of simple logistic regression showed that both mother's higher education and effective family functioning were associated with low sugar consumption, which suggested that these factors contributed to the acquisition of good dietary behaviour. Children whose mothers reported higher education were significantly (p=0.001) 59% (OR 0.41; 95% CI: 0.25,0.68) less likely to consume sugary foods more than four times per day compared to children whose mothers reported lower qualifications. Similarly, effective general family functioning was highly significantly associated with lower consumption of sugary foods by children. There was a 77% reduction in children's chances of consuming sugary foods more than four times per day for every unit increase in the general functioning score, where higher scores indicate more effective general family functioning (Table 2).

Although not significant, the associations for age, sex and IMD were in expected directions, with boys, four year olds and children living in more deprived areas being more likely to consume sugary foods more than four times per day by comparison with girls, three year olds and children living in less deprived areas. Children with Asian mothers were significantly 2.69 times more likely to consume sugary foods frequently compared with children with White mothers (95% CI: 1.53, 4.74). Hierarchical modelling confirmed that children with Asian mothers were significantly 3.46 times more likely to consume sugary foods more than

four times per day (95% CI: 1.63, 5.25) compared with children with White mothers, after adjusting for age, gender, mother's education and IMD.

Hierarchical modelling (Table 3) confirmed the highly significant association between effective general family functioning and the consumption of sugary foods more than four times per day. There was a 67% reduction in children's frequent consumption of sugary foods with every unit increase in the general family functioning score. This association was independent of mother's education, mother's ethnicity, level of deprivation, children's age or sex. Hierarchical modelling also confirmed that mother's higher education had a positive influence against consumption of sugary foods more than four times per day by children. Children whose mothers had a higher qualification were 65% less likely to consume more than four intakes of sugary foods (OR 0.35; 95% CI: 0.21, 0.58) compared with children whose mothers reported lower qualifications, after adjusting for age, gender, mother's ethnicity and IMD.

The results of mediation analysis suggested that effective family functioning may have a buffer effect on the negative impact of lower education on sugar consumption. When tested for mediation, using the four steps proposed by Baron and Kenny (1986), it was found that this relationship was partially mediated through general family functioning. The association was attenuated by 9% when general family functioning was added to the model indicating that part of the association between mother's education and children's sugar consumption is potentially mediated through general family functioning (Table 3, model 3).

Similarly, the association between high sugar consumption and children with Asian mothers was attenuated by 16% when general family functioning was added to the model (Table 3). When tested further for mediation [Baron and Kenny, 1986], it was confirmed that this relationship was partially mediated through general family functioning.

Discussion

The main finding of this study is that effective general family functioning may contribute to the acquisition of good dietary behavior of three and four year old children in East London, a multicultural and deprived area of the UK. The positive influence of effective general family functional on sugar consumption is plausible. First, the day to day functioning of families provides the best context within which specific rules are established regarding three and four year old children's health behaviours, including sugar consumption behaviours. Positive

social interactions enhance the adoption of healthy dietary habits [Benton, 2004]. Therefore, the favourable atmosphere created by effective general family functioning may facilitate better acceptance of rules by children and enhance their ability to behave in a health promoting manner [Rhee, 2008]. On the other hand, ineffective functioning could lead to problems, including the adoption of unhealthy behaviours [Ryan et al., 2005].

To our knowledge, this is the first study which demonstrates the relationship between effective general family functioning (as measured by the FAD), and low sugar consumption. Nevertheless, this finding corroborates the wider, but related, literature on the link between effective family functioning and children having a 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 has been linked to eating disorders [Emanuelli et al., 2003] and obesity in children [Chen and Kennedy, 2005]. The findings of this study support the idea that effective family functioning is more important for the health of family members than the family structure *per se* [Fisher-Owens et al., 2007; Sweeting and West, 1995; World Health Organisation, 2004].

The importance of family-based programmes in reducing childhood obesity has been recognised [Kitzman-Ulrich et al., 2010]. However, there has been a lack of upstream interventions targeted at improving the home environment [Flynn et al., 2006]. Frequent sugar consumption seldom occurs in isolation and is often an indicator of the larger dietary picture, which affects a multitude of chronic diseases. Family functioning is modifiable and is therefore amenable to interventions. Our findings suggest that improving family functioning could equip families with resources that encourage healthy behaviours, even in the presence of less than optimal social and economic circumstances. Furthermore, an intervention aimed at improving family functioning may have enormous potential to improve the quality of family life in a whole range of areas. By equipping the family with skills to handle their day to day lives, health-related behaviours become embedded in daily activities, and therefore become sustainable even in the midst of adversity. In addition, interventions at the family level have the ability to influence outcomes at whole population levels [National Institute For Health and Clinical Excellence, 2007]. This underpins the importance of influencing family environments positively. An increase in the general family functioning score by just one unit has the potential to reduce children's chances of consuming sugary foods frequently by 67%. Therefore, an intervention to improve general family functioning has significant potential to reduce the risk of children developing unhealthy dietary behaviours and promote health effectively.

The main limitation to studying sugar consumption is related to its measurement. Food frequency questionnaires (FFQs) offer a cost-effective and appropriate means of assessing habitual long-term diet and are relatively easy to use [Cade et al., 2002]. However, the validity of FFQs have been challenged, with the suggestion that they are susceptible 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 [McNeill et al., 2009]. This study adopted a conservative approach to the calculation of daily sugar consumption frequency; and it is more likely that frequent consumers were misclassified as low frequency consumers than the reverse.

Other potential limitations of this study are related to the obtaining information by self-reports; the presence of incomplete data; and the cross-sectional nature of the study design. Respondents may have felt embarrassed to reveal private details of their life; answers may have been influenced by the person's feelings at the time they filled out the questionnaire; and subjects may have forgotten pertinent details of their relationship. It is also possible that answers were influenced by social desirability bias.There was minimum manipulation of the data and good completeness of data. It is unlikely that missing data have influenced the findings. Cross-sectional data do not allow causal inferences to be drawn because of the difficulty in establishing temporal relations. This design is recommended for the exploration of associations between the risk factors and the outcome of interest, if there is limited research to support the hypothesis. Furthermore, it is more likely that family functioning has affected sugar consumption than the reverse causality. The findings of this cross-sectional study are relevant to the further understanding the complex process that underpins the development of children’s sugar consumption behaviours. Once a clear understanding of this association is established, further research should be carried out adopting a randomised controlled trial design.

In conclusion, a mother’s perception of effective general family functioning (defined as a family that is able to manage daily life and resolve problems in the context of warm and affective family interactions, through clear communication, well-defined roles and flexible behaviour control), has a significant protective effect against high frequent intakes of sugary foods by their three and four year old children.

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AUTHORS CONTRIBUTION

All authors contributed to selection of key covariates, wrote and reviewed the manuscripts. SN and WM analysed the data. WM conceived of the study, oversaw the implementation and conducting of the fieldwork and provided overall guidance.

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Legends

Table 1. Characteristics of the study sub-sample

Table 2. Simple logistic regression models for the relationship between children's age, sex, mother's ethnicity, mother's marital status, mother's education, Index of Multiple Deprivation and General family functioning, and consumption of sugary foods more than four times per day by three and four year old children in the study sub sample

Table 3. Hierarchical logistic regression models for the association between socio-demographic variables and general functioning, and the consumption of sugary foods more than four times per day by three and four year old children in the study sub sample.

502 Table 1.

Variables (N=698)	Frequency	Weighted Proportion
Age: 3 years 4 years	 359 339	 49% 51%
Gender: Male Female	 356 342	 47% 53%
Mother's ethnicity: White Asian Black Mixed/Others	 253 225 200 20	 57% 26% 11% 6%
Mother's marital status: Living alone Living with a partner	 131 567	 20% 80%
Mother's Education: Lower qualification (None, Secondary school, technical) Higher qualification (A levels, university, postgraduate)	 303 395	 45% 55%
IMD Less deprived (IMD score ≤ 21.22) More deprived (IMD score ≥21.23)	 127 571	 28% 72%
Children consuming sugary foods more than four times per day	122	17%
General family functioning	Mean	(95% CI)
	3.16	(3.12, 3.20)

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504 Table 2.

Variables (N=698)	Odds Ratio (95% CI)	P value
Age: 3 years 4 years	1 1.58 (0.97,2.58)	 0.07
Sex: Male Female	1 0.70 (0.42,1.17)	 0.17
Mother's Ethnicity: White Asian Black Mixed/Other	 1 2.69 (1.53,4.74) 1.29 (0.68,2.45) 1.43 (0.34,6.04)	 0.001 0.43 0.63
Mother's marital status: Living alone Living with a partner	 1 1.22 (0.61, 2.43)	 0.58
Mother's Education Lower (None, Secondary school, technical) Higher (A levels, university, postgraduate)	 1 0.41 (0.25, 0.68)	 0.001
IMD Less deprived (1st, 2nd, 3rd quintile) More deprived (4th, 5th quintile)	 1 1.87 (0.89, 3.90)	 0.10
General family functioning	0.23 (0.11, 0.46)	<0.001

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512 Table 3.

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 1.54 (0.92,2.59)
Sex: Male Female	1 0.70 (0.41,1.18)	1 0.72 (0.42,1.23)	1 0.72 (0.42, 1.23)
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 3.06 (1.63, 5.72)*** 1.20 (0.61, 2.36) 1.54 (0.39, 6.11)
IMD: Less deprived More deprived		 1 1.92 (0.89,4.14)	 1 1.79 (0.83, 3.87)
Mother's Education: Lower Higher		 1 0.35 (0.21,0.58)***	 1 0.41 (0.23, 0.70)***
General Functioning			0.33 (0.15, 0.72)**

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514 * p≤0.05, **p≤0.01, ***p≤0.001

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

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

517 Model 3: Adjusted for variables in Model 2 plus family general functioning

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