Family Functioning and Dental Behaviours of Pre-school Children

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Objectives: To examine the association of family functioning with child dental behaviours and to identify family functioning domains associated with those behaviours. ***Methods***: Cross-sectional data from the East London Oral Health Inequalities (ELOHI) study were analysed in a subsample of 733 parent-child (3-4-years-olds) dyads. Family functioning was measured with the 60-item Family Assessment Device that yielded a general functioning score and six domain scores (roles, communication, problem solving, affective involvement, affective responsiveness, and behaviour control). Child dental behaviours were sugar intake, dental attendance and toothbrushing frequency. The association of family functioning with each dental behaviour was assessed in logistic regression models adjusted for confounders (parental sociodemographic and child demographic factors). ***Results***: Unhealthy general functioning was associated with greater odds of reporting high child intake of sugars (OR: 1.78, 95%CI: 1.01-3.13) as well as lower odds of reporting frequent child brushing (OR: 0.76, 95%CI: 0.50-1.18) and a child visit for dental check-up in the past year (OR: 0.98; 95%CI: 0.62-1.53), after adjustment for confounders. Unhealthy functioning in roles, affective involvement and behaviour control were associated with high child sugar intake whereas unhealthy functioning in roles was inversely associated with frequent child toothbrushing. No family functioning domain was associated with child dental attendance pattern. ***Conclusions***: Healthy family functioning was associated with more favourable child dental behaviours. How a family functions, particularly in terms of how they define roles and support each other emotionally, is likely to be relevant to child oral health.

Keywords: *children, family, dental caries, sugars, toothbrushing*

Introduction

Childhood dental caries is a common chronic disease that adversely impacts children, families and society (Seow, 2018; Tinanoff *et al.*, 2019). It is a multi-factorial, with social, psychosocial, behavioural and biological determinants (Fisher-Owens *et al.*, 2007; Tinanoff *et al.*, 2019). Dental behaviours, such as high sugar intake, infrequent toothbrushing and irregular access to preventive services, are considered proximal predictors of caries experience across the life course (Kim Seow, 2012; Leong *et al.*, 2013; Pitts *et al.*, 2017). The family environment, in which children develop and thrive, plays an important role in establishing favourable health behaviours early in life (Chi *et al.*, 2017; Scaglioni *et al.*, 2018), including dental behaviours (Hooley *et al.*, 2012).

Many characteristics of the family environment have been studied in relation to child oral health (Hooley *et al.*, 2012). One factor that has gained recent attention is family functioning; the psychosocial features of family dynamics (i.e. their interactions and relationships) (Halliday *et al.*, 2014; Leeman *et al.*, 2016). Family functioning embraces a variety of themes including emotional attributes (e.g., warmth, tenderness, closeness, support, safety, responsiveness), physical health environment (e.g., health habits, activities and products), family governance (e.g., establishment of expectations and rules), quality of intra-familial relationships (i.e., parent-child, sibling and marital), characteristics of cognitive development and engagement (e.g., interaction and talking with children, spending time in reading and learning), and extra-familial connectedness (i.e., involvement with extended family, neighbourhood, work, school and community service)

(Epstein *et al.*, 1978; Ryan *et al.*, 2005). Although several frameworks conceptualise family functioning, the McMaster model (Miller *et al.*, 2008; Ryan *et al.*, 2005), and the Family Assessment Device (FAD) to measure functioning (Epstein *et al.*, 1983; Mansfield *et al.*, 2015; Miller *et al.*, 1985), were identified among the most relevant for research on childhood caries in a recent systematic review (Duijster *et al.*, 2013).

A few studies have examined the association between family functioning and childhood oral health, with conflicting results. Three Dutch studies found that healthier family functioning was associated with lower caries experience, although only at bivariate level (de Jong-Lenters *et al.*, 2018; Duijster *et al.*, 2015; Duijster *et al.*, 2014). An Australian study associated healthier family functioning with lower odds of carers reporting poor child oral health, even after adjustment for confounders (Renzaho and de Silva-Sanigorski, 2014). Two other studies have focused on dental behaviours among young children, particularly sugar intake. Nanjappa et al. (2015) showed that preschool children in families with unhealthy functioning consumed more sugars, after adjustment for parental sociodemographic factors and child demographic characteristics. Similarly, Renzaho et al. (2014) reported that children were more likely to drink sweet beverages if they lived in families with unhealthy functioning, after adjustment for family and child factors. There is a lack of studies examining family functioning influences on other child dental behaviours. The aims of this study were to examine the association between family functioning and three child dental behaviours (sugar intake, dental attendance pattern and toothbrushing frequency) and to identify the family functioning domains associated with those behaviours.

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Methods

Data for this study were obtained from the East London Oral Health Inequalities (ELOHI) study, which was a mixed-methods study designed to elucidate the relationship among area deprivation, dental behaviours and oral health. The Outer North East London Research Ethics Committee approved the study protocol (08/H0701/93). This study pooled data from the surveys carried out among 16-65-year-old adults and 3-4-year-old children, respectively. Families were recruited using stratified two-stage random sampling to represent the general non-institutionalised population in Outer North East London (Waltham Forest, Redbridge and Barking and Dagenham). The sampling frame contained 2528 valid addresses, of which 1437 households agreed to participate (response rate: 57%). In each selected household, up to two adults and one child were invited to take part. In all, 1174 children participated in one or more elements of the survey.

A subsample of 994 parent-child dyads were eligible for this analysis, of whom 261 were excluded due to missing data on child dental behaviours (n=39), family functioning (n=141) or covariates (n=120). Therefore, the study sample included 733 participants. In families where both parents completed the questionnaire, maternal responses were used as mothers are often the primary carers of children. However, paternal responses were chosen in 13 cases because the mother's questionnaire had missing data on one or more relevant variables.

Parents completed two structured questionnaires in their own homes, providing information about themselves and their children, respectively. The child questionnaire enquired about the child's demographics (age and gender) and dental behaviours (sugar intake, dental attendance pattern and toothbrushing frequency). Data on child consumption of seven sugary foods (chocolate, biscuits or cookies, cakes, confectionary or other sweets, sweetened milk, sweetened fruit juice and sweetened fizzy drinks) were collected using 7-point ordinal scales (ranging from never to more than once a day). Weighted scores were used to match the lower frequency of consumption in each response category, namely more than once a day=2, once a day=1, most days (4/7)=0.57, once a week (1/7)=0.14, once a month=0 and never=0. These weighted scores were summed to estimate the daily frequency of intake of sugary foods, ranging from 0 to 14 times a day. Responses were categorised as ≤4 sugary foods a day versus >4 sugary foods a day (Bernabe *et al.*, 2014; Nanjappa *et al.*, 2015). Child toothbrushing frequency was reported on a 5-point scale (more than 3 times a day, 3 times a day, twice a day, once a day, less than once a day) and responses were categorised as once a day or less often versus twice a day or more often. Child dental attendance pattern was derived from responses to two questions on last dental visit and reason for the visit. Children who had a check-up in the last year were considered regular attenders whereas those who have never visited the dentist or whose last visit was due to trouble with their teeth were considered problem-oriented attenders.

The adult questionnaire enquired about sociodemographic characteristics (age, gender, marital status, ethnicity, and socioeconomic position) and family functioning. Marital status was recoded as living alone (single, separated, widowed or divorced) or with a partner (married, remarried or cohabiting). Parental ethnicity was categorised into four groups: White, Asian, Black and Mixed/Other. Socioeconomic position was measured through education and the National Statistics SocioEconomic Classification (NS-SEC). Education was indicated by the highest degree or qualification (no qualifications, secondary school, A levels and technical qualifications, first university degree or higher degree). NS-SEC groups were derived using the self-coded method based on current or last main job or occupation, employment status, size of organisation and supervisory status. Five operational categories were derived: (i) managerial and professional, (ii) intermediate, (iii) small employers and own account workers, (iv) lower supervisory and technical, and (v) semi-routine and routine occupations. For complete population coverage, full-time students, individuals who had never worked or were in long-term unemployment were added as not working. Family functioning was measured using the FAD (Epstein *et al.*, 1983), a self-reported measure based on the McMaster model (Epstein *et al.*, 1978; Miller *et al.*, 2008; Ryan *et al.*, 2005). The FAD is widely used, with reported evidence of good validity, reliability, and cross-cultural applicability (Epstein *et al.*, 1983; Mansfield *et al.*, 2015; Miller *et al.*, 1985). It consists of 60 items organised in six domains: problem solving (6 items), communication (9 items), roles (11 items), affective responsiveness (6 items), affective involvement (7 items), behaviour control (9 items). A general functioning subscale (12 items) is also available, which measures the overall family functioning. Responses are recorded through agreement to each item and coded as 1=strongly agree, 2=agree, 3=disagree and 4=strongly disagree. Many FAD items are negatively phrased requiring reverse coding before calculating domains scores. Each scale score is calculated separately as the mean item score. The overall domain score can range from 1 to 4, with higher scores indicating unhealthier family functioning. Thresholds in each domain score were used to define healthy versus unhealthy functioning: namely 1.9 for behaviour control, 2.0 for general functioning, 2.2 for problem solving, communication and affective responsiveness, 2.1 for affective involvement, and 2.3 for roles (Miller *et al.*, 1985). A domain score cannot be calculated if 40% or more of responses in that domain are missing. When less than 40% of the responses in a domain are missing, they are imputed with the average of all available items (Ryan *et al.*, 2005).

All analyses were weighted to account for unequal probabilities of selection and non-response, and to yield a representative sample of the local population. They also took into account the complex survey design (stratification and clustering) to produce corrected standard errors. Data were analysed using Stata/MP version 16.1 (StataCorp, College Station, TX, USA).

We first compared the prevalence of the three child dental behaviours (sugar intake, dental attendance and toothbrushing frequency) according to parental demographic (gender, age, ethnicity and marital status) and socioeconomic characteristics (education and socioeconomic classification) as well as child demographic characteristics (gender and age) using the Chi-squared test. The association of general family functioning with

each child dental behaviour was assessed in crude and adjusted binary logistic regression models. Odd ratios (ORs) with 95% confidence intervals (95% CIs) were thus reported as the measure of association. The adjusted model controlled for parental demographic factors (gender, age, ethnicity and marital status), socioeconomic position (education and socioeconomic classification) and child demographic factors (gender and age). The same set of regression models was estimated for testing the association of each family functioning domain (problem solving, roles, communications, affective responsiveness, affective involvement and behaviour control) with each child dental behaviour.

Results

The characteristics of the sample are shown in Table 1. The prevalence of unhealthy general functioning was 49.1%, ranging from 12.0% for problem solving to 56.6% for behaviour control. In all, 17% of children consumed more than 4 sugary items per day. High sugar intake was more common among children of younger, non-White, less educated and non-working parents as well as among older children. Also, 40% of children had a dental check-up in the past year. Attendance for a dental check-up in the past year was more common in children whose parents were older, from higher socioeconomic groups, and from White ethnicity. Furthermore, 68% of children brushed their teeth twice or more often daily. This level of brushing was more common among children of white and female respondents.

Unhealthy general functioning was associated with 2.77 (95% CI: 2.44-9.53) greater odds of consuming more than 4 sugary items a day as well as with 31% (OR: 0.69; 95% CI: 0.45-1.05) and 33% (OR: 0.67; 95% CI: 0.45-1.00) lower odds of having a dental check-up in the last year and brushing twice or more often a day, respectively, in crude models (Table 2). These associations were attenuated after adjustment for parental sociodemographic and child demographic factors (Table 3). In the adjusted models, unhealthy general functioning was associated with greater odds of reporting high child intake of sugars (OR: 1.78; 95% CI: 1.01-3.13) as well as lower odds of reporting frequent child brushing (OR: 0.76, 95% CI: 0.50-1.18) and a child visit for dental check-up in the past year (OR: 0.98; 95% CI: 0.62-1.53).

By domain, unhealthy functioning in all six domains, except for problem solving, was positively associated with high child sugar intake. In addition, unhealthy functioning in communication, affective involvement and behaviour control were inversely associated with the child having had a dental check-up in the past year. Whereas unhealthy functioning in roles, affective involvement and behaviour control were inversely associated with higher child toothbrushing frequency in the unadjusted regression models (Table 2). After adjustments (Table 4), unhealthy functioning in roles, affective involvement and behaviour control remained associated with high child sugar intake. Only unhealthy functioning in roles remained inversely associated with frequent child toothbrushing. No domain scores remained associated with child dental attendance pattern after adjustments.

Table 1. Child dental behaviours by child and parental characteristics

	Full sample (n=733)	>4 sugary items/day (n=130)	Check-up in last year (n=242)	Brushing 2+ times/ day (n=456)
Parent's gender[a]				
Men	9.8	14.5	39.2	46.5
Women	90.2	17.1	40.2	70.2
p-value[b]		0.622	0.912	0.002
Parent's age				
16 to 34 years	51.8	21.5	30.5	66.2
35 to 44 years	43.8	12.7	49.0	70.5
45 to 65 years	4.4	6.2	55.0	63.5
p-value		0.014	<0.001	0.607
Parent's ethnicity				
White	35.2	12.0	52.1	76.3
Asian	32.7	27.0	24.3	56.1
Black	29.1	16.0	27.5	57.1
Mixed / other	3.0	17.2	22.0	65.5
p-value		0.007	<0.001	<0.001
Marital status				
Cohabiting	83.1	17.1	40.1	66.5
Living alone	16.9	15.8	39.9	74.9
p-value		0.783	0.978	0.156
Parent's education				
None	8.6	20.5	23.8	63.5
Secondary school	24.8	22.3	36.6	68.2
A-levels	25.2	20.0	43.7	67.8
Degree or higher	41.3	10.7	43.9	69.2
p-value		0.037	0.113	0.916
Parent's socioeconomic classification				
Managerial/ professional	42.2	6.6	44.7	70.3
Intermediate	15.0	20.2	48.7	67.1
Routine/ manual	15.7	18.6	30.9	68.3
Not working	27.1	31.3	32.0	64.6
p-value		<0.001	0.039	0.755
Child age				
3 years	52.0	13.5	37.8	69.3
4 years	48.0	20.1	42.4	66.8
p-value		0.048	0.349	0.546
Child gender				
Male	52.7	20.0	38.4	66.3
Female	47.3	13.9	41.7	69.7
p-value		0.084	0.502	0.436

[a] Parent's gender refers to whether it was the mother or the father who completed the questionnaire.
[b] Chi-squared test was used for comparisons.

Table 2. Crude associations between unhealthy family functioning and child dental behaviours (n=733)

Family functioning domains[b]	>4 sugary items/day		Check-up in last year		Brushing 2+ times/day	
	OR[a]	[95% CI]	OR[a]	[95% CI]	OR[a]	[95% CI]
General functioning	2.77	[1.62-4.74]	0.69	[0.45-1.05]	0.67	[0.45-1.00]
Problem solving	1.80	[0.89-3.65]	1.20	[0.65-2.21]	0.86	[0.46-1.60]
Communication	1.90	[1.17-3.11]	0.55	[0.35-0.84]	0.80	[0.53-1.20]
Roles	1.90	[1.17-3.10]	0.82	[0.53-1.26]	0.60	[0.40-0.91]
Affective responsiveness	2.10	[1.25-3.51]	0.64	[0.40-1.02]	0.85	[0.54-1.32]
Affective involvement	3.17	[1.92-5.22]	0.52	[0.34-0.79]	0.61	[0.41-0.91]
Behaviour control	3.81	[2.04-7.14]	0.48	[0.31-0.73]	0.59	[0.38-0.91]

[a] Logistic regression was fitted for each binary outcome and odds ratios (OR) reported.
[b] Unhealthy family functioning compared against healthy family functioning (reference group).

Table 3. Models for the association of general functioning with child dental behaviours (n=733)

Explanatory variables	>4 sugary items/day		Check-up in last year		Brushing 2+ times/day	
	OR[a]	[95% CI]	OR[a]	[95% CI]	OR[a]	[95% CI]
General functioning						
Healthy	1.00	[Reference]	1.00	[Reference]	1.00	[Reference]
Unhealthy	1.78	[1.01-3.13]	0.98	[0.62-1.53]	0.76	[0.50-1.18]
Parent's gender						
Men	1.00	[Reference]	1.00	[Reference]	1.00	[Reference]
Women	0.90	[0.40-2.03]	1.01	[0.52-1.95]	2.90	[1.34-6.29]
Parent's age, in years	0.97	[0.94-1.01]	1.04	[1.01-1.08]	1.02	[0.98-1.05]
Parent's ethnicity						
White	1.00	[Reference]	1.00	[Reference]	1.00	[Reference]
Asian	2.26	[1.20-4.26]	0.26	[0.16-0.43]	0.42	[0.26-0.68]
Black	1.27	[0.65-2.49]	0.31	[0.18-0.51]	0.40	[0.24-0.64]
Mixed/Other	1.40	[0.37-5.32]	0.22	[0.06-0.81	0.52	[0.18-1.57]
Marital status						
Cohabiting	1.00	[Reference]	1.00	[Reference]	1.00	[Reference]
Living alone	0.78	[0.37-1.63]	1.29	[0.71-2.36]	1.42	[0.76-2.65]
Parent's education						
None	1.00	[Reference]	1.00	[Reference]	1.00	[Reference]
Secondary school	1.19	[0.48-2.92]	1.72	[0.67-4.42]	1.43	[0.63-3.25]
A-levels	1.05	[0.40-2.71]	3.46	[1.28-9.38]	1.57	[0.70-3.51]
Degree or higher	0.68	[0.25-1.91]	3.19	[1.19-8.54]	1.70	[0.74-3.94]
Parents' socioeconomic classification						
Managerial/professional	1.00	[Reference]	1.00	[Reference]	1.00	[Reference]
Intermediate	3.28	[1.38-7.78]	1.38	[0.76-2.50]	0.85	[0.47-1.53]
Routine/manual	1.97	[0.90-4.32]	0.91	[0.46-1.80]	1.30	[0.68-2.50]
Not working	3.96	[1.85-8.45]	1.08	[0.60-1.96]	1.02	[0.59-1.77]
Child sex						
Boy	1.00	[Reference]	1.00	[Reference]	1.00	[Reference]
Girl	0.67	[0.39-1.15]	1.09	[0.72-1.64]	1.08	[0.72-1.62]
Child age						
3 years	1.00	[Reference]	1.00	[Reference]	1.00	[Reference]
4 years	1.49	[0.89-2.50]	1.29	[0.84-1.97]	0.85	[0.58-1.26]

[a] Logistic regression model was fitted for each child dental behaviour. Odds ratios (OR) were reported.

Table 4. Models for the association of family functioning domains with child dental behaviours (n=733)

Family functioning domains[b]	>4 sugary items/day		Check-up in last year		Brushing 2+ times/day	
	OR[a]	[95% CI]	OR[a]	[95% CI]	OR[a]	[95% CI]
Problem solving	1.63	[0.77-3.48]	1.74	[1.00-3.01]	1.03	[0.55-1.93]
Communication	1.59	[0.92-2.74]	0.78	[0.49-1.25]	0.99	[0.64-1.53]
Roles	1.81	[1.09-3.02]	0.91	[0.58-1.44]	0.58	[0.38-0.89]
Affective responsiveness	1.60	[0.92-2.80]	0.88	[0.52-1.48]	1.05	[0.66-1.69]
Affective involvement	2.21	[1.25-3.92]	0.79	[0.50-1.23]	0.73	[0.47-1.12]
Behaviour control	2.61	[1.31-5.21]	0.76	[0.47-1.23]	0.75	[0.46-1.20]

[a] Logistic regression model was fitted for each child dental behaviour. Odds ratios (OR) were reported. The association of each family functioning domain with each dental behaviour was tested in regression models adjusted for parental demographic factors (age, gender, ethnicity and marital status), socioeconomic conditions (education and socioeconomic classification), and child demographic factors (age and gender).
[b] Unhealthy family functioning compared against healthy family functioning (reference group)

Discussion

Children from families with unhealthy functioning were more likely to consume sugary foods over 4 times a day and less likely to brush their teeth twice a day or more, independent of parental and child characteristics. However, family functioning was not associated with child dental attendance. Unhealthy functioning in roles, affective involvement and behaviour control were associated with high child sugar intake whereas unhealthy functioning in roles was associated with less frequent child toothbrushing.

Our findings on the association of unhealthy general family functioning with higher sugars intake among young children confirm those from previous studies (Nanjappa et al., 2015; Renzaho et al., 2014). Further, they associate unhealthy general family functioning with other child behaviours (such as less frequent toothbrushing). For the first time, we found evidence on which aspects of the family dynamics were associated with both child dental behaviours. Families with healthy functioning, with well defined roles, good involvement and responsiveness, and appropriate behaviour control provide their children with an environment that is more conducive to the adoption of favourable behaviours (Ryan et al., 2005). These domains were associated with child sugar intake whereas well defined roles were associated with child toothbrushing frequency. This emphasises the role of parental responsibility in caring for and supporting their child and performing their role of brushing their 3-4-year-olds' teeth as young children do not yet have the necessary skills to do this unaided. Taken together, these findings suggest that clear allocation and fulfilment of responsibilities and tasks between family members as well as showing interest and involvement in each other, might be possible features of the family dynamics that could be addressed with interventions to improve child dental behaviours.

Unhealthy family functioning was not associated with irregular child dental attendance. The use of dental services may differ from sugar intake and toothbrushing as families may face external barriers that fall outside their perceived direct control. That said, child dental services are free and comprehensive in England, which suggests that other factors (beyond affordability) affect child attendance pattern. Data from the latest national oral health survey of children have shown increasing numbers of parents reporting difficulties finding an NHS dentist over the past decades (Holmes et al., 2016). The fact that ELOHI families were recruited from a deprived, ethnically diverse area of London suggests issues of geographical accessibility and accommodation (language and cultural barriers) could be relevant, although this needs further exploration.

Our findings have implications for practice and further research. The current study recognised the role that families play in shaping child behaviours, in general, and dental behaviours, in particular. In this regard, curbing sugar intake is particularly important to tackle multiple chronic conditions in childhood, such as obesity and dental caries. Family functioning provides a useful theoretical framework for the development of home-based interventions to address this common risk factor. Although evidence on the effectiveness of supervised toothbrushing to prevent dental caries is inconclusive (Dos Santos et al., 2018), the benefits of fluoride toothpaste are indisputable. The lack of theory underpinning the development of family-based interventions to improve child brushing behaviour has been emphasised (Aliakbari et al., 2021). In that sense, family functioning provides a sound theoretical framework worth exploring. Building on this work, longitudinal studies with multiple assessments of family functioning, child behaviours and oral health would be useful to confirm the present findings. Further studies could also explore the role of child dental behaviours in explaining the association between family functioning and childhood dental caries (de Jong-Lenters et al., 2018; Duijster et al., 2015; Duijster et al., 2014). Qualitative research would shed light on the specific routines of families with healthy functioning in relation to child oral health.

Some limitations of our study need to be discussed. First, we used cross-sectional data so we could not establish causal inferences or temporal relations. Second, the response rate was moderate which might affect the generalisability of findings. However, survey weights were used during the analysis to compensate for non-response and produce population-level estimates. Third, the self-reported nature of data on private family life, relationships and their children's behaviours might have been prone to information bias

(particularly recall and social desirability bias). However, we used a validated instrument to measure family functioning, the FAD, and the prevalence of children with favourable dental behaviours was similar to those reported in the latest national child oral health survey in the UK (Holmes *et al.*, 2016), which give some credibility to our findings.

Conclusion

This study provides evidence that healthy family functioning was associated with more favourable dental behaviours among children. How a family functions, particularly in terms of how they define roles and provide emotional support, might be relevant to improving child dental behaviours, and subsequently, child oral health.

Acknowledgements

Conflict of interests

The authors declare that there are no conflicts of interests in this study.

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