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ADVANCES IN PEDIATRIC RESEARCH

Oral health behaviors associated with dental general anesthesia among healthy children

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Abstract

Background: Background: The aim of this survey was to investigate family-related factors among healthy children treated under dental general anesthesia (DGA) compared to those treated in a normal dental setting.

Methods: The survey comprised 87 children whose dental treatment was performed under DGA and 103 age-matched children who were treated in a normal setting. The children were healthy 3 to 11-year-olds, and their parents filled out the questionnaire on parental dental fear, DGA experiences in the family, and oral health behaviors. The data were collected in primary health care in the city of Oulu, Finland, during 2014–2016.

Results: In the DGA group, the proportion of fearful parents was three-fold higher and the proportion of siblings with DGA experience four-fold higher than in the comparison group; the differences between the groups were statistically significant. The dietary habits were statistically significantly poorer in the DGA group than among the comparison group when several indicators were considered. Linear regression analysis showed that treating a child in DGA was associated with harmful oral health behaviors like eating candy, drinking juice, and poor tooth brushing habits.

Conclusions: Parental dental fear, DGA experiences of siblings, and harmful oral health behaviors were more common among children treated in a normal dental setting. Screening children and families for the risk indicators identified in this study may help prevent unnecessary DGAs among healthy control.

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Introduction

Dental caries are a major public health challenge worldwide, and the number of people with untreated caries increased to 3.5 billion in 2015 [1]. At the same time, there is an increase in the consumption of foods and drinks containing sugar, causing not only a risk of caries risk but also a risk of diet-related diseases, such as type 2 diabetes and cardiovascular diseases [2-4]. Wellbeing due to oral health conditions can be maintained with very simple and inexpensive daily behaviors: brushing teeth with fluoride dentifrice twice daily; choosing a proper, healthy diet; and visiting the dentist

regularly [5]. If these behaviors are not maintained by children, they can develop early childhood caries (ECC) in the worst case, consequently requiring the use of dental general anesthesia (DGA). The main reason for the use of DGA among children is caries in Finland and worldwide. A 2005 study found that healthy DGA patients aged 16 years or younger and treated in the primary health care setting in the city of Helsinki, Finland, commonly belonged in the high caries risk group (mean number of teeth with caries, dt + DT = 7.7 ± 3.0) [6]. In comparison, only 6–8 % of children aged 6 to 15 years old were reported to have a high risk for dental caries (dt + DT = 3) in 1999 [7]. It has even been stated that DGA in childhood is a risk factor for future caries in adolescence [8], and that status may be a clinically useful adjunct to identify people at high risk of developing caries.

In addition to dental caries, another important factor leading to DGA is dental fear [6,9]. Parents of children treated under DGA often have false beliefs and are indifferent as to their children's poor oral condition [10]. It has also been reported that dental caries risk is associated with family habits and parental behavior [11]. To our knowledge there is no literature on whether factors associated with families are related to the need for DGA use in healthy control.

The aim of this survey is to investigate parental dental fear, DGA family experiences, family size, as well as oral health behaviors among healthy children treated under DGA or in a normal dental setting. Our hypothesis is that all of these issues are related to the use of DGA in healthy children.

Methods

Study population

In Finland, children under 18 years of age are entitled to free public dental health services. If there is a need for DGA (e.g. an extensive treatment need with respect to age or co-operation), healthy children are treated under DGA fort a small fee. The population in this cross-sectional survey comprised children treated under DGA (case group) and children treated in a normal setting (comparison group). All the children were 3 to 11 years old and healthy. The data for both groups were gained from the questionnaires filled out by the parents of the child participants. The parents in the DGA group filled out the forms while they waited for their child to recover after DGA. The parents of the children in the comparison group responded to the questionnaire during the child's appointment. No parents refused to answer the questionnaire.

The participants in the DGA group (n=87) were treated under DGA within primary health care in the city of Oulu, Finland. The data concerning the DGA group were collected between November 2014 and December 2015 by the anesthesia staff. The DGA patients comprised those who had a dental treatment need that could not be accomplished in a normal setting. Prior to DGA, all referrals were evaluated (and most DGA were also carried out) by an experienced pediatric dentist (P.R). No referral to DGA was based on a parent's wish. The comparison group comprised 3 to 11-year-old children coming for their regular dental examination in the dental clinic of the same organization (n=103) without randomization (convenience sample). Presuming a 20% difference between the groups, a sample size of 80 children was calculated as the minimum number of participants in the comparison group in order to identify a statistically significant difference between the two groups with power $1-\beta = 0.95$. The data concerning for the comparison group were collected between September 2016 and December 2016. Most participants in the comparison group were also treated clinically by P.R.

Questionnaire

The questionnaire has been used in several previous studies investigating oral health behaviors of children [12-14]. It comprises 25 questions about oral health related issues and background factors. The response alternatives were mostly "yes" or "no", with only a few open-ended questions. Parents were asked to provide the following background factors: the age of the child (*years*), the number of adults living in the family (*n*), the number of children living in the family (*n*), if the respondent had dental fear (*yes/no*), if the respondent or the other parent had ever been treated under DGA (y*es/no*), and whether siblings had ever been treated

under DGA (*yes/no*). Parents were also asked about the child's dietary habits such as snacking (*once/ twice/more than twice per day*), snacking in the family (*yes/no*), drinks during the meal (*water/milk/juice/something else*) and for quenching thirst (*water/milk/juice/something else*), and if certain products were consumed daily (*yoghurt/hot chocolate/candy/cookies/potato chips*). Concerning tooth brushing habits, the parents were asked how many times per day they washed their child's teeth (*less than once, once, twice*), if the child washed their teeth on their own (*yes/no*), if the child used an electric toothbrush (*yes/no*), and if the child used xylitol products (*yes/no*). When a parent provided multiple answers to one question, the worst alternative was chosen for statistical analyses. All child data was anonymized.

Statistical analyses

The outcomes of this descriptive survey were analyzed and presented in frequencies, proportions, means, and standard deviations (SD). Association between variables was analyzed using cross-tabulation. The significance of these findings was tested using the chi-squared test. Differences between the groups were considered statistically significant when p values ≤0.05. A sum score was calculated for responses on oral health behaviors according to their proposed harmfulness (-1 to +1), the most favorable option was assigned the score -1 and the most harmful option was assigned the score +1. The sum score was calculated as follows: the most common drink for quenching thirst (no answer = 0, water =-1, milk or juice = 1), eating candy daily (no answer = 0, yes = 1, no =-1), frequency of brushing teeth per day (no answer = 0, once = 0, less than once = 1, twice = -1), night bottle (no answer = 0, yes = 1, no = -1), the most common drink for meals (no answer = 0, juice = 1, water or milk = -1). A linear regression analysis was performed using the sum score as a dependent variable to examine the association with various factors: parental dental fear (yes/no), sibling's DGA (yes/no), age of the child (0–6/7–12), number of children in the family, dental treatment performed under DGA/in a normal dental setting, and gender (boy/girl). Analyses were performed using SPSS software version 22.0 (Chicago, Illinois, USA).

Results

None of the parents refused to fill out the questionnaire, but some parents left some questions unanswered. For example, the number of parents in the family was often left unanswered in both groups. The study groups were quite similar in terms of group size, gender and age distribution (n.s.). The number of children was lower in the families of the comparison group participants; the number of families with four or more children was two-fold higher in the DGA group than in the comparison group (Table 1).

Table 1. Distribution of the participants according to age, gender and family size

		DGA group n (%)	Comparison group n (%)	p
Age	3–6 years	37 (42.5)	42 (41.0)	n.s
	7–11 years	49 (56.3)	61 (59.2)	.
Gender	boy	56 (64.4)	58 (56.3)	n.s
	girl	30 (34.5)	43 (41.7)	
Number of parents	1 parent	11 (12.6)	19 (18.4)	n.s
	≥ 2 parents	66 (75.9)	75 (72.8)	
	no answer	10 (11.5)	9 (8.7)	
Number of children in the family	1 child	6 (6.9)	16 (15.5)	n.s
	2 children	26 (29.9)	39 (37.9)	
	3 children	22 (25.3)	28 (27.2)	
	≥4 children	30 (34.5)	19 (18.4)	

The proportion of children with fearful parents was three-fold higher and the proportion of siblings with a prior DGA experience was four-fold higher in the DGA group than the comparison group; the differences between the groups were statistically significant. In addition, there was a tendency (11.5% vs. 7.8%) of higher prevalence of DGA

treatments among the parents in the DGA group compared to the comparison group (n.s.) (Table 2).

Drinking habits at meals and for quenching thirst were considerably poorer in the DGA group than in the comparison group, and the differences were statistically significant. For example, drinking juice was more common and drinking water less common in the DGA group. Drinking milk to quench thirst was also more common in the DGA group than in the comparison group. Daily consumption of candy ($p \leq 0.05$), yoghurt or potato chips were also more frequent behaviors in the DGA group than in the comparison group. During infancy, the DGA group members had used night bottles more often than the comparison group. While the comparison group mainly drank only water or milk, the DGA group also consumed hot chocolate and juice. There was also a difference between the groups concerning a daily family meal; more families in the comparison group responded that they had a daily meal together (Table 3).

Table 2. Distribution of the participants according to parental dental fear and previous family members' DGA treatments

	DGA group n (%)	Comparison group n (%)	p
Fearful parent	22 (25.3)	8 (7.8)	0.001
DGA of parent	10 (11.5)	8 (7.8)	n.s.
DGA of sibling	15 (17.2)	4 (3.9)	0.009

Daily xylitol chewing gum use was higher in the comparison group than in the DGA group ($p \leq 0.05$). Almost all the children used fluoride toothpaste in both the DGA and comparison groups. The proportion of those using an electronic toothbrush, on the other hand, was more than 10% higher in the DGA group compared to the comparison group. In more than half of the cases in both groups, teeth were brushed twice daily; the proportion of frequent brushers, however, was higher in the comparison group (Table 4).

Table 3. Dietary behaviors among the participants in the DGA and comparison group

Variable	DGA group n (%)	Comparison group n (%)	p
number of daily			n.s.
1 snack	27 (31.0)	36 (35.0)	
2 snacks	49 (56.3)	58 (56.3)	n.s.
≥ 2 snacks	9 (10.3)	7 (6.8)	
snacking per se	48 (55.2)	43 (41.7)	
drink during meals			0.039
water	8 (9.2)	21 (20.4)	
milk	69 (79.3)	80 (77.7)	
juice	6 (6.9)	1 (1.0)	
drink when thirsty			0.001
water	47 (54.0)	84 (81.6)	
milk	21 (24.1)	6 (5.8)	
juice	16 (18.4)	10 (9.7)	
daily yoghurt	62 (71.3)	65 (63.1)	n.s.
daily hot chocolate	19 (21.8)	22 (21.4)	n.s.
daily candies	3 (3.4)	0 (0.0)	0.048
daily cookies	8 (9.2)	12 (11.7)	n.s.
daily potato chips	3 (3.4)	2 (1.9)	n.s.
night bottle during	41 (47.1)	40 (38.8)	n.s.
daily family meals	71 (81.6)	92 (89.3)	n.s.

The linear regression analysis showed that treating a child in a normal setting instead of with DGA was associated with oral health behaviors that are not considered harmful. The regression estimate was 95% (-1.49 to -0.42). In the analysis, the other variables were not statistically significantly associated with harmful oral health behaviors (parental dental, fear, sibling´ s DGA, age of a child, number of children in the family or gender) (Table 5).

Table 4. Participants' oral hygiene behaviors and use of xylitol products in the DGA and comparison group

Variable		DGA group n (%)	Comparison group n (%)	p
Frequency of child's tooth brushing/day	*Once or less*	7 (8)	15 (14.6)	n.s.
	Once	29 (33.3)	18 (17.5)	n.s.
	Twice or more	46 (52.9)	65 (63.1)	n.s.
Child brushes their own teeth		51 (58.6)	64 (62.1)	n.s.
Use of electronic toothbrush		64 (73.6)	64 (62.1)	n.s.
Use of fluoride toothpaste		82 (94.2)	100 (97.1)	n.s.
Child uses xylitol products		71 (81.6)	97 (94.2)	0.021
Parent uses xylitol products daily		54 (62.1)	68 (66.0)	n.s.

Table 5. Linear regression analysis for the association between harmful oral health behaviors and family- related variables

Variable	Sum	
	β	95% CI
Parental dental fear (yes/no)	-0.138	-0.724–0.448
Sibling DGA (yes/no)	-0.356	-1.009–0.299
Age of child (0-6, 7-11)	0.144	-0.377–0.664
Number of children in the family (1,2,3,4, ≥5)	-0.113	-0.713–0.486
Dental treatment done under DGA or in a normal Dental setting	-0.956	-1.489–-0.423
Gender (boy/girl)	-0.385	-0.889–0.118

Discussion

Our hypothesis about an association between the use of DGA among healthy children and the existence of parental dental fear, DGA history in the family, big family size, and harmful oral health behaviors were proven right. There seems to be a risk that the use of DGA may become habitual in certain families with harmful health behaviors. As far as we know this is the first survey to identify the characteristics of children who are treated with DGA compared to children treated in a normal dental setting.

In the DGA group, the oral health situation in general was poor enough to justify treatment under DGA, whereas the comparison group could be treated in a normal setting. P.R. was familiar with families in both groups and their oral health circumstances were well known to her, even though the Decayed, Missing, Filled (DMF) or Community periodontal index (CPI) were not linked with the questionnaire. A similar group to the study cohort (age, Finnish nationality, health condition, institution) comprising children treated with DGA was previously published with decayed teeth (DT) and decayed primary teeth (dt) indexes [6] and we assume that the caries situation is similar in our DGA group. Lack of clinical details in this survey can be considered as a shortcoming as can incomplete data; however, a strength of this survey was that the dropout rate was zero.

A high number of siblings and child's high birth order within the family affect the development of ECC [15,16]. Our findings showed that the family size was bigger in the DGA than in the comparison group, which indirectly supports earlier findings [15,16]. Several other socioeconomic factors, such as maternal education level or immigrant background, are also reported to influence ECC [17], but in this survey, we did not study these factors. In Finland, the socioeconomic differences are in any case smaller compared to many other countries [18]. Immigrants are known to be frequent users of DGA [19]; however, the number of immigrants in Oulu was very low at that time of this study.

This survey shows that parental dental fear is associated with the use of DGA. Indeed, parental dental fear is often the reason behind the child's treatment under DGA among both healthy and medically compromised children [20]. Therefore, family background should be taken into consideration when a child ends up being treated under DGA. The differences between the DGA and comparison groups were surprisingly high for parental dental fear and the number of siblings previously treated under DGA. There seems to be a tendency that certain families may consider DGA to be a normal dental health care practice. This phenomenon of the entire family opting for DGA could be addressed by paying more attention to

preventing dental fear in everyday dental practice [21].

Frequent and high consumption of sugar-containing products, such as sugary drinks, is known to increase the incidence of caries [22] and the present survey confirms previous findings that the prevalence of DGAs is associated with harmful oral health behaviors. Children in the DGA group had significantly more harmful drinking habits: they drank considerably more juice and less water than the comparison group. Drinking milk to quench thirst was also almost five times more common in the DGA group. Children in the DGA group used night bottles during their infancy more than the comparison group, and the drinks provided were more harmful (hot chocolate and juice), while more children in the comparison group received milk and water. It would have been interesting to ask parents about their child's consumption of soft drinks.

Responses by the comparison group revealed more favorable dietary habits, including daily family meals. Skipping breakfast can be a significant caries coefficient in adolescents [23-25]. This issue could have been explored in more detail in this survey. Why is it so difficult for some families to control simple eating and drinking behaviors? Is it because of laziness or indifference? Socioeconomic factors (such as unemployment or parental sickness) could be an explanation, but not all the unhealthy habits described here can be explained, for example, by a family's financial situation. In Finland, good quality tap water is available everywhere and the cost is minimal. Dietary oral health promotion should be offered if signs of risk behavior are evident because even a slight decrease in sugar consumption can result in a significant decrease in the levels of caries [26].

Previous findings concerning low tooth brushing frequency in Finland [27,28] is also supported by this survey. Even in the comparison group, only 63% of parents reported that the child's teeth were brushed twice daily. The same phenomenon was reported in the 2009/2010 WHO report, according to which 64% of 13-year-old Finnish girls and 47% of Finnish boys brushed their teeth more than once per day. In comparison, 88% of Swiss girls and 80% of Swiss boys brushed their teeth more than once per day [29]. The difference between the DGA and comparison groups in terms of the use of xylitol products was statistically significant. In Finland, the main xylitol products used are xylitol chewing gum products. Many people are aware that the consumption of 5 g xylitol per day promotes good oral health [30].

Conclusions

This study identified several family-related factors associated with the use of DGA in healthy children. Such factors should be addressed in everyday clinical pediatric dentistry. This would require sensitivity by the dentist, but such factors should not be neglected when dealing with young children who often do not make their own daily choices in relation to food and drink and are often not able to care for their own personal hygiene. When a child's oral health deteriorates, it is crucial to educate and support the parents. To address these issues, a great effort should be made, and, perhaps, fresh approaches adopted. This topic should also be monitored by future research efforts.

Ethical approval

Permission to carry out this survey was obtained from the registrar of Oral Health Care at the Municipal Health Center of the City of Oulu, Finland. The Ethical Board of the Northern Ostrobothnia Hospital District, Finland, did not consider that informed patient consent was necessary as answering the questionnaire was voluntary and anonymous, and answering did not influence the treatment after DGA.

Author contribution

PR designed the study, collected the data, performed the data analyses together with HV, and wrote the manuscript. M-LL and VA were engaged in the process of conception, design, analysis and writing the manuscript.

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