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ORIGINAL ARTICLE

Sweets consumption of preschool children—extent, context, and consumption patterns

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Abstract
Objectives Sweets consumption is one of the risk factors of caries, especially among children. The aim of our study was to explore the extent and context of preschoolers' sweets consumption and to identify high-risk groups.
Materials and methods The baseline cross-sectional data used originated from a nutritional intervention study encompassing 879 parental surveys, which were obtained in 52 kindergartens in Baden-Württemberg—the third largest federal state in Germany—between September and March 2009. Our outcome variable "sweets consumption" was operationalized using food-frequency items and analyzed by testing the influence of sociodemographic, educational, cultural, and family context covariates.
Results Most preschoolers consumed sweets every day—on average 9.7±6.2 times per week. Most popular were cookies, gummy bears, and chocolate. Sweets consumption did not correlate significantly with sociodemographic factors like age and sex but rather was associated with cultural and contextual factors such as immigrant background, parental education, specific nutritional knowledge levels, and access arrangements in the home.
Conclusions The consumption patterns identified are a result of high availability and parental influence (factors such as parents' knowledge levels, interest in, and habits regarding their child's nutrition).
Clinical relevance Dental practitioners should place more emphasis on gathering information from young patients regarding excessive and frequent consumption of sweets and consequently on trying to educate the children and their parents on oral health risks associated with such consumption. Particular attention is to be paid to children of Turkish and Arabic decent, as they have been shown to consume above-average amounts of sweets.

Keywords Child · Kindergarten · Food supply · Caloric intake · Candy · Cultural background · Prevalence

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Introduction

One of the key responsibilities a dentist faces is to encourage patients to maintain good oral health. The excessive consumption of sweets in combination with inadequate toothbrushing undermines such efforts [1]. The frequent consumption of sweets is not only unfavorable for children's general health [2] but it also presents a risk factor for dental caries, particularly in combination with poor oral hygiene due to the prolonged contact of sugars with susceptible tooth surfaces [3–8]. The continuing increase in the consumption of sweets around the world demonstrates the relevance of this topic for dentistry [9–12].

The consumption of sweets is particularly critical for young children: Nutritional habits which last a lifetime are established at birth and during a child's development as part of a learning and socialization process and are stabilized by regular consumption [13]. Especially in preschool age, the extent of sweets consumption has a formative effect on further nutritional choices. Considering the effects of sweets

consumption in association with inadequate toothbrushing on oral hygiene and oral health [4, 14], it is all the more surprising that hitherto, only a few studies have been carried out on the sweets consumption habits of preschool children.

The specific setting in dentist's offices offers ideal prevention and intervention possibilities. Preschool children's dental checkups could be used by every dental practitioner to provide preschool children and their parents with adequate information on the relationship between caries, poor oral hygiene, and sweets consumption, as well as guidance about the prevention of dental caries. This is particularly important as it has been shown that a mother's risk awareness plays a crucial role in good oral health among young children [15, 16].

The first aim of our study was to explore the extent and context of preschoolers' sweets consumption. Further aims were to investigate which sociodemographic, social, educational, and motivational factors are associated with preschool children's sweets consumption and whether high-risk groups could be identified. Our analysis uses standardized proxy interviews with the parents of approximately 900 3- to 6-year-old children from 52 German kindergartens.

Methods

Setting

We used baseline data from the state-sponsored health promotion program "Komm mit in das gesunde Boot" ("Come aboard the healthy boat"), collected by the senior author and her research group [17]. This project was carried out in Baden-Württemberg, the third largest federal state in Germany. With a population of nearly 11 million residents, Baden-Württemberg has an extensive network of more than 7,600 kindergartens located in urban and rural settings, in which enrolled preschoolers are cared for by certified teachers. The cluster sampling procedure used for the evaluation of the state-sponsored program is documented in detail elsewhere [17].

Inclusion criteria for kindergartens and children

Kindergartens from three predefined regions with a minimum of 15 children per kindergarten were eligible for this study. Within the 52 recruited kindergartens, all children between 3 and 6 years of age were eligible and those whose parents provided written permission were included in the study, which was carried out between September 2008 and March 2009. Proxy interviews were conducted with the legal guardians (parents, foster parents), who will be called "parents" from now on for simplification purposes.

Questionnaire

The standardized written questionnaire consisted of 87 questions on the child's biopsychosocial situation, nutrition, and overall health. It was developed in collaboration with the independent scientific Leibniz Institute for Social Sciences (GESIS, Mannheim, Germany), which specializes in the evaluation of study designs and questionnaires. A pretest (n=8) and a pilot test (n=33) were conducted. Data were entered by professional typists using double entry procedures and plausibility checks. Altogether, questionnaires were handed out to 1,134 children. The return rate was 85.9 % (n=974). After the exclusion of incomplete data, 879 parents' questionnaires were available for our analysis.

Operationalization

The outcome "sweets consumption" was established using several food frequency items, assessing the consumption of cookies, gummy bears, chocolate bars, candies, cake, and refrigerated sweet foods as separate items, with answers formulated (and weighted) as follows: "never" (0), "less than once a week" (0.5), "one to three times a week" (2), "four to six times a week" (5), "daily" (7), and "several times daily" (14). The resulting data were added to form an index of "weekly food frequency of sweets" with a theoretical maximum value of 84 points (six sweets × 14). As the data approximated normal distribution and because of the large sample size, a z-transformation could be waived according to the central limit theorem. This has the advantage of allowing a simple and comprehensive interpretation of the quasimetric outcome variable and the possibility of applying parametric statistical procedures. In order to enable logistic regression analysis, an additional dummy variable was derived by means of a median split of the outcome variable with the cut point of 8.5. The purpose of the complementary logistic regression models was to prove the stability of the linear model.

Covariates of sweets consumption

Children's sociodemographic factors, gender, age, and presence of siblings, were recorded, as well as the family structure and context. To operationalize the family structure, all children who lived either with their grandparents, foster parents, other relatives, or in a single-parent family were categorized as "not living in a nuclear family." The mother's country of origin was categorized using free text information from the parental questionnaire in due consideration of the typical migrant structure in Germany. The child's socioeconomic status was estimated using his/her mother's self-report of the highest level of educational attainment as a proxy [18, 19]. According to the International Standard

Classification of Education (ISCED) [20], we defined three categories of maternal education: "high"=ISCED—level 5/6, "middle"=ISCED—level 4, and "low"=ISCED—level 1/2/3.

In addition, relevant knowledge on nutrition was included as a covariate. The variable was based upon a parental rating of the healthiness of products frequently advertised for children in Germany, which subsequently allowed the comparison of nutritional knowledge with the ISCED-based education level. Products that were rated by the parents are a "childrens cake snack", a high-calorie combination of dough and rich cream (417 kcal, 34.5 g carbohydrates and 27.3 g fat per 100 g), and a "children's cream", a sweetened, rich yogurt mixture (105 kcal, 13.0 g carbohydrates and 2.9 g fat per 100 g) using the question: "How would you evaluate the following statement: Children's products such as cake and cream snacks are healthy?" In the original questionnaire we used the product names and trademarks. The answer "does not apply to at all" was defined as high nutritional knowledge, "does not really apply to" as moderate, and "applies to for sure," "applies," and "neither/nor" as comparatively low nutritional knowledge.

The parents' level of interest in healthy nutrition for their children was assessed using a five-point ordinal scale. Based upon a left-skewed distribution, we combined the original five categories to three ordinal categories "low to moderate interest" (1–3), "high interest" (4), and "very high interest" (5). Furthermore, parents were asked whether their children were allowed to decide on their own when to consume sweets: "Do you allow your child to decide on his/her own, whether and when he/she consumes sweets?" (0 = no, 1 = yes). In addition, we asked if a box of sweets was kept at home and what the typical occasions were in which the parents permitted their children to consume sweets.

Statistical analyses

Bivariate analyses (chi-square tests) and multiple linear and logistic regression analyses were performed. In order to avoid an overfitted model, only variables significant in bivariate analyses with sweets consumption as a dependent variable were included in the multiple regression. As further analyses showed that including all bivariate significant variables caused the variable "gender of the child" to become significant, it was also incorporated into the final model (Table 2, model 4). All tests were two-tailed at a level of significance of $p \leq 0.05$. All analyses were performed using SPSS/PASW for Windows, Version 18.0 (SPSS Inc. Chicago, IL, 60606, USA).

Ethics and human subjects' confidentiality

The parents of all children participating in the study provided their written informed consent. Ethical approval was granted by the ethics committee of the Medical Faculty Mannheim, Heidelberg University (ID 2008-275N-MA).

Results

Food frequency and product choice

None of the children examined abstained from eating sweets completely. On average, sweets were consumed 9.7 times per week (±6.2). Every fifth child consumed sweets one to four times per week (18.2 %, Fig. 1). Every sixth child received sweets more than twice a day on average (16.6 %, Fig. 1).

Cookies, gummy bears, and chocolate are the most popular sweets among children. Figure 2 gives a differentiated view of food frequencies. Cake, candies, and refrigerated candy bars are eaten less frequently compared to the other products.

Parents' habits and attitudes

In half of the households (48.2 %), an unsecured source of sweets in the form of a box, a shelf, or a drawer existed and was generally accessible to the children. However, only 11.4 % of the parents stated that their child is indeed allowed to decide freely when and how many sweets he/she consumes. Furthermore, 54.0 % of the parents stated a very high interest in their child's nutrition and 34.1 % stated high interest. The concrete question as to whether typical products advertised for children (such as the above-mentioned snacks) are healthy was negated by most of the parents (does not apply to at all 54.7 % and does not really apply to 24.0 %).

Occasions

Active demands by the children (91.8 %) and visits to relatives and friends (88.7 %) represent the most common occasions on which children receive sweets. Further

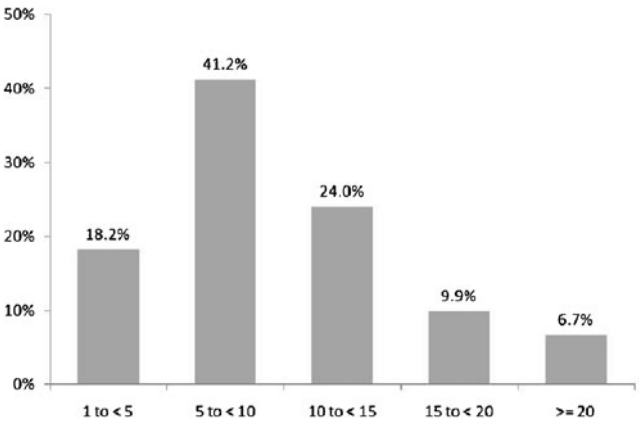

Fig. 1 Frequency of sweets consumption among preschool children per week (categorized). Baden-Württemberg, Germany, 2008–2009, "Komm mit in das gesunde Boot" ("Come aboard the healthy boat")

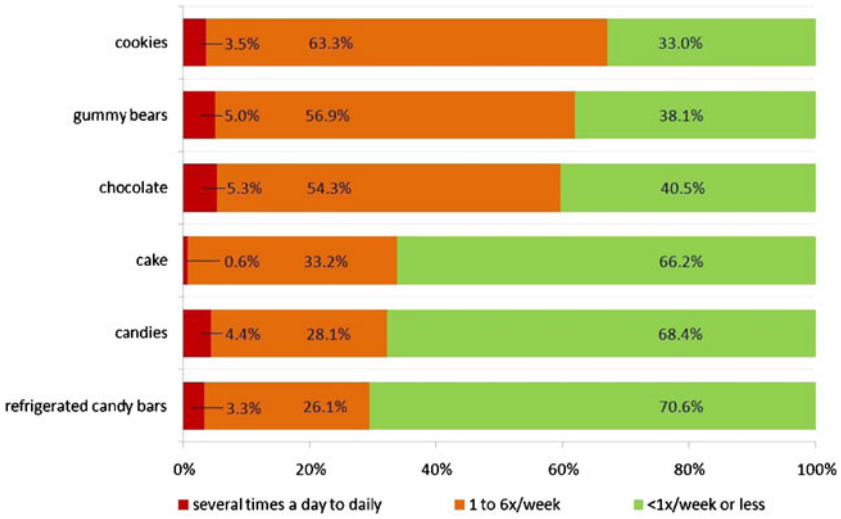

Fig. 2 Frequency of sweets consumption among preschool children by type of products. Note: Multiple answers were possible. Baden-Württemberg, Germany, 2008–2009, "Komm mit in das gesunde Boot" ("Come aboard the healthy boat")

occasions include sweets as dessert (81.5 %) and as snacks while traveling (67.2 %). In approximately two-thirds of all households (65.0 %), sweets are utilized as a reward. Further typical occasions are consumption in front of the television (53.7 %), as snacks (48.7 %), and as consolation (28.2 %).

Correlates of sweets consumption

The average consumption of sweets varies marginally between the sociodemographic groups of children; neither significant gender-nor significant age-dependent differences were found in the quantitative outcome score (Table 1). Whether a child had siblings or not or was living with their biological parents, grandparents, other relatives, or with foster parents was not a significant determinant of sweets consumption. Kindergarten location—meaning a rural or an urban residential environment—did not show a significant association with sweets consumption either (Table 1).

Sweets consumption apparently does not correlate with the sociodemographic features of children but rather seems to be related to parent-specific factors. For example, children aged from 3 to 6 with Turkish and Arabic immigrant background consumed sweets considerably more frequently than children of German decent. Also, a higher maternal education level is associated with significantly lower levels of sweets consumption. Sweets were consumed especially frequently by preschool children whose parents had a low level of knowledge concerning healthy nutrition and let their children decide freely when and where they "eat treats" (Table 1).

In additional multiple linear regression analyses including all bivariate significant variables (Table 2), the positive association between Turkish or Arabic immigrant background and sweets consumption decreases when adjusting for the other variables yet stays significant and relevant in the final model (models 1–4). The comparison of the variables "mother's level of education" and "parents' nutritional knowledge" (model 3) suggests that concrete nutritional awareness and parents' knowledge level rather than their formal education level correlates with the children's consumption rates. We could not find any gender differences after adjustment to relevant covariates (model 4 [21]). The effect of the child being able to freely decide when and how many sweets to eat stayed significant even in the final regression model. The correlation coefficient R^2 ranged between 2.4 and 5.2 %. Additional logistic regression analyses—conducted for internal validation—led to weaker, but comparable effects (data not shown).

Discussion

Most preschoolers consume sweets every day—on average 10 times per week. Most popular are cookies, gummy bears, and chocolate. These consumption patterns are a result of high availability and parental influence (such as their knowledge level, interest in, and habits regarding their children's nutrition). The extent of sweets consumption is influenced less by sociodemographic characteristics such as the age or sex of the children but rather depends on parental factors. Therefore, providing parents with oral health education appears to be a promising preventive measure to reduce sweets consumption rates among preschool children [15, 16]. Children from Turkish and Arabic families as well as from households with less nutritional knowledge and inappropriate access arrangements consume significantly more sweets more frequently.

Positioning in the current state of research

The present study shows that preschool children consume considerably more sweets than has been recommended by

Table 1 Bivariate analyses of psychosocial influence of sweets consumption

Variable	Number	mean (±SD)	*p* value
Sociodemographic factors of the child			
Gender			
Male	458	9.49 (±5.95)	0.230
Female	421	9.99 (±6.37)	
Age			
3–4 years old	147	9.22 (±5.87)	0.540
5 years old	388	9.79 (±5.51)	
6 years old	344	9.87 (±6.93)	
Presence of siblings			
Only child	160	9.84 (±5.82)	0.800
Siblings	719	9.70 (±6.23)	
Family context			
Not in a nuclear family	79	9.05 (±5.53)	0.307
In a nuclear family	800	9.79 (±6.22)	
Kindergartens' contextual environment			
Rural	640	9.63 (±6.17)	0.460
Urban	239	9.98 (±6.14)	
Social, educational, and motivational factors of the parents			
Mother's country of origin			
German	682	9.31 (±5.36)	<0.001
Turkish or Arabic	42	13.06 (±8.04)	
East European	91	11.08 (±8.91)	
Others	64	10.28 (±7.01)	
Mother's level of education			
Low	191	10.93 (±7.71)	0.008
Middle	494	9.48 (±5.73)	
High	194	9.17 (±5.31)	
Parents' nutritional knowledge			
Low	187	11.54 (±7.02)	<0.001
Middle	211	10.11 (±6.29)	
High	481	8.85 (±5.55)	
Parents' interest in healthy child nutrition			
Low up to moderate interest	104	9.62 (±6.17)	0.969
High interest	300	9.70 (±5.45)	
Very high interest	475	9.77 (±6.58)	
Freedom of choice			
No	779	9.47 (±5.87)	0.006
Yes	100	11.74 (±7.81)	

Baden-Württemberg State, Germany, 2008–2009 study: "Komm mit in das gesunde Boot" ("Come aboard the healthy boat"), $n=879$

medical associations (such the German Association for Nutrition, the Research Institute for Child Nutrition, and the consumer protection information service [22]). The consumer protection information service recommends that the age group analyzed in this study should not consume more than seven portions of sweets per week. Thus, the consumption rates actually identified among the study's participants (with an average consumption rate of 9.7 and a median consumption rate of 8.5) exceed this recommendation.

A similar recommendation has been issued by the Research Institute for Child Nutrition: Based on the German Association for Nutrition's stipulations, the Research Institute for Child Nutrition recommends that a 3-year-old child should not consume more than a third, and a 6-year-old, not more than half a typical 60-g chocolate bar per day [22–24]. Sweets consumption rates also exceed recommendations in other Western countries [10, 25, 26]. It should be borne in mind that not only the level of sugar and sweets consumption has an impact on oral health and dental caries development but also how often preschool and school children consume between-meal snacks and sugary beverages plays a significant role in caries prevalence [1, 27, 28]. Due to the multifactorial nature of caries development, the importance of oral hygiene (frequency of toothbrushing with fluoridated dentifrices) should also be taken into consideration [1, 14, 29, 30]. However, the oral hygiene practices of preschool children could not be evaluated in this study.

Long-term excessive intake of hypercaloric food leads to malnutrition and increases the likelihood of diseases such as type 2 diabetes mellitus, arterial hypertension, and adiposity [3, 9, 31]. The majority of current research on preschool children's sweets consumption has therefore taken health outcomes such as adiposity and type 2 diabetes as endpoints. However, equally important are the effects of sweets consumption on oral health.

Sweets consumption was also explored in the German Health Interview and Examination Survey for Children and Adolescents ("KiGGS") between 2003 and 2006, but it lacked an in-depth analysis of determinants. The percentage of children aged 3 to 6 years who consumed cookies, chocolate, and other sweets on a daily basis was comparable to our findings [23]. In a regional study in the city of Braunschweig, Germany, around half of the children consumed sweets at least once a day, with 10 % eating them several times a day [32]. Another regional study in the German city of Dortmund reported similar findings (Dortmund Nutritional and Anthropometrical Longitudinally Study "DONALD," 1985–1995) and could show that 2-year-old children already have similar nutritional patterns to adults [33]. Furthermore, studies from Germany and Austria in over 6-year-old children show that in this age group, sweets consumption rates also exceeded respective recommendations [34, 35].

According to the "five major steps to intervention" ask, advise, assess, assist, and arrange ("the five A's"), dentists should at least first ask the parents of very young patients about their children's sweets consumption (ask) and secondly provide the parents with information regarding the associated oral health risks (advise). Recently published randomized controlled trials have confirmed that providing mothers with

Table 2 Regression coefficients of different multiple linear regression analyses concerning sweets consumption

	Model 1	Model 2	Model 3	Model 4
Mother's country of origin[a]				
Turkish or Arabic	+3.77 [1.87; 5.67], 0.001	+3.29 [1.30; 5.27], 0.001	+2.64 [0.65; 4.64], 0.010	+2.66 [0.66; 4.66], 0.009
East European	+1.90 [0.57; 3.23], 0.005	+1.71 [0.35; 3.06], 0.014	+1.05 [−0.32; 2.42], 0.132	+1.06 [−0.31; 2.43], 0.129
Others	+0.85 [−0.72; 2.41], 0.289	+0.77 [−0.80; 2.34], 0.336	+0.53 [−1.03; 2.08], 0.506	+0.52 [−1.03; 2.08], 0.508
Mother's level of education[b]				
Middle		+0.80 [−1.87; 0.28], 0.147	−0.41 [−1.49; 0.67], 0.458	−0.44 [−1.52; 0.65], 0.428
High		−1.15 [−2.40; 0.11], 0.074	−0.53 [−1.81; 0.75], 0.419	−0.51 [−1.80; 0.77], 0.433
Parents nutritional knowledge[c]				
Middle			+1.04 [0.04; 2.04], 0.041	+1.04 [0.04; 2.04], 0.043
Low			+1.99 [0.90; 3.08], 0.001	+1.97 [0.89; 3.06], 0.001
Freedom of choice[d]				
Yes			+1.47 [0.18; 2.76], 0.026	+1.44 [0.15; 2.73], 0.029
Gender of the child[e]				
Female				0.42 [−0.38; 1.23], 0.302
Intercept β	+9.29, 0.001	+10.04, 0.001	+8.96, 0.001	+8.78, 0.001
R^2	0.024	0.028	0.051	0.052
$\Delta R^2/p$ value		0.004, 0.187	0.023, 0.001	0.001, 0.302

Shown are the regression coefficient, [95 % CI], and the p value (n=879). The dependent variable is the frequency of sweets consumption per week. Baden-Württemberg State, Germany, 2008–2009 study: "Komm mit in das gesunde Boot" ("Come aboard the healthy boat")

[a] Reference category: German

[b] Reference category: Low

[c] Reference category: High

[d] Reference category: No

[e] Reference category: Male

guidance on caries prevention helps to reduce their children's snacking frequency and thus the prevalence of dental caries [15, 16].

Occasions on which children eat sweets vary within families and give insight into behavioral conditioning. For example, the use of sweets as a reward increases their attractiveness and—due to conditioning—also increases consumption [36]. Such dysfunctional reward strategies were reported by two out of three families in our study. This corresponds with previous research which has also shown that children's sweets consumption is higher in families which use such reward strategies [37, 38]. These findings led to the behavioral guideline that sweets should not be used as a reward [24, 38]. Due to the fact that television viewing is associated with the consumption of unhealthy food such as fast food and sweets [39–41], it seems alarming that in our study, every second child consumed sweets in front of the television. Generally, restriction rules seem to be effective in this context [37]. However, several authors give cause for concern that overly restrictive rules and complete abstinence from sweets might increase the attractiveness of the forbidden [42–45]. Dentists should therefore also inform parents of young patients that they should limit their children's sweets consumption, although they need not completely forbid them from eating sweets. Above all, sweets should not be used as a reward nor should the consumption of sweets while watching television be allowed.

Further starting points for preventive strategies might be focused on risk groups with above-average consumption rates. Our data show a nonsignificant, slightly higher consumption rate for girls which increases with age, which corresponds with German national representative data [22]. A study on preschool children in Belgium showed significant differences with similar trends [26].

Furthermore, we could show that parental factors are stronger determinants of sweets consumption than child demographics. Education and socialization of children is multidimensional [46], with parents contributing to their nutritional behavior via intentional control and sanction mechanisms as well as by means of social learning processes [47, 48]. By observing the eating and drinking behavior of "significant others" like parents, siblings, or friends, the child's own nutritional behavior is coined [13, 37, 49]. The strong influence of education and socialization on children's

sweets consumption can be seen in our data in the significantly higher consumption rates among children with an immigrant background, which is in line with other German data [22, 50]. The level of sweets consumption is higher among children from Turkish and Arabic backgrounds in particular. Previous researchers have explained these findings by claiming that in Turkish and Arabic cultures, food plays a more central role in life and that care for the child's well-being is overly associated with an overabundance of food. These cultural beliefs might represent a symbolic overcoming of former poor living conditions in Arabic and Turkish regions, which results in the insistent offering of food as a sign of hospitality [51].

Previous literature has also reported differences in sweets consumption in relation to educational status [52–55]. All studies cited demonstrate that the sweets consumption rates of children whose parents have higher education levels are lower than those of children whose parents have lower education levels. Although we could also show this relationship in our data, this bivariate effect of educational status on sweets consumption disappears after adjusting for variables such as immigration background and specific nutritional knowledge. On the one hand, this supports the hypothesis that educational differences possibly only reflect differences in the education levels of immigrants and the resulting culturally based parental lack of nutritional knowledge. Secondly, the parents' nutritional knowledge per se seems more important for children's sweets consumption than their overall education level, indicating that specific education on nutritional rules and food quality might help to lower the socioeconomic imbalance in nutritional behavior [15]. Quantitative and qualitative studies, however, show that many parents do not seize the opportunity to positively influence their child's behavior: Often, a large discrepancy between (high) nutritional knowledge levels of parents and (lacking) implementation was reported [38, 56]. Thus, to reduce the frequency of sweets consumption among children, as well as the above-mentioned education of parents during their child's treatment or during a prophylaxis appointment, more intensive, tailored oral health interventions (e.g., motivational interviewing) are additionally recommended. Such interventions should focus on parental education and training concerning concrete behavioral rules rather than on general nutritional knowledge transfer.

Strengths and limitations

First, our study is one of the few studies to explore the determinants of sweets consumption in children. Secondly, the sample consists of preschool children, a generally understudied risk group which might be crucial for effective early prevention efforts. Thirdly, in addition to descriptive analyses, we searched for determinants which are amenable to change and therefore might inform future interventions. Our study thus might be regarded as one of the most differentiated surveys on sweets consumption in this age group. The fact that some studies on sweets are funded by food industries (e.g., [53]) underlines the importance of independent studies like the one presented here.

The methodological limitations of our study mainly concern the selectivity of the study sample and the measurement of sweets consumption. Our study sample was recruited from 52 kindergartens from three regions within the federal state of Baden-Württemberg. Therefore, the sample of almost 900 preschoolers cannot be considered to be representative of the whole of Germany. However, additional analyses comparing our sample with all German preschoolers show that, with regard to most characteristics, there was no significant difference. In fact, 52 % of all preschoolers were boys in our sample (compared to 51 % boys among all German preschoolers, $p=0.567$) and the presence of siblings among the preschoolers amounted to 82 % in our sample (compared to 81 % in all German preschoolers, $p=0.390$). The only slight difference which was identified between our sample and the national cohort of preschoolers was the mother's country of origin (our sample: German 78 %, national average: German 81 %; $p=0.030$) [22, 23]. When interpreting the data, it is necessary to bear in mind that not all children attend kindergarten in Germany but, after all, around 84.2 % of those between 3 and 6 [22, 23]. Additionally, the explained variance of our calculation model is not unusual for regressions regarding health behavior.

Our main outcome sweets consumption was measured using a food frequency questionnaire. Although such questionnaires are established measurement tools for assessing nutritional behaviors, they have some methodological limitations. For example, the quality of measurement depends on the definition chosen: In our questionnaire, we chose to include quite a broad range of sweets. Despite this, due to restrictions on the length of the questionnaire, consumption of sugar-sweetened beverages could not be included. Furthermore, a general limitation of food frequency questionnaires is that they only measure the frequency of consumption instead of the absolute amount consumed. Food frequency surveys are often substituted by alternative methods with extensive individual records of the amount consumed, including calorie count and serving size. The latter was not feasible in our study. However, due to their prospective nature, quantitative records can also have downsides, as they might induce reactive nutritional behaviors [57]. On the other hand, surveys such as ours might be biased by social desirability [58], which results in underreporting [59]. However, the above-mentioned methodological limitations are more critical for the interpretation of the absolute consumption data than for analyses of determinants and correlates.

Conclusions

Based upon the data from this large regional sample of preschool children, the family and cultural context appears to play a central role in forming sweets consumption behaviors in early childhood [13, 37, 60, 61]. Additionally, specific nutritional knowledge and concrete nutritional rules seem to be more important than parental education levels in general. When informing parents about the oral health risks associated with excessive sweets consumption, dentists should pay particular attention to children of Turkish and Arabic decent.

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Ethical standards The parents of all children participating in the study provided their written informed consent. Ethical approval was granted by the ethics committee of the Medical Faculty Mannheim, Heidelberg University (ID 2008-275N-MA).

Conflict of interest The authors declare that they have no conflict of interest.

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