

Excess Body Weight, Snack Limits and Dental Caries in Brazilian Preschoolers: A Population-Based Study

Gabriela Macedo Fraiz¹, Sandra Patrícia Crispim², Gisele Ristow Montes³, Giovana Solheid Gil⁴, Francine Sumie Morikava⁵, Danielle Veiga Bonotto⁶, Fernanda Morais Ferreira⁷, Fabian Calixto Fraiz⁸

¹Multi-professional Healthcare Program, University Hospital, Universidade Federal do Paraná, Curitiba, PR, Brazil.

 0000-0002-9183-2130

²Department of Nutrition, Universidade Federal do Paraná, Curitiba, PR, Brazil.  0000-0002-2257-9899

³Department of Stomatology, Universidade Federal do Paraná, Curitiba, PR, Brazil.  0000-0003-3997-2109

⁴Department of Stomatology, Universidade Federal do Paraná, Curitiba, PR, Brazil.  0000-0002-6690-1317

⁵Department of Stomatology, Universidade Federal do Paraná, Curitiba, PR, Brazil.  0000-0002-4200-9973

⁶Department of Stomatology, Universidade Federal do Paraná, Curitiba, PR, Brazil.  0000-0003-3174-2237

⁷Department of Pediatric Dentistry and Orthodontics, Universidade Federal de Minas Gerais, Belo Horizonte, MG, Brazil.

 0000-0001-9400-1167

⁸Department of Stomatology, Universidade Federal do Paraná, Curitiba, PR, Brazil.  0000-0001-5290-7905

Author to whom correspondence should be addressed: Fabian Calixto Fraiz, Universidade Federal do Paraná, Department of Stomatology, Av. Prof. Lothário Meissner, 632, Jardim Botânico, Curitiba, Paraná, Brazil. 80210-170. Phone: +55 41 3360-4021. E-mail: fabianfraiz@gmail.com.

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Abstract

Objective: To evaluate the relationship between excess body weight (EBW) and the prevalence of dental caries in preschoolers considering parental control regarding snack consumption. **Material and Methods:** An observational, population-based, cross-sectional study was conducted at Municipal Child Education Centers in the city of Curitiba, Brazil, involving a representative sample of 686 preschool children aged four to five years and eleven months and their parents/caregivers. Dental caries was analyzed using the dmft index. Weight and height were measured for the determination of the body mass index, which was categorized for each z-score range considering age and sex. Children with overweight or obesity were considered to have EBW. The assessment of nutritional status was performed with the aid of the WHO Anthro and WHO Anthro Plus programs. The data were analyzed using univariate and multivariate Poisson regression analysis with robust variance ($\alpha=0.05$). **Results:** The children with EBW had a lower prevalence rate of caries, but this association lost its significance when adjusted by the other variables included in the multivariate model. In the multivariate regression analysis, household income per capita (PR=0.804; 95%CI: 0.665-0.972), child's age (PR=1.015; 95%CI: 1.001-1.029) and snack limits (PR=0.839; 95%IC: 0.732-0.962) were associated with a greater prevalence rate of dental caries. **Conclusion:** Excess body weight was not significantly associated with dental caries, whereas a lower parental limit regarding snack consumption by the children was independently associated with a higher prevalence rate of dental caries.

Keywords: Nutritional Status; Overweight; Feeding Behavior; Child, Preschool; Dental Caries.

Introduction

Inadequate eating practices, particularly the increasing consumption of ultra-processed foods, with the consequent increase in the ingestion of added sugar [1,2], can exert an influence on health outcomes, such as obesity [3] and dental caries [4]. Although caries and nutritional problems in childhood have a common risk factor [5] and studies have investigated the relationship between these events, the literature offers inconclusive and conflicting findings [6]. Some studies indicate a positive association between caries in the primary dentition and the body mass index [7,8], whereas others have found an inverse association [9,10] or no association at all [11]. Moreover, a nonlinear association has been reported in which both children with overweight or obesity and those who are thin or very thin have a higher prevalence rate of dental caries than children in the ideal weight range [12,13]. It seems that the relationship between obesity and dental caries is more evident in industrialized countries and those with a higher income than those with a lower income [14] or little industrialization [15].

It is likely that different environments and data collection procedures as well as the age and ethnicity of the participants contribute to the lack of conclusive findings. To overcome these problems, a standardized method has been suggested with the adequate control of confounding factors that exert an influence on dental caries and nutritional status [12,14,15].

Although the two conditions are closely associated with sugar intake [5], one must also consider that the ingestion of a particular food depends on various aspects, including parental behavior regarding the dietary habits of children [16,17]. In preschoolers, adequate parental dietary behavior, especially with regard to the restriction of snacks, is associated with both a lower prevalence rate of caries [18] and the control of a child's weight [17] and it is likely that this aspect exerts an influence on the relationship between nutritional status and dental caries. Therefore, the aim of the present study was to clarify the association between excess body weight and the prevalence of caries in preschool children considering parental control with regard to snack consumption.

Material and Methods

Study Design and Sample Characteristics

An observational, population-based, cross-sectional study was conducted involving a representative sample of preschool children aged four to five years and eleven months enrolled in the municipal public school system in the city of Curitiba, Brazil, and their parents/caregivers who reside in the same home. Curitiba is the capital of the state of Paraná in southern Brazil and has a Municipal Human Development Index classified as very high (0.823) [19].

The sample size was calculated considering a 56.2% prevalence rate of dental caries at five years of age [20], a 95% confidence level ($1-\alpha$) and 5% precision required for the estimates. The sample was corrected by 50% for the cluster effect and increased by 20% to compensate for possible dropouts, leading to a total sample of 704 preschool children aged four and five years.

Two-stage random cluster sampling was performed with the selection of preschools, followed by the selection of children at each school. To ensure representativeness, the total sample was distributed among the nine administrative districts of the city, maintaining the proportion of the number of children enrolled in preschools in each district. If a selected student was not present or did not meet the inclusion criteria, another child was selected. Children with a debilitating health condition at the time of data collection (fever, nausea, etc.), those with an orthodontic appliance and those who declined to participate were excluded from the study.

Data Collection

Data collection was performed by three examiners who had undergone training for the anthropometric measures (weight and height) and a calibration exercise for the evaluation of dental caries (inter-examiner agreement: Kappa ≥ 0.844 ; intra-examiner agreement: Kappa ≥ 0.921). A pilot study was first conducted involving 80 preschool children and their parents/caregivers in the municipal education system in the same age group as the main study.

Parents/caregivers were asked to complete a questionnaire addressing the socioeconomic and demographic characteristics of the family, such as child's sex, child's age, schooling of the parent/caregiver and household income. For the evaluation of the behavior of parents/caregivers regarding the control of snack consumption, the Snack Limits domain of the Parent Mealtime Action Scale was used [21], which has been translated and validated for use in Brazil [22]. The Snack Limits domain reflects the limits established by parents/caregivers regarding children's consumption of snacks each day and is composed of three questions (Do you set limits for how many sweets the child could have each day? Do you set limits for how many sodas the child could have each day? Do you set limits for how many salty snacks the child could have each day?). A three-point scale (never, sometimes, always) was used for the parents/caregivers to report the frequency with which they adopt each of the three actions described in this domain in a typical week. The answers were tabulated and the mean of the questions was calculated considering never = 1, sometime = 2 and always = 3, with a higher score (1 to 3) denoting a greater frequency of permissive behavior on the part of parents/caregivers [21,22].

The clinical examinations were conducted at the schools under natural light with the aid of a flat number 5 mouth mirror and standard periodontal probe. The teeth were cleaned with gauze prior to the examination. Caries experience was determined using the decayed, missing and filled teeth (dmft) index following the diagnostic criteria established by the World Health Organization (WHO) [23].

For the anthropometric measures, the children were weighed on a digital scale (Plenna®, São Paulo, SP, Brazil) and height was measured using a stadiometer (Sanny®, American Medical do Brasil Ltda, São Bernardo do Campo, SP, Brazil) attached to a smooth wall. The measurements were taken following the standards of the WHO [24]. The body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared (kg/m²) [24]. The classification of

nutritional status based on the BMI of children less than five years of age was performed using the child growth curves proposed by the WHO [25]. BMI was categorized using the z-score references established by the WHO considering age and sex (ideal weight range: z-score ≥ -2 standard deviations [SD] and $\leq +1$ SD; overweight: z-score $> +1$ SD; obesity: z-score $> +2$ SD; underweight: z-score < -2 SD [26]).

Statistical Analysis

Data were analyzed using IBM SPSS Statistics for Windows Software, version 19 (IBM SPSS Inc., Chicago, IL, USA). Univariate Poisson regression with robust variance was used to determine associations between caries experience and the covariables studied as well as between excess body weight and snack limits. Variables with a p-value < 0.20 in the univariate analyses were incorporated into the multiple Poisson regression model and those that remained significant ($p < 0.05$) as well as the variables of interest and variables that permitted the best fitness of the model were maintained in the final model. The level of significance was set to 5%.

The dependent variable (caries experience) was dichotomized as present ($dmft \geq 1$) or absent ($dmft = 0$). Nutritional status was dichotomized as ideal weight or excess body weight (overweight + obesity). As only one child had a z-score > -2 SD, the underweight group was not included in the analyses. The snack limits domain was analyzed as a numerical variable ranging from 1 to 3. Reported tooth brushing was dichotomized as \leq once a day or \geq twice a day. Regarding socioeconomic and demographic aspects, sex was dichotomized as female or male and schooling of parent/caregiver was dichotomized as \leq eight or $>$ eight years of study. Income was analyzed as a numerical variable using the Brazilian monthly minimum wage (BMMW = R\$ 714.00; US\$ 296) at the time of the data collection) as the unit of measurement. Age in months was also analyzed as a numerical variable.

Ethical Aspects

This study was conducted in accordance with the Declaration of Helsinki and received approval from the Curitiba Municipal Department of Education and Health as well as the Human Research Ethics Committee of the Federal University of Paraná (Certificate No. 638.861). Only children whose parents/caregivers signed the statement of informed consent and who individually agreed to participate were included in the study.

Results

A total of 686 preschool children were evaluated. Girls accounted for 52% of the sample ($n = 357$). Age ranged from 48 to 70 months (mean = 60.9 ± 6.4 months). Mean income per capita was 2.77 (± 1.58) times the BMMW (median = 2.52 x BMMW). The mean dmft index was 2.18 (± 3.07 ; median: 1; range: 0 to 16 and 51.5% of the children had caries experience ($dmft \geq 1$). Regarding nutritional status, one child (0.1%) was classified as underweight, 404 children (58.9%) were in the ideal weight range, 89 (13%) were at risk of overweight, 114 (16.6%) were classified as overweight,

75 (10.9%) were classified as obese and three children (0.4%) did not permit the anthropometric evaluation.

In the univariate analysis, the prevalence of caries experience was higher among children with a lower household income, older age and lower parental limits regarding snack consumption compared to children without these conditions (Tables 1 and 2). Greater parental control regarding snack consumption was found among children with excess body weight ($p=0.047$, $PR=1.23$; 95%CI: 1.003 to 1.50). The prevalence of caries was lower among children with excess body weight (Table 1), but this association lost its statistical significance when adjusted by the other variables incorporated into the multivariate model ($PR_{adj}=0.841$; 95% CI: 0.704 to 1.004) (Table 3). In the multivariate model, the prevalence of dental caries was higher among preschoolers with an older age, lower household income per capita and whose parents reported placing a lower limit on snack consumption (Table 3).

Table 1. Distribution of dental caries among preschool children according to nutritional status, dental hygiene and sex.

Variables	Dental Caries				Total N (%)	p-value*	PRc	95% CI
	Absent (dmft = 0)		Present (dmft ≥ 1)					
	N (%)	N (%)	N (%)	N (%)				
Nutritional Status*								
Ideal Weight	180	44.6	224	55.4	404 (59.2)	0.011	1	
Excess Body Weight	152	54.7	126	45.3	278 (40.8)		0.817	0.699-0.955
Tooth Brushing (Daily Frequency)*								
≤ 1	54	44.6	67	55.4	121 (18.5)	0.244	1	
≥ 2	268	50.3	265	49.7	533 (81.5)		0.898	0.749-1.076
Sex								
Boys	155	47.1	174	52.9	329 (48.0)	0.471	1	
Girls	178	49.9	179	50.1	357 (52.0)		0.948	0.820-1.096

*Univariate Poisson Regression; *Frequencies less than 686 due to missing data; Significant results at 5% level in bold; PRc = Crude Prevalence Ratio; CI = Confidence Interval.

Table 2. Distribution of household income, child's age and snack limits according to dental caries among preschool children.

Variables	Dental Caries						p-value*	RPC	95% CI
	Absent (dmft = 0)			Present (dmft ≥ 1)					
	Mean	SD	Median	Mean	SD	Median			
Household Income <i>per capita</i> (BMMW)	0.80	0.56	0.70	0.69	0.41	0.63	0.005	0.762	0.630-0.921
Child's Age (Month)	60.2	6.2	61.0	61.5	6.5	62.0	0.012	1.016	1.003-1.028
Snack Limits	2.69	0.49	3	2.60	0.56	3	0.010	0.847	0.747-0.961

*Univariate Poisson Regression, Significant results at 5% level in bold; PRc = Crude Prevalence Ratio; CI = Confidence Interval; BMMW = Brazilian Monthly Minimum Wage (\$ 296 at time of study; 2014).

Table 3. Multivariate Poisson regression model for prevalence of dental caries.

Variables	p-value	PRadj	95% CI
Nutritional Status			
Ideal Weight	0.056	1	
Excess Body Weight		0.841	0.704-1.004
Household Income <i>per capita</i> (BMMW)	0.024	0.804	0.665-0.972
Child's Age (Month)	0.032	1.015	1.001-1.029
Snack Limits	0.012	0.839	0.732-0.962

PRadj = Adjusted Prevalence Ratio; CI = Confidence Interval; BMMW = Brazilian Monthly Minimum Wage (\$ 296 at time of study; 2014).

Discussion

The main finding of the present study was the lack of an association between dental caries and excess body weight among preschool children when confounding factors were controlled. Although the literature offers inconclusive results [12,14,15], a positive association between these variables was expected, since such events share at least one well-known etiological factor: sugar intake [5]. However, a negative association was found between excess body weight and dental caries in the univariate analysis.

Although the children with excess body weight had different eating patterns from those in the ideal weight range, with a greater consumption of foods with added sugar and highly processed products [27], one should also consider the fact that parents/caregivers may begin to restrict their children's consumption of foods with a high energy content in an attempt to control weight [28], which could exert an influence on the incidence of dental caries. In the present study, the children with excess body weight were submitted to greater control of snack consumption. When analyzed separately, excess body weight was a protection factor against dental caries. However, when controlled for the level of parental restriction regarding snack consumption, the association between excess body weight and dental caries lost its statistical significance, although this association maintained borderline significance.

Dental caries and childhood obesity both have a multifactor etiology and the development of these two conditions involves important social-behavioral components, as both are strongly associated with eating practices [29]. Nonetheless, an important distinction must be considered: while the volume, frequency and quality of the foods ingested are the most important factors in obesity [30], the local effect of eating practices (frequency and quality) are suggested to have a greater impact on dental caries than the systemic effect of nutrient intake [31].

With the evident increase in the prevalence of children with excess body weight and intensive prevention campaigns, many families have given more attention to dietary practices. Although parents have difficulties identifying the weight status of their overweight children [32], those with a good perception of this condition in their children stimulate a healthier dietary pattern [33]. The present findings indicate that part of the contradictions found in the literature regarding the association between nutritional status and dental caries in children may be attributed to dietary measures that families adopt to control childhood obesity, which is an aspect that has been under-investigated. Parental behavior regarding the snack limits can have benefits with regard to both the control of dental caries and childhood obesity and should therefore be encouraged.

The present results should be considered in the context of the limitations of the study. The cross-sectional design does not allow the establishment of causality. Moreover, part of the data was collected through questionnaires, which are subject to the respondent's interpretation. Although anonymity was assured, one cannot discard the possibility of the under-reporting of inadequate behaviors, since parents/caregivers have a tendency to answer questions in a way that they consider to be socially acceptable.

The uniting of nutrition and dentistry provides greater adequacy and coherence in health education activities, which could result in better health outcomes. Therefore, educational actions aimed at the prevention of an inadequate nutritional status also have considerable potential with regard to benefitting the promotion of oral health.

Conclusion

Among the preschoolers analyzed in the present study, excess body weight was not significantly associated with dental caries, whereas a lower parental limit regarding snack consumption by the children was independently associated with a higher prevalence rate of dental caries.

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Conflict of Interest: The authors declare no conflicts of interest.

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