



Pesquisa Brasileira em Odontopediatria e
Clínica Integrada

ISSN: 1519-0501

apesb@terra.com.br

Universidade Federal da Paraíba
Brasil

Almeida Salvador Lima, Christiana; Rosada Peruchi, Carla Thais; Poli- Frederico, Regina
Célia; Simões Carvalho Tomasetti, Cristina; Calvo Fracasso, Marina de Lourdes; Macie,
Sandra Mara

Exploring the Association between Dental Caries, Obesity and Sensory Characteristics in
Students Living in Southern Brazil

Pesquisa Brasileira em Odontopediatria e Clínica Integrada, vol. 14, núm. 4, 2014
Universidade Federal da Paraíba
Paraíba, Brasil

Available in: <http://www.redalyc.org/articulo.oa?id=63739258003>

- How to cite
- Complete issue
- More information about this article
- Journal's homepage in redalyc.org

redalyc.org

Scientific Information System

Network of Scientific Journals from Latin America, the Caribbean, Spain and Portugal

Non-profit academic project, developed under the open access initiative

Original Article

Exploring the Association between Dental Caries, Obesity and Sensory Characteristics in Students Living in Southern Brazil

Christiana Almeida Salvador Lima¹, Carla Thais Rosada Peruchi², Regina Célia Poli-Frederico³, Cristina Simões Carvalho Tomasetti⁴, Marina de Lourdes Calvo Fracasso⁵, Sandra Mara Maciel⁵

¹Post-Graduation Program in Dentistry, State University of North Paraná, Londrina, PR, Brazil.

²Post-Graduation Program in Dentistry, State University of Maringa, Maringá, PR, Brazil.

³School of Dentistry, State University of North Paraná, Londrina, PR, Brazil.

⁴School of Nutrition, State University of North Paraná, Londrina, PR, Brazil.

⁵School of Dentistry, State University of Maringa, Maringá, PR, Brazil.

Author to whom correspondence should be addressed: Sandra Mara Maciel, Av. Mandacaru, 1550. Bloco S08, 87083-170, Maringá, PR Brasil. Phone: +55 (44) 3011-9051. E-mail: sandramaciel53@gmail.com.

Academic Editors: Alessandro Leite Cavalcanti and Wilton Wilney Nascimento Padilha

Received: 09 March 2014 / Accepted: 6 October 2014 / Published: 12 December 2014

Abstract

Objective: To investigate possible associations between dental caries, obesity, sweet taste preference and sensitivity to bitter taste in children and adolescents. **Material and Methods:** This is a cross-sectional study with a sample of 462 schoolchildren aged 6-15 years enrolled in public schools of Pato Branco, PR. Their oral conditions were examined by adopting the criteria of the World Health Organization. Nutritional status was assessed using anthropometric criteria, adopting the reference standards of the Center for Disease Control and Prevention. To determine the taste sensitivity, sweet taste preference and sensitivity to phenylthiocarbamide (PTC) tests were applied. In the statistical analysis of data, Chi-square, Mann Whitney and Kruskal Wallis tests were used, adopting significance level of 5%. **Results:** Low dental caries severity levels were observed among students. Overweight was diagnosed in 24.4% of students. The lowest DMFT index was recorded among obese individuals ($p < 0.05$). High levels of sweet taste preference were identified. No statistically significant association was detected between the sensory characteristics assessed and the occurrence of dental caries and obesity in the study sample. **Conclusion:** The high levels of sweet taste preference, as well as the dental caries and overweight rates observed, although with no statistically significant associations, highlight the need for intersectoral interventions with a focus on healthy eating habits in order to reduce the risk and incidence of chronic diseases in this population.

Keywords: Dental caries; Obesity; Taste; Child; Adolescent.

Introduction

The sensory characteristics of taste sensitivity to sweet and bitter is hereditary and sweet taste preference is innate [1] and can be adjusted according to the higher or lower exposure to food items containing sugar [2]. Current data have shown that despite recommendations for maximum sugar consumption of 15 kg / year [3], the average consumption of Brazilians is nearly four times this amount, reaching levels of up to 59.2Kg / year [4]. This high sugar intake can potentially cause numerous problems to the health of individuals such as the development of several noncommunicable chronic diseases (NCD) [5], among which dental caries [6,7] and obesity [5,8].

There are variations in taste sensitivity in humans [9] and some studies have shown that the taste sensitivity to phenylthiocarbamide (PTC) and 6-n-propylthiouracil (PROP) is associated with liking sweet flavors or not [10]. The scientific literature has pointed to a higher prevalence of dental caries among children insensitive to bitter taste [9,10]. The amount and frequency of sucrose intake are important factors involved in the etiology of dental caries and the development of obesity, although the relationship between both is not causal, diet plays a significant etiological role in common [11]. However, the literature addressing the relationship between both shows conflicting results [12,13], and little has been explored about the relationship between these two health problems with the taste sensory characteristics of children [14].

Urbanization and the concomitant increased exposure of foods containing sugar increases the taste threshold for sweet, a fact that leads to higher consumption of sugar and increased risk for developing dental caries, hypothesis confirmed by a study conducted in Iraq [15], which demonstrated that subjects with high levels of sweet taste preference consumed larger amount of sugar and had higher incidence of dental caries than other subjects. These results are in line with a study conducted in Brazil [14] that found that in addition to the higher prevalence of dental caries, higher levels of obesity are observed in children with high levels of sweet taste preference. In contrast, in other Brazilian publication [16], the association between sweet taste preference and dental caries could not be detected, although 76.5% of children have preferred the most sugary tea concentrations (0.6 to 0.9M).

According to studies on taste sensitivity, children insensitive to bitter taste may show more frequent consumption of higher concentrations of sugar compared to sensitive ones and are therefore more susceptible to dental caries [9,10]. Similarly, those insensitive to bitter taste usually consume more fat and / or energy than sensitive subjects, so a strong association between insensitivity to bitter taste and higher Body Mass Index has been found [17].

Brazilian studies [12,18] evaluating the common risk factors for dental caries and obesity in schoolchildren aged 12-15 years, regardless of school type, found no evidence that indicated association between these two diseases. Global health promotion actions, through the control of a small number of risk factors, may have a great impact on various diseases and at a lower cost compared to approaches to specific diseases [19]. Working with the common risk factor "diet" can prevent various diseases.

Whereas the amount and frequency of sucrose intake are important factors involved in the etiology of dental caries and development of obesity and that these may be influenced by the sensory characteristics of taste sensitivity to bitter taste and sweet taste preference, the aim of this study was to investigate possible associations between these variables in children and adolescents in southern Brazil.

Material and Methods

Laryngeal Preliminary procedures to research and sample selection

This is a cross-sectional study conducted with children and adolescents living in Pato Branco, municipality located in western state of Parana, which at the time of the survey, had 68,735 inhabitants and the 3rd highest Human Development Index (HDI) of the state and fluoridated public water supply. The research protocol was approved by the Ethics Committee on Research Involving Human Beings of the University of Northern Paraná (PP075 / 07).

From the total of 9,226 schoolchildren aged 6-15 years of both genders enrolled in public schools in 2006, the minimum sample size was estimated at 385, dimensioned to an error probability of 3% and 95% confidence. This value was added of 20% (N = 462) for eventual losses and refusals. After the development of a pilot study with 60 schoolchildren for calibration and training of the team involved, participants were selected using the simple random sampling technique. Informed consent forms were signed by parents / guardians. The data collection period covered the first semester of 2007.

First stage: Assessing nutritional status, oral health and sociodemographic data

Caries experience was assessed using the dmft index (number of decayed, those with extraction indication and filled deciduous teeth) and DMFT (number of decayed, missing and filled permanent teeth), according to the diagnostic criteria defined by the World Health Organization (WHO) [20]. A single examiner, with the aid of a recorder, led all examinations. In the intra-examiner agreement assessment, the Kappa value obtained was 0.91. In the data analysis, the prevalence of dental caries was assessed (proportion of subjects with dmft / DMFT ≥ 1) and the severity / intensity of the disease (average dmft / DMFT in the group).

Clinical examinations were conducted according to WHO recommendations [20], under natural light, ambient conditions, with the aid of a clinical mirror after cleaning the teeth with gauze to remove food debris when necessary. Biosecurity standards have been met by the field team.

The nutritional status of children was assessed by anthropometric measurements of weight and height by an appropriately trained team. Weight was measured in kilograms using a Plenna digital anthropometric scale with capacity of 150 kg and 100gr scale and height was measured in meters with a tape measuring type Secca vertical stadiometer. A single data collection was performed and the children were evaluated without shoes and wearing the school uniform only.

For the diagnosis of the nutritional status, the Body Mass Index (BMI) was calculated and the classification was made taking as reference the curves of the Center for Disease Control and Prevention (CDC) for children and adolescents aged 2-20 years [21]. Students with BMI below the 5th percentile were diagnosed as underweight. Those with BMI above the 95th percentile (p95) were classified as obese; and those with BMI between the 85th percentile (p85) and the 95th percentile (p95) were considered overweight.

A semi-structured questionnaire to identify socio-demographic characteristics was applied by trained interviewers.

Second phase: assessing the taste threshold to the bitter taste and sweet taste preference

Genetic susceptibility tests to bitter taste and sweet taste preference were conducted in a subsample of 105 children, which included students with and without dental caries and with and without excess weight (overweight and obesity). This subsample was calculated from the minimum sample n established, 385, considering the margin of error (5%) and the caries (40.6%) and overweight and obesity (24.0%) prevalence, which were found in the pilot study. The n estimated to caries was 23 and for obesity 26. Considering possible losses, we worked with n equal to 30.

The evaluation of the sweet taste preference was performed using a modified version [16] of the Sweet Preference Inventory [22], where five different concentrations of sugary tea solutions: 0.075; 0.15M; 0.3M; 0.6M and 0.9M were appreciated. The solutions were prepared on the day of evaluation and placed in five pots, with identification codes. When performing the test, five cups (50ml), with codes strategically placed were randomized on a tray. Standardized instructions, appropriate to the age group of children were provided. After all the solutions have been tried, the student was asked to indicate that of his preference. During the testing process, students had at their disposal a glass of water (200ml) for mouthwash between stimuli.

The sensitivity to bitter taste was established by the method, whereby the test-solution of phenylthiocarbamide (PTC) is diluted by a factor of 1: 2 in 15 steps, starting from the most diluted solution ($0.5 \mu\text{mol} \cdot \text{L}^{-1}$) to a maximum concentration of $8.5 \text{ mmol} \cdot \text{L}^{-1}$ [23]. In the test conducted with students, two drops of different solution concentrations were applied on the back of their tongues, starting with the most diluted. Between each solution concentration, they rinsed their mouth with water. They were asked to indicate in which of the solutions, the bitter taste was perceived for the first time. Students who recognized the solutions below the median threshold were classified as sensitive and those who did it above the median value as insensitive.

Data analysis was performed using the Statistical Package for Social Science (SPSS), version 17.0 for Windows. First, descriptive univariate analysis was performed, followed by bivariate analysis. The Kolmogorov-Smirnov test indicated the necessity of using non-parametric statistics in the treatment of numeric variables. Thus, to test possible associations between the study variables, the chi-square, Mann Whitney and Kruskal Wallis tests were applied. Statistical significance was set at 5%.

Results

Of the total students invited to participate in the study, the response rate obtained was 90.2% (417 out of 462), and from the 417 students who started the study, 32 (7.6%) were excluded for the following reasons: incomplete questionnaire ($n = 9$) or absence of anthropometric measurements ($n = 23$). The final sample consisted of 385 schoolchildren.

Among children and adolescents of this study, there was a predominance of females (68.1%), age group 6-10 years (60.0%), stable union of mothers (68.3%), and low maternal educational level (80.8%). As for income, it was observed that 63.4% of families earned up to two minimum wages per month.

With regard to oral and anthropometric assessments (Table 1), it was found that about 50% of children had caries experience with mean dmft of 1.79 (SD = 2.50) and mean DMFT equal to 1.23 (SD = 1.96). Most (73.5%) received a diagnosis of eutrophy. Excess weight was present in 23.9% of the sample, with overweight and obesity rates of 15.1% and 8.8%, respectively.

Table 1. Prevalence and severity of dental caries among 385 students enrolled in public schools according to the nutritional status.

Nutritional status	Caries Prevalence			Caries Severity			
	n	Deciduous	Permanent	dmft	Median	Mean	DMFT
	(%)	(%)	(%)	Mean (SD)	(min-max)	(SD)	Median (min-max)
Underweight	10 (2.6)	4 (2.3)	5 (2.9)	2.00 (3.05)	0.00 (0-7)	1.50 (2.01)	1.00 (0-6)
Eutrophy	283 (73.5)	127 (71.8)	136 (79.1)	1.75 (2.52)	0.00 (0-11)	1.35 (2.08)	1.00 (0-5)
Overweight	58 (15.1)	28 (15.8)	22 (12.8)	1.59 (2.20)	1.00 (0-9)	0.90 (1.32)	0.00 (0-4)
Obesity	34 (8.8)	28 (10.2)	9 (5.2)	2.38 (2.65)	2.00 (0-10)	0.71 (1.69)	0.00 (0-9)
Total	385 (100.0)	177 (46.0)	172 (44.7)	1.79 (2.50)	0.00 (0-11)	1.23 (1.96)	0.00 (0-15)
<i>p value</i>		0.304*	0.009*	0.423†		0.042†	

*Chi-square test; †Kruskal-Wallis test; $p < 0.05$

Statistically significant correlation ($p < 0.05$) was found between caries severity in the permanent dentition and the nutritional status of the population studied, with lower DMFT index (0.71 ± 1.69) in the obesity group. Unlike in the primary dentition, obese subjects exhibited higher dental caries rate, but this relationship did not reach statistical significance. It is noteworthy that only in the permanent dentition, the prevalence of caries was significantly lower among students who were diagnosed with low weight or obesity (Table 1).

In analyzing the relationship between the two health problems evaluated and the demographic characteristics of students (Table 2), it was observed that caries severity in the permanent dentition was significantly higher in females (DMF-T = 1.40, SD = 2.14) and among students above 11 years (DMF-T = 2.34, SD = 2.79). On the other hand, in the primary dentition,

caries severity was higher in males (dmft = 2.26, SD = 2.68) and in the age group of 6-10 years (dmft = 2.71, SD = 2.76). No statistical difference in relation to nutritional status between genders was observed, but higher obesity rate was observed in the age group 6-10 years (73.5%).

Table 2. Nutritional status and dental caries severity among 385 students from public schools, according to gender and age.

	Nutritional status				Caries severity			
	Underweight	Eutrophy	Overweight	Obesity	dmft	DMFT		
	n (%)	n (%)	n (%)	n (%)	Mean (SD)	Median (min-max)	Mean (SD)	Median (min-max)
Sex								
Male	1 (10.0)	93 (32.9)	19 (32.8)	10 (29.4)	2.26 (2.68)	1.00 (0-11)	0.88 (1.44)	0.00 (0-7)
Female	9 (90.0)	190 (67.1)	39 (67.2)	24 (70.6)	1.57 (2.38)	0.00 (0-11)	1.40 (2.14)	1.00 (0-15)
p value		0.877*			0.001‡		0.012‡	
Age								
6-10	5 (50.0)	163 (57.6)	38 (65.5)	25 (73.5)	2.71 (2.76)	2.00 (0-11)	0.64 (1.07)	0.00 (0-6)
11 e +	5 (50.0)	120 (42.4)	20 (34.5)	9 (26.5)	0.42 (1.04)	0.00 (0-7)	2.12 (2.57)	1.00 (0-15)
p value		0.036*			<0.001‡		<0.001‡	

*Chi-square test; ‡Mann-Whitney test; p<0.05.

Sensory tests were conducted with 105 children / adolescents (Table 3), among which a high level of sweet taste preference was observed, and 68.6% chose high sugary solutions (0.6 and 0.9 M), 13.3% chose low sugary solutions (0.075 and 0.15 M) and the rest chose intermediate sugary solutions (0.3M). In relation to the sensitivity to bitter taste, there was proportionality between insensitive (50.5%) and sensitive students (49.5%). It was observed that in this subsample of children, overweight and obesity rates were equal to 16.2% and 23.8%, respectively.

Table 3. Relationship between dental caries severity in deciduous (N = 98) and permanent dentition (N = 105), sweet taste preference and sensitivity to bitter taste in subsample of students.

Sensory characteristics	Caries severity				
	n (%)	dmft		DMFT	
		Mean (SD)	Median (min-max)	Mean (SD)	Median (min-max)
Sweet preference					
Low	14(13.3)	1.29(2.19)	0.00(0-8)	0.64 (1.00)	0.00(0-3)
Intermediate	19(18.1)	1.63 (2.38)	0.00(0-7)	0.63 (0.95)	0.00(0-3)
High	72(68.6)	1.65 (2.54)	0.00(0-10)	1.07 (1.75)	0.00(0-9)
p value		0.936†		0.684†	
Sensitivity to bitter					
Sensitive	52(49.5)	1.69 (2.36)	0.00(0-8)	0.92 (1.25)	0.00(0-6)
Insensitive	53(50.5)	1.51 (2.55)	0.00(0-10)	0.94 (1.82)	0.00(0-9)
p value		0.444‡		0.303‡	

†Kruskal-Wallis test; ‡Mann-Whitney test; p<0.05.

Despite the higher caries index in deciduous teeth have been reported among students who preferred more concentrated sucrose solutions (dmft = 1.65) and among those classified as sensitive to bitter taste (dmft = 1.69), these relations did not reach statistical significance. In the analysis of the permanent dentition, no significant association was observed between dental caries severity and sensory tests. The DMFT index was higher among students who showed high sweet taste preference, but was similar between sensitive and insensitive to bitter taste (Table 3).

No statistical association between nutritional status and sensory tests was found (Table 4). The high sweet taste preference prevailed among all students, regardless of nutritional diagnosis, and the greatest overweight and obesity rates were observed in the group of students classified as sensitive to PTC.

Table 4. Nutritional status of subsample of students (n = 105) enrolled in public schools according to the sensory characteristics.

Sensory characteristics	Nutritional status [†]			<i>p value</i> [*]
	Eutrophy n (%)	Overweight n (%)	Obesity n (%)	
Sweet preference				
Low	7 (11.1)	3 (17.6)	4 (16.0)	0.746
Intermediate	12 (19.0)	4 (23.5)	3 (12.0)	
High	44 (69.8)	10 (58.8)	18 (72.0)	
Sensitivity to bitter				
Sensitive	27 (42.9)	11 (64.7)	14 (56.0)	0.179
Insensitive	36 (57.1)	6 (35.3)	11 (44.0)	

*Chi-square test; p<0.05; †Underweight exclusion.

Discussion

Studies conducted in Brazil seeking to explore associations between sensory factors of sensitivity to bitter taste, sweet taste preference, dental caries and the presence of obesity in schoolchildren were not found. In this study, no significant associations between these health problems and sensory factors were found; however, the lowest dental caries rate was found among those who preferred less sugary solutions. In addition, a higher percentage of obesity was observed among individuals with high sweet taste preference and sensitivity to bitter. When the relationship between oral and anthropometric conditions was evaluated, statistically significant association was found ($p < 0.05$), and the lowest DMFT index was recorded in the obese group.

The absence of statistical association, when taste tests were introduced, had also been perceived by other authors [14,16]. However, as in our study, these authors found that the prevalence of caries in the primary dentition was higher in the group of individuals who chose higher sucrose concentrations. Similarly, in the permanent dentition, higher caries severity was observed in the group of children with high levels of sweet taste preference. Previous studies have mentioned that the association between sweet taste preference and dental caries can be hidden when the most common preference is high [15].

With respect to sensitivity to bitter taste, similar proportions of insensitive (50.5%) and sensitive students (49.5%) were found, which had similar dental caries rates, differing from a previous study [9], where the proportion of 1/3 of insensitive to bitter taste was reported, besides the existence of association between insensitivity to bitter taste and higher dental caries severity. In relation to the association of this sensory characteristic with the presence of overweight and obesity, contradictory results with those of previous publication were also found [24], and, in our study, a higher proportion of overweight students were classified as sensitive. It is noteworthy that in both studies, statistically significant association between sensitivity to bitter taste and nutritional status was not verified.

Evidence indicates that obesity is related to preference and intake of sweet and high-fat diet, suggesting that liking sweet can be genetically mediated [25]. Although most obese individuals preferred solutions with the highest sucrose concentrations of this study, no significant association between sweet taste preference and nutritional status was found. Similarly, a cross-sectional study conducted with 12-year-old children [26] found an association of sugar consumption with the DMFT index, but not with body mass index (BMI). On the other hand, in investigation that evaluated the relationship between overweight / obesity, dental caries and sugar consumption in 463 adolescents [27], caries experience was associated with both overweight / obesity (OR = 3.68, CI = 1.79-7.56) and sugar consumption more than once per day (OR = 3.13, CI = 1.25-7.85).

Publications specifically addressing the relationship between dental caries and excess weight (overweight and obesity) have shown controversial results [12,18,28]. Some studies reported no association between dental caries and obesity among adolescents aged 12-15 years [12,18]. In contrast, significant association between dental caries severity and obesity in children and adolescents was reported in another study [29], which identified higher dental caries rates among obese individuals. The analysis of data of a national survey conducted in the USA between 1999 and 2002 [30] found that the Body Mass Index (BMI) was inversely associated with dental caries severity in the permanent dentition, a result similar to our study, where it was observed that obese children showed lower dental caries rate when compared to those with normal weight. Perhaps, this lower dental caries severity among obese individuals is related to the greater intake of caries-protective foods such as high-fat products. But this is a hypothesis, further investigations that include the type and amount of food eaten by the study population can better explain these relationships. In addition, there is a need to investigate confounding factors such as age, economic class and the country children live (if developed or not), as they may influence the results [13].

The small size of the subsample studied may explain the inconsistency of results for the sensory tests. However, the fact that the study included all obese individuals (N = 28) diagnosed in the first phase of the study should be taken into account. Although the number of obese individuals is increasing, they still represent a small percentage of the population, making it difficult to collect information from larger groups, especially with more delimited ages. Another possible limitation of this study is related to the impossibility of direct comparisons of results obtained in the analysis with

other epidemiological studies precisely due to differences such as study site, time of performance and age group analyzed. The ideal situation would be conducting multicenter studies for this type of research.

Conclusion

Despite the absence of a statistically significant association between sensory factors and chronic diseases, the high levels of sweet taste preference, as well as the high dental caries and overweight rates registered in the study population are noteworthy. Findings in this study highlight the need for intersectoral interventions with a focus on healthy eating habits with sugar consumption restriction aimed at preventing chronic diseases and also indicate the need for further studies to explore the complex relationship between sugar intake, dental caries, obesity and confounding factors.

References

1. Tatzer E, Schubert MT, Timischl W, Simbrunger G. Discrimination of taste and preference for sweet in premature babies. *Early Hum Dev* 1985; 12(1):23-30.
2. Drewnowski A, Rock CL. The influence of genetic taste markers on food acceptance. *Am. J Clin Nutr* 1995; 62:506-11.
3. Van Horn L, Johnson RK, Flickinger BD, Vafiadis DK, Yin-Piazza S. Translation and implementation of added sugars consumption recommendations: A conference report from the American Heart Association Address Sugars Conference 2010. *Circulation* 2010; 122:2470-2490.
4. Levy RB, Claro RM, Bandoni DH, Mondini L, Monteiro CA. Disponibilidade de “açúcares de adição” no Brasil: distribuição, fontes alimentares e tendência temporal. *Rev Bras Epidemiol* 2012; 15(1):3-12.
5. Johnson RK, Appel LJ, Brands M, Howard BV, Lefevre M, Lustig RH, Sacks F, Steffen LM, Wylie-Roset J. Dietary sugars intake and cardiovascular health: a scientific statement from the American Heart Association. *Circulation* 2009; 120(11):1011-20.
6. Moynihan P, Petersen PE. Diet, nutrition and the prevention of dental diseases. *Public Health Nutr* 2004; 7(1A):201-26.
7. Palacios C, Joshipura KJ, Willet WC. Nutrition and health: guidelines for dental practitioners. *Oral Diseases* 2009; 15(6):369-81.
8. Singhal N, Misra A, Shah P, Rastogi K, Vikram NK. Secular trends in obesity, regional adiposity and metabolic parameters among Asian Indian adolescents in North India: A comparison data analysis of two selective sample 5 years apart (2003-2008). *An Nutr Metab* 2010; 56:176-81.
9. Rupesh S, Nayak UA. Genetic sensitivity to the bitter taste of 6-n-Propylthiouracil: a new risk determinant for dental caries in children. *J Indian Soc Pedod Prev Dent* 2006; 24(2):63-8.
10. Verma P, Shetty V, Hedge AM. Propylthiouracil (PROP) – A tool to determine taster status in relation to caries experience, *Streptococcus mutans* levels and dietary. *J Clin Pediatr Dent* 2006; 31(2):113-7.
11. Traebert JM, Moreira EAM, Bosco VL, Almeida ICS. Transição alimentar: problema comum à obesidade e desnutrição. *Rev Nutrição* 2004; 17(2):247-53.
12. Alves LS, Susin C, Damé-Teixeira N, Maltz M. Overweight and obesity are not associated with dental caries among 12 years old South Brazilian Schoolchildren. *Community Dent Oral Epidemiol* 2013; 41:224-31.
13. Hayden C, Bowler JO, Chambers S, Freeman R, Humphris G, Richards D, et al. Obesity and dental caries in children: a systematic review and metaanalysis. *Community Dent Oral Epidemiol* 2013; 41:289-308.
14. Lanza P. Relação entre a preferência paladar ao doce, o padrão de saúde bucal e o estado nutricional em crianças de creches públicas de Londrina-PR. [Dissertação]. Londrina:Universidade Norte do Paraná; 2006.
15. Jamel HA, Sheiham A, Watt RG, Cowell CR. Sweet preference, consumption of sweet tea and dental caries; studies in urban and rural Iraqi populations. *Int Dent J* 1997; 47(4):213-7.

16. Maciel SM, Marcenes W, Sheiham A. The relationship between sweetness preference, levels of salivary mutans streptococci and caries experience in Brazilian pre-school children. *Int J Paediatr Dent* 2001; 11:123-30.
17. Tepper BJ. 6-n-Propylthiouracil: a genetic marker for taste, with implications for food preference and dietary habits. *Am J Hum Genet* 1998; 63(5):1271-6.
18. Moreira PVL, Rosenblatt A, Severo AMR. Prevalence of dental caries in obese and normal – weight Brazilian adolescents attending state and private schools. *Community Dent Health* 2006; 23(4):251-53.
19. Sheiham A, Watt RG. The common risk factor approach: a rational basis for promoting oral health. *Community Dent Oral Epidemiol* 2000; 28(6):399-406.
20. World Health Organization. Oral health surveys: basic methods. 4th ed. Geneva: WHO, 1997
21. Center for Disease Control and Prevention. National Center for Health Statistics CDC growth charts 2000 United States NCHS. BMI Growth charts. [cited 2007 Oct 15]. Available from: <<http://www.cdc.gov/growthcharts>>
22. Land D, Sherperd R. Scaling and ranking methods. In: Piggot JR. (Ed.) *Sensory analysis of foods*. New York: Elsevier Applied Science, 1984
23. Sodr  LMK. (Org.). *Pr ticas de gen tica*. Londrina: EDUEL, 1999.
24. Reed DR, Bachmanov AA, Beauchamp GK, Tordoff MG, Price RA. Heritable variation in food preferences and their contribution to obesity. *Behav Genet* 1997, 27(4):373-87.
25. Drewnowski A, Henderson SA, Cockcroft JE. Genetic sensitivity to 6-n-propylthiouracil has no influence on dietary patterns, body mass indexes, or plasma lipid profiles of women. *J Am Diet Assoc* 2007; 107(8):1340-8.
26. Tramini P, Molinari N, Tentscher M, Demattei C, Schulte AG. Association between caries experience and body mass index in 12 year old French children. *Caries Res* 2009; 43:468-73.
27. Honne T, Pentapati K, Kumar N, Acharya S. Relationship between obesity / overweight status, sugar consumption and dental caries among adolescents in South India. *Int J Dent Hygiene* 2012; 10:240-4.
28. Wu L, Chang R, Mu Y, Deng X, Wu F, Zhang S, Zhou D. Association between obesity and dental caries in Chinese Children. *Caries Res* 2013; 47:171-6.
29. Sakeenabi B, Swamy HS, Mohammed RN. Association between obesity, dental caries and socioeconomic status in 6 and 13 year old school children. *Oral Health Prev Dent*. 2012; 10(3):231-41.
30. Macek MD, Mitola DJ. Exploring the association between overweight and dental caries among US children. *Pediatr. Dent* 2006; 20(4):375-80.