Dental Caries Protection Factors in 5-year-old Brazilian Children

Maria Cristina Reis Tavares, BDS, MS DPH
Simone Tetu Moysés, BDS, MS DPH, PhD, DPH
Samuel Jorge Moysés, BDS, MS DPH, PhD DPH
Júlio César Bisinelli, BDS, DDS *Beatriz Helena Sotille França, DDS*
Flávio Alves Ribeiro, DDS, SDP

ABSTRACT

Purpose: The purpose of this study was to identify dental caries protection factors in 5-year-old children in the city of Curitiba, Brazil.
Methods: This case-controlled study was based on secondary data obtained from electronic medical records of 5-year-old children using Curitiba's municipal health service in 2005. Independent variables included those related to the child and his or her family context. The association between variables was studied by chi-squared, Fisher's exact, and Mann-Whitney's tests and multiple logistic regression.
Results: Caries experience was slightly associated with nutritional state, preschool experience (if the child regularly attended a preschool), and mother's age and education level. Multiple logistic regression confirmed most bivariate associations. Children who had normal weight (odds ratio [OR]=2.23; 95% confidence interval [CI]=1.04, 4.80) or who were overweight (OR=2.74; 95% CI=1.15, 6.53), did not go to preschool (OR=1.59; 95% CI=1.05, 2.41), and whose mothers were at least 26 years old (OR=1.62; 95% CI=1.14, 2.30) had a greater probability of being caries-free.
Conclusion: Normal or overweight children who did not attend preschool and whose mothers were at least 26 years old had a greater probability of being caries-free.
(J Dent Child 2008;75:264-70)

Received May 25, 2007; Last Revision October 29, 2007; Revision Accepted October 29, 2007.

KEYWORDS: DENTAL CARIES, EPIDEMIOLOGY, PRESCHOOL CHILDREN

Improvements in oral health observed in recent years are not equally shared by all societies in the world.[1-3] In Brazil, the most recent national epidemiological survey of oral health demonstrated differences between regions and age groups.[4] Although the survey indicated a tendency for a drop in the incidence of dental caries among 12-year-olds, the percentage of 5-year-olds who were caries-free remains below the World Health Organization's (WHO) year 2000 goal.

Curitiba, the capital of the state of Paraná, Brazil, has managed to achieve a 51% caries-free rate among 5-year-olds. The regional differences in caries experience in this age group observed in Brazil, however, was present within Curitiba's urban regions.[5]

Associations between dental caries and socioeconomic indicators have been demonstrated previously at both the general and individual level.[6-9] Although behavioral factors can lessen the impact of the socioeconomic environment, they do not explain the higher level of caries prevalent among economically underprivileged children.[10,11] Environmental impact is particularly important for children, since the accumulation of advantages or disadvantages during childhood will continue to affect them.[12-16] Furthermore, caries experience in primary teeth can be an important predictor of caries in permanent teeth.[3,17-19]

Dr. Tavares is professor of Pediatric Dentistry and Dental Public Health, Faculty of Dentistry, Positivo University, Curitiba, Brazil; Drs. S.T. Moysés, S.J. Moysés, Bisinelli and França are professors of Dental Public Health, all in the Faculty of Dentistry, Dentistry, Pontifical Catholic University of Paraná, Curitiba, Brazil. Dr. Ribeiro is Professor of Prosthetic Dentistry, Department of Dentistry, Tuiuti University of Paraná, Curitiba, Brazil.
Correspond with Dr. Tavares at cris.reis@terra.com.br

Understanding protection factors can help to guide more far-reaching health promotion programs and, in contrast to programs aimed at high risk individuals, assist in the development of population strategies—leading to healthier childhoods and adulthoods.[20,21]

The purpose of this study was to identify dental caries protection factors in 5-year-old children in the city of Curitiba, Brazil.

METHODS

This study was authorized by the Ethics Research Commission of the Curitiba Health Department (authorization no. 15/2005). Subject inclusion criteria included all electronic medical/dental records of 5-year-old children who used Curitiba's municipal oral health service in 2005. The exclusion criteria were medical/dental records incorrectly completed, dental records with "*white spot*" as the only diagnosis, children's records with a different address than that of their mothers' records, and children's records without any medical appointment.

Caries-free cases were defined as 5-year-olds without any record of disease diagnosis and/or any curative treatment procedure until the data collection. The control group was comprised of 5-year-olds with caries experience who had any of the following diagnoses noted on their dental records: decay; restoration without decay; dental pulp necrosis; periapical abscess; and/or restorative treatment procedures. The classification of the groups, depending on whether caries was present or not, was used because of the lower probability of error by noncalibrated examiners than in the case of classification using decayed teeth or lost and filled deciduous teeth (df-tnt).[11]

Variables included: the child's nutritional state (by weight for age and gender[22]); vaccinations taken (complete or incomplete); the child's preschool experience (preschool attendance or nonattendance); and general health condition (the number of medical appointments and emergencies until data collection and type of occurrence was recorded, according to the International Classification of Diseases, [ICD]). Variables related to the family context included: water supply in the home; wastewater disposal; mother's monthly income, age, education level, marital status, and participation in community organizations; oral hygiene habits; and dental procedures within the last 2 years.

Statistical Package for Social Science (SPSS) 10.0 for Windows (SPSS, Inc, Chicago, Ill) was used to perform statistical analysis.[23] The analysis between the independent variables (cases vs controls) was performed utilizing frequency distribution. The chi-squared, Fisher's exact, and Mann-Whitney's tests were used to carry out bivariate analyses of association. Multivariate logistic regression, using the stepwise method, was employed to enable the construction of odds ratios (**ORs**) with confidence intervals (95% **CI**).

With the exception of nutritional state, the variables were dichotomized to enable multivariate logistic regression analysis. In the case of continual variables with an abnormal distribution, the median was used as the cutoff point. Variables that yielded a $P \leq .10$ value in the bivariate analysis were kept in the model. The OR and corresponding 95% CI were calculated for each putative protection factor, using the risk factor (based on the literature) as a reference. $P \leq .05$ values were considered statistically significant.

RESULTS

Sample size for adequate power was calculated based on the prevalence of the condition studied in the target population: 51% of 5-year-olds in Curitiba were caries-free,[5] with a 95% CI of ±3%. As the absence and presence of caries were almost equally represented in the study cohort, a paired control was selected for each case. From a population of 9,892 children who were 5 years old on the day they used municipal health services, all of them exposed to fluoridated water (Curitiba have fluoridated water since 1958), our calculation determined that 966 children (483 cases and 483 controls) should be included in the study. This number was increased by 20% to compensate for the exclusion criteria, bringing the final groups to 580 cases and 580 controls. The final sample's size, after eligible electronic medical record selection, was 982 electronic medical records (491 cases and 491 controls). The sample was comprised of 490 girls and 492 boys. The frequency distribution of the variables showed little variation between the individuals characterized as cases or controls (Table 1).

Variation between cases and controls was observed in mother's age, child attending preschool and nutritional status. In the case group (caries-free) and control group (with caries experience), respectively, 40% and 60% of the mothers at the time of the study were younger than 26 years old, 40% and 60% of children had preschool experience, and 36% and 67% of children were underweight.

Bivariate analysis (Table 1) revealed an association between caries experience, nutritional state, and child's institutional experience. A greater number of caries-free children had normal weight or were overweight (chi-square=5.88; P=.05) and did not attend preschool (Fisher's exact test; P=.02). The following variables did not show an association with caries incidence: vaccinations; number of times a doctor had been consulted (routinely or in an emergency context); and the ICD type.

Maternal age (Fisher's exact test; P=.003) and education (Fisher's exact test; P=.049) were associated with caries experience in children. Older mothers and those with more than 11 years of education were more likely to have caries-free children. The other maternal variables (marital status, income, participation in community organizations, being subjected to dental procedures within the last 2 years, and brushing frequency) were not associated with children's oral health.

The chi-squared test demonstrated an association between mother's age, education level, and monthly income. Younger mothers had fewer years of education (chi-square=3.73; P=.05) and no income (chi-square=6.16; P=.046). Mothers

Table 1. Frequency Distribution of the Variables and Results of the Bivariate Analysis for Dental Caries Protection Factors in 5-year-olds, Attending Public Health Services in Curitiba, Brazil, in 2005

Variables	Cases		Controls		Total		*P*-value
	N	(%)	N	(%)	N	(%)	
Wastewater							.91*
Open sewer	38	8	42	8	80	8	
Cesspit	73	15	72	15	145	15	
Sewer	357	73	358	73	715	73	
No data	23	54	19	4	42	4	
Water supply							.42*
Well or other	03	1	01	<1	4	<1	
Public water	463	94	471	96	934	95	
No data	25	5	19	<4	44	<5	
Monthly mother's income							.77*
No income	294	60	311	63	605	52	
<$486 (US)	158	32	150	31	308	31	
≥$486 (US)	14	3	09	2	23	2	
No data	25	5	21	4	46	5	
Mother's ys of education							.049 †
<11	309	63	339	69	648	66	
≥11	137	28	112	23	249	25	
No data	45	9	40	8	85	9	
Mother's participation in neighborhood groups							.36 †
Does not participate	311	63	320	65	631	64	
Participates	146	30	144	29	290	30	
No data	34	7	27	6	61	6	
Dental treatment during the 2 last years (mother)							
None	202	41	198	40	400	41	.85 †
Preventive	69	14	58	12	127	13	
Curative/restorative	193	39	206	42	399	40	
Only endodontic and/or exodontic treatment	27	6	29	6	56	6	
Mother's brushing frequency/day							.44*
1x	115	23	102	21	217	22	.20 ‡
2x	216	44	219	45	435	44	
3x	134	28	150	30	284	29	
No data	26	5	20	4	46	5	
Mother's age (ys)							.00 †
<26	69	14	105	21	174	18	
≥26	422	86	386	79	808	82	

Table 1. Continuation

Variables	Cases		Controls		Total		*P*-value
	n	(%)	n	(%)	n	(%)	
Attended preschool							.02 †
Yes	44	9	67	14	111	11	
No	447	91	424	86	871	89	
Vaccinations							.24 †
Incomplete	166	34	148	30	314	32	
Complete	325	66	343	70	668	68	
No. of medical appointments							.54 *
0-3	205	42	209	43	414	42	.96 ‡
3-6	187	38	172	35	359	37	
6-25	99	20	110	22	209	21	
No. of medical emergencies							.88 *
0	203	41	212	43	415	42	.66 ‡
1	129	26	124	25	253	26	
2	77	16	70	14	147	15	
≤3	82	17	85	18	167	17	
Nutritional state							.05 *
Underweight	13	3	23	5	36	4	
Overweight	56	11	39	8	95	10	
Normal	422	86	429	87	851	86	

** Chi-squared test.* *† Fisher's exact test.* *‡ Mann-Whitney's test; source: study data.*

with overweight children had more years of education (chi-square=5.98; *P*=.05) and better income (chi-square=13.44; *P*=.009) than mothers with underweight children.

The logistic regression model confirmed the associations found using bivariate analysis, except in the case of mother's education and nutritional state. In the unadjusted model, mothers with more than 11 years of education had a greater probability of having caries-free children than mothers with fewer than 11 years of education. This finding, however, lost significance in the presence of the other variables. The opposite was true with the variable nutritional status. Although being overweight demonstrated an association with being caries-free in both unadjusted and adjusted models, the normal weight category changed in the adjusted model, indicating statistical significance (Table 2).

DISCUSSION

The present study indicated that not being underweight is a protective factor against dental caries development. Prior studies examining the role of nutritional deficiency in caries development have principally dealt with its effects on the pre-eruptive period, such as enamel development and saliva composition and flow.[24] Being underweight at 5 years old can be considered a biological marker of the socioenvironmental conditions in which a child is living. Because malnourishment (or undernourishment) is associated with circumstances involving social deprivation, it may affect cognitive development in addition to physical development[13] and, thus, is a cause for concern in any society. The relationship between poor nutrition and compromised immune function may place the very survival of malnourished children at risk.[25] Indeed, chronic malnutrition is a factor associated with 50% of the world's child mortality, and being underweight is associated with 60% of children who die before they reach 5 years of age.[26]

While sifting through the multitude of factors that may lead to a child being underweight and establishing a direct relationship with caries experience is not a straight forward

*Table 2. Results of the Multivariate Logistic Regression for Dental Caries Protection Factors in 5-year-olds Who Attended Public Health Services in Curitiba, Brazil, in 2005 **

Variables	Unadjusted odds ratio (95% conficence interval)	*P*-value	Adjusted odds ratio (95% conficence interval)	*P*-value
Mother's ys of education		.049		.10
< 11	1		1	
≥ 11	1.34 (1.00-1.80)		1.28 (0.95-1.72)	
Mother's age (ys)		.003		.007
< 26	1		1	
≥ 26	1.66 (1.19-2.32)		1.62 (1.14-2.30)	
Attended preschool		.02		.03
Yes	1		1	
No	1.60 (1.07-2.40)		1.59 (1.05-2.41)	
Nutritional state				
Underweight	1		1	
Overweight	2.54 (1.15-5.62)	.02	2.74 (1.15-6.53)	.04
Normal	1.74 (0.87-3.48)	.11	2.23 (1.04-4.80)	.0003

** Source: study data.*

process,[27] it is important to consider all the sequelae with which this condition may be associated, including compromised oral health. A longitudinal study by Dye in the United States found that children who did not eat breakfast every day were more likely to develop caries.[28] On the other hand, there is still disagreement regarding the relationship between caries incidence and obesity, which is generally associated with an imbalance between energy (calorie) consumption and burning.[29,30] While the survey by Macek and Mitola (2006),[31] like the present study, did not reveal an association between being overweight and caries incidence, it did demonstrate that overweight children had a lower caries severity in permanent teeth. Meanwhile, other studies have demonstrated a positive relationship between obesity and dental caries.[32,33]

The present study's results, however, should be viewed with caution, since a small portion of the children in the sample was overweight. These individuals may have suffered the influence of other contextual variables, such as a mother's educational level and income, which were covariates in the associations' tests. In the present study population, the protective role of more favorable socioenvironmental factors appears to have been stronger than inadequate diet.

Our data suggested that not attending preschool was a protection factor regarding dental caries. The demand for the use of preschools has increased throughout the world, due to the increase in single, separated, and/or working mothers. It is, therefore, necessary to ensure that preschools are physically and socially healthy places in terms of minimizing the risks of becoming ill.[25] Schools are considered a favorable social ambient for health promotion.[34,35] Previous studies, however, have demonstrated a greater prevalence of respiratory illnesses and diarrhea in schoolchildren due to the risk associated with contact with a larger number of people in a closed environment.[25] A recent study in Pernambuco, Brazil, found that, while all of the preschools studied provided nutrition and menus prepared by nutritionists, some did not control the consumption of sugar. In these schools, there were higher caries rates.[36] In another study, preschool children with lower monthly fees were offered more sweet foods than those from more economically privileged preschools.[8] This suggested that the choice of diet is determined socially.[37]

Mothers who were at least 26 years old were shown to be a protection factor against dental caries in their 5-year-old children. This agrees with the findings of other authors, showing prevalence of the df-t index different from 0 in younger mothers.[38,39] As children's health depends directly on the ability of their parents, especially their mothers, to take care of them, they may be at risk when their parents are not sufficiently mature to do so. Teenage pregnancies, more common in underprivileged social groups,[40] represent a risk to the oral health of the children when they are born. Among other difficulties, very young mothers frequently have to

abandon their education, which can affect the future of their children, given that the mother's education can be directly related to her child's health.[15,26,40,41] A woman's education has a direct beneficial effect on reproductive health, reducing maternal mortality rates, improving childcare, and reducing birth rates and poverty. Economically underprivileged families tend to have more children, creating an additional hardship, since their income is not sufficient to invest in the education and health of each and every child.[26] Thus, the situation repeats itself and perpetuates this family model in the subsequent generations.

Children are particularly vulnerable to the environment in which they are born and develop. Environmental risks interact over time, increasing the potential of other risk factors. This makes it difficult to isolate their impact on the health of these individuals.[25]

This study's findings strengthen the position that public policies emphasizing health promotion and a common risk approach could be much more effective and the most effective way to improve the population's health. Despite caries experience, the sample group was shown to be relatively homogenous. Further studies should be carried out to determine caries experience deficiencies in homogeneous populations.

CONCLUSIONS

Based on this study's results, the following conclusions can be made:

1. Caries development in 5-year-olds who attended public health services in Curitiba, Brazil, was influenced by nutritional status, institutional experience (preschool attendance), and mother's age.
2. Five-year-old children who were of normal weight or were overweight, who were not in preschool, and whose mothers were at least 26 years old were more likely to be caries-free.

ACKNOWLEDGEMENTS

The authors wish to thank the Curitiba Health Department, Curitiba, PR, Brazil, for its collaboration and the National High Level Personnel Improvement Coordination (CAPES), Brasilia, Distrito Federal, Brazil, for its support of this study.

REFERENCES

1. Peterson HG, Bratthall D. The caries decline: A review of reviews. Eur J Oral Sci 1996;104:436-43.
2. Bonecker M, Cleaton-Jones P. Trends in dental caries in Latin American and Caribbean 5- to 6-year-old and 11- to 13-year-old children: A systematic review. Community Dent Oral Epidemiol 2003;31:152-7.
3. Antunes JLF, Peres MA, Mello TRC, Waldman EA. Multilevel assessment of determinants of dental caries experience in Brazil. Community Dent Oral Epidemiol 2006;34:146-52.
4. Brasil Ministry of Health Ministério da Saúde. SB Brasil Project: Oral health condition of Brazilian population 2002-2003—main results). Available at: "http://www.webcitation.org/5Sw1uMMZh". Accessed June 6, 2005.
5. Curitiba PR. Oral health condition of Curitiba's population. In: Curitiba Municipal Public Health Service. Department of Epidemiology; 2005.
6. Leite ICG, Ribeiro RA. Dental caries in primary dentition in public nursery school children in Juiz de Fora, Minas Gerais, Brazil. Cadernos de Saúde Pública 2000;16:717-22.
7. Patussi MP, Marcenes W, Croucher R, Sheiham A. Social deprivation, income inequality, social cohesion, and dental caries in Brazilian school children. Soc Sci Med 2001;53:915-25.
8. Sayegh A, Dini EL, Holt RD, Bedi R. Food and drink consumption, sociodemographic factors, and caries occurrence in 4- to 5-year-olds in Jordan. Br Dent J 2002;193:37-42.
9. Peres MA, Peres KG, Antunes JLF, Junqueira SR, Frazão P, Narvai PC. The association between socioeconomic development at the town level and distribution of dental caries in Brazilian children. Rev Panam Salud Publica 2003;14:149-57.
10. Schou L, Uitenbroek D. Social and behavioral indicators of caries experience in 5-year-old children. Community Dent Oral Epidemiol 1995;23:276-81.
11. Slade GD, Sanders AE, Bill CJ, Do LG. Risk factors for dental caries in 5-year-old South Australian population. Aust Dent J 2006;51:130-9.
12. Blane D. The life course, the social gradient, and health. In: Marmot M, Wilkiresin RG, eds. *Social Determinants of Health*. Oxford: Oxford University Press; 1999:64-80.
13. Wadsworth M. Early Life. In: Marmot M, Wilkresin RG, eds. *Social Determinants of Health*. Oxford: Oxford University Press; 1999:44-63.
14. Nicolau B, Marcenes WA, Barteley MA, Sheiham AA. A life course approach to assessing causes of dental caries experience: The relationship between biological, behavioral, socioeconomic, and psychological conditions and caries in adolescents. Caries Res 2003;37:319-26.
15. Nicolau B, Marcenes W, Allison P, Sheiham A. The life course approach: Explaining the association between height and dental caries in Brazilian adolescents. Community Dent Oral Epidemiol 2005;33:93-8.
16. Sanders AE, Spencer AJ. Childhood circumstances, psychosocial factors, and social impact of adult health. Community Dent Oral Epidemiol 2005;33:370-7.
17. Li Y, Wang W. Predicting caries in permanent teeth from caries in primary teeth: An eight-year cohort study. J Dent Res 2002;81:561-6.

18. Thomson WM, Poulton R, Milne BJ, Caspi A, Broughton JR, Ayers KM. Socioeconomic inequalities in oral health in childhood and adulthood in a birth cohort. Community Dent Oral Epidemiol 2004;32:345-53.
19. Seike MS, Raadal R, Strand GV, Espelid I. The relation between caries in primary dentition at 5 years of age and permanent dentition at 10 years of age: A longitudinal study. Int J Paediatr Dent 2006;16:152-60.
20. Burt BA. Concepts of risk in dental public health. Community Dent Oral Epidemiol 2005;33:240-7.
21. Batchelor PA, Sheiham A. The distribution of burden of dental caries in school children: A critique of the high-risk caries prevention strategy for population. BMC Oral Health 2006;6: 1-5 Available at: "http://www.webcitation.org/5Sw5y7qXN". Accessed March 22, 2006.
22. National Center of Health Statistics. CDC Grows Charts: United States. In: *National Center of Chronic Disease Control and Prevention.* Washington, DC: US Department of Health and Human Services; 2000.
23. Statistical Package for the Social Sciences [computer program]. Version 10.0 for Windows. Chicago, Ill; SPSS, Inc; 1999.
24. Psoter WJ, Reid BC, Katz RV. Malnutrition and dental caries: A review of the literature. Caries Res 2005;39:441-7.
25. Satterthwaite D, Hart R, Levy C, Mitlin D, Ross D, Smit J, et al. *The Environment for Children: Understanding and Acting on the Environmental Hazards That Threaten Children and Their Parents.* London, UK: Earthscan Publications Ltd; 1996.
26. World Health Organization, Organization for Economic Co-operation and Development. *Guidelines and Reference Series: Poverty and Health.* Geneva: WHO; 2003.
27. Burt BA, Pai S. Does low birth weight increase the risk of caries? A systematic review. J Dent Educ 2001; 65:1024-7.
28. Dye BA, Shenkin JD, Ogden CL, Marshall T, Levy SM, Kanellis MJ. The relationship between healthful eating practices and dental caries in children 2-5 years old in the United States, 1988-1994. J Am Dent Assoc 2004;135:55-66.
29. Baker S, Barlow S, Cochran W, Fuchs G, Lish W, Krebs N, et al. Overweight children and adolescents: A clinical report of North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition. J Pediatr Gastroenterol Nutr 2005;40:533-43.
30. Daniels SR, Arnett DK, Eckeli RH, Gidding SS, Haymen LL, Kumanyka S, et al. Overweight children and adolescents: Pathophysiology, consequences, prevention, and treatment. Circulation 2005;111: 1999-2012.
31. Macek MD, Mitola D. Exploring the association between overweight and dental caries among US children. Pediatr Dent 2006;28:375-80.
32. Willerhausen B, Hass G, Krammenauer F, Hohenfellner K. Relationship between high weight and caries frequency in German elementary school children. Eur J Med Res 2004;9:400-4.
33. Hilgers KK, Kinane DE, Scheetz JP. Association between childhood obesity and smooth-surface caries in posterior teeth: A preliminary study. Pediatr Dent 2006;28:23-8.
34. Moyses ST, Moyses SJ, Watt RG, Sheiham A. Associations between health promoting school polices and indicators of oral health in Brazil. Health Promot Int 2003;18:209-18.
35. Kwan SYL, Petersen Pe, Pine CM, Borutta A. Health-promoting schools: An opportunity for oral health promotion. Bull World Health Organ 2005;83:677-85.
36. Rodrigues CS, Sheihan A. The relationship between dietary guidelines, sugar intake, and caries in primary teeth in low-income Brazilian 3-years-olds: A longitudinal study. Int J Paediatr Dent 2000;37:47-55.
37. Hamasha AA, Warren JJ, Levy SM, Broffitt B, Kanellis MJ. Oral health behaviors of children in low and high socioeconomic status families. Pediatr Dent 2006;28:310-5.
38. Mattila ML, Rautava P, Sillanpaa M, Paunio P. Caries in 5-year-old children and associations with family-related factors. J Dent Res 2000;79:875-81.
39. Schulman JD, Taylor SE, Nunn ME. The association between asthma and dental caries in children and adolescents: A population-based case-control study. Caries Res 2001;35:240-6.
40. Sharpe S, Mauthner M, France-Dawson M. *Family Health: A Literature Review.* 1st ed. London, UK: HEA; 1996.
41. Peres MA, Latorre RMdO, Sheiham A, Peres KG, Barros FC, Hernandez PG, et al. Social and biological early life influences on severity of dental caries in children aged 6 years. Community Dent Oral Epidemiol 2005;33:53-63.