Trends in Dental Caries Rates in 12- and 13-Year-Old Schoolchildren from Florianópolis (Brazil) between 1971 and 2005

Marina Leite Souza^a/João Luiz Dornelles Bastos^b/Marco Aurélio Peres^c

Purpose: To estimate dental caries prevalence and severity among all 12- and 13-year-old schoolchildren enrolled in a public school in 2005 and to establish comparisons with the results of studies previously conducted in the same school in 1971, 1997 and 2002.

Methods: A cross-sectional study involving 190 children was carried out. A single calibrated examiner collected the clinical data according to the World Health Organization (1997) criteria.

Results: The response rate was 90.0%. Between 1971 and 2005, the observed reduction in caries prevalence was 58.2%, whereas the mean DMFT Index declined from 9.2 to 0.8, which corresponds to a reduction of 91.3%. The significant caries index (SiC) reduced from 3.4 (Cl 95% 3.0–3.8) in 2002 to 2.2 (Cl 95% 1.8–2.5) in 2005.

Conclusion: This study indicates an actual decline in dental caries prevalence and severity among the schoolchildren during the studied period, even though different diagnostic criteria were used.

Key words: caries, DMFT Index, oral health, significant caries index (SiC)

Oral Health Prev Dent 2006; 4: 187-192.

Submitted for publication: 15.09.05; accepted for publication: 13.02.06.

Dental caries is a major public health problem and is one of the most common chronic diseases among human populations. It affects considerable proportions of schoolchildren and adults in several industrialised, Latin and Asian countries (Petersen, 2003), causing pain/discomfort and resulting in high costs associated with treatment (Reisine, 1985). Nonetheless, recent declines in dental caries rates in children and young age-groups have been extensively documented (Bonecker and Cleaton-Jones, 2003; Seppa et al, 2000; Sgan-Cohen et al, 2000).

Information from the World Health Organization (WHO) on the prevalence of dental caries in 12-year-old children, the age of reference for international comparisons, reveals two distinct trends: (i) declining prevalence of dental caries in developed countries, such as Japan, Australia and Finland; and (ii) increasing rates in Chile and Jordan (WHO, 2002).

Three nation-wide studies demonstrated a large reduction in caries severity between 1986 and 2003 in Brazil. The mean DMFT Index of children aged 12 years decreased from 6.7 to 2.8 during the observed period, which corresponds to a decrease of 58.2%. In addition to this nationally reported decline, numerous surveys carried out in Brazilian municipalities showed similar trends (Table 1).

In Florianópolis, the capital of Santa Catarina State (Brazil), three cross-sectional studies were conducted among all 12- and 13-year-old children attending the same school in 1971, 1997 and 2002. The first two, under similar methods and diagnostic criteria, registered a reduction of 32.6% in caries severity

^a Curso de Graduação em Odontologia da Universidade Federal de Santa Catarina

^b Programa de Pós-Graduação em Epidemiologia, Universidade Federal de Pelotas

^c Departamento de Saúde Pública da Universidade Federal de Santa Catarina

Reprint requests: Dr. Marco Aurélio Peres, Universidade Federal de Santa Catarina, Centro de Ciências da Saúde, Departamento de Saúde Pública, Campus Universitário – Trindade, Florianópolis – SC CEP: 88010-970, Email: mperes@ccs.ufsc.br

Reference	City	Age	Period	Total reduction (%)	Annual reduction (%)
Viegas and	Barretos, SP	12	1971-1987	57.7	3.6
Viegas, 1988					
Basting et al, 1997	Piracicaba, SP	12	1971-1996	77.0	3.1
Dini et al, 1999	Araraquara, SP	12	1989-1995	31.5	5.2
Narvai et al, 2000	São Paulo, SP	12	1986-1996	68.2	6.8
Traebert et al, 2001	Blumenau, SC	12	1968-1998	81.7	2.7
Bastos et al, 2002	Bauru, SP	12	1976-1995	58.2	3.0
Panizzi et al, 2004	Chapecó, SC	12	1996-2002	45.4	7.5

(Freysleben et al, 2000). The latter, carried out in 2002, confirmed the declining trend and documented a decrease of 28.2% and 53.3% in caries prevalence and severity respectively (Bastos et al, 2004). To our knowledge, there are few studies conducted in the same school for such a long period of time under the supervision of the same research team.

The main objective of the present study was to estimate dental caries prevalence and severity among all 12- and 13-year-old schoolchildren enrolled in a public school in 2005 and to establish comparisons with the results of studies previously conducted in the same school in 1971, 1997 and 2002.

MATERIALS AND METHODS

The sample comprised all 12- and 13-year-old children (n = 190) enrolled in a public school (Padre Anchieta Basic School) from Florianópolis, Santa Catarina, Brazil, in 2005. Prevalence and severity of dental caries were measured through DMFT Index in respect to the criteria set forth by WHO in 1997 (WHO, 1997).

Before commencing the clinical examinations, the only examiner (MLS) was trained and calibrated by a member of the research team (JLDB), regarded as the gold standard, according to methods and procedures published previously (Peres et al, 2001). One in every 20 children was re-examined to test intra-examiner agreement. Reliability was assessed through the Kappa test on a tooth-by-tooth basis. The gold standard (JLDB) was responsible for the collection of clinical data in the previous study (2002), and had been trained by an experienced dental epidemiologist (MAP). The latter was in charge of the calibration procedures placed in the 1997 survey. Children were clinically examined at the school under natural light using plane mouth mirrors and sterilised gauze to remove gross debris. A scribe recorded all clinical data in appropriate forms.

Data were processed for analysis using the Statistical Package for Social Sciences 10.0 (SPSS) for Windows (Nie et al, 1975). Descriptive statistics of DMFT Index, including confidence intervals (95%) were calculated. Significant caries index (SiC) for the years 2002 and 2005 was calculated by taking the mean DMFT from the one-third of the individuals who presented the highest DMFT values in the given populations (Bratthall, 2000). The Care Index was obtained for the group as a whole in 1971, 1997, 2002 and 2005 as the ratio of the mean filled (F) component to the mean DMFT Index and later multiplied by 100 (Walsh, 1970).

Differences in the mean DMFT Index according to age and gender were tested through Mann-Whitney U-Test considering the asymmetric distribution of the DMFT Index. The significance level was set at p < 0.05.

A letter was sent to the parents of the selected children explaining the aims, characteristics and importance of the study and asking for their participation. The Ethics Committee of the Federal University of Santa Catarina granted formal ethical approval for this project.

RESULTS

From a total of 190 schoolchildren, four could not be reached due to school absences, nine refused to participate in the study and six were transferred to other schools, which gives a response rate of 90.0%. Kappa values calculated for intra-examiner variability were all higher than 0.7 and the great majority of values were equal to one.

Table 2 displays the age and gender distribution of the samples in 1971, 1997, 2002 and 2005. In 1971 there were 127 children (62.9%) aged 12 years, while in 1997, 2002 and 2005 there were 101 (57.7%), 88 (52.1%) and 118 (69.0%) children of the same age respectively. The gender distribution varied from 90 (51.4%) boys in 1997 to 77 (45.6%) in 2002 and 81 (47.4%) in 2005. The gender distribution for the year 1971 is unavailable.

Differences in the DMFT Index across gender and age were not statistically significant, yielding p-values of 0.1 and 0.4 by Mann-Whitney U-Test respectively. Therefore all results are presented for the sample as a whole.

Between 1971 and 2002, the decayed component (D) showed the greatest reduction, followed by the missing (M) and F components (91.7%, 79.5% and 29.0% respectively). However, between 2002 and 2005, the F component demonstrated the greatest decline (53.0%), while the D component reduced by 29.2% and the M component reduced by 50.0% (Table 3).

Caries prevalence declined from 98.0% (CI 95% 96.0-100.0) in 1971 to 93.7 (Cl 95% 90.0-98.0) in 1997, when the Klein and Palmer (1938) diagnostic criteria were adopted. Between 1997 and 2002, and considering the WHO diagnostic criterion set forth in 1987 (WHO, 1987) and 1997 (WHO, 1997) respectively, the caries prevalence declined from 80.0% (Cl 95% 74.0-86.0) to 57.4% (CI 95% 50.0-65.0). In the last period of observation (2002-2005), caries prevalence declined from 57.4% (Cl 95% 50.0-65.0) to 40.9% (CI 95% 33.5-48.4) according to the criteria proposed by WHO in 1997 (WHO, 1997).



Souza et

Fig 1 Trends in mean DMFT Index among 12- and 13-yearold schoolchildren enrolled in Padre Anchieta Basic School in 1971, 1997, 2002 and 2005. Florianópolis, SC, Brazil, 2005. * Klein and Palmer (1938) diagnostic criteria

** WHO diagnostic criteria (WHO, 1987)

*** WHO diagnostic criteria (WHO, 1997)

The mean DMFT Index was 9.2 (CI 95% unavailable) in 1971, which declined to 6.2 (Cl 95% 5.2-7.4) in 1997 according to the Klein and Palmer (1938) diagnostic criteria. The mean DMFT Index reached 3.0 (CI 95% 2.7-3.3) in 1997 and 1.4 (Cl 95% 1.1-1.6) in 2002, when the WHO diagnostic criteria were adopted (WHO, 1997). In 2005, the last year of observation, the mean DMFT Index recorded was 0.8 (CI 95% 0.6-1.0). The general trend in the DMFT Index is represented in Fig 1.

The values of SiC for the years 2002 and 2005 were 3.4 (CI 95% 3.0-3.8) and 2.2 (CI 95% 1.8-2.5)

Variables	197:	L	199	7	200)2	20	05	
	n	%	n	%	n	%	n	%	
Age									
12 years	127	62.9	101	57.7	88	52.1	118	69.0	
13 years	75	37.1	74	42.3	81	47.9	53	31.0	
Total	202	100.0	175	100.0	169	100.0	171	100.0	
Gender									
Male	*	*	90	51.4	77	45.6	81	47.4	
Female	*	*	85	486	92	54.4	90	52.6	
Total	202	100.0	175	100.0	169	100.0	171	100.0	



Table 3 Mean DMFT Index and its components decayed (D), missing (M) and filled (F) teeth in 12- and 13-year-old schoolchildren enrolled in Padre Anchieta Basic School in 1971, 1997, 2002 and 2005. Florianópolis, SC, Brazil, 2005 Schoolchildren enrolled in Padre Anchieta Basic School in 1971, 1997, 2002 and 2005. Florianópolis, SC, Brazil, 2005												
Year	D		Μ			F	F			DMFT Index		
	Mean	CI 95%	%	Mean	CI 95%	%	Mean	CI 95%	%	Mean	CI 95%	%
1971**	7.9	*	85.6	0.4	*	4.2	0.9	*	10.1	9.2	*	100.0
1997***	2.4	4.6-6.8	90.7	0.03	0.02-0.04	0.5	0.6	0.2-0.9	8.8	3.0	5.2-7.4	100.0
2002****	0.7	0.6-0.7	46.8	0.08	0.03-0.1	5.8	0.7	0.5-0.9	47.5	1.4	1.1-1.6	100.0
2005****	0.5	0.3-0.6	56.8	0.04	0.01-0.06	4.9	0.3	0.2-0.4	38.3	0.8	0.6-1.0	100.0
* Unavailable information ** Klein and Palmer (1938) diagnostic criteria *** WHO diagnostic criteria (WHO, 1987) **** WHO diagnostic criteria (WHO, 1997)												

respectively. This corresponds to a reduction of 35.3% in the SiC.

DISCUSSION

This study presents an actual decline in caries experienced among schoolchildren enrolled in a public school in Southern Brazil, named Padre Anchieta Basic School, over a period of 34 years. All studies conducted between 1971 and 2005 were supervised by the same research team, followed similar methods in calibration training of the examiners and achieved high scores of reliability. These factors contribute to the internal validity of the presented data. Nevertheless, one of the limitations is the lack of an interexaminer reliability assessment, since different examiners of the same team were involved in the consecutive cross-sectional investigations. In fact, we believe that this may have not biased our estimates, since only one examiner was responsible for the collection of clinical data in each study year, the field-work had been under supervision of the same person throughout the majority of the studies, and the methods and procedures adopted for calibration training, which were based on a previously published paper (Peres et al, 2001), were strictly followed.

Even though different diagnostic criteria were adopted in some of the conducted investigations, a significant reduction of 58.2% in caries prevalence between 1971 and 2005 is worth noting.

Bonecker and Cleaton-Jones (2003), in a systematic review of caries trends in Latin American and Caribbean countries between 1970 and 2002, concluded that a considerable reduction in caries prevalence and severity occurred in children 11–13 years old. In Brazil, nationwide as well as local studies support such a trend. In the city of São Paulo, a reduction of 68.2% was recorded between 1970 and 1996, which corresponds to an annual decrease rate of 2.6% (Narvai et al, 2000). In Paulínia, a medium-sized city located in São Paulo State, a decrease of 66.7% in caries severity was registered over a period of 6 years (Gomes et al, 2004).

With regard to the M component, it maintained the relative weight of around 5% throughout the entire observation period. The only occasion when it was very low was in 1997, when it reached 0.5% of the mean DMFT Index. These data may be attributed to decreasing numbers of teeth being extracted due to dental caries.

The F component had a relative weight of around 10% in the first two surveys, but increased its relative participation in 2002 (47.5%) and decreased in 2005 (38.3%). Therefore, a small relative reduction of the filled component occurred in the last observation period. The Care Index shows the same trend observed for the filled component during the studied period, which may be interpreted as a result of restricted access to oral health services between 2002 and 2005 and/or changes in criteria for placement of fillings over time.

Mean value of DMFT Index recorded by the present study is considered very low and has already reached the WHO goals for the year 2010 (Gomes et al, 2004). Among all components of the DMFT Index, the D component presented a great relative weight (of about 90%) in the first 2 years of examination. In 2002 it declined to 46.7% and soon after reached 56.8% of the mean DMFT Index. This finding may be interpreted as a result of decreasing numbers of decayed teeth in the studied population.

Reduction in caries experience could also be confirmed in the one-third of individuals presenting the highest DMFT values according to the SiC, which de-



clined 35.3% from 2002 to 2005 in the present study. This finding was also reported in other countries, such as Switzerland (Marthaler et al, 2005), Mexico, France and Senegal (Nishi et al, 2002). Reduction in the SiC Index was simultaneous to the observed reduction in DMFT Index, meaning that those most affected by dental caries also benefited from the improvement in oral indices.

Considering the studied period as a whole (1971– 2005), fluoridation of water supplies, which began to be implemented in 1982 in Florianópolis, and the increase in the consumption of fluoridated dentifrices after the end of 1980s may have been the main reasons for the observed decline in caries experience. Moreover, the improvement in the socioeconomic conditions of Florianópolis, evidenced by data presented in the city's official website (www.pmf.sc.gov.br), may have played a role in the reported caries decline.

Changes in diagnostic criteria, on the other hand, have really contributed to the mentioned reduction, a finding previously reported in another publication (Marcenes et al, 2001). Such a finding was evidenced in the two 1997 studies, conducted by one of the present researchers. In the first 1997 study, caries was recorded if frank cavitation was present or if the explorer resisted removal after the insertion into a pit or fissure with moderate to firm pressure, if a softness at the base of the area was identified or if opacity adjacent to pit or fissures showed evidence of undermined or demineralised enamel. Also, caries was recorded in a smooth area of facial or lingual surface if there was a white spot as evidence of subsurface demineralization or softness was identified by the penetration of the explorer. In the second clinical examination performed in 1997 one week later, the WHO criteria proposed in 1987 were used (WHO, 1987). Caries was recorded as present when a lesion in a pit or fissure, or on a smooth tooth surface, had a detectable softened wall. A tooth with a temporary filling was also included in this category. On proximal surfaces, the examiner must have been certain the explorer had entered a lesion. Where any doubt existed, caries was not recorded as present. A single dentist using exactly the same protocol, i.e. equipment, position and lighting, but not the same criteria in the second examination, carried out both clinical examinations. This made it possible for us to detect the contribution of changing diagnostic criteria toward reduction of caries: between 1971 and 1997, although 47.2% of the reduction was real, 52.8% of it was a statistical artefact due to changes in the criteria for measuring caries used by epidemiologists (Marcenes et al, 2001).

Finally, the results of this study cannot be inferred to all schoolchildren aged 12 and 13 years in Florianópolis, although the data may be used as a proxy for the dental conditions of this city and may serve as a diagnostic picture for policy makers in order to implement oral health surveillance and interventions/services.

ACKNOWLEDGEMENTS

Marina Leite Souza was supported by a grant from the Conselho Nacional de Desenvolvimento Científico e Tecnologico (CNPq) of Brazil.

REFERENCES

- Basting RT, Pereira AC, Meneghim MC. Avaliação da prevalência de cárie dentária em escolares do município de Piracicaba, SP, Brasil, após 25 anos de fluoretação das águas de abastecimento público. Rev Odontol Univ São Paulo 1997;11:287-292.
- Bastos JL, Nomura LH, Peres MA. Tendência de cárie dentária em escolares de 12 e 13 anos de idade de uma mesma escola no período de 1971 a 2002, em Florianópolis, Santa Catarina, Brasil. Cad Saude Publica 2004;20:117-122.
- Bastos RS, Bijella VT, Bastos JRM, Buzalaf MAR. Declínio da cárie dentária e incremento no percentual de escolares, de 12 anos de idade, livres da doença, em Bauru, São Paulo, entre 1976 e 1995. Rev Fac Odontol Bauru 2002;10:75-80.
- Bonecker M, Cleaton-Jones P. Trends in dental caries in Latin American and Caribbean 5–6- and 11–13-year-old children: a systematic review. Community Dent Oral Epidemiol 2003; 31:152-157.
- Bratthall D. Introducing the Significant Caries Index together with a proposal for a new global oral health goal for 12-yearolds. Int Dent J 2000;50:378-384.
- Dini EL, Foschini AL, Brandao IM, da Silva SR. Mudanças na prevalência de cárie em crianças de sete a 12 anos de Araraquara, São Paulo, Brasil: 1989-1995. Cad Saude Publica 1999;15:617-621.
- Freysleben GR, Peres MA, Marcenes W. Prevalência de cárie e CPO-D médio em escolares de doze a treze anos de idade nos anos de 1971 e 1997, região Sul, Brasil. Rev Saude Publica 2000;34:304-308.
- Gomes PR, Costa SC, Cypriano S, de Sousa Mda L. Paulínia, São Paulo, Brasil: situação da cárie dentária com relação às metas OMS 2000 e 2010. Cad Saude Publica 2004;20:866-870.
- 9. Klein H, Palmer CE. Dental caries in American indian children. Washington DC: Government Printing; 1938.
- Marcenes W, Freysleben GR, Peres MA. Contribution of changing diagnostic criteria toward reduction of caries between 1971 and 1997 in children attending the same school in Florianopolis, Brazil. Community Dent Oral Epidemiol 2001;29:449-455.
- 11. Marthaler T, Menghini G, Steiner M. Use of the Significant Caries Index in quantifying the changes in caries in Switzerland from 1964 to 2000. Community Dent Oral Epidemiol 2005;33:159-166.
- Narvai PC, Castellanos RA, Frazao P. Prevalência de cárie em dentes permanentes de escolares do município de São Paulo, SP, 1970-1996. Rev Saude Publica 2000;34:196-200.



- Nie N, Hull CH, Jenkins JG, Steinbrenner K, Brent DH. SPSS: statistical package for the social sciences. 2nd ed. New York: McGraw-Hill; 1975.
- Nishi M, Stjernsward J, Carlsson P, Bratthall D. Caries experience of some countries and areas expressed by the Significant Caries Index. Community Dent Oral Epidemiol 2002;30:296-301.
- Panizzi M, Peres MA, Moschetta JDF. Saúde Bucal: em busca da universalidade, da integralidade e da equidade. In: Franco TB, Peres MA, Foschiera MMR, Panizzi M, editors. Acolher Chapecó. São Paulo: Hucitec; 2004:145-176.
- Peres MA, Traebert J, Marcenes W. Calibração de examinadores para estudos epidemiológicos de cárie dentária. Cad Saude Publica 2001;17:153-159.
- 17. Petersen PE. The World Oral Health Report 2003: continuous improvement of oral health in the 21st century the approach of the WHO Global Oral Health Programme. Community Dent Oral Epidemiol 2003;31 Suppl 1:3-23.
- 18. Reisine ST. Dental health and public policy: the social impact of dental disease. Am J Public Health 1985;75:27-30.
- 19. Seppa L, Karkkainen S, Hausen H. Caries trends 1992-1998 in two low-fluoride Finnish towns formerly with and without fluoridation. Caries Res 2000;34:462-468.

- Sgan-Cohen HD, Katz J, Horev T, Dinte A, Eldad A. Trends in caries and associated variables among young Israeli adults over 5 decades. Community Dent Oral Epidemiol 2000;28:234-240.
- 21. Traebert JL, Peres MA, Galesso ER, Zabot NE, Marcenes W. Prevalência e severidade da cárie dentária em escolares de seis e doze anos de idade. Rev Saude Publica 2001;35:283-288.
- 22. Viegas Y, Viegas AR. Prevalência de cárie dental em Barretos, SP, Brasil, após dezesseis anos de fluoretação da água de abastecimento público. Rev Saude Publica 1988;22:25-35.
- 23. Walsh J. International patterns of oral health care: the example of New Zealand. N Z Dent J 1970;66:143-52.
- 24. WHO. Global Oral Health Data Bank. Geneve: World Health Organization; 2002.
- 25. WHO. Oral health surveys: basic methods. Geneve: World Health Organization; 1997.
- 26. WHO. Oral health surveys: basic methods. Geneve: World Health Organization; 1987.