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Trends in dental caries in 1- to 4-year-old children in a Brazilian city between 1997 and 2008

MARCELO BÖNECKER[1], THIAGO MACHADO ARDENGHI[2], LUCIANA BUTINI OLIVEIRA[3], AUBREY SHEIHAM[4] & WAGNER MARCENES[5]

[1]Department of Orthodontics and Pediatric Dentistry, School of Dentistry, Universidade de São Paulo, São Paulo, Brazil, [2]Department of Stomatology, Universidade Federal de Santa Maria, RS, Brazil, [3]School of Dentistry, Universidade de São Paulo, São Paulo, Brazil, [4]Department of Epidemiology and Public Health, University College London, UK, and [5]Department Adult Oral Health, Queen Mary's Medical and Dental School, London, UK

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Objective. The objective of this study was to assess trends in dental caries prevalence and severity in 1- to 4 year-old children living in Diadema, Brazil, over a 11-year period, from 1997 to 2008.

Methods. In 2008 an epidemiological oral health survey was carried out and the results on caries were compared with five cross-sectional studies carried out using the same methods and criteria in 1997, 1999, 2002, 2004, and 2006 in the same city. In all surveys, children were randomly selected from those attending a National Day of Children's Vaccination. Calibrated dentists carried out the clinical examination using WHO criteria. Caries trends were assessed by time-lag analysis. In total, 5348 children were examined in the six surveys over the 11-year period.

Results. Time-lag analysis showed a marked and statistically significant decline in the prevalence (χ^2 for trends: $P < 0.001$) and severity (Kruskal–Wallis: $P < 0.001$) of dental caries between 1997 and 2008.

Conclusion. In conclusion, the last cohort of preschool children in Diadema had much better dental caries status than those in 1997.

Introduction

Oral health surveys provide important descriptive information about the disease status and contribute to the development of rational health policies for the target population[1–4]. Therefore, it is essential to monitor changes in prevalence and severity of oral disease and to assess relevant and putative risk factors over time[5].

Numerous reports demonstrate the declining trends in dental caries in the permanent dentition[6–11] and in primary teeth of children under 5 years old[12–22]. Even though a significant decrease in caries experience in primary teeth have been demonstrated in industrialized countries in the 1970s and early 1980s[23–26], a number of reports show a levelling off or even a small increase in the prevalence and severity of caries in primary teeth[18–22,27,28].

There are no national data about trends of dental caries in Brazilian preschool children. Our unique series of cross-sectional studies of dental caries using the same methods and diagnostic criteria since 1995 in children under 5 years old in Diadema demonstrated that oral health in preschool children in Diadema improved markedly during 1995–1999[17]. We were interested to assess whether that trend had continued. The objective of this study was to assess trends in dental caries prevalence and severity in 1- to 4-year-old children living in Diadema, Brazil, over a 11-year period, from 1997 to 2008.

Methods

The study was approved by the Ethics in Research Committee of Faculty of Dentistry, University of São Paulo and parents' consent was obtained prior to each survey. The same

Correspondence to:
Dr Marcelo Bönecker, Department of Orthodontics and Pediatric Dentistry, Universidade de São Paulo, Av. Prof. Lineu Prestes, 2227, Zipcode: 05508-900 São Paulo, Brazil.
E-mail: bonecker@usp.br

methodology was applied as in all previous studies in the same city[17,29–31].

Population and sample

Diadema had an estimated population of 357,064 inhabitants that included 35,034 children under 5 years old. From information provided by local authorities and a previous study,[17] socio-economic status in the area of the survey was homogeneous for this age group. Children are mainly from low socio-economic backgrounds. The city has a fluoridated water supply (0.7 ppm) since 1988. No preventive oral health programmes have been undertaken exclusively for this age group in the city, except in 2002. Oral health strategies have mainly focused on the whole population.

A series of cross-sectional surveys was conducted on a representative sample of 1- to 4-year-old children of Diadema using the same protocol in all six cross-sectional surveys in 1997, 1999, 2002, 2004, 2006, and 2008.

For the survey carried out in 1997, it was estimated that a minimum sample size of 180 children in each age group was required to achieve a level of precision with a standard error of 3.5% or less. The 95% CI level and a prevalence of caries experience of 50% were used for the calculation[32]. As four ages were surveyed in 1997, the minimum sample size required was 720. For the survey carried out in 1999, a minimum sample size of 122 children in each year of age was required to achieve a level of precision with a standard error of 3.5% or less. The 95% CI level and a prevalence of caries experience of 20% were used for the calculation. As four ages were studied in 1997, the minimum sample size required was 488. The prevalence of 20% was predicted based on previous results of the survey carried out in 1997. For the subsequent surveys the results of the prevalence of dental caries in each of the last data collection were used to calculate sample size considering the same standard error of 3.5% or less and the 95% CI level. The minimum sample size required was 500 for the survey carried out in 2002[30] and 625 for the surveys carried out in 2004, 2006,[31] and 2008. Participants were systematically selected from all children attending a National Day of Children's Vaccination carried out in the city of Diadema. All the 15 health centres in the city were used as sampling points in all six surveys because the city is administratively divided into 15 regions and each had a public health centre that was responsible for the vaccination of all children living in that area. Each fifth child in the queue for vaccination was invited to participate in the dental survey. Quota sampling was adopted because the population was equally distributed in all regions. Refusals were replaced by the next child in the queue.

Clinical examination

All dental examinations were carried out by 15 dentists. Each dentist was randomly allocated to the 15 health centres in all surveys. All dentists participated in a training and calibration exercises before each survey. Children were dentally examined seated on a dental chair. Very young children were examined sitting on the lap of one of their parents. Before the clinical examination, wet gauze pads were used to clean tooth surfaces. The teeth were dried and examined under the standard illumination provided by a conventional operating dental light. The diagnosis was made by visually examining dental surfaces with a plane mouth mirror. The WHO (1997) dental caries diagnostic criteria were used for classifying caries[1]. For all teeth and surfaces, the clinical examination assessed whether teeth were sound, decayed, filled or indicated for extraction.

Data analysis

Data analysis was performed with STATA software Stata Version 8.0 (Stata Corporation, College Station, Texas, USA). Caries prevalence (dmf > 0) and severity (dmfs) were calculated. The time-lag analysis was used to assess the trend of dental caries prevalence and severity between children in the same age group examined in each year of data collection. As a result of the skewed distribution (Kolmogorov–Smirnov test) of dental caries

severity in all surveys, a nonparametric test (Kruskal–Wallis) was performed to assess the difference in dmfs values in each age-groups according to the year of the survey. Trends in dental caries prevalence were assessed using Chi-square for trend.

Results

A total of 801, 562, 841, 925, 1021, and 1198 children were enroled in the studies in 1997, 1999, 2002, 2004, 2006, and 2008 respectively (Table 1). The response rates in all surveys were above 95%. Kappa values for inter- and intra-examiner agreement ranged between 0.75 and 0.87 in all surveys.

Table 1 presents the number of children examined and the percentage of children with dmf > 0 by age and year of survey. A marked significant decline in the prevalence of dental caries was observed over the 11-year period (Chi-square for trend: $P < 0.001$). Caries prevalence decreased remarkably until 1999, while between 1999 and 2002 an increase occurred. After 2002 the prevalence continued to decrease in all age groups.

Figure 1 shows the percentage of caries-free children during the 11 years of the study, by age. Secular trends over the whole study period indicated an increase in the percentage of caries-free children; there was a significant increase in the number of caries-free children when comparing the 1997 survey to that in 2008 (Chi-square for trend: $P < 0.001$). The same significant trend was observed for the 4 year olds.

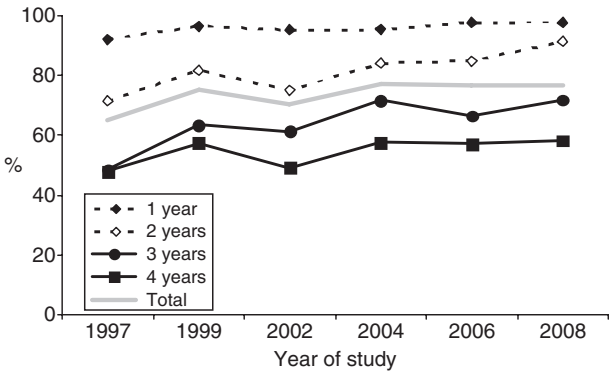

Fig. 1. Percentage of caries-free children by years in each survey, Diadema, Brazil.

Table 1. Number of children examined (n) and dental caries prevalence (dmfs > 0), by age and survey year.

	1997		1999		2002		2004		2006		2008		
Age groups (years)	*n*	dmf > 0 (%)	*n*	dmf > 0 (%)	*n*	dmf > 0 (%)	*n*	dmf > 0 (%)	*n*	dmf > 0 (%)	*n*	dmf > 0 (%)	*P*-value*
1	203	7.9	143	3.5	210	4.8	238	4.6	263	2.3	228	2.2	0.003
2	196	28.6	142	18.3	225	24.9	227	15.9	258	15.1	229	8.7	< 0.001
3	202	51.5	140	36.5	197	38.6	229	28.4	254	33.5	387	28.2	< 0.001
4	200	52.0	136	42.7	209	50.7	231	42.4	247	42.9	354	41.8	0.020
Total	801	34.9	562	24.9	841	29.5	925	22.7	1021	23.1	1198	23.5	< 0.001

*Reduction statistically significant according to the survey year (Chi-Square for trend).

Table 2. Mean dmfs and ds/dmfs by age and survey year.

	1997		1999		2002		2004		2006		2008		
Age group years	dmfs	ds	dmfs	ds	dmfs	ds	dmfs	ds	dmfs	ds	dmfs	ds	*P*-value*
1	0.2	0.2	0.4	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.040
2	1.1	1.0	1.1	1.0	1.1	1.1	0.8	0.8	0.9	0.8	0.2	0.2	< 0.001
3	3.3	2.9	2.3	2.0	1.9	1.6	1.6	1.2	2.1	1.6	1.7	1.5	< 0.001
4	4.1	3.2	3.2	2.5	3.3	2.7	2.2	2.0	2.9	2.0	2.5	1.9	0.020
Total	2.1		1.7		1.6		1.2		1.5		1.3		< 0.001

*Kruskal–Wallis rank test.

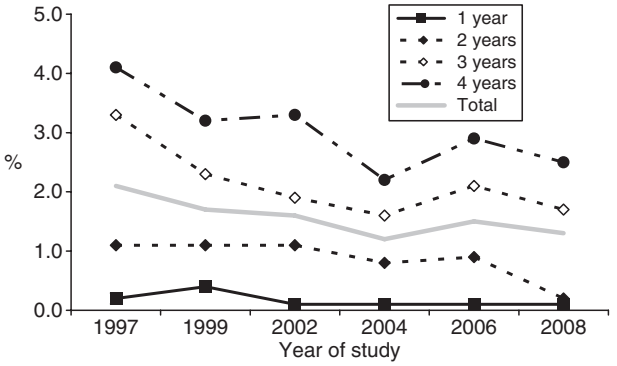

Fig. 2. Caries severity (dmfs) by age and year of the study.

The mean dmfs values by the four ages over the 11 year period are shown in Table 2 and Fig. 2. The dmfs values for the total population of preschool children decreased considerably between 1997 and 2008 (Kruskal–Wallis test: $P < 0.001$). In each age the downward trend was similar. The decay component was the main component of the dmfs in all surveys and ages (Table 2).

Discussion

There were significant reductions in both the proportion of children with caries and mean dmfs at ages 1, 2, 3, and 4 years over the 11 years, 1997 and 2008. There are very few such long-term caries trend studies in children under 5 years old to compare with our findings[12–15,19,21]. The trend in dental caries in children 1- to 4-years-old in a Brazilian city reported here is very similar to trends observed in the same age group in other countries[12–22,33,34]. The trend found for Brazilian children under 5 years old follows the trends observed in systematic reviews containing data for Caribbean and Latin America countries for children 5–6 years old[35].

Comparisons with other Brazilian epidemiological trend studies are not possible. Nevertheless, there are a few single cross sectional studies with children under 5 years old. The results show that there are large variations between the prevalence and dmfs values in different regions of Brazil[4,36–40]. In Brazil, the last countrywide survey showed a high prevalence of dental caries (59.3%) and a mean of 2.8 dmft in 5-year-old children[41].

Even though the trends in caries prevalence and mean dmfs between 1997 and 2008 are statistically similar, they have different shaped frequency distributions (Figs 1 and 2). The trend in caries-free prevalence shows a slightly downward trend in 2002 and upward in 2004. On the other hand, a slightly downward trend in dmfs was seen in 2004 and an upward one in 2006. Sampling bias and/or variation in diagnostic criteria may explain these differences. That is unlikely since the same sampling method, diagnostic criteria and calibrated examiners were used in all surveys. An oral health programme focused in preschool Diadema children started just after the 2002 survey may have affected caries levels in 2004. If it did, however, the same impact was not seen in 2006 cohort possibly because of the fact that its period was short. In addition, oral health programmes have been demonstrated to have a very limited impact on improving oral health in this age group[42].

It has been suggested that caries prevalence in the primary dentition tends to stabilize with dmft scores of 1.3–1.6 and 60% of caries-free children[34]. Nevertheless, the trends in Diadema show that further improvements in caries levels is possible since more than 60% of the preschool children in the city are

caries-free children with a dmft ranging from 1.3 to 1.6.

There is a gratifying downward trend in caries in preschool children in Diadema. Nevertheless the explanations of the trend are not clear and the reasons for the decline are obscure. Our results from dietary and oral hygiene studies conducted in 1997 and 1999 provides little evidence to suspect a change in sugars intake, nor is there a suggestion of changes in oral hygiene behaviours in babies and toddlers[43]. Socio-economic status was associated with caries prevalence and severity. Such data were collected in the surveys in 2004, 2006, and 2008. There was an association between dental caries and nutritional status in children living in Diadema. Children with malnutrition and living in adverse socio-economic conditions were more likely to have caries.[31]

Around 1990, the economy of Diadema City began to improve markedly. The same political party has been in the power since 1993 for four consecutive periods and health and social indicators have been improving since then[44].

Fluoride toothpaste and fluoridated water have been used in Diadema well before the surveys started in 1995 and no mass preventive programmes were in place in the study area although the prevalence of using fluoride toothpaste may have increased and that may account for the trends.

The mean number of tooth surfaces with decay was very high. Decay was the most frequent component of dmfs index for all ages throughout the six surveys. Such low treatment rates may be because of the fact that parents could not afford the available dental treatment for babies and toddlers.

The quality of the data in a sequence of six cross sectional studies is very important for obtaining reliable information. The strengths of this study are that the same sample selection procedures and diagnostic criteria and almost all the same calibrated examiners were used in all surveys on representative samples in the same 15 health centers. The weakness of the study could be the cross-sectional design and the variation of sample size in each survey. Nevertheless, many caries trends studies[6–22] have used cross-sectional and not longitudinal studies. Even though the six samples were well matched by age and sex during the study, the sample size varied throughout the years, especially in 1999. This is because of the fact that in that particular survey not only caries but also malocclusion was assessed and that entailed using a smaller sample size as the oral clinical examinations took much longer.

The results of these surveys highlights the importance of both better effective preventive and therapeutic care at an earlier age, than what is routinely provided by school-age based dental care programmes at present. If further improvement in oral health of children in Diadema Brazil is to be achieved, the main strategies should be health promotion, particularly related to diet, health promoting nurseries and the provision of evidence based dental care for this age group.

What this paper report adds?

- This work gives information about trends in dental caries prevalence and severity in Brazilian preschool children.

Why this paper is important to paediatric dentistry?

- There are very few long-term caries trend studies in children under 5 years old.
- It is essential to monitor changes in prevalence and severity of oral disease and to assess relevant and putative risk factors over time.

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