

Evaluation of simplified DMFT indices in epidemiological surveys of dental caries

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Keywords

Oral health. Dental caries, epidemiology.
Dmf index. Dental health surveys.
Prevalence.

Abstract

Objective

To analyze whether two simplified indices, "DMF in 6 Teeth" (DMF6T) and "DMF in two quadrants" (DMF2Q), could be indicated for epidemiological surveys of oral health according to dental caries distribution.

Methods

The sample came from epidemiological data in 29 municipalities. A total of 2,378 examinations were done on 12-year-old schoolchildren. The mean DMFT from each locality was utilized to obtain three DMFT prevalence groups (low, moderate and high), for which the simplified indices were calculated. Statistical analysis was done using intraclass correlation and the Wilcoxon and chi-squared tests, with a significance level of 5%.

Results

Intraclass correlation between the DMFT index and the simplified indices ranged from 0.82 to 0.95 ($p < 0.05$). No significant differences in the prevalence of the studied parameters were observed between the means of the DMFT and DMF2Q indices ($p > 0.05$), although DMF6T showed differences. The proportions of decayed, missed and filled teeth were similar between the DMFT and DMF2Q indices ($p > 0.05$).

Conclusions

The simplified DMF2Q index can be used in epidemiological surveys in areas with low, moderate and high prevalence of dental caries. However, better evaluation of the DMF6T index needs to be made.

INTRODUCTION

The DMFT index has been widely utilized in epidemiological surveys of oral health. It is recommended by the World Health Organization (WHO) for measuring and comparing the experience of dental caries in populations. The index expresses the mean number of decayed, missing and filled teeth in a group of individuals.²² Because caries has characteristics of symmetry and bilaterality, some authors proposed simplified indices for dental caries.^{4,14,18,20} Pinto¹² stated that such indices were used for obtaining fast and practical overall knowledge

of the epidemiological conditions of populations of children.

Although in practice these indices were utilized in local epidemiological surveys, according to reports from dentists and the records of public oral health services, there are few descriptions in the literature of studies of the utilization of these simplified measurements. It was found in most locations where such measurements were utilized in a more routine manner that a high prevalence of caries was observed.

However, over the last thirty years, important studies

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have demonstrated an evident reduction in the prevalence and severity of dental caries among children in industrialized countries,^{11,13} Latin America and the Caribbean,² and also in various localities in Brazil.^{3,10}

Considering this new epidemiological reality, there is a need for assessing whether the simplified indices can still be recommended for investigating the distribution of dental caries, as an alternative for the DMFT index or when detailing of the caries is unnecessary. It is also believed that reducing the number of teeth to be examined would enable investigation of dental caries activity. This situation is still not considered in the WHO diagnostic criteria, while it is fundamental for increasing the quality of service planning and the definition of the most appropriate strategies for controlling caries.

Despite the unmatched contribution and importance of epidemiological measurements for organizing and planning healthcare services, it is known that municipalities have difficulty in undertaking periodic epidemiological surveys of oral health. There are also difficulties in making professionals available for calibrating and collecting data, to put this type of study into practice. Thus, methodologies that reduce the duration of the oral examination may be desirable for specific situations in which conventional measurement cannot be utilized, thereby enabling a degree of resource rationalization.

Thus, the objective of the present study was to verify whether the simplified indices known as "DMF in 6 teeth" (DMF6T) and "DMF in 2 quadrants" (DMF2Q)⁴ can be indicated for epidemiological surveys of dental caries, considering the present-day distribution of caries.

METHODS

Between 1998 and 2001, epidemiological surveys of oral health were carried out in 30 municipalities located in the region of Campinas, State of São Paulo. The surveys included different age groups of the population and evaluated different dental problems. To diagnose the dental condition, the methodology proposed by WHO²² was utilized. In this, between-examiner concordance percentage was measured during the calibration processes (results greater than 85%) and the within-examiner concordance percentage was measured in around 10% of the sample during the data collection phase (the final values achieved were over 89%). This was a systematic probabilistic sample, without replacements, and a response rate of 84.1% was obtained.

Approval for the study was obtained from the Research Ethics Committee of Piracicaba Dental School,

Universidade Estadual de Campinas (no. 089/2002). Following this, computerized databases were created using the information available from these municipalities up to March 2002. Examination records with incomplete data and invalid fields were excluded. The final selection consisted of epidemiological data on 2,378 12-year-old schoolchildren. The DMFT index was obtained for each locality.

The municipalities were then divided according to a severity scale⁹ that suggests that the DMFT index for 12-year-old children can be utilized as an indicator of the state of health between different populations. This scale indicates very low prevalence when the DMFT is between 0 and 1.1; low prevalence between 1.2 and 2.6; moderate prevalence between 2.7 and 4.4; high prevalence between 4.5 and 6.5; and very high prevalence when the DMFT is greater than or equal to 6.6.

The prevalence groups were made up as follows: one municipality was considered to have very low prevalence of caries (125 oral examinations); 13 with low prevalence (n=1,141); 14 with moderate prevalence (n=1,018); and two with high prevalence (n=188). No municipality presented DMFT≥6.6 and thus no sample was obtained for the very high prevalence category.

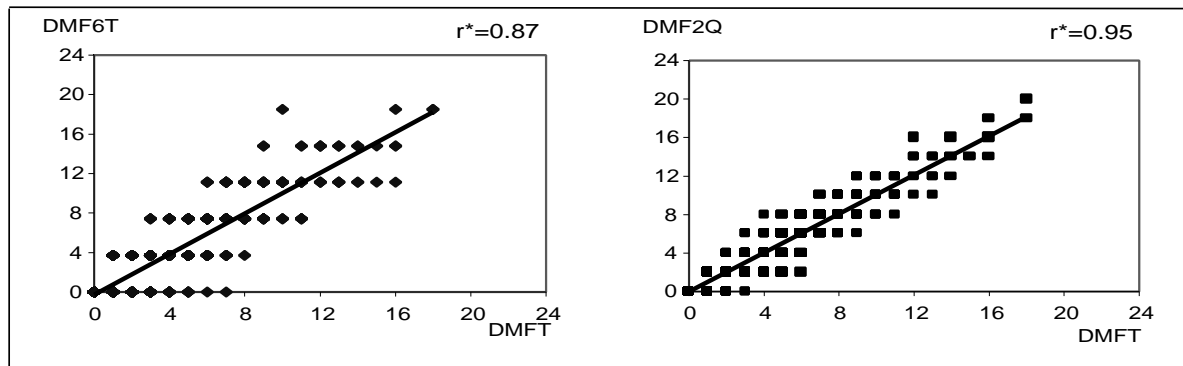
The variability (standard deviation) of the mean of the DMFT index was calculated, accepting an error of 5% and a confidence interval of 95%.¹⁶ This enabled verification of whether the number of sample elements in each prevalence group would be sufficient for the analyses. The schools in the municipality with very low prevalence were thus excluded, because of insufficient sample size for the analyses, according to the criteria adopted for the present study. Thus, in the end three prevalence groups were obtained (low, moderate and high), and these were identified in 29 municipalities.

The simplified indices selected were the ones proposed by Guimarães.⁴ These are known as "DMF in 6 teeth" (DMF6T) and "DMF in 2 quadrants" (DMF2Q). The DMF6T index corresponds to the mean number of permanent teeth attacked by caries in six selected teeth (16, 11, 24, 37, 32 and 45). It is calculated by means of simple linear regression, based on a regression coefficient of 0.27 for the age of 12 years, with a significance level of 5%, using the following equation:*

$$X = Y/B$$

where:

*Adapted from Guimarães⁵ (1971)



*r: Intraclass correlation coefficient

Figure - Dispersion and intraclass correlation coefficient (r) graphs between observed DMFT and the simplified DMF6T and DMF2Q indices, in municipalities with moderate caries prevalence among 12-year-old children.

X = estimated DMF index

Y = DMF in 6 teeth

B = regression coefficient according to age, with the value of 0.27 for the age of 12 years

The DMF2Q index corresponds to the mean number of permanent teeth attacked by caries in the upper left and lower right quadrants. It is calculated by multiplying the DMFT value obtained from the two quadrants by two.

The DMFT, DMF6T and DMF2Q indices were calculated in this way for each individual in the sample, in each prevalence group and each municipality. The Epi Info version 5.01 software was utilized for the calculations and EPIBUCO for the processing and analysis of the data (Narvai & Castellanos, 1999).^{*} Specific adaptations were developed for the calculation of the simplified indices.

For the statistical analysis, a significance level of 5% was adopted. The intraclass correlation coefficient and statistical significance were calculated for each caries prevalence group, along with sensitivity and specificity measurements. The Wilcoxon test was applied to verify whether there were differences between the means for the DMFT index and the simplified indices. The utilization of non-parametric tests was justified since the DMFT index did not present normal distribution in any of the situations studied ($p < 0.0001$).

To verify the dispersion of the data, dispersion diagrams were utilized. The chi-squared test was also utilized, with the purpose of verifying whether the percentages of decayed, missing and filled teeth obtained via the DMFT index were similar to the percentages found via the simplified indices.

RESULTS

The relationship between the DMFT index and the simplified indices was verified by means of the dispersion diagrams, for low, moderate and high prevalence of caries. There was a very similar pattern for the three caries groups, i.e. there was greater closeness of the results between the DMFT index and the DMF2Q index. The intraclass correlation coefficient for moderate caries prevalence was 0.87 when the DMFT index was compared with the DMF6T simplified index, and 0.95 in relation to the DMF2Q index (Figure).

The means for the DMFT index according to caries prevalence group can be seen in Table 1. This shows that the numerical differences between the values of the simplified indices and the DMFT index are very small, according to the prevalences analyzed. The intraclass correlation coefficient between the DMFT index and the simplified indices was more than 0.82 and significant in all the situations analyzed. The values from the sensitivity and specificity tests are also shown. The simplified indices were seen to be highly sensitive for detecting individuals with caries. However, the specificity ranged from 0.37 to 0.80 and did not correctly identify the individuals without caries.

With the aim of testing the simplification measures in relation to the differences in the degree of caries, the data were also stratified by municipality (Table 2). The DMFT index did not present normal distribution ($p < 0.0001$). It ranged from 1.76 to 2.64 in the municipalities with low caries prevalence, from 2.71 to 4.00 in the municipalities with moderate caries prevalence, and from 5.20 to 6.20 in the two municipalities with high caries prevalence. In the low prevalence group, statistically significant differences were observed in four municipalities when the DMFT and

^{*}Narvai PC, Castellanos RA. Levantamento das condições de saúde bucal – Estado de São Paulo, 1998 [on-line]. São Paulo: Núcleo de Estudos e Pesquisas de Sistemas de Saúde, Faculdade de Saúde Pública da USP; 1999. [Report presented to the Health Department of the State of São Paulo as the conclusion for the research project]. Available from: <http://www.saude.sp.gov.br/html/fr_sbucal.htm> [2004 Oct 23]

Table 1 - Intraclass correlation coefficient and sensitivity and specificity tests between the DMFT and simplified indices, according to the prevalence of caries at the age of 12 years. Region of Campinas, State of São Paulo, 1998 to 2001.

Variables	Prevalence of caries		
	Low (N=1,141)	Moderate (N=1,049)	High (N=188)
DMFT (se)*	2.29 (0.06)	3.36 (0.10)	5.54 (0.27)
DMF6T (df)**	2.06 (-0.23)	3.20 (-0.16)	5.10 (-0.44)
Intraclass correlation	0.82	0.87	0.87
p-value	<0.0001	<0.0001	<0.0001
Sensitivity	1.0	1.0	1.0
Specificity	0.57	0.80	0.37
DMF2Q (df)**	2.32 (+0.03)	3.40 (+0.04)	5.68 (+0.14)
Intraclass correlation	0.94	0.95	0.95
p-value	<0.0001	<0.0001	<0.0001
Sensitivity	1.0	1.0	1.0
Specificity	0.80	0.77	0.65

*se: Standard error

**df: Numerical difference between the DMFT and simplified indices

DMF6T indices were compared. In the moderate prevalence group, statistically significant differences were found in only three municipalities when the DMFT and DMF6T indices were compared, and in one municipality when the means of the DMFT and DMF2Q indices were compared. In the high prevalence group, there were differences in one municipality between the DMFT and DMF6T indices.

In the low, moderate and high caries prevalence groups, the Wilcoxon test demonstrated that the means for the DMF2Q simplified index were similar

($p > 0.05$) to the means for the DMFT index. However, the opposite was found between the means for the DMF6T simplified index and the DMFT index: a statistically significant difference ($p < 0.05$) was observed, as shown in Table 2.

With the aim of verifying whether the simplified indices could be recommended for the planning of services, the percentage compositions of the components of the DMFT index and simplified indices in the low, moderate and high caries prevalence groups were verified (Table 3). Thus, differences were presented as the propor-

Table 2 - Averages for the DMFT and simplified caries indices for 12-year-old children, according to the municipalities investigated in the region of Campinas, State of São Paulo, 1998 to 2001.

Municipalities	Sample (N)	DMFT	Simplified indices		Statistical tests (p-values)		
			DMF6T	DMF2Q	Normality	Wilcoxon test DMFT and DMF6T	DMFT and DMF2Q
Bragança Paulista	84	2.51	2.16	2.55	<0.0001	<0.0001*	0.9111
Cabreúva	64	2.17	2.02	2.31	<0.0001	0.1514	0.3316
Cosmópolis	85	2.34	2.13	2.33	<0.0001	0.6903	0.2392
Indaiatuba	88	1.84	1.68	1.86	<0.0001	0.2701	0.7981
Itupeva	104	2.33	1.92	2.37	<0.0001	0.0107*	0.7405
Jaguariúna	85	1.88	1.74	1.95	<0.0001	0.1716	0.2074
Joanópolis	130	2.51	2.16	2.63	<0.0001	0.0086*	0.1367
Jundiá	99	2.30	2.22	2.24	<0.0001	0.5695	0.2217
Louveira	87	2.43	2.17	2.51	<0.0001	0.1757	0.5497
Nova Odessa	102	2.41	2.25	2.31	<0.0001	0.0577	0.2043
Pedreira	54	1.76	1.71	1.67	<0.0001	0.5893	0.4518
Piracaia	73	2.64	2.53	2.77	<0.0001	0.4735	0.2742
Santo Antônio da Posse	86	2.42	1.89	2.35	<0.0001	0.0051*	0.5140
Total for low prevalence group	1,141	2.29	2.06	2.32	<0.0001	<0.0001*	0.3254
Águas de Lindóia	76	3.62	3.70	3.87	<0.0001	0.7415	0.0808
Arthur Nogueira	100	3.59	3.59	3.52	<0.0001	0.8069	0.6322
Atibaia	59	3.19	2.57	3.49	<0.0001	0.0487*	0.0161
Campo Limpo Paulista	66	3.60	3.31	3.46	<0.0001	0.1434	0.2230
Holambra	31	3.13	3.46	2.97	<0.0001	0.1769	0.4131
Hortolândia	92	4.00	3.90	4.09	<0.0001	0.3407	0.6918
Jarínú	90	2.71	2.47	2.82	<0.0001	0.0297*	0.2691
Monte Mor	87	2.71	2.47	2.62	<0.0001	0.1173	0.4046
Tuiuti	62	3.70	3.46	3.74	<0.0001	0.4954	0.7941
Valinhos	72	3.50	3.39	3.42	<0.0001	0.5381	0.6173
Vargem	104	3.90	3.34	3.94	<0.0001	0.0027*	0.6339
Vinhedo	81	2.83	2.28	2.89	<0.0001	0.8016	0.5432
Pinhalzinho	68	3.28	3.32	3.35	<0.0001	0.2143	0.5451
Bom Jesus dos Perdões	61	2.98	2.91	3.08	<0.0001	0.7697	0.4231
Total for moderate prevalence group	1,049	3.36	3.20	3.40	<0.0001	<0.0001*	0.2243
Pedra Bela	123	5.20	4.66	5.30	<0.0001	0.0027*	0.4445
Monte Alegre do Sul	65	6.20	5.92	6.40	<0.0001	0.2213	0.2315
Total for high prevalence group	188	5.45	5.10	5.68	<0.0001	0.0019*	0.1816

*Statistically significant differences

tions of missing teeth in the low prevalence group and filled teeth in the high prevalence group, between the DMFT index and the percentages estimated via the DMF6T index. No significant differences in the percentages of decayed, missing and filled teeth were observed between the values obtained by means of the DMFT index and the DMF2Q simplified index.

DISCUSSION

The simplified indices were developed through the application of linear regression. Although the data in our samples did not present normal distribution, the same equation was applied with the aim of verifying the viability of using the simplified indices. Another presupposition that supported the development of these methods was the theory of bilaterality of dental caries, which was subsequently confirmed by work done among children and adolescents aged seven to 15 years.^{1,4,17-19} However, this theory was rejected by Wood.²¹ In a study of the distribution of dental caries among 12-year-old children, this author found that 44% of the first upper molars and 32% of the first lower molars presented occlusal caries in just one of the teeth of each pair.

Jackson et al⁷ evaluated a total of 32,000 records from a population aged over 15 years. It was observed that caries attacks were asymmetrical in most individuals, but that the degree of asymmetry remained effectively constant after the age of 20-30 years, considering specific sites on the tooth (occlusal, mesial and distal surfaces). Hujuel et al⁶ also stated that the distribution of caries is nonrandom and is concentrated on one side of the mouth. These latter authors examined 12,776 adult individuals, of whom approximately 50% had two or more pairs of homologous teeth that were discordant.

In the light of the results obtained in the present study and in view of the divergences found in the scientific literature, it was considered important

to verify whether there was similarity in the distribution of caries between pairs of homologous teeth (result not presented). Both in the upper and lower arches, the proportions of teeth with some caries were very similar. No statistically significant differences were found for any pairs of homologous teeth, and the p-values were greater than 0.1542 (chi-squared test).

Thus, the results from the present study for the age and prevalences studies have shown that the dental caries is distributed such that it affects homologous teeth similarly. No differences were found between the means, from applying the DMF2Q simplified index or the DMFT index. This confirms the theory of bilaterality of dental caries for the age of 12 years, considering that the DMF2Q is based on examination of one upper and one lower quadrant. It is, however, emphasized that no investigation of the symmetry of caries in relation to specific sites on the teeth was done, since our data did not allow such analysis. This merits future investigation.

Small numerical differences were observed between the means for the DMFT index and the simplified indices (Tables 1 and 2), with better results for the DMF2Q index. The simplified indices therefore had acceptable levels of reproducibility, both in relation to the means and considering the correlation, for which the values were very high and significant. Thus, the findings of Guimarães⁴ were corroborated.

With regard to validity measurements, the simplified indices were shown to be very sensitive for correctly detecting occurrences of caries (Table 1). However, their specificity was shown to be inadequate, with worse results for the DMF6T simplified index in relation to the high caries prevalence group. This is therefore a limitation to the application of these indices. In other words, the simplified indices were shown to have the sensitivity to detect the disease, but did not cor-

Table 3 - Percentage compositions of the DMFT and simplified indices, according to the prevalence of caries at the age of 12 years. Region of Campinas, State of São Paulo, 1998 to 2001.

	Components of the DMFT	Components of the DMF6T	Components of the DMF2Q
Low prevalence group			
Decayed (%)	26.69	26.57	26.51
Missing (%)	2.45	0.94*	2.24
Filled (%)	70.87	72.48	71.00
Moderate prevalence group			
Decayed (%)	31.43	32.09	31.45
Missing (%)	4.73	2.09*	4.43
Filled (%)	63.83	65.82	64.13
High prevalence group			
Decayed (%)	29.66	24.71	30.53
Missing (%)	3.55	1.93	3.18
Filled (%)	66.79	73.36*	66.29

*Significant differences (p<0.05) by means of the chi-squared test

rectly identify the individuals with no occurrences of caries. Thus, it must be considered that the purpose of these indices is to measure the disease in population groups, and they were shown to be adequate for this.

The DMF2Q simplified index showed similarities with the percentages of components in the DMFT index. It presented the same proportions of decayed, missing and filled teeth, independent of the prevalence of caries. This indicates that the DMF2Q index can also be utilized for the planning and evaluation of oral health programs. This result corroborates the findings of Guimarães & Guimarães,⁵ who observed this similarity among young people aged 18 to 25 years. However, the DMF6T simplified index did not show this similarity: significant differences were observed with regard to the percentages of missing teeth in the groups with low and moderate caries prevalence and the percentages of filled teeth in the groups with low, moderate and high caries prevalence (Table 3).

It is very likely that the differences observed with regard to the components of the DMF6T simplified index are related to the present importance of caries occurrences in the molars. Some researchers have related a tendency for caries to be concentrated in grooves and fissures.^{8,15,19} The DMF2Q index takes such situations into account, but the DMF6T does not. The results from the present study suggest that an adjustment should be made in the equation, so as to give greater weight to the occurrence of caries in the molars, or even to select other teeth that better express the hierarchy of dental caries attack.

There may be another explanation, related to the present distribution of dental caries. It is possible that, at the time when these simplified indices were developed, dental caries was following patterns of normal distribution in most localities. This was not observed in the present study after applying the test of normality ($p < 0.0001$). The samples analyzed emphasized differences in attack, identified through the wide variations in the DMFT index.

In addition, Guimarães⁴ and Rodrigues et al¹⁴ com-

mented that the utilization of simplified indices brought in advantages in the planning and evaluation of oral health programs. The duration of the examinations can be reduced by approximately 40%, thereby diminishing the costs of this type of study. However, it must be taken into consideration that the time and resources needed for some stages of putting an epidemiological survey into operation, such as the preparation of examination record cards, authorizations, publicity, drawing of names and recruiting of participants, cannot be altered by substituting the measures taken.

One prospect for future research supported by the findings from the present study is that simplifying the DMFT index would facilitate the investigation of caries activity, such as in relation to the presence of pre-cavitated lesions, plaque and gingivitis. There would be a consequent increase in the quality of information, with obvious implications for the planning and evaluation of services.

Thus, the results from the present study allow utilization of the "DMF in 2 quadrants" index to be recommended in situations of high, moderate and low prevalence of caries. It can be utilized especially when a rapid diagnosis of the situation of dental caries is desired, provided that such diagnoses are coherent with the objectives of the study. It is a reliable alternative that can be applied in epidemiological surveys of oral health. However, the "DMF in 6 teeth" simplified index merits further study, since it was not seen to have good reproducibility at the prevalences studied. Finally, it is emphasized that future studies must include analysis of populations that present very high or very low prevalence of caries, and should enable the application of simplified indices to other age groups of the population.

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REFERENCES

1. Berman DS, Slack GL. Dental caries in English school children: a longitudinal study. *Br Dent J* 1972;133:529-38.
2. Bónecker 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;31:152-7.
3. Dini EL, Foschini ALR, Brandão IMG, Silva SRC. Changes in caries prevalence in 7-12 year-old children from Araraquara, São Paulo, Brazil: 1989-1995. *Cad Saúde Pública* 1999;15:617-21.
4. Guimarães LOC. Contribuição para o estudo da bilateralidade da cárie dentária em dentes permanentes. *Rev Fac Odontol São Paulo* 1971;9:311-8.

5. Guimarães LOC, Guimarães AMR. Simplificação do índice CPO dos 18 aos 25 anos. *Rev Saúde Pública* 1990;24:407-11.
6. Hujoel PP, Lamont RJ, DeRouen TA, Davis S, Leroux BG. Within-subject coronal caries distribution patterns: an evaluation of randomness with respect to the midline. *J Dent Res* 1994;73:1575-80.
7. Jackson D, Burch PRJ, Fairpo CG. Right/left asymmetry of caries at mesial and distal surfaces of permanent teeth. *Br Dent J* 1979;147:237-40.
8. McDonald SP, Sheiham A. The distribution of caries on different tooth surfaces at varying levels of caries: a compilation of data from 18 previous studies. *Community Dent Oral Epidemiol* 1992;9:39-48.
9. Murray JJ. O uso correto de fluoretos na saúde pública. São Paulo: Editora Santos; 1992.
10. Narvai PC, Castellanos RA, Frazão P. Prevalência de cárie em dentes permanentes de escolares no município de São Paulo, SP, 1970-1996. *Rev Saúde Pública* 2000;34:196-200.
11. Petersson HG, Bratthall D. The caries decline: a review of reviews. *Eur J Oral Sci* 1996;104:436-43.
12. Pinto VG. Identificação de problemas. In: Saúde bucal coletiva. São Paulo: Editora Santos; 2000. p. 139-222.
13. Pitts NB, Evans DJ, Nugent ZJ, Pine Cm. The dental caries experience of 12-year-old children in England and Wales. Surveys coordinated by the British Association for the Study of Community Dentistry in 2000/2001. *Community Dent Health* 2002;19:46-53.
14. Rodrigues CRMD, Ando T, Guimarães LOC. Simplificação do índice de cárie nas idades de 4 a 6 e de 7 a 10 anos (dentições decídua e mista). *Rev Fac Odontol São Paulo* 1989;3:454-9.
15. Silva BB, Maltz M. Prevalência de cárie, gengivite e fluorose em escolares de 12 anos de Porto Alegre, RS, Brasil, 1998/1999. *Pesq Odontol Bras* 2001;15:208-14.
16. Silva NN. Amostragem probabilística: um curso introdutório. São Paulo: EDUSP; 2001. p. 128.
17. Vasconcelos MCC, Silva SRC. Distribuição de cárie dentária na dentição permanente de escolares, em Araraquara, SP. *Rev Fac Odontol São Paulo* 1992;6:61-5.
18. Vasconcelos MCC, Jesus BJ, Nogueira JRB, Lui Filho O. Distribuição de cárie dentária na dentição permanente de escolares: experiência por dente. *Rev Fac Odontol São Paulo* 1994;8:125-30.
19. Vehkalahti M, Helminen S, Rytömaa I. Caries decline from 1976 to 1986 among 15-year-olds in Helsinki. *Caries Res* 1990;24:179-285.
20. Viegas AR. Simplified indices for estimating the prevalence of dental caries-experience in children seven to twelve years of age. *J Public Health Dent* 1969;29:76-91.
21. Wood PF. Asymmetry of caries attack on the occlusal surfaces of first permanent molar teeth. *Aust Dent J* 1985;30:123-7.
22. World Health Organization. Oral health surveys: basic methods. 4th ed. Geneva; 1997.