Comparison of the def Index With Nyvad's Caries Diagnostic Criteria in 3- and 4-year-old Colombian Children

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Abstract

Purpose: The aims of this research were to determine the epidemiological profile of dental caries in 3- and 4-year-old preschool children living in Bogotá, Colombia, and to compare two different caries indices—the standard def and Nyvad´s new caries diagnostic criteria.

Methods: The children were screened by two calibrated examiners who first brushed the children's teeth and air dried them for 5 seconds before they were examined. The diagnostic criteria used were the standard def-t and def-s and the def-t and def-s of the new caries diagnostic system proposed by Nyvad. The chi-square test[2] was used with a significance level of 5%.

Results: Prevalence of caries was 70% using the standard def-t criteria and 97% with the criteria proposed by Nyvad. The standard def-t and def-s were 3.3 and 5.7, respectively, and the def-t and def-s with the Nyvad citeria were 8.7 and 14.3, respectively.

Conclusions: Prevalence of caries was high, indicating that the population studied had a high disease rate. The results obtained with the more detailed Nyvad new caries diagnostic criteria were higher than the ones obtained with the standard def-t index, both for teeth and surfaces.(*Pediatr Dent.* 2003;25:132-136)

KEYWORDS: CARIES PREVALENCE, COLOMBIAN CHILDREN, NYVAD CARIES CRITERIA

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Dental caries is a process or dynamic disease that takes place in teeth in direct contact with microbial deposits resulting in a loss of mineral and localized destruction of hard tissues.[1-4] This disease represents the leading cause of morbidity in Bogotá's child population, and is among the first 10 reasons for outpatient care visits in the Colombian population.[5]

In the III National Oral Health Study (III ENSAB) completed in 1998, children below 5 years of age were not screened, creating a void of epidemiological information on dental caries. The last caries record of this age population was registered in national studies in 1965-1966 and 1977-1980.

In developed countries where dental programs have been organized for the child population, the caries prevalence has decreased 90% for the 12-year-old population.[6] In the majority of underdeveloped countries, the prevalence has stayed the same or even increased. In Colombia, the results of the III ENSAB (1998) show that the caries prevalence has decreased, but this change has not been homogenous, showing differences that can be explained by poverty, access to dental services and education. For example, the caries prevalence for 5-year-olds was lower in the urban areas and in the high socioeconomic strata than in the rural areas or low socioeconomic strata.[5]

Traditionally in epidemiological studies, the standard DMF/def indices have been used to evaluate caries status in a given population. This is a simple index, which can be modified by specific circumstances and has been accepted for several years.[7] It has some limitations, such as the underestimation of the prevalence and severity of caries, because it does not register the initial manifestation of caries like the white spot lesion.[6]

Table 1. Comparison of the New Nyvad Caries Diagnostic Criteria and the def Index Used in this Study[5]

Nyvad caries diagnostic criteria[9]	def index criteria used in this study[5]
0 Sound	Sound
1 Active caries (intact surface)	Sound
2 Active caries (surface discontinuity)	Caries
3 Active caries (cavity)	Caries
4 Inactive caries (intact surface)	Sound
5 Inactive caries (surface discontinuity)	Sound
6 Inactive caries (cavity)	Caries
7 Filling (sound surface)	Filled
8 Filling+active caries	Filled with caries
9 Filling+inactive caries	Filled
X Extracted because of caries	Lost because of caries

A new caries diagnostic system proposed by Nyvad in 1999 includes the initial manifestation of caries in the precavitated stages.[8] This system differentiates between active and inactive caries lesions at both the cavitated and non cavitated levels. Each tooth surface of all erupted teeth is classified according to 1 of the following criteria : 0=sound; 1=active, surface intact; 2=active, surface discontinuity; 3=active, cavity; 4=inactive, surface intact; 5=inactive, surface discontinuity; 6=inactive, cavity; 7=filled; 8=filled with inactive lesion; 9=filled with active lesion; and X=extracted.[9] (Table 1)

The purpose of this investigation was to determine the caries epidemiological profile of 3- and 4-year-old preschool children in Bogotá, Colombia using both the standard def index and Nyvad´s new caries diagnostic criteria.

Methods

Sample selection

A descriptive cross-sectional study of caries prevalence was performed with a population of 453 preschool boys and girls 3 to 4 years of age. Children were sampled from 2 types of institutions: (1) the public day-care centers, which are part of the Instituto Colombiano de Bienestar Familiar (ICBF); and (2) the private day-care centers. From the 104 public day-care centers, a random sample of 23 day-care centers was taken where 300 children (66%) were screened. Among the 259 private headstarts, 70 were visited and a total of 153 children (34%) were screened, giving a confidence level of 95%. With this sample, the different areas of the city were represented. The children were selected randomly, so that every one had the same chance to participate in the study. According to the last population statistics made by the government, 66 % of the Colombian child population is below the limits of poverty, which means that the economic income does not allow the children to have a sufficient daily meal.[21] It was decided to screen more children from the public institutions so that a more accurate view of the caries situation in 3- and 4-year-old preschool children could be obtained.

Table 2. Distribution of Examined Children in Regard to Type of Institution, Age and Gender, Bogotá, Colombia, 2000

	3 years		4 years		
Institution	Male	Female	Male	Female	Total
Public	69	77	82	72	300
Private	32	39	43	39	153
Total	217		236		453

Clinical examination

Before this institutionally approved study was started, the children's parents and teachers were informed of its purpose and their consent was obtained. Immediately before the clinical exam, the teeth of the children were cleaned with a brush appropriate for their age, to remove dental plaque. Portable dental units and standardized halogen light headlamps were used by all of the examiners.

Two examiners were fully calibrated for the 2 indices used in this study: the standard def criteria, which were used in previous Colombian epidemiological studies (III ENSAB),[5] and Nyvad´s new caries diagnostic criteria.[8] For Nyvad´s caries diagnostic criteria, first a translation from English to Spanish of Nyvad´s original article was made by a native English speaker, then by a native English speaker dentist and finally by a Colombian pediatric dentist. Secondly, any doubts the examiners had were resolved by the caries criteria author so that all the criteria were clearly understood. In the third step, a written examination was taken by the examination team. Finally, the fourth step was the practical calibration, which was made over 3 days: in day 1, 5 children were screened; in day 2, another 5 children were screened; and in day 3, the 10 children were mixed and screened again. Between the 3 days, there was an intervals of 1 week, so that the examiners would not remember the children's teeth. For the def index calibration, steps 3 and 4 were made under the close supervision of one of the authors who participated in the III ENSAB.

Teeth were examined with an intraoral no. 5 mirror and a no. 23 explorer. Before each surface was examined, it was dried for 3 to 5 seconds with cotton rolls. The explorer was used to remove the remaining dental plaque deposits, and to assess the loss of dental structure (cavitation) and the superficial texture (rough, leathery and soft). The explorer was only used when the visual criteria (bright vs opaque) were not enough to classify a lesion as inactive or active and to determine if the surface was leathery. Teeth with mixed lesions: active and inactive caries were diagnosed as active. Teeth with more than 2 lesions were classified

Table 3. Def-t Index Using the Nyvad Caries Diagnostic Criteria by Age, Institution and Gender, Bogotá, Colombia, 2000

Variables	Nyvad criteria	1	2	3	4	5	6	7	8	9	X	Total
Age												
	3 years	3.9	1.7	0.7	1.2	0.2	0.1	0.5	0.03	0.04	0.03	8.53
	4 years	3.4	2.3	0.8	1.3	0.2	0.1	0.7	0.04	0.04	0.07	8.89
Type of institution												
	Public	3.9	2.3	0.8	1.2	0.2	0.1	0.6	0.04	0.05	0.08	9.33
	Private	3.2	1.6	0.6	1.3	0.3	0.2	0.6	0.05	0.03	0.02	8.02
Gender												
	Male	3.6	1.9	0.6	1.2	0.2	0.04	0.6	0.04	0.03	0.04	8.3
	Female	3.7	2.2	0.9	1.3	0.2	0.07	0.6	0.04	0.05	0.07	9.1
Total		3.66	2.03	0.7	1.3	0.2	0.1	0.6	0.04	0.04	0.1	8.7

Table 4. Def-s Index Using the Nyvad Caries Diagnostic Criteria by Age, Institution and Gender, Bogotá, Colombia, 2000

Variables	Nyvad criteria	1	2	3	4	5	6	7	8	9	X	Total
Age												
	3 years	5.9	2.5	1.7	1.7	0.3	0.1	1.0	0.1	0.1	0.2	13.6
	4 years	5.4	3.3	1.5	1.8	0.4	0.2	1.7	0.1	0.1	0.4	14.9
Type of institution												
	Public	6.1	3.3	1.7	1.8	0.3	0.1	1.3	0.1	0.1	0.4	15.4
	Private	4.7	2.2	1.5	1.9	0.5	0.3	1.6	0.2	0.2	0.1	13.2
Gender												
	Male	5.3	2.8	1.1	1.8	0.3	0	1.3	0.1	0.1	0.2	13.1
	Female	5.9	3.1	2.1	1.7	0.4	0.2	1.4	0.2	0.1	0.4	15.5
Total		5.6	2.9	1.6	1.7	0.3	0.2	1.3	0.1	0.1	0.3	14.3

Table 5. Def-t Index for Caries Activity Using Nyvad´s Caries Diagnostic Criteria for Age, Institution, and Gender, Bogotá, Colombia, 2000

Variables	Active	Inactive	Filled	Extracted	Total
Age					
3 years	6.42	1.51	0.55	0.03	8.51
4 years	6.53	1.58	0.69	0.07	8.89
Institution					
Public	6.97	1.52	0.62	0.07	9.21
Private	5.51	1.61	0.65	0.019	7.80
Gender					
Female	6.1	1.44	0.67	0.04	8.25
Male	6.8	1.57	0.69	0.07	9.13
Total	6.48	1.55	0.63	0.057	8.7

using the more severe lesion. The diagnostic criteria used in the study were the def index[5] and the caries diagnostic criteria described by Nyvad.[8] (Table 1)

The criteria classified teeth according to the severity of caries: X=missing; 3=active caries (cavity); 2=active caries (surface discontinuity); 8=filling+active caries; 1=active caries (intact surface); 6=inactive caries (cavity); 5=inactive caries (surface discontinuity); 9=filling+inactive caries; 4=inactive caries (intact surface); 7=filling (sound surface); 0=sound.[2] (Table 1)

The kappa test score for interexaminer and intraexaminer reliability was between 0.98 and 1.0 and between 0.6 and 0.7, respectively.

Data analysis

To establish stastistical differences between the observed frequencies for the prevalence of caries, a chi-square test[2] was used with a 95% significance level.

Results

The distribution of the sample in both groups for type of institutions, age and gender is shown in Table 2.

With the standard def index, 73% of the population experienced dental caries. The def-t index was 3.3 for the entire sample. For the 3-year-old children it was 2.9, and it increased to 3.7 at 4 years of age. In the public day-care centers, the def-t was 3.7 and for the private ones, it was 2.8. The average number of decayed teeth (d) in the sample was 2.8, extracted teeth (e) 0.065, and restored teeth (f) 0.4.

The def-s index for the whole sample was 5.7. The def-s for 3 year olds was 4.99, and it increased to 6.29 in the 4-year-old group. In the public day-care centers, it was 6.69 and 4.65 for the private ones. The average number of decayed surfaces (d) for the sample was 4.5, missing (m): 0.23 and filled: 0.95. The occlusal surface was the most affected with 38% decayed, and the mesial had 10% affected.

When Nyvad´s caries diagnostic criteria were used, the caries prevalence was 97%. For the children in public day-care centers, prevalence of dental caries was 99% and for

Table 6 .Comparison of the Findings as Measured with the Standard def-t and def-s Indices and Nyvad's Indices, Bogotá, Colombia, 2000

Variables	dmf-t (standard)	dmf-t (Nyvad)	dmf-s (standard)	dmf-s (Nyvad)
Age				
3 years	2.9	8.5	4.9	13.6
4 years	3.7	8.9	6.3	14.9
Institution				
Public	3.7	9.3	6.7	15.4
Private	2.8	8.0	4.6	13.1
Gender				
Female	3.0	8.3	5.0	13.2
Male	3.6	9.2	6.2	15.5
Total	3.3	8.7	5.7	14.3

the group in private day-care centers, the prevalence of caries was 95%.

When Nyvad's criteria were used, the def-t was 8.7 and the def-s was 14.3 for the whole group (Tables 3 and 4).

With Nyvad´s caries diagnostic criteria, the most affected surface was the facial at 45%, and the least affected was the mesial at 6%. Using the same criteria, the active lesion predominated (Table 5).

The values using Nyvad´s caries diagnostic criteria for the whole of Bogotá's population (8.7 and 14.3) were much higher than those obtained with the def-t and def-s index, with values of 3.3 and 5.7, respectively (Table 6).

Discussion

This study showed high indices of dental caries in 3- to 4-year-olds in Bogotá. If the data obtained are compared with information from other worldwide epidemiological studies, higher and lower scores than those of this study are found. [10,11,12,13,14,15,16,17,18] This can be explained by the differences in the public health systems and preventive methods of each country, and also by the economic and socio-cultural diversity.

The prevalence of caries found for the 3- and 4-year-olds (73%) was higher than the 1 reported in the III ENSAB (64%) for Colombian 5 year olds. This discrepancy in the results could be explained by the size and type of the sample in the previous III ENSAB[(5)].

The results of this study show that the majority of the children, even though they were covered by oral health services, were not treated and the national dental caries index is increasing in this age group. By comparing the socioeconomic status (public day-care centers vs private day-care centers) this relationship stays the same, which could mean that the problem is not difficulty in access to oral services, but of education and lack of parental consciousness in the importance of oral health in the primary dentition.

In the 4-year-old group, the prevalence of caries was higher than in the 3-year-old group, which shows an increase in the progression of caries as the children's age increases. The same tendency can be observed with the def index, which was 2.9 at 3 years of age increasing to 3.7 at 4 years and 3.9 at 5 years (this last result taken from the III ENSAB of 1998).[5] A real need exists for improving early diagnosis and treatment of 3- and 4-year-old preschool children. Preventive measures, such as educating parents and teachers about oral hygiene habits in children, are examples.

With respect to the different components of the def-t index for the 3- and 4-year olds in the public and private day-care centers, the decayed teeth component had the greatest score. However, the missing teeth component decreased, which can mean that children are going to the dentist when they have a carious lesion that needs treatment but the prevention programs have not had great impact .

If new, more sensitive diagnostic criteria, like Nyvad´s criteria, identify incipient dental caries, they should be used in planning prevention programs because when non-cavitated lesions are detected, disease may be more easily controlled. With early caries diagnosis, a preventive treatment plan can be made. For example, the early diagnosis of occlusal caries lesions supports predicting the onset of caries at approximal surfaces.[8]

Although it has been recognized that precavitational stages of carious lesions can be diagnosed in clinical settings, it has been common to omit such diagnoses from recording systems used in epidemiological studies because the diagnoses cannot be made reliably.[9] However, other studies have shown that interexaminer and intraexaminer agreement can be high for the diagnosis of noncavitated lesions[9] following extensive training and calibration of the examiners. The inter and intraexaminer agreements were 0.70 and 0.69.

The prevalence values with Nyvad´s caries diagnostic criteria were 97%, were higher than those obtained with the def index. The system proposed by Nyvad evaluates caries from the initial or precavitated lesion, while the def index counts the disease only when it is in the cavitation state, thus underestimating the prevalence and severity of the caries. In Colombia, the application of sealants is made over sound teeth. Care must be taken when interpreting caries prevelance results because when Nyvad's criteria are used, the molars that are sealed were considered filled resulting in an increase in the number of filled teeth for this index.

The most affected surface in this study when the standard def index was used was the occlusal. Using Nyvad´s criteria, it was the facial. This could happen because most of the noncavitated lesions (active or inactive) were found on the facial surface, and the cavitated lesions on the occlusal surface. When applying the def index criteria, only cavities are registered, and when Nyvad´s criteria are used, the disease is registered in initial stages, even without a

cavity. The advantage of applying Nyvad´s caries diagnostic criteria is seen to reduce the need of treatment on a long-term basis because initial lesions are diagnosed, and measures can be applied to stop the progression of the lesion.[20] This means that a less invasive treatment can be performed favoring the cost-benefit relationship.

A limitation of Nyvad´s diagnostic system is that it is more difficult to make an exact diagnosis of a precavitated active lesion such as a white spot lesion over the occlusal surface than over the facial surface. These lesions can be underdiagnosed, progressing to frank cavitation. On the other hand, because of the physiologic wear of the occlusal surface during mastication, these lesions can disappear.

Conclusions

1. The prevalence of caries in the 3- and 4-year-old children living in Bogotá, Colombia, was high, which indicates a population with a high caries prevalence that increases with age. These results were greater in public institutions than in private ones.
2. Nyvad´s new caries diagnostic criteria produces values much higher than those with def caries index system.
3. Nyvad´s criteria are a good caries diagnostic tool that should be used in the future because it registers the initial stages of the disease, even before a cavity exists. It also measures the activity of the carious lesion, favoring the cost–benefit relationship when treatment plans are made.

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