



Pesquisa Brasileira em Odontopediatria e  
Clínica Integrada

ISSN: 1519-0501

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Universidade Estadual da Paraíba  
Brasil

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Pesquisa Brasileira em Odontopediatria e Clínica Integrada, vol. 15, núm. 1, 2015  
Universidade Estadual da Paraíba  
Paraíba, Brasil

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Original Article

## Prevalence of Dental Caries in Preschool Children by ICDAS Diagnostic Methodology

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Academic Editors: Alessandro Leite Cavalcanti and Wilton Wilney Nascimento Padilha

Received: 02 April 2014 / Accepted: 15 June 2015 / Published: 17 August 2015

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### Abstract

**Objective:** To evaluate the prevalence of caries with the ICDAS index (*International Caries Detection and Assessment System*) using different cut-off points in children from public and private institutions as well as to associate the presence of caries with socioeconomic indicators, sex, age, type of school (urban or rural) and also family health program with dentist's presence at the school. **Material and Methods:** An analytical cross-sectional study with a stratified sample (n = 612) in children ranging from three to six years old, in public and private institutions of the city of Barras, State of Piauí, Brazil. The clinical examination was based on ICDAS criteria, and a questionnaire for socioeconomic and educational level data was also applied. Different cut-off points were used, as follows: cut-off point 1 (scores 0 and 1 considered as healthy and scores 2-6 classified as decayed); cut-off point 2 (scores from 0 to 2 classified as healthy, scores 3 to 6 as decayed) and cut-off point 3 (0 to 3 healthy, 4 to 6 decayed). Univariate and Multiple Poisson regression analysis were performed, with 5% significance level. **Results:** For cut-off point 1, the prevalence was 68.8%; Cut-off point 2, 67.9% and at the cut-off point 3, 60.6%. An association was found in the prevalence of caries with the child's age (p = 0.004), school zone (urban or rural) (p = 0.004) and the presence of the dentist at school (p = 0.001). **Conclusion:** Taking into account the various cut-off points, the prevalence of caries in preschool children was considered high. The presence of caries lesions is more likely to occur in five year- old boys living in the countryside.

**Keywords:** Dental Caries; Preschool Children; Epidemiology.

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## Introduction

Although literature shows caries decline in the past decades [1,2], this is still the most prevalent disease in Pediatric Dentistry. Caries is a multifactorial chronic disease, whose clinical manifestation is influenced by many biological and behavioral factors, leading to the formation of caries lesions which begin in the enamel and if the carious process is not halted, the injuries increase often leading to early tooth loss [3].

Early childhood caries can interfere with permanent teeth formation as well as child's development in overall [4]. Literature reports that this severe disease has a major impact on preschoolers' quality of life, by causing tooth pain and feeding impairing [5,6].

The dental caries can be prevented and/or controlled when its etiology and risk factors for its development are known. The control and reversion of injuries are possible if diagnosed at early stages [7]. Early diagnosis of caries lesions is important since the dynamic nature of the lesion progression allows the continuous mineral loss interruption when the balance between minerals from teeth and oral fluids is restored.

Several researchers used too many caries detection methods, which impaired both the standardization and the comparison between them. A group of researchers met in 2002, aiming to create an international index, which was then named International Caries Detection and Assessment System (ICDAS).

The cavities evaluation and detection by ICDAS was proposed to be used in clinical trials, in clinical practice and in epidemiological studies [9]. Researchers assessed the feasibility of ICDAS index in epidemiological survey, compared to WHO criteria and came to the conclusion that besides providing information on non-cavitated caries lesions, the ICDAS index can also generate data comparable to surveys that used WHO criteria [11].

Another study concluded that dozens of described cavities are similar to ICDAS and they can be compared to WHO criteria, when actual values are used without differences and incipient decay or cavitation lesions are observed [12].

Researchers have shown that in the caries lesion detection concerning the occlusal surface at various stages of the disease process, ICDAS presents diagnostic accuracy, which can be compared to previous data using similar classification systems. A more intense training and calibration exercises in order to enhance further accuracy and reproducibility improvement is advisable [13]. Different cut-off points can be used with ICDAS, according to the need; in an article, three different cut-off points (CP) were used as follows: CP 1: inclusion of all carious lesions (scores 1 to 6, considered as dental caries); CP 2: incipient carious lesions were taken into account (scores 0 and 1 classified as healthy and 2 to 6 considered decayed); and CP 3: cavitated lesions (0-2 classified as healthy and 3 to 6 as decayed) [12]. Adding the use of four cut-off points : score 1 (1-6 classified as decay); score 2 (0 and 1 regarded as healthy, 2 to 6 considered decayed); score 3 (0 and 2 considered healthy, 3 and 6 considered decayed); score 4 (0 to 3 considered healthy 4 to 6 considered decayed) [11]. It can be

said that, in the visual detection of caries lesions the ICDAS can be considered a useful and easy system as well as clearly defined by the scores [14].

Literature presents a well-established relationship between socioeconomic factors and oral health, besides low family income interfering with caries experience. Adding to these factors, studying in a public school together with the low educational level of parents and/or legal guardians increase the chances of having caries experience, indeed [15].

The aim of this study was to evaluate the prevalence of dental caries using ICDAS method with different cut-offs in children from three to six years old in public and private institutions, in the city of Barras, State of Píauí, Brazil as well as to associate the presence of caries with socioeconomic indicators, sex, age, type of school, (urban or rural area) and the presence of the dentist's in the family health program in the school area.

## Material and Methods

The analytical cross-sectional study with a stratified sample was approved by the Research Ethics Committee of the Center for Dental Research - São Leopoldo Mandic, based in the city of Campinas, São Paulo State, Brazil, under the #. 2012/0258. Parents and/or legal guardians authorized the children's participation by signing the informed consent. All participants were examined and instructed about oral hygiene, guided and supervised concerning the practice of teeth brushing and those in need of dental treatment were invited to perform treatments in municipal health centers. Study participants were selected from students enrolled in public schools (urban area: 1,190 students and rural area: 1,383) and the private school participants in number of 160 students, totaling 2,733 students from 3 to 6 years old, coming from the city of Barras (44,850 inhabitants), located at the northern state of Piauí, Brazil, [16] The research was conducted by only one examiner from February to June 2012.

For sample size calculation, we have used 50% prevalence [17], considering a sampling error of 4% with a 95% confidence level and 10% for possible losses was added. Thus, the ideal sample was considered 660 children.

Inclusion criteria were: 3 to 6 year-old children, both sexes, no racial distinction, good health students from public and private schools. The exclusion criteria were parents who did not allow the participation of children in the research, children who did not allow the examination as well as the children missing on the day of the dental exam.

The survey was conducted in schools by a single calibrated researcher and the notes were taken by trained oral health nurse. Calibration was performed in 85 children (13.88% of the sample) and the coefficient of intra-examiner agreement ( $\kappa = 0.99$ ) for ICDAS index was considered excellent.

The participants received oral health instructions and supervision during teeth brushing previously to dental examination. The visual examination was carried out based on the criteria for the presence and depth of caries [18] and it was held with the school children sitting on the chair

and their head lying on the examiner's lap, under artificial light (flashlight), with oral mirror #5. Sterile gauze was used to dry the teeth when necessary. Caries diagnosis was performed, the need for treatment and X-ray advised and sequelae traumatized teeth verified. Since this was an epidemiological field survey, not performed in the dental chair and without the use of a triple syringe, the ICDAS score 1 was considered as zero (Chart 1). The socioeconomic classification questionnaire was used in order to categorize the respondent's living situation and it was evaluated the level of formal education together with the possession of consumer's goods, factors which emphasize the purchasing power estimations of individuals and families [19].

Chart 1. ICDAS Scores.	
Code	Clinical Signs
0	No change in the enamel translucency after 5 second-drying
1	Visible opacity after 5 second-drying Pigmentation restricted to crack bottom
2	Visible opacity even in the presence of moisture Diffuse pigmentation
3	Cavity restricted to enamel
4	Underlying dentin shadow
5	Underlying cavity with dentine exposure involving less than half the surface
6	Underlying cavity with dentine exposure involving more than half the surface

The socioeconomic classification reading was done by checking the sum of points. Data from this study were tabulated in an Excell spreadsheet and statistically analyzed in Stata 9.0 software (Stata Corp LP, College Station, USA).

Initially a descriptive analysis of the variables involved in the study was performed. Afterwards, the mean (standard deviation) of decayed teeth per individual was calculated considering three ICDAS cut-off points: cut-off point 1 (score 0 and 1 considered as healthy and scores 2-6 classified as decayed); cut-off point 2 (scores from 0 to 2 classified as healthy, scores 3 to 6 as decayed) and cut-off point 3 (0 to 3 healthy 4 to 6 decayed). In order to assess the association of independent variables with the prevalence of caries, Poisson analyzes were performed. For that, two issues were used: prevalence of children with caries lesions considering the ICDAS cut-off point 1 (cavitated and non-cavitated lesions) and prevalence of caries considering the ICDAS cut-off point 3 (cavitated carious lesions in dentin). At the beginning analyzes of univariate Poisson regression with robust variance were carried out. In these analyzes, the prevalence ratio values with their confidence intervals to 95% (95% CI) was calculated. The p values were also calculated by the Wald test. After univariate analysis, there were multiple Poisson regression analyzes. In order to enter the final model, the variables with a significance level of 20% in the univariate analysis were tested. For the variable retention in the final model, a 5% significance level was considered.

## Results

The sample of 612 students was examined and divided as such: 289 (47.22%) females and 323 (52.78%) were male, aged between 3 and 6 years old living in the city of Barras, State of Piauí, Brazil. The children were randomly chosen in 23 schools: 2 private schools, 15 rural public schools and 6 urban public schools, considering the representation according to the number of students in each school. The sample was initially calculated as 660 children, but there was a 10% increase for any losses, which later on showed to be low. This was also a contributory factor for the sample to be considered representative of the population. For the assessment of intra-examiner agreement the weighted Kappa test with quadratic approach was used because the ICDAS is based on increasing order of severity, and blunders (3 vs. 6, for example), would have greater weight in the test. 85 children were re-examined, and the Kappa coefficient - intra-examiner: 0.99 was considered an excellent index. Table 1 presents descriptive data of the sample, where it can be observed that there is a predominance of 586 individuals (95.7%) who study in public schools and only 26 (4.2%) who study in private schools, and the countryside presenting the higher number of students, 319 (52.1%). The presence of a dentist responsible for the care, i.e. the insertion of these students in the "Family Health Strategy", already appears positive since it covers 409 students of the sample (66.8%). The students' parents and/or legal guardians presented low educational level (70.6%- eight or fewer years of study), with predominance belonging to D and E lower social classes (90.8%).

**Table 1. Descriptive features of the sample.**

Variable	N	%
<b>Sex</b>		
Female	289	47.22
Male	323	52.78
<b>Age</b>		
3 - 4 years old	187	30.56
5 years old	274	44.77
6 years old	151	24.67
<b>School</b>		
Public	586	95.75
Private	26	4.25
<b>School zone</b>		
Rural	319	52.12
Urban	293	47.88
<b>Dentist's presence at school</b>		
No	203	33.17
Yes	409	66.83
<b>Parents and/or Legal guardian Education</b>		
≤ 8 years	424	70.67
> 8 years	176	29.33
<b>Social Class</b>		
A	0	0.0
B	4	0.65
C	52	8.50
D	439	71.63
E	117	19.12

Different values compared to 612 due to lack of questionnaire information.

The prevalence of caries (ICDAS) in children aged 3-6 years old ( $n = 612$ ) of the municipality of Barras-State of Piauí, Brazil, was considered high, according to Table 2 which shows the average number of decayed teeth per individual according to the different cut-off points used in the survey. When all dental changes are considered (cavitation and no cavitation) as decay, at cut-off point 1, the average of decayed teeth per individual was 3.70, higher than that when only the cavitation was taken into account at the cut-off point 2 (3.38) and if only comparing the cavities in dentin, the cut-off point 3, presented a lower average (2.59).

**Table 2. Caries Prevalence and average number of decayed teeth per individual, according to different ICDAS cut-off points.**

ICDAS cut- off point	Average of decayed teeth (sd)	Prevalence N (%)
<b>Cut-off point 1</b>	3.70 (4.00)	421 (68.79)
<b>Cut-off point 2</b>	3.38 (3.62)	416 (67.97)
<b>Cut-off point 3</b>	2.59 (3.10)	371 (60.62)

Table 3 shows the univariate and multiple Poisson regression analysis of the presence of caries lesions considering- ICDAS, cut-off point 1 i.e. taking into account cavitated and non-cavitated lesions. The independent variables in the final model (multiple) presented a statistically significant association showing higher chance of caries for male children at five years old.

**Table 3. Independent variables associated with the presence of carie lesions, concerning ICDAS cut-off point 1( cavitated and non-cavitated lesions) 2 to 6 scores classified as decayed).**

Variables	Unadjusted analysis	p	Adjusted analysis	p
<b>Sex</b>				
Male	1,00		1,00	
Female	0,85 (0,76 – 0,94)	0,004	0,86 (0,77 – 0,96)	0,008
<b>Age</b>				
3 e 4 years	1,00		1,00	
5 years	1,26 (1,09 – 1,45)	0,001	1,22 (1,08 – 1,47)	0,004
6 years	1,24 (1,06 – 1,46)	0,005	1,16 (0,99 – 1,40)	0,066
<b>School</b>				
Private	1,00		*	*
Public	2,03 (1,19 – 3,45)	0,009		
<b>School zone</b>				
Urban	1,00		1,00	
Rural	1,21 (1,09 – 1,35)	0,000	1,17 (1,05 – 1,31)	0,004
<b>Presenc of dentist at school</b>			*	*
Yes	1,00			
No	1,18 (1,06 – 1,31)	0,001		
<b>Education of parents /or legal guardians</b>			*	*
> 8 years	1,00			
≤ 8 years	1,16 (1,01 – 1,32)	0,027		
<b>Social Class</b>			*	*
B	1,00			
C	2,38 (0,42 – 13,23)	0,320		
D	2,66 (0,48 – 14,56)	0,259		
E	2,31 (0,60 – 18,16)	0,167		

\* variable not selected for final model.

Table 4 shows the analysis of univariate and multiple Poisson regression of the presence of caries lesions concerning ICDAS cut-off point 3 that is, considering only the cavitated carious lesions in dentin. The multiple model highlights higher chance of caries for five year- old males living in the countryside.

**Table 4: Independent variables associated with the presence of carie lesions, concerning ICDAS cut-off point 3(dentin cavitated lesions) 0 to 3 scores classified as healthy and 4 to 6 as decayed).**

Variables	Unadjusted analysis	p	Adjusted analysis	p
<b>Sex</b>				
Male	1,00		1,00	
Female	0,79 (0,69 – 0,90)	0,001	0,81 (0,70 – 0,92)	0,002
<b>Years</b>				
3 e 4 Years	1,00		1,00	
5 Years	1,40 (1,15 – 1,68)	0,000	1,34 (1,11 – 1,61)	0,002
6 Years	1,33 (1,08 – 1,61)	0,007	1,24 (1,00 – 1,51)	0,047
<b>School</b>			*	*
Private	1,00			
Public	2,04 (1,13 – 3,63)	0,017		
<b>School zone</b>				
Urban	1,00		1,00	
Rural	1,23 (1,07 – 1,44)	0,002	1,19 (1,02 – 1,37)	0,021
<b>Presence of dentist at school</b>			*	*
Yes	1,00			
No	1,17 (1,03 – 1,35)	0,012		
<b>Education of parents /or legal guardians</b>			*	*
> 8 years	1,00			
≤ 8 years	1,26 (1,06 – 1,54)	0,006		
<b>Social Class</b>			*	*
B	1,00			
C	2,17 (0,38 – 12,18)	0,374		
D	2,32 (0,42 – 12,83)	0,327		
E	2,93 (0,53 – 16,07)	0,217		

\* Variable not selected for final model.

## Discussion

In this study the prevalence of caries in preschool children evaluated by ICDAS was high (68.7%) concerning the cut-off point 1, corroborating other studies [1,6]. SB-Brazil (2005) the national epidemiological study, showed a prevalence of caries in the Northeast region of 65.1% in 5 year- old children. On the other hand SB-Brazil (2011) pointed out that the prevalence of caries was slightly lower (58.4%). Both studies indicated that the caries experience is higher in the Brazilian North and Northeast regions compared to others. SB Brazil used the WHO index, which can be compared with the cut-off point 3 (60.6%), in our study.

This research used the ICDAS as caries diagnostic index. Previous studies have demonstrated that ICDAS can be used in epidemiological surveys [11], since it allows flexibility in the use of different cut-off points and it helps to study caries diseases according to their severity. Furthermore, ICDAS data can be transformed into WHO index.



So far, literature has not presented any manuscript using ICDAS in the Piauí State. Therefore this study demonstrates the first data, using this index, in this population. Nonetheless it should be highlighted that this is a cross-sectional study where exposure and outcome were collected simultaneously bringing some limitations.

It is known that injury detection before cavitation stage is of utmost importance due to the reversible feature of caries in its early stages along with the underestimation of caries experience in a given population when injury diagnose is performed only in the advanced level of cavitation.

Score system that categorize the lesions, including the previous cavity stage, indicate better the real changes in the incidence of caries in the current population [23].

Researchers have stated that as early clinical management progressed together with minimum intervention procedures, the initial enamel and / or dentin lesions can halt the carious process. On the other hand in later stages, if "minimal intervention" procedures were adopted, the choice was for the use of restorative procedures of saving tooth structure and control of its etiological factors. The non-cavitated lesions should be included in epidemiological studies [9,10].

Due to verifying the need for restorative treatment and preventive actions, this study used two different ICDAS cut-off points: cut-off point 1 since it includes all injury scores, i.e., white spot lesions; enamel lesions and dentin (68.8%) and the cut-off point 3 because it only represents the most advanced lesions, i.e., cavities in dentin (60.6%).

Recent decades have shown a reduction in the speed of progression of carious lesions. However, unless they are controlled, injuries can continue to progress and new lesions may develop throughout life. Thus, what once had been considered as an eradication of the disease can be a life time postponement of the clinically manifesting disease presented as cavitated carious lesions in part of the population [24]. Mainly due to the widespread use of fluoride, the detection of carious lesions in both occlusal surfaces as proximal became more difficult since fluoride helps maintaining the enamel integrity, which may hide an underlying lesion to apparently intact enamel [25,26]. When the analysis of the independent variables was performed in two statistical models, both in the cut-off points 1 and 3, only the age of five-year old was statistically associated with caries experience. Concerning cut-off point 1, the absence of the dentist at school and dental caries experience were statistically significant.

In the public school of the city of Barras, in the State of Piauí, the study showed high decay rate and 66.8% of students relying on "Family Health strategy", in which dental care is included, therefore the need to count on preventive and restorative actions, is important for the policy makers.

The low representation of students from private schools (4.25%) was due to lack of responses to the questionnaire by parents and/or legal guardians and the refusal of private school students to participate in the research.

It should be considered that in Barras-PI there are only two private schools, representing 4% of municipal schools. A small percentage of the population has access to this type of school, probably due to its low social status. In another study [15], it was found that children studying in public

school are more likely to experience caries when compared to those studying in private schools which was not possible to be observed in our study because of the small percentage of private schools in the city of Barras.

## Conclusion

The prevalence of caries in preschool children is high, taking into account the respective cut-off points. The presence of caries lesions are more likely to occur in five year- old boys living in the countryside.

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