Comparison between dmf/DMF and ICDAS in Brazilian schoolchildren: a cross-sectional study

Comparação entre ceo/CPO e ICDAS em escolares brasileiros: um estudo transversal

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ABSTRACT
The objective was to compare the use of the International Caries Detection and Assessment System (ICDAS-II) and the dmft/DMFT (WHO) indexes in epidemiological surveys in schools. Two calibrated examiners analyzed 402 public school children aged 5-12 years, in the city of Mesquita, Rio de Janeiro, Brazil, using ICDAS-II and WHO criteria. The schools are located in areas covered by the Family Health Strategy. The DMF-DMF-S, dmf-t, dmf-s, the prevalence of decayed teeth, and examination time were calculated using both systems. The research subjects participated in health education and prevention activities and oral hygiene training. Data were statistically analyzed and the mean dmf-t / DMF-T was 2.35 (sd ± 2.15) and 3.18 (sd ± 2.31), respectively, using the WHO criteria. When considering the score of the three-ICDASII the average was 2.64 (sd ± 1.89) and 3.45 (sd ± 2.48). With the score-2 ICDASII, 4386 surfaces with lesions were identified, 2795 (63.7%) were not considered when we used the dmf-t / DMF-T. The average examination time was almost twice as long to ICDAS-II (3.2 ± 1.9 min) and WHO (1.8 ± 0.9 min). Conclusion: The ICDAS-II, and provide information on non-cavitated lesions of caries, shows significant experience of dental caries in schoolchildren from the city, and can generate data comparable with previous research that used the WHO criteria.

Keywords: Dental Caries, Heatlh Promotion, Health Planning Support, Epidemiology

RESUMO
O objetivo foi comparar a utilização do Sistema Internacional de Detecção e Avaliação de Cárie (ICDAS-II) e dos índices ceo-d/CPOD (OMS) em inquéritos epidemiológicos em escolas. Dois examinadores calibrados analisaram 402 crianças de 5 a 12 anos de escola pública, na cidade de Mesquita, Rio de Janeiro, Brasil, utilizando os critérios do ICDAS-II e da OMS. As escolas estão localizadas em áreas de abrangência da Estratégia Saúde da Família. O CPOD, CPO-D, ceo-d, ceo-d, a prevalência de dentes cariados e o tempo de exame foram calculados usando os dois sistemas. Os sujeitos da pesquisa participaram de atividades de educação em saúde e prevenção e capacitação em higiene bucal. Os dados foram submetidos à análise estatística e a média do índice ceo-d/CPO-D foi de 2,35 (dp ± 2,15) e 3,18 (dp ± 2,31), respectivamente, utilizando o critério da OMS. Quando considerado o escore-3 do ICDASII a média foi 2,64 (dp ± 1,89) e 3,45 (dp ± 2,48). Com o escore-2 do ICDASII, 4386 superfícies com lesões foram identificadas, 2795 (63,7%) não foram

consideradas quando foi utilizado o ceo-d/CPO-D, critério da OMS. O tempo de exame médio foi de quase o dobro do tempo para ICDAS-II (3,2 ± 1,9 min) e OMS (1,8 ± 0,9 min). O ICDAS-II, proporciona informações sobre lesões cariosas não-cavitadas, mostra expressiva experiência da doença cárie em escolares do município, e pode gerar dados comparáveis com pesquisas anteriores que utilizaram o critério da OMS.

Palavras-chave: Cárie Dentária, Promoção da Saúde, Apoio ao Planejamento em Saúde, Epidemiologia

1 INTRODUCTION

Dental caries is a global and multifactorial disease[1,2] considered a public health problem. In this perspective, the disease cannot be eradicated, but carious lesions may not manifest clinically during the life of individuals if the strategies available for this purpose are continuously used, such as controlling causal and determinant factors (dental plaque and diet) added to the use fluoride and educational programs.[3,4]

According to the World Health Organization (WHO)[5], dental caries have been detected at the cavitation level because examiners often cannot detect non-cavitated lesions. However, the inclusion of non-cavitated caries is necessary because they may be a part of preventive management planning, reducing the costs of the restorative treatment.[6-10]

Methods of detecting non-cavitated carious lesion aim to improve the sensitivity of the epidemiology. The International Caries Detection and Assessment System (ICDAS) was developed for the use in clinical research, clinical practice, and epidemiology[9]. It was designed to provide epidemiological surveys with acceptable reliability in detecting lesions in the cavitation and non-cavitation stages.[9,11] The ICDAS-II allows evaluating caries lesions at the enamel level.[11-13] The current format of the DMF index, proposed by the WHO[5] and most used index in epidemiological caries surveys since 1939, is unable to provide this information.

This study aimed to evaluate the feasibility of using the ICDAS-II index in comparison with the WHO dmf/DMF indexes in epidemiological surveys of dental caries in preschool and school children in areas covered by the Family Health Strategy (FHS), in the city of Mesquita (RJ, Brazil), and inter-examiner reliability in both criteria.

2 MATERIALS AND METHODS

This is a descriptive cross-sectional epidemiological survey composed of a sample of individuals residing in a city of the state of Rio de Janeiro, Brazil. The children were

previously submitted to educational and preventive instructions and supervised brushing. Two examiners performed the dmft/DMFT epidemiological examinations in the schoolyard, under natural light, with the children lying on school tables. The material used for data collection during the examinations was a flat oral mirror number 5, a previously sterilized ICP probe (ballpoint), disposable wooden spatulas, and cotton rollers. For the ICDAS-II index, the children were evaluated immediately after the first examination, which was performed inside the City Health Department vehicle. Before the epidemiological examination using the ICDAS-II index, dental prophylaxis was performed with pumice stone and water, and the triple syringe was dried with compressed air. The epidemiologic examination time in this research was controlled with chronometers. The data collected was registered in appropriate records to each index and transcribed to the computer, in which it was analyzed.

The inclusion criteria were 5-year-old students with only deciduous teeth in the oral cavity, 12-year-old students, students enrolled in public schools, and residents of the areas covered by the FHS program with an oral health team (OHT), in the city of Mesquita. The exclusion criteria were individuals outside the inclusion criteria, the ones that missed school in the examination days, children whose parents did not sign the Free and Informed Consent Form (FICF), and students that did not want to participate in the research even with the FICF signed.

Seven schools were selected and 450 were invited for this research. However, 89.3% of the children comprised the final sample of this study (n = 402), randomly. There were 208 5-year-old children (116 boys and 92 girls) and 194 12-year-old-children (101 girls and 93 boys). The schoolchildren were chosen randomly using the inclusion and exclusion criteria as parameters. The participants delivered the FICF signed by their parents or guardians. This research was performed after the approval of the research protocol by an Institutional Research Ethics Committee under registration 1876-CEP/HUPE.

The data of the epidemiological examinations were tabulated and later submitted to statistical analysis. The DMFT/dmft and DMFS/dmfs values obtained by the ICDAS-II and the WHO criteria were compared using the Wilcoxon test. The prevalence of dental caries by the WHO and ICDAS-II criteria at two cut-off points was compared using the McNemar test. The duration of the epidemiological examination using the same criteria was compared using the Wilcoxon test. Intra- and inter-examiner reproducibility were calculated at the dental surface level using Kappa analysis. The significance level of the analyses was 5%.

3 RESULTS

A total of 402 children were assessed in this research (208 were 5 years old and 194 were 12 years old). That means that the rate of acceptance was 89.3%, considering that 450 children were instructed about the necessity of filling out and returning correctly the consent form and the epidemiological examination in each school. In the 5-year-old group, there was 55.8% (116) of boys and 44.2% (92) of girls. In the 12-year-old group, there was 52.0% (101) of girls and 48.0% (93) of boys.

To classify the caries-positive children, the samples were divided into two cut –off points, scores 2 and 3 respectively, based on the WHO and ICDAS-II indexes. All caries-positive children by the WHO criteria had caries cavities in the ICDAS criteria. A total of 129 (62.0%) 5-year-old children were considered caries-positive by the WHO index. For ICDAS-II scores 3 and 2, there were 134 (64.4%) and 189 (90.8%) caries-positive children, respectively. For children aged 12 years, the values were 127 (65.5%) for the WHO criteria and 138 (71.1%) and 181 (93.3%) for the ICDAS-II scores 3 and 2. These values are observed in Table 4.

The children were therefore classified as free of carious cavities – 79 (38.0%) of 5-year-old children in the WHO criteria, 74 children (35.6%) in the ICDAS-II score 3, and only 19 children (9.2%) in the ICDAS-II score 2. Regarding the 12-year-old children, 67 (34.5%) were free of carious cavity in the WHO criteria, 56 (28.9%) in the ICDAS score 3, and 13 (6.7%) in score 2 (Table 1).

Table 1: Number and Percentage of schoolchildren at 5 and 12 years old free of carious cavity and with carious cavity for WHO and ICDAS II criteria.

Tooth condition						
	Without caries			With caries		
Age	WHO	ICDASII Score 3	ICDASII Score 2	WHO	ICDASII Score 3	ICDASII Score 2
5 years	38% (79)	35,6% (74)	9,2% (19)	62% (129)	64,4% (134)	90,8% (189)
12 years	34,5% (67)	28,9% (56)	6,7% (13)	65,5% (127)	71,1% (138)	93,3% (181)

Statistical analyzes were performed using the age and gender of children as independent variables and the presence or absence of caries as dependent variables. The ANOVA and Scheffé test verified the relationship among the variables, dental caries, genders, and the two age groups. The level of significance was α = 0.5. There was no statistically significant difference between the presence of dental caries and the genders (p

= 0.47). However, age was a present and significant effect on the presence of dental caries (p <0.0001) and it could be stated that, in this study, older children had better experiences with dental caries.

Table 2 shows the dmfs and dmft values obtained in the ICDAS-II and the WHO criteria for 5-year-old children, who were compared using the Wilcoxon test. The data were submitted to statistical analysis and the mean ($\pm$ SD) of the dmft index was 2.35 (sd $\pm$ 2.15) in the WHO criteria. When considering the ICDAS-II score 3, the mean was 2.64 (sd $\pm$ 1.89). The dmft values obtained with the WHO and ICDAS-II score 3 were comparable. The values of the dmfs and dmft scores were calculated using the data obtained by the WHO and ICDAS-II criteria at two cut-off points: score 2 and score 3. There was no significant difference between the dmft and dmfs values obtained with the WHO and ICDAS-II score 3 criteria. When the cut-off was score 2, the values increased approximately three-fold due to the carious lesion increase in the sample studied. The prevalence of dental caries was compared with the McNemar test. For ICDAS-II scores 2 and 3, caries prevalence was 78.2% and 60.7%, respectively, and these values were higher than that of the WHO criteria, which was 59.3%. For the ICDAS-II score 2, the prevalence was significantly higher.

Table 2: Comparis on between dmfs/dmft (mean $\pm$ SD) and prevalence of caries with ICDAS-II scores 2 and 3 as cut off and the same parameters for the WHO criteria for 5-year-old children.

dmft/dmfs - WHO creteria		dmfs- ICDAS II creteria	
		Score 2	Score 3
ceo-s	4,61 $\pm$ 3,92	11,45 $\pm$ 9,43	4,87 $\pm$ 4,68
valor p (1)	-	<0,001	(0,079)
Prevalence of dmf	2,35 $\pm$ 2,15	6,47 $\pm$ 3,89	2,64 $\pm$ 1,89
p value (1)	-	<0,001	(0,734)
Prevalence (IC 95%)	59,3 (56,2 – 61,5)	78,2 (74,3 – 82,7)	60,7 (58,9 – 66,1)
p value (2)	-	<0,001	1,00

1-ICDAS compared to WHO by Wilcoxon and 2-ICDAS Test compared to WHO by McNemar's Test.

Table 3 shows the DMFS and DMFT values obtained through the ICDAS-II and the WHO criteria for 12-year-old children, compared using the Wilcoxon test. In the data submitted to statically analysis and mean ($\pm$SD), the DMFT index was 3.18 (sd $\pm$ 2.31) by the WHO criteria.

Table 3: Comparis on between DMFS/DMFT (mean $\pm$ SD) and prevalence of caries with ICDAS-II scores 2 and 3 as cut off and the same parameters for the WHO criteria for 12-year-old children.

dmft/DMFTs - WHO creteria		dmfs- ICDAS II creteria	
		Score 2	Score 3
CPO-S	5,49 $\pm$ 3,72	13,24 $\pm$ 9,02	5,23 $\pm$ 2,67
valor p (1)	-	<0,001	(0,078)
CPO-D	3,18 $\pm$ 2,31	6,97 $\pm$ 3,74	3,45 $\pm$ 2,48

p value (1)	-	<0,001	(0,697)
Prevalence (IC 95%)	61,4 (57,8 – 64,2)	88,3 (81,2 – 90,3)	62,3 (58,1 – 64,3)
p value (2)	-	<0,001	1,00

1-ICDAS compared to WHO by Wilcoxon and 2-ICDAS Test compared to WHO by McNemar's Test.

When considering the ICDAS-II score 3, the mean was 3.45 (sd ± 2.48). The DMFT values obtained with the WHO and ICDAS score 3 were comparable. The DMFS and DMFT values were calculated using the data obtained by the WHO and ICDAS-II criteria at two cut-off points: score 2 and score 3. There was no significant difference between the DMFT values obtained with the WHO and ICDAS-II score 3 criteria. When the cut-off was score 2, there was a significant increase in value due to a considerable increase of carious lesions in the sample studied. Caries prevalence was calculated using the WHO and ICDAS-II criteria and it was compared using the McNemar test. For the ICDAS-II scores 2 and 3, caries prevalence was respectively 88.3% and 62.3%. These values were higher than that of the WHO criteria (61.4%). For the ICDAS score 2, the prevalence was significantly higher.

When considering the ICDAS-II score 2, there were 4386 lesions, from which 2795 (63.7%) were not considered in the indexes recommended by the WHO.Intra- and inter-examiner reproducibility was calculated at the dental surface level using Kappa statistics with a non-weighted approach, agreeing more with the WHO criteria than the ICDAS-II, either considering all ICDAS-II statements or score 2 and score 3 separately. Most disagreements occurred when non-cavitated lesions by the ICDAS-II score 2 were considered as the cut-off point (Table 4).

Table 4: Intra and inter-examiner comparison, reliability values (95%) obtained in the oral examinations using the WHO criteria and the ICDAS-II criteria, using scores-2 and 3 as cut-off.

	dmft/DMFTs - WHO creteria		dmfs- ICDAS II creteria	
	Intra	Inter	Intra	Inter
Decayed, Missing, Filled surfaces	0,92 (0,89 – 0,94)	0,89 (0,78 - 0,92)	0,78 (0,74 - 0,83)	0,72 (0,69 - 0,81)
ICDASII score 2	–	–	0,74 (0,69 - 0,85)	0,69 (0,63 - 0,79)
ICDASII score 3	–	–	0,80 (0,74 – 0,88)	0,75 (0,71 - 0,84)

Table 5 shows that the mean examination time for completing the epidemiological examinations was almost double the time for ICDAS-II (3.2 ± 1.9 min) when compared with dmft/DMFT, WHO criteria (1.8 ± 0.9 min, p <0.001). The duration of the examinations was compared using the Wilcoxon-Mann-Whitney test, or simply the Wilcoxon test.

Table 5: Comparis on between the time duration (in min) of the epidemiological exams ICDAS-II and dmft/DMFT, for 5 and 12 years old children (mean ± SD).

	dmf-s/DMF-S - ICDAS-II criteria	dmf-d/DMF-D – WHO criteria
5 years	3,6 ± 2,4	2,3 ± 1,4
12 years	3,1 ± 1,6	1,6 ± 0,7
Total average value	3,2 ± 1,9	1,8 ± 0,9

ICDAS-II was compared with the WHO criteria (Wilcoxon test) $p < 0.001$

4 DISCUSSION

Considering the Brazilian values in the epidemiological survey (SB-Brazil 2019), the dmft and DMFT values were respectively 2.3 and 2.1 in the 5 and 12-year-old children. The highest mean DMFT value among 12-year-olds in the samples studied is 3.2 and it was obtained in the north region of Brazil, in the SB-Brasil 2010.[14] This corroborates other studies based on probabilistic samples, populations, and similar ages.[15-18]

Studies report that children from disadvantaged neighborhoods are more prone to a high risk of caries.[19-20] Caries prevalence (74.7%) was reported in Colombian low-income children aged between 2.5 and 4 years, through the ICDAS-II criteria.[21] According to the authors, the low caries prevalence could be explained by the small age group of the studies. The prevalence of dental caries in studies with children may be related, among other factors, to the low importance parents and professionals give to the deciduous dentition, which is a problem extensively discussed in studies aimed at the deciduous dentition[22-24] and the failures in structuring oral health actions integrated into maternal and child health.[25]

In this study, caries prevalence in 5-year-old children for dmft, WHO criteria, was 59.3% and carious cavities in the ICDAS-II index in scores 3 and 2 were, respectively, 60.7% and 78.2%. In the 12-year-old group, the prevalence was 61.4% for DMFT, WHO criteria, and 62.3% and 88.3% for ICDAS-II criteria, scores 3 and 2, respectively.

There was no significant relationship between tooth indentation and the present study (p=0.47), agreeing with the studies performed in other regions of Brazil.[26,27] Regarding age, this study detected a significant presence of dental caries (p<0.0001). It is possible to affirm that older children presented better experiences with dental caries, which corroborated previous studies.[15,16,18,20]

In the ICDAS-II index score 3, several mean values were comparable to the dmft/DMFT, WHO criteria, with standard deviations and similar caries prevalence,

corroborating comparability with the previous study conducted with younger children.[26] However, in the present study, regarding score 3 of the ICDAS, the mean was 2.64 and 3.45, respectively for the 5 and 12-year-old groups, which is higher than the value obtained by the dmft/DMFT (WHO criteria).

When including non-cavitated carious lesions, the values increased significantly, corroborating previous studies.[25-27] The ICDAS-II score 2 identified 4386 lesions and 2795 (63.7%) of those were not considered diseased sites when using the WHO criteria for dmf/DMF.

An initial chemical change on the enamel surface is the first sign of dental caries, when cavity formation may be prevented. As for the progression phase, it may be paralyzed, emphasizing the importance of diagnostic criteria such as the ICDAS-II, considering this system is traditionally used in dental surveys to detect dental caries, because the one proposed by the WHO cannot diagnose/measure non-cavitated lesions.

In this study, the rate of students free of caries (dmf = 0 or DMF = 0) by the WHO criteria was 38% for 5-year-old children and 34.5% for 12-year-old children. When using ICDAS-II score 3, the values were respectively 35.6% and 28.9%. In contrast, the prevalence of dental caries in school children in Chennai at the age group of 6 years was 57%, seven year 67%, eight year 63%, nine year 74%, 10 year 76%, 11 year 74%, 12 year 69%, 13 year 71%, and 14 year 69%.[7]

The inclusion of carious lesions before dental cavitation may decrease examiner reliability.[5] In the present study, the ICDAS-II index showed lower Kappa values than the WHO criteria, but when using cut-off scores indicating reliability in the presence of cavitation, the agreement values for the ICDAS-II were higher than the WHO criteria.

Considering the high Kappa statistic values in the follow-up examinations of students and the assessment of intra- and inter-examiner using the WHO and ICDAS-II criteria, the results of reliability were high for caries experience, corroborated by previous studies.[15,21,23]

The reproducibility of Kappa intra-examiner in this study was 0.89-0.94 for the WHO criteria and 0.69-0.88 for the ICDAS-II, while inter-examiner Kappa values were 0.78-0.92 for the WHO criteria and 0.63-0.84 for ICDAS-II. This finding may be attributed to the training and calibration to which the examiners were subjected in this research. The training period and calibration sessions of the professionals was similar to other studies.[25-27] The time required to complete the evaluation of the different indexes presented innumerable variables. In the present study, the oral test with ICDAS-II required double the time to be performed (3.2 ± 1.9 min) than the WHO criteria (1.8 ± 0.9 min).

Despite the longer time, using ICDAS-II in epidemiological surveys is feasible but the longer examination could be a limiting factor for its application in preschool children in the behavioral aspect.[16] Although time is a limiting factor of the ICDAS-II, the same is true when planning to define actions based on health promotion.

5 CONCLUSION

Using the ICDAS-II as an epidemiological tool in community studies is feasible because it produces internationally comparable data. Score 3 as a cut-off provided comparable data with dmft/DMFT by the WHO criteria. When using the ICDAS-II score 2, information on non-cavitated carious lesions was diagnosed, while this was not possible for the dmft/DMFT. The use of the ICDAS-II index in the epidemiological survey required double the time when compared to dmft/DMFT but it presented good intra- and inter-examiner reproducibility.

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