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Article

Comparison of two dental caries risk assessment tools in peruvian children.

Comparación de dos herramientas para medir el riesgo de caries en niños peruanos.

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Abstract: Caries risk assessment protocols and tools are helpful for evidence-based clinical decision making. **Objective:** To compare the dental caries risk using two assessment tools in Peruvian children aged 7 to 11 years. **Material and Methods:** : 265 children from the Educational Institution (EI) Policía Nacional del Perú Juan Ingunza Valdivia were evaluated in 2019. The tools used to compare the risk of dental caries were the Reduced Cariogram and the Biological Caries Risk. The clinical examination was performed in a single time for both tools, evaluating oral hygiene and caries experience. **Results:** When using both tools, it was found that each one of the age groups have a different Caries Risk distribution than the other groups and this difference is statistically significant (p=0.001). When comparing both tools, a statistically significant difference was found between their diagnoses at the moderate and high-risk levels; however, diagnoses at the low level show agreement. **Conclusion:** There is a difference in the assessment of the level of risk between both tools, specifically at the moderate and high levels, with most of the children assessed at low risk levels.

Keywords: *dental caries susceptibility; risk assessment; dental caries; clinical decision-making; child; Peru.*

Resumen: Los protocolos y herramientas de evaluación del riesgo de caries son de gran ayuda para la toma de decisiones clínicas basadas en evidencia. **Objetivo:** Comparar el riesgo de caries dental utilizando dos herramientas de evaluación en niños peruanos de 7 a 11 años. **Material y Métodos:** Se evaluaron 265 niños de la Institución educativa (I.E.) Policía Nacional del Perú Juan Ingunza Valdivia en el año 2019; las herramientas utilizadas para comparar el riesgo de caries dental fueron: Cariograma Reducido y Riesgo Biológico de Caries. El examen clínico se realizó en un solo tiempo para ambas herramientas, evaluando la higiene oral y la experiencia de caries. **Resultados:** Al usar ambas herramientas se encontró que cada uno de los grupos de edad tienen una distribución del riesgo de caries diferente a los otros grupos y esta diferencia es estadísticamente significativa (p=0,001). Al comparar ambas herramientas se encontró diferencia estadísticamente significativa entre sus diagnósticos en los niveles de riesgo moderado y alto,

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sin embargo, los diagnósticos en el nivel bajo concuerdan. **Conclusion:** Existe diferencia en la valoración del nivel de riesgo entre ambas herramientas, específicamente en los niveles moderado y alto, siendo la mayoría de los niños valorados en niveles de riesgo bajo.

Palabras Clave: *susceptibilidad a caries dentarias; medición de riesgo; dental caries; toma de decisiones clínicas; niño; Perú.*

INTRODUCTION.

Dental caries is considered a dynamic disease, mediated by a biofilm, modulated by diet, multifactorial in nature, and non-communicable, resulting in mineral loss of tooth structure. Additionally, it has biological, behavioral, psychosocial, and environmental factors as determinants.[1]

A prevalence of 85% in dental caries was reported in Peru in children under 11 years old, and 76% in children of preschool age (3 to 5 years).[22] For this reason, this disease is considered a public health problem not only in Peru but worldwide due to its prevalence and severity, which increase with age and eventually have a dramatic impact on the community.[2-5] Hence, it is advisable to use a tool that assesses caries risk in individual patients or groups.

Caries risk assessment is a tool used by dentists to estimate how probable an individual or group of patients are to develop carious lesions. Its use is a crucial element to draw up specific strategies in the control of risk factors for caries in Peruvian patients, increase protection factors and thus prevent and/or manage the disease. In addition, at the population level, it can serve as a guide for the design of public interventions.[6] Currently there are several tools that assess caries risk, the most widely used and validated in most countries is the Cariogram software.[7,8] The evidence has not yet allowed to determine which tool offers better reliability, when to perform the examination or how often.

However, scientific academies and international associations for children's oral health care widely recommend its use because its benefits outweigh its possible undesirable effects.[8] The Cariogram software is a very complete tool, since apart from evaluating the risk of each patient, it shows the importance of each factor in a descriptive and personalized way.

This tool has nine items that include clinical examinations as well as microbiological and salivary tests, which interactively show the factors related to dental caries.[7,9]

To reduce costs, time and make its use feasible in epidemiological surveys, the original Cariogram was modified to create a Reduced Cariogram tool, which consists of seven items, where microbiological and salivary tests are not considered.[9-12] In 2010, Peterson *et al.*,[10] decided to carry out the first study with a two-year follow-up to evaluate the sensitivity and specificity of the Reduced Cariogram in 392 Swedish children aged 10 to 11 years and compared it to the full or complete version.

They concluded that the Reduced Cariogram can be used for the prediction of caries in older children. A similar result was obtained in a 2013 study, in which Lee *et al.*,[11] compared the results obtained with the complete Cariogram tool and the reduced one in 80 young Koreans aged 15-30 years. They concluded that the Reduced Cariogram can be used in clinical practice to determine caries risk in patients who need preventive and restorative treatment, but individually. This is precisely the main objective tool used for risk assessment of caries in both children and adults, but mainly in patients with special needs.[6,13]

Furthermore, in 2014, Petsi *et al.*.[12] compared the risk profiles in 90 healthy Greek adolescents between 9 and 18 years old with fixed orthodontic treatment using the complete Cariogram with and without salivary secretion and *Streptococcus mutans* counts.

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They reported that the Reduced Cariogram can be used safely, since the results were not significantly altered when eliminating the *Streptococcus mutans* counts. Due to the evidence presented above, it is concluded that the Reduced Cariogram is a valid and evidence-based tool to determine caries risk.

A caries risk assessment tool proposed by Mattos *et al.*,[14] has been used in Peru since 1996. It is a quick and simple model, called Biological Caries Risk. They used ten data divided into two columns in a positive and negative version, which include socioeconomic factors, systemic diseases, diet and oral hygiene. The sum of these factors determines the patient's caries risk as follows:

Low (less than 3);

Moderate (between 4 and 7) and;

High (more than 7).

Unfortunately there is not much research about this tool, especially when compared with other methods. Consequently, it is relevant to be able to compare a widely used method such as the Reduced Cariogram with another method created in Peru, the Biological Caries Risk, to establish the similarities and differences in the assessment of caries risk in Peruvian children.

MATERIALS AND METHODS.

Study design

A cross-sectional and comparative observational study was carried out following the ethical principles established by the Declaration of Helsinki. The study was approved by the Research Committee of Universidad Peruana de Ciencias Aplicadas.

Participants

The population consisted of children who attended the Educational Institution (EI) of the National Police of Peru Juan Ingunza Valdivia located in the constitutional province of Callao in the city of Lima, during the year 2019. The children of this institution belonged to the socioeconomic levels (SEL) "C" and "D" according to the 2017 National Census of Peru.

The SEL classification in Peru is determined by the monthly income of each family, which in the case of level C and level D is S/.3,970 and S/.2,480 Peruvian soles, respectively. To determine sample size, the estimation formula of two proportions was used, with a confidence level of 95% and a power of 80% using the Epidat 4.2 software, chosen by systematic random probability sampling. The final sample consisted of 265 children.

The inclusion criteria were children from 7 to 11 years old enrolled in the EI, whose parents signed the informed consent. The exclusion criteria included those children who did not present any permanent molars in the occlusal plane, children who had some type of previously diagnosed mental or physical disability, children undergoing some type of orthopedic and/or orthodontic treatment, children who had received dental treatments or any type of dental care during the previous 6 months before the application of the questionnaire.

Data collection procedure

The present research was carried out in two phases:

a) **Phase 1:** parents were informed about the study, and those who accepted their children's participation in the research proceeded to sign the informed consent. A file was made with the affiliation data and a clinical history. Then the questions of both tools were applied. Previously diagnosed diseases, exposure to fluorinated compounds, diet, oral hygiene, etc. were recorded.

b) **Phase 2:** the clinical evaluation was carried out in a conditioned environment at the educational institution. For the evaluation of the oral hygiene index, the researchers were calibrated in the use of the oral hygiene index according to Greene and Vermillion and the DMFT/dmft index; (inter-examiner ICC of 0.934 and 0.951, respectively; values that show a very good agreement).

The procedure was performed on a stretcher, the examiner used a headlight (Energizer, USA), with a mouth mirror N°5 (Hu-Friedy, Germany), which helped to have a direct and indirect visualization. A plaque revealing solution (Eufar, Colombia) was placed on the vestibular surfaces of 11, 16, 26 and 31, and lingual surfaces 36 and 46; only teeth that

were in the occlusal plane were considered. The revealing solution was used to facilitate the visibility of the bacterial plaque, and it consisted of a modification of the original oral hygiene evaluation index.

The codes used to evaluate the soft or calcified plaque range from 0 to 3. The registration of the staining of the teeth was evaluated as follows: code 1, teeth with 1/3 staining of the tooth, code 2 with 2/3 staining of the tooth, and code 3 with 3/3 staining of the evaluated tooth. The evaluation of calcified plaque was also performed.

After this, the oral hygiene index was determined by adding and dividing all the codes found for soft plaque and calcified plaque. After the evaluation was carried out, the sum of the scores of the teeth examined was carried out, and they were divided by the number of teeth analyzed. The final scores were classified as good (0.0-1.2), moderate (1.3 -3.0), and poor (3.1-6.0).

Finally, the examiner proceeded to remove the revealing solution with the help of dental floss (Johnson & Johnson, Colombia), toothbrush and toothpaste (Colgate, United States), so that with the help of the examiner, patients could brush their teeth according to the modified Bass technique to be able to remove the bacterial plaque and the remains of the stain.

The odontogram format was used for the evaluation of dental caries, according to the 2019 Health Technical Standard of the Ministry of Health of Peru. The evaluation was carried out with direct and indirect visualization using a mouth mirror No.5 (Hu-Friedy, Germany), and a WHO 11.5 periodontal probe (Hu-Friedy, Germany).

The order of the evaluation procedure was the following: upper right quadrant, upper left quadrant, lower left quadrant, and lower right quadrant, following the ordered sequence. The DMFT and dmft indexes were the epidemiological indicators of dental caries used in permanent and deciduous dentition, respectively.

Two tools were used to assess caries risk: the Reduced Cariogram and the Biological Caries Risk. To use the Reduced Cariogram, the program was downloaded and installed, and these seven items were evaluated: caries experience (DMF, dmf), medical history, content and frequency of diet, oral hygiene, fluoride, and clinical examination and judgment.

Regarding the Biological Caries Risk tool, the following factors were evaluated: caries experience, which contains the following three levels: low (up to two lesions on the occlusal side), moderate (between 2 and 6 lesions on the occlusal side), and high (more than 6 lesions on the occlusal side or 1 non-occlusal side); daily diet: low (up to 3 times extrinsic sugars), moderate (more than 3 to 4 times extrinsic sugars), and high (more than 4 times extrinsic sugars); and oral hygiene: classified into the three following levels: good (0, 0-1.2), moderate (1.3-3.0), and poor (3.1-6.0).

Statistical analysis

The statistical software used was STATA® version 14. A bivariate analysis was performed between the results obtained with the Cariogram tool and the Biological Caries Risk tool and the sociodemographic variables: age, gender, and socioeconomic level, respectively.

Pearson's Chi square test and Fisher's Exact Test were used to determine the association between the results of the Cariogram tool and the Biological Caries Risk, where $p<0.05$ was considered statistically significant.

RESULTS.

More than half of the sample consisted of girls (58.11%). A third of the children were 9 years old (33.96%), and children between the ages of 9 to 11 accounted for more than two-thirds of the entire sample. On the other hand, in relation to socioeconomic level, it was observed that they were part of the socioeconomic levels C and D; the majority belonged to level D (67.55%). (Table 1)

From the bivariate analysis of the Caries Risk of the Cariogram according to the age of the children (Table 1), it is concluded that each one of the age groups has a different Caries Risk distribution from the other groups and this difference is

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Table 1. Dental caries risk using the Reduced Cariogram tool according to gender, age, and socioeconomic level.

		Caries Risk (Reduced Cariogram)				
		Poor n (%)	Moderate n (%)	High n (%)	(%)	*p*-value
Gender	Female	72(46.75)	34(22.08)	48(31.17)	154(58.2)	0.372
	Male	55(49.55)	30(27.03)	26(23.42)	111(41.8)	
Age	7 years	7(17.95)	17(43.59)	15(38.46)	39(14.71)	
	8 years	13(37.14)	.	22(62.86)	35(13.20)	
	9 years	50(55.56)	27(30.0)	13(14.44)	90(33.96)	<0.001*
	10 years	40 (68.97)	9(15.52)	9(15.52)	58(21.9)	
	11 years	17(39.53)	11(25.58)	15(34.88)	43(16.23)	
Socioeconomic level	C	75(87.21)	7(8.14)	4(4.65)	86(32.5)	<0.001*
	D	52(29.05)	57(31.84)	70(39.11)	179(67.5)	

*: Fisher's exact test; $p<0.05$ - (.): represents the value 0.

Table 2. Dental caries risk using the Biological Caries Risk tool according to gender, age, and socioeconomic level.

		Risk (Biological Caries Risk)				
		Poor n (%)	Moderate n (%)	High n (%)	(%)	*p*-value
Gender	Female	72(46.75)	8(5.19)	74(48.05)	154(58.1)	0.777
	Male	55(49.55)	7(6.31)	49(44.14)	111(41.9)	
Age	7 years	7(17.95)	15(38.46)	17(43.59)	39(14.71)	
	8 years	13(37.14)	.	22(62.86)	35(13.20)	
	9 years	50(55.56)	.	40(44.44)	90(36.96)	
	10 years	40(68.97)	.	18(31.03)	58(21.88)	<0.001*
	11 years	17(39.53)	.	26(60.47)	43(16.22)	
Socioeconomic level	C	75(87.21)	2(2.33)	9(10.47)	86(32.5)	<0.001*
	D	52(29.05)	13(7.26)	114(63.69)	179(67.5)	

*: Fisher's exact test; $p<0.05$ - (.): represents the value 0.

Table 3. Comparison of the risk of dental caries using the Reduced Cariogram and Biological Caries Risk tool in children aged 7 to 11 years.

	Poor n (%)	Moderate n (%)	High n (%)	*p*-value
Reduced Cariogram	127 (47.92)	64 (24.15)	74 (27.92)	<0.001*
Biological Caries Risk	127 (47.92)	15 (5.66)	123 (46.42)	

* Pearson's Chi-Square test, $p<.0.05$

statistically significant (p=0.001). Low caries risk was more prevalent in both genders. In relation to the socioeconomic level, most of the children who belonged to level C presented a low risk (87.21%), unlike the children of level D, who in a little more than a third (39.11%) presented a high risk. There are significant differences between age and socioeconomic level with the use of the Reduced Cariogram tool; however, there is no difference in relation to gender (p=0.372).

Table 2 shows the results of bivariate analysis of the Biological Caries Risk tool according to the age of the children; it is concluded that each one of the age groups have a different distribution of the caries risk to the other groups, and this difference is statistically significant (p=0.001).

According to socioeconomic levels, most children belonging to level C presented low risk (87.21%), unlike children in level D, whose two-thirds presented high risk (63.69%).

Table 3 shows the comparison of the level of dental caries risk using the Reduced Cariogram and the Biological Caries Risk tool. A statistically significant difference was found between the diagnoses obtained by the Reduced Cariogram and by the Biological Caries Risk at their moderate and high levels; however, the diagnoses at the low level agree with each other (p<0.001).

DISCUSSION.

According to the IAPD, the evaluation of caries risk is considered a key element in the adoption of preventive measures and in the making of decisions about the treatment of caries in infants, children, adolescents.[6,13] Therefore, caries risk indicates the probability of a higher incidence of caries during a certain period, or the probability that there will be a change in the activity and/or severity of the already present lesions.[13] In 2017, Taqi *et al.*,[9] used the Reduced Cariogram to determine dental caries risk in a population of 226 Pakistani children aged 11 to 12 years. They found that the prediction of caries risk using the Reduced Cariogram is similar to using the complete Cariogram tool.

Additionally, they reported that the use of the complete Cariogram can demotivate the patient because it would take more time and increase the costs. They found a higher percentage of children with low risk, in addition to finding a statistically significant difference in relation to the type of school (public or private).[15] These results are similar to those of the present study, since there was a higher percentage of children with low risk.

The latter may be due to the fact that among the enrollment requirements for the Educational Institution each year, it is essential to present a medical certificate, to have had a dental consultation and be free of caries. In addition, the children attending these ins-titutions have health care paid by the Police of the Country's health insurance policy. In 1996 in Peru, Mattos *et al.*,[14] proposed the evaluation model called Biological Caries Risk, which they used in pediatric dentistry.

This model was used in 2017 by Borda to determine caries risk in 172 children from 5 to 12 years of age living in the city of Piura.[16] She reported a higher percentage of children with a high risk (62.2%), which contrasts with this study. Petterson *et al.*,[10] suggest that the Reduced Cariogram tool is reliable especially when assessing the low risk of caries.

In the present study it was observed that both tools evaluated the same number of children as low risk of caries, but the moderate and high levels showed a significant difference. Specifically for these two levels, the Reduced Cariogram has a decreased specificity.[12] The preventive and corrective strategies of the moderate and high-risk levels are not so different except for the time span between check-ups, X-rays, and fluoride application, which will be more frequent at a high level.[13]

The limitations of this study are mainly the little research conducted on this topic; only one study was found including the Biological Caries Risk tool and no study comparing both tools. Therefore, it is necessary to conduct new research that provides evidence of both tools to better understand their specificity and real sensitivity in predicting caries

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risk, so that the clinician can decide which tool to use based on actual evidence. Another limitation of this study is its cross-section, which just gives information of a defined moment in time, *i.e.*, at the time of measurement.

Finally, it is concluded that there is a difference in the assessment of the level of risk between both tools, specifically when assessing the moderate and high levels. Most of the children were rated at low risk levels.

According to the results, it cannot be concluded yet which tool is the most effective, because there is little evidence about the effectiveness of the Biological Caries Risk tool. Furthermore, it is highly recommended for clinicians to use tools that have studies that support their validity, carried out in various populations, and such is the case of the Reduced Cariogram.

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