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Prevalence of Dental Caries Among Costa Rican Male Students Aged 12-22 Years Using ICDAS-II

Prevalencia de caries en varones costarricenses escolarizados de 12 a 22 años utilizando ICDAS-II

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ABSTRACT: Objective: Dental decay is a public health challenge in Low- and Middle-Income Countries, particularly for young people, often confronted to healthcare access barriers. The aim of this study was to determine the prevalence and severity of dental caries among young male students in Costa Rica. Study design: A cross-sectional study was performed in 428 Costa Rican male students aged 12-22 years, who attended a nonprofit social welfare boarding school in 2019. A clinical examination was ran by three calibrated examiners following the International Caries Detection and Assessment System (ICDAS-II). Results: Caries prevalence was estimated at 83%, 15% have lost a tooth due to dental decay, 61% have at least one filled tooth, 36% have at least one filled and decayed tooth. The most frequent caries lesions were codes 2-Inactive (46.7%), and code 1-Inactive (23.8%). DMFT indicated a mean index using ICDAS-II 1-6>0 codes of 7.89. Using ICDAS-II 3-6>0 as threshold, the index

decreases to 3.94. Finally, the lower and upper first permanent molars were found to be the most affected teeth. Conclusions: Dental caries experience represents a significant public health burden in young people, requiring better access to public dental healthcare.

KEYWORDS: ICDAS-II; Prevalence; Dental caries; Dental experience; DMFT; Adolescents; Young people; Costa Rica; Low-and Middle-Income Country.

RESUMEN: Objetivo: La caries dental continúa siendo uno de los grandes desafíos de salud pública en los países de ingresos bajos y medios, en particular para los jóvenes, que a menudo se enfrentan a barreras de acceso a la atención médica y odontológica. El objetivo de este estudio es determinar la prevalencia y severidad de la caries dental entre jóvenes estudiantes varones en Costa Rica. Diseño del estudio: se realizó un estudio transversal con 428 estudiantes varones costarricenses de entre 12 y 22 años, que asistieron a un internado de asistencia social sin fines de lucro llamado Ciudad de los Niños en 2019. Tres examinadores calibrados realizaron un examen clínico siguiendo el Sistema Internacional de Detección y Evaluación de Caries. (ICDAS-II). Resultados: La prevalencia de caries se estimó en 83%, el 15% ha perdido un diente debido a caries dental, el 61% tiene al menos un diente obturado, el 36% tiene al menos un diente obturado y con caries. Las lesiones de caries más frecuentes fueron los códigos 2-Inactivo (46,7%) y el código 1-Inactivo (23,8%). CPOD indicó un índice medio utilizando códigos ICDAS-II 1-6>0 de 7,89. Usando ICDAS-II 3-6>0 como umbral, el índice disminuye a 3,94. Finalmente, los primeros molares permanentes inferiores y superiores resultaron ser los dientes más afectados. Conclusiones: La experiencia de la caries dental representa una carga de salud pública significativa en los jóvenes, que requiere un mejor acceso a la atención médica dental pública.

PALABRAS CLAVE: ICDAS-II; Prevalencia; Caries dental; Experiencia dental; CPOD; adolescentes; Jóvenes; Costa Rica; País de ingresos bajos y medios.

INTRODUCTION

Dental caries is a multifactorial disease, showing the interrelation between biological and social factors (1). Biologically, dental caries is characterized by a dysbiotic process produced when the dental biofilms move from a balanced and diverse microorganism of low cariogenicity, to a high cariogenicity population of microorganisms (2). This can result in an increased production of organic acids, promoting a hard tissue net mineral loss. The first carious lesion is not clinically visible, nevertheless, if the intraoral buffer mechanisms do not break the demineralization process, it can continue to a incipient enamel lesion (3).

Socially, more than a half of the world's population is affected by untreated oral conditions (4), being caries in permanent teeth the most prevalent condition evaluated between 1990 to 2015 (5). Additionally, dental decay touches primarily the most disadvantage populations (6),

showing a strong social gradient, both between and within countries (7,8). Thus, it continues to represent a public health challenge, particularly for low- and middle-income countries (LMIC's) (9). Previous studies have shown that dental caries prevalence is increasing in the developing world (9), particularly due to the growing availability and consumption of industrialized sugars (10).

Another limitation regarding LMIC's, is the lack of reliable information, especially in specific risk population subgroups. This is particularly the case for adolescents and young adults. A 2019 WHO & UNICEF report on youth health stated that "most countries do not know the magnitude of the disease burden, health needs and barriers to services" (11). Indeed, compared to other range age, studies in young people remain rare (12) and are conducted mainly in high income countries. Evidence from industrialized economies have shown that, while the prevalence of untreated caries lesions and the number of decayed, filled, or missing teeth (known as caries experience) have been, in average, declining in children (13) and adolescents (14), this progress has been accompanied by an increase of the social gradient of inequality (15). However, limited information is available regarding dental caries prevalence in Latin American young people, with the exception of Brazil (16). Two previous studies have assessed dental decay in young individuals in Costa Rica. One of them was conducted in 1986, and focused on access to health care (17). The second one (2017), evaluated dental caries in 201 children and adolescents in government's foster-care institutions (18). Costa Rica's last representative survey was conducted in 1999, among 12-year-old (19), reporting a caries experience prevalence of 71.9%, and a mean number of Decayed / Filled / Filled and Decayed / Missed for dental caries (DMFT -WHO) (20) of 2.46 (19).

Costa Rica has a national health care system, constitutionally conceptualized as universal, mandatory and solidarity for all citizens (21). Although, the health system includes some aspects of dental health, it remains quite limited. For instance, WHO estimations from 2013, indicated that only 600 state-employed dentists were in charge of attending all public dental needs in the country (22). These leaves the great majority of dental services to private practice (23), since we account for nearly 5446 dentists in Costa Rica, for a variable dentists-to-population ratio of 11 for 10000 inhabitants (24), doubling the average density in the Organization for Economic Cooperation and Development (OECD) member countries (6.1/10000 inhabitants). Disadvantaged Costa Ricans, and particularly young people, are often excluded from the universal health coverage (11), increasing their vulnerability.

This study aims to assess the prevalence and severity of dental caries among Costa Rican male students aged 12-22 years using ICDAS-II. This is the first study conducted exclusively in young students using a standardized caries indicator in Costa Rica, and could be useful to better implement and guide future public dental health policies and interventions.

METHODS

STUDY DESIGN AND PARTICIPANTS

A cross-sectional study was performed using data from Costa Rican male students aged 12-22 years, who attend a nonprofit social welfare school run by the Order of Augustinian Recollects called "Ciudad de los Niños" (Children's City). This organization was originally created to receive street children, coming from urban and rural areas, such as, indigenous areas, or those whose parents cannot take care of them. The institution functions as a boarding school, and receives partial financial support by the Costa Rican government, allowing students to receive an economic incentive during the academic cycle and technical capacitation in

automotive mechanics, electromechanics, precision mechanics and agroindustry.

All teenage high school students without orthodontic appliances were invited to participate in the study, representing an initial population of 499 persons in 2019. Thirty-one persons decided not to participate in the study, forty were excluded, either for orthodontic reasons or because they were not present at the moment of data collection (N=71). The final sample size included 428 persons, representing 86% of the original population.

Data collection was carried out during two weeks in February 2019 on site. Previous to the clinical examination, participants were asked to clean their teeth with a new tooth brush under supervision. Dental school students reinforce individual dental brushing and flossing to ensure that tooth surfaces were clean. The participants completed a self-reported questionnaire and were clinically examined for caries detection using three portable dental units, equipped with individual lamps. The examination was performed at the same hours in the morning in a well-ventilated and well-illuminated large room. The examiners systematically dyed the dental surfaces with sterile gauze, and performed dental examination using a sterile mouth mirror. All instruments used were sterilized following the infections protocol control of the University of Costa Rica Dentistry Faculty, using external and internal controls in each cycle of sterilization. The subjects with dental emergencies were immediately referred to the Dentistry Faculty for the needed dental care.

ICDAS SYSTEM AND RESEARCHER'S CALIBRATION

The clinical data was collected following the International Caries Detection and Assessment System (ICDAS-II), derived from the International Caries Classification and Management System ICCMS (25). The system has been recommended for clinical practice, research and development of public health programs. ICDAS-II allows a clinical and visual method for caries detection from the earliest states, allowing an assessment of both severity and level of activity of the caries lesions. It comprises 7 codes according to the caries lesion severity, being code 1 the first clinical observed change of disturbance in the enamel, and 7 the most severe caries lesion (Table 1) (26). ICDAS-II is considered as a robust scoring system to assess the severity and activity of coronal caries lesions, showing a strong correlation with histology, and allows a substantial level of reproducibility and accuracy for assessing primary coronal caries lesions (16). When including the level of activity (27), two additional codes were added for codes 1 and 2 (1 active, 1 inactive / 2 active, 2 inactive) (Table 1). The WHO 11.5 metallic ball- ended probe was only used in case of a diagnostic uncertainty.

Mesial and distal surfaces were not systematically recorded, since the clinical examination was only based on the examiner's observations, and a radiographic study was not ran.

Three examiners (KMC, SGF, AGF) were previously calibrated on ICDAS, and underwent a recalibration process with the University of Bergen, Norway given by a professor in Pediatric Dentistry. Timepoint 1: the three examiners underwent a theoretical training session according to ICDAS II criteria. The examiners underwent a laboratory practice session with clinical pictures and previously diagnosed extracted teeth affected by different degrees of caries severity. Then, the clinical calibration exercises took place and the scoring results of each examiner were compared to the gold standard. This part of the calibration process was performed during a time period of a week. Timepoint 2: Finally, 10 days later a re-assessment of some clinical pictures and results of the children caries exam by surfaces of each examiner were compared with those previously achieved at Timepoint 1. Test 1 (inter-examiner) showed a mean weighted Cohen's kappa of 0.84

(individual weighted Cohen's kappa: KMC: 0.85, SGF: 0.82, AGF: 0.84). The mean weighted Cohen's kappa for Test 2 (intra-examiner) was 0.90 (individual weighted Cohen's kappa: KMC:0.94, SGF:0.81, AGF:0.97).

ETHICS AND DATA

Written informed consent was obtained from the boarding school Principal, as the general proxy and legal representative of all students. Participants read and signed the informed consent form and to ensure the wiliness and autonomy to participate in the study, voluntary abstention was considered for exclusion. A second written informed consent was completed by each participant directly, for both minors and adults. The ethical approval was given by the Institutional Science and Ethics Committee of the University of Costa Rica (VI-5629-CEC-0008-2018), in conformity to recognized international standards, the Declaration of Helsinki and according to the national law of biomedical research.

MEASUREMENTS

PREVALENCE OF DENTAL CARIES EXPERIENCE IN THE SAMPLE

Represents the percentage of the population with untreated caries lesions, filled, decayed, lost and healthy. Prevalence of dental caries experience was calculated dividing the total number teeth filled / filled & decayed / decayed / lost by the total number of participants (428).

The statistical unit used is the individual (Table 2).

PREVALENCE OF DENTAL CARIES EXPERIENCE ACCORDING TO TOTAL TEETH

Represents the percentage of the total number of teeth filled / filled & decayed / decayed / lost, divided by the total of theoretical teeth that should be present (28 teeth per person, excluding 68 temporary teeth). The statistical unit used is the tooth (Table 3).

PREVALENCE OF DENTAL CARIES IN THE TEETH SAMPLE USING ICDAS

Classification according to the caries severity and caries level of activity, using the ICDAS codes (see Table 1 and Table 4).

MOST AFFECTED TEETH

We assessed highest caries experience by teeth (Table 5).

MEAN NUMBER OF DECAYED, MISSING, AND FILLED PERMANENT TEETH (MEAN DMFT) IN THE SAMPLE

The mean number of DMFT is the sum of individual DMFT values divided by the sum of the population.

We calculated the DMFT indicator following the WHO recommendations (taking into account only cavitated caries lesions) and taking the ICDAS codes as threshold (taking into account incipient caries lesions) (Table 6).

STATISTICAL ANALYSES

Descriptive statistics were carried out using STATA V14.

RESULTS

Table 1 presents the description if ICDAS codes used in this study. Table 2 shows the results of the prevalence of dental caries experience in the sample. This study examined 428 young male students aged 12-22 with mean age of 15 years old. The total average prevalence of dental caries

was found to be 83%, 15% of the study sample have lost a tooth due to dental decay, 61% of the sample have at least one filled tooth, 36% of the population have at least one filled and decayed tooth, 4% of the population have at least 1 missing tooth for causes other than dental caries Finally, 6% of the population was classified as completely "healthy", having all their teeth classified as sound. Table 2 also shows the prevalence by age range, being those in the 18-22 category the most affected by all the caries experience assessed.

Table 3 shows the prevalence of dental caries experience taking as a statistic unite the tooth. In total 11984 teeth were examined; temporary teeth were excluded from the analyses (n=84). The final sample represented 11916 permanent teeth, of which, 71.4% were classified as sound, 8.2% filled, 2.1% filled and decayed, 17.0% decayed, 1.0% absent due to caries, and 0.2% were lost for other reasons than caries. On average, from 28 teeth present in the mouth, 8.3 had some kind of caries experience.

Table 4 indicate the prevalence of dental caries using ICDAS classification. The most frequent caries lesion found in the sample is codes 2-Inactive (46.7%), followed by code 1-Inactive (23.8%). In general, codes 1 and 2 represent the large majority of dental decay observed in the sample, counting for 83% of all dental caries lesions. The most severe caries lesions found are also the least frequent (code 5: 5.6% and code 6: 0.9%).

Table 5 shows the impact of dental experience according to two-digit notation codes for the adult dentition based on the World Dental Federation (FDI) nomenclature (28). The group of teeth more impacted by caries experience are the lower and upper first permanent molars in the next order: 46 (79.8%), 36 (78.9%), 16 (69.6%) and 26 (69%), followed by the second lower and upper permanent molars of each arch: 37 (62.9%), 47 (58.4), 27 (47.9%) and 17 (43.2%). The third group of teeth more impacted are the first upper premolars: 24 (36.7%), 14 (34.9%), followed by the lower second premolars: 45 (30%), 35 (26.5%). The least impacted are the lower permanent incisors.

Table 6 presents the DMFT-WHO indicator calculated using ICDAS codes. According to WHO, the criteria to record carious crown is "an unmistakable cavity, undermined enamel, or a detectably softened floor or wall" (29). The equivalency point between these two systems was at score 3 of the ICDAS II in this particular study. If we use the code 3 to identified only cavitated caries, DMFT indicator drops to 3.94 from 7.89, mean index considering a caries lesion from ICDAS code 1.

Table 7 shows the distribution of the mean number of caries lesions by age according to ICDAS codes 1 to 6 among the studied population, that reflects the natural history of the disease, the higher mean was identified in the 18 years old and over, (11.5;CI [10.3-12.6]), and the lowest mean number in the 12-13-year-old group (6.1; [CI 5.3-6.9]).

Table 1. ICDAS codes used in the present study.

Codes	Criteria
0	Sound tooth surface, no evidence of caries after drying. Surface not restored or sealed (use with the codes for primary caries) (48).
1A	First Visual Change in Enamel Active Lesion. First visual change in enamel active lesion. Only visible after prolonged drying an opacity or discoloration consistent with demineralization is attributable to an active caries lesion and not consistent with the clinical appearance of sound enamel. When evaluated with the ball-ended probe, feels rough when the tip is moved gently across the surface. Lesion is in a dental biofilme stagnation area, with presence of gingival swelling and redness, bleeding caused by a careful probing of the gingival margin (49-51).
1I	1I First Visual Change in Enamel Inactive Lesion. When seen wet there is no evidence of any change in color attributable to carious activity, but after prolonged air drying a carious opacity (white or brown lesion) is visible, and it is not consistent with the clinical appearance of sound enamel. Feels hard and smooth when the tip of the ball- ended probe is moved gently across the surface. The caries lesion can be located at some distance from the gingival margin, or with the absence of gingival swelling and redness, or bleeding caused by a careful probing of the gingival margin (49-51).
2A	Distinct Visual Change in Enamel when Viewed Wet Active Lesion. There is a carious opacity or discoloration that is not consistent with the clinical appearance of sound enamel, opaque with loss of luster, feels rough when the tip of the ball-ended probe is moved gently across the surface. Lesion is in a dental biofilme stagnation area, with presence of gingival swelling and redness, bleeding caused by a careful probing of the gingival margin (49-51).
2I	Distinct Visual Change in Enamel when Viewed Wet Inactive Lesion There is a carious opacity or discoloration that is not consistent with the clinical appearance of sound enamel, surface is whitish, brownish or black. Enamel may be shiny and feels hard and smooth when the tip of the ball- ended probe is moved gently across the surface. For smooth surfaces, the caries lesion can be located at some distance from the gingival margin, or with the absence of gingival swelling and redness, or bleeding caused by a careful probing of the gingival margin (49-51).
3	Localized enamel breakdown due to caries with no visible dentine or underlying shadow: opacity or discoloration wider than the natural fissure/fossa when wet and after prolonged air drying (48).
4	Underlying dark shadow from dentin, +/– Localized enamel breakdown (48).
5	Distinct cavity with visible dentine: visual evidence of demineralization and dentine exposed (48).
6	Extensive distinct cavity with visible dentine and more than half of the surface involved (48).

Table 2. Prevalence dental caries experience among participants grouped by age (statistical unit: the individual).

Variable	12-13 y	14-15 y	16-17 y	18-22 y	Total
Absent due to caries	23%	15%	9%	12%	15%
Absent due to other causes than caries	3%	3%	2%	10%	4%
Filled	47%	55%	72%	80%	61%
Filled and decayed	28%	28%	40%	58%	36%
Decayed	81%	83%	82%	92%	83%
Sound	10%	7%	3%	0%	6%
N (5 missing values)	97	153	123	50	428

Table 3. Prevalence of dental caries experience according to the total of present teeth (statistical unit: the tooth).

Variable	Number of teeth	Percentage
Sound	8513	71,44%
Absent due to caries	116	0,97%
Absent due to other causes than caries	24	0,20%
Filled	981	8,23%
Filled and decayed	251	2,11%
Decayed	2031	17,04%
Total of permanent teeth	11916*	100,00%
Total of temporary teeth	68	
Total of teeth	11984**	

Note:
* Theoretical n for permanent teeth =11916 teeth. Calculated as follows:
428 (number of individuals) x 28 (number of present theoretical teeth) - 68 (temporary teeth excluded) = 11916
** Total of theoretical N =11984 teeth. Calculated as follows:
Calculated as follows: 428 (number of individuals) x 28 (number of theoretical teeth = 11984

Table 4. Prevalence of dental caries according to ICDAS codes.

Variable	N	%
Sound	8513	71,4%
Other categories	1121	9.4%
Decayed / Filled and Decayed	2282	19.2%
Total	11916	100,00%
ICDAS codes		
1A	53	2,3 %
1I	543	23,8 %
2A	226	9,9 %
2I	1065	46,7 %
3	153	6,7 %
4	94	4,1 %
5	127	5,6 %
6	21	0,9 %
Total	2282	19.2%

Table 5. Percentage of teeth with history of dental caries according to FDI nomenclature.

Teeth number	Percentage
11	9,8
12	11,7
13	4,7
14	34,9
15	25,9
16	69,6
17	43,2
21	8,5
22	14,1
23	5
24	36,7
25	25,6
26	69
27	47,9
31	0,2
32	0,2
33	0,7
34	23
35	26,5
36	78,9
37	62,9
41	0,2
42	0,5
43	0,9
44	25,8
45	30
46	79,8
47	58,4

Table 6. DMFT calculated using different ICDAS thresholds.

ICDAS-II 3-6 > 0 **Using code 4 as threshold for caries criteria (equivalent of the DMFT/WHO indicator)**		
	N	**Mean**
Decayed	338	0.79
Absent due to caries	116	0.27
Filled	981	2.29
Filled and decayed	251	0.59
Total	1686	
N	428	
DMFT>4	3,94	

ICDAS-II 1-6 > 0 **Using ICDAS codes as threshold for caries criteria (up to code 1)**		
	N	**Mean**
Decayed	2031	4.75
Absent due to caries	116	0.27
Filled	981	2.29
Filled and decayed	251	0.59
Total	3379	
N	428	
DMFT>1	7,89	

Table 7. Mean number of Decayed, Missing, and Filled Permanent Teeth (following ICDAS codes) according to age in the studied population (n=428).

Age	**Mean**	**IC**	**N**
12-13	6,1	[5.3-6.9]	97
14	6,7	[5.5-8.0]	74
15	8,5	[7.3-9.6]	79
16	7,9	[6.8-9.0]	67
17	8,4	[7.1-9.6]	56
18 and over	11,5	[10.3-12.6]	50
Missing			5
Total	7,89		428

DISCUSSION

This study showed that prevalence of dental caries was 83% among young male from a boarding school in Costa Rica, while only 6% was classified as completely healthy. Additionally, when calculating DMFT-WHO indicator, the mean index using ICDAS-II 1-6>0 codes was estimated at 7.89 (using ICDAS code 1 as threshold). However, for ICDAS-II 3-6>0 (threshold considered at 4, following WHO definitions of caries), the index decreases to 3.94. Finally, we revealed that ICDAS-II codes 1 and 2 represented the large majority of dental decay lesions, and the most affected teeth were the lower and upper first permanent molars.

The prevalence of dental caries and mean DMFT index found in this study, is higher compared to certain international investigations conducted in children and adolescents. For instance, in a 2010 study in children and adolescents aged 5, 12 and 15 in Denmark (30), the DMFT index in was estimated at 2.2. A study in France estimated prevalence of dental caries in young students at 43% (31). However, these findings are difficult to compare, since the indicators and methodology used are not equivalent. There are relatively few studies using ICDAS-II among adolescents or young adults. Arangannal *et al.*, presented, using ICDAS-II, that children and adolescents in India had an average prevalence of 68.8% (32). In Spain, a study indicated that prevalence using caries lesions ICDAS-II 1-6>0 as threshold for 15-year-old was 84.8%, quite similar to the findings in our study (33). Only one study has used ICDAS-II in Costa Rica, and it showed that caries prevalence among foster-care children aged between 2 and 17-year-old was estimated at 96.35% (18). Sugar availability and cultural-related factors, such as health behaviors, can explain the differences average prevalence found between countries (34). However, regarding Costa Rican's studies, differences can be partially explained by the existence of social inequalities in oral health. It is not surprising to find the highest caries prevalence in adolescents in foster-care, being an extremely vulnerable group cumulating several social and health risks. Our study sample represents as well a vulnerable population, coming mainly from socioeconomically disadvantaged areas and families. Thus, prevalence differences can be found if diverse socioeconomic groups are analyzed. The existence of a strong social gradient in oral health in Costa Rica was already been suggested in previous studies (35,36).

Regarding the caries experience-from an incipient carious lesion to the filled teeth–this study showed the least fillings (47%) to be found on the youngest population (12-13 years old). The group between 18-22 years exhibited the highest number of cavities (92%), and the largest number of teeth with fillings (80%). This can probably relate to an existent, but delayed, access to health care when it comes to dental treatments, strongly suggested by the relation to the percentage of participants that received dental care, which increases according to age. Of all examined teeth with history of disease, 39.9%, were restored or extracted, consistent with previous literature where the history of dental decay increases with age (33). According to Shulman and Cappelli: "the longer a tooth is exposed to the oral environment, the more time for the caries process to work. Although DMFT index increases with age, the contribution of decay decreases and that of the filled and missing components increases"(37).

Previous epidemiological surveys using ICDAS-II on adolescents in disadvantaged communities have revealed a higher prevalence of codes 1 and 2 compared to the other codes (38). In our study, the activity of dental caries was only evaluated at the initial stages, demonstrating that carious lesions can often become inactive and stop its advance. This indicates that oral health education and access to topical and community fluoridations (39), are essential to intervene in the natural progress of the disease avoiding severe stages (40).

We additionally showed that the lower and upper first permanent molars are the group of teeth more impacted with caries lesions. Due to the mean age of the participants, they had a higher number of permanent molars and premolars in active eruption process. In this process, the "groove-fossa system" is under greater risk by the thick biofilm accumulation (41). There is also evidence that proper oral hygiene on the occlusal surface of partially erupted teeth is difficult (42), and there is a significant reduction in detectable dental biofilm in fully erupted teeth, compared to the partly erupted; because mechanical oral function of partially erupted teeth is limited (43,44). Matching with our results, it has already been reported that occlusal molars surfaces are the most caries susceptible of all. From the most susceptible to the least susceptible surfaces, it can be cited: occlusal surface of the four first molars, occlusal surface of the lower second molars, occlusal surface of the upper second molars, mesial surface of the upper first molars (45-47).

The main limitation of this study relates to the non-representative sample of young people. It was conducted in a sample with only young males, coming from socially deprived groups compared to the general population. However, the sample comprises individuals from all the national territory, and allowed to validate a study design for future epidemiological studies. It generates valuable data to present before financial institutions for future research projects. Future studies should be based in a representative sample of young individuals representing both sex/gender and all social groups in the country.

Despite these limitations, this study presents several strengths. It is the first research in Costa Rica adapting a study protocol exclusively for young individuals with a significant sample. We ran this study using a validated methodology such as ICDAS-II, with three calibrated examiners, producing robust and reproductible results.

CONCLUSION

These findings have shown that dental caries experience continues to represent one of the main public health burdens in Costa Rica. Our study shows dental decay as the most prevalent disease in young male in socially and economically deprived groups. This justifies the need for new oral health promotion approaches, considering health and disease social determinants. Oral health education, preventive and not invasive dental treatments, such as timely and appropriate fluoride applications at the individual and community level, are to be considered. Finally, our study shows the urgency for the social security system to prioritize real access to healthcare for young people and adolescents in the country.

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