CLINICAL RESEARCH

Prevalence of Tooth Loss, Bleeding on Probing and Malocclusion as Oral Disease Indicators in Costa Rican Male Adolescents: a Cross Sectional Study

Prevalencia de la pérdida de piezas dentales, del sangrado al sondeo y la maloclusión como indicadores de enfermedades orales en adolescentes varones costarricenses: un estudio transversal

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ABSTRACT: The evidence to characterize oral health during adolescence in Costa Rica is limited. This lack of adequate research makes it difficult to develop appropriate health policies for this subgroup of the population. This is particularly important because adolescence is the period during which good health habits must take root in order to foster good physical and cognitive development. This study aims to determine the prevalence of tooth loss, bleeding on probing and malocclusion in Costa Rican male adolescents at the "Colegio Técnico Profesional San Agustín" (St. Augustine's Technical High School) located in the province of Cartago. Data was collected from 428 male adolescents aged 12-22 years in a cross-sectional study during 2019. Prevalence of tooth loss was calculated as the number of individuals having lost at least one tooth. The average number of teeth lost by individuals was also recorded. The bleeding on probing was an indicator used as a proxy parameter for monitoring periodontal health where the presence of bleeding on probing and calculus was also recorded.

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Malocclusion was measured using the Dental Aesthetic Index (DAI). The results showed that the prevalence of tooth loss, bleeding on probing and malocclusion was of 19%, 70.0% and 98%, respectively. It was also found that 81% of the participants had all their teeth, 11% had lost 1 tooth, 8% had lost more than one tooth of which 0.5% had lost more than 5 teeth. Considering a general classification of periodontal problems based on bleeding on probing and presence of calculus, the prevalence of periodontal problems increases to 92%. Regarding the DAI, the category identifying a very severe malocclusion was the most prevalent in the sample (88%). It is alarming the high prevalence of tooth loss, bleeding on probing, and malocclusions in a sample of Costa Rican male adolescents, compared to similar studies in other countries. The overarching conclusion of this study is that oral diseases represent an important health problem that urgently need proper public health action.

KEYWORDS: Prevalence; Oral health; Tooth loss; Bleeding on probing; Malocclusion; Adolescents; Costa Rica.

RESUMEN: La evidencia para caracterizar la salud bucal durante la adolescencia en Costa Rica es limitada. Esta falta de investigación adecuada dificulta el desarrollo de políticas de salud convenientes para este subgrupo de la población. Esto es particularmente importante porque la adolescencia es el período durante el cual se deben arraigar buenos hábitos de salud para fomentar un buen desarrollo físico y cognitivo. Este estudio tiene como objetivo determinar la prevalencia de pérdida de piezas dentales, sangrado al sondeo y maloclusión en adolescentes varones costarricenses del Colegio Técnico Profesional San Agustín ubicado en la provincia de Cartago. Se recopilaron datos de 428 adolescentes varones de 12 a 22 años en un estudio transversal durante 2019. La prevalencia de pérdida de piezas dentales se calculó como el número de individuos que habían perdido al menos una pieza dental. También se registró el número promedio de dientes perdidos por individuos. El sangrado al sondeo fue un indicador utilizado como parámetro para el seguimiento de la salud periodontal donde también se registró la presencia de sangrado al sondeo y cálculo dental. La maloclusión se midió utilizando el Índice Estético Dental (DAI, por sus siglas en inglés). Los resultados mostraron que la prevalencia de pérdida de piezas dentales, sangrado al sondeo y maloclusión fue del 19%, 70,0% y 98%, respectivamente. También se encontró que el 81% de los participantes tenían todos sus dientes, el 11% había perdido 1 pieza dental, el 8% había perdido más de una pieza dental, de los cuales el 0,5% había perdido más de 5 piezas dentales. Considerando una clasificación general de problemas periodontales basada en sangrado al sondeo y presencia de cálculo, la prevalencia de problemas periodontales aumenta al 92%. En cuanto al DAI, la categoría que identifica una maloclusión muy severa fue la más prevalente en la muestra (88%). Es alarmante la alta prevalencia de pérdida de piezas dentales, sangrado al sondeo y maloclusiones en una muestra de adolescentes varones costarricenses, en comparación con estudios similares en otros

países. La conclusión general de este estudio es que las enfermedades bucodentales representan un importante problema de salud que necesita urgentemente una acción adecuada de salud pública.

PALABRAS CLAVE: Prevalencia; Salud oral; Pérdida de piezas dentales; Sangrado al sondeo; Maloclusión; Adolescentes; Costa Rica.

INTRODUCTION

Oral health is a fundamental part of general health and significant correlations have been found between the condition of the oral cavity and some chronic diseases, as well as quality of life (1,2). It is a multidimensional indicator that relates to economic, social, and psychological dimensions (3,4). The state of the oral health for a particular human group can be studied using measures of morbidity (5).

Oral diseases are classified as a major global health burden (6). Effective action to prevent oral problems require developing epidemiological records, measure the impact of promotion strategies, prepare preventive campaigns, communicate the benefits of oral health to target groups, and implementing educational programs related to prevention (7). Despite being an essential component to implement adequate public health strategies, there is little epidemiological surveillance data of the main oral health diseases in Low- and Middle-Income Countries (LMIC) (8). Costa Rica it is a middle-income Latin American country with 5-million inhabitants. Although the country has a public a national healthcare system (9), limited evidence exits regarding the most prevalent oral diseases.

There is a need to properly document oral health and dental care of adolescents. Additionally, scarce evidence has been produced to characterize oral health during adolescence in Costa Rica (10,11). Somewhat overlooked to prioritize childhood and adult oral health studies and evaluations, adolescence is a fundamental moment in life, where physical health thrives, but health behaviors establish and can affect future health and well-being. It is a period of life with significant physical and cognitive development, during which oral and dental care habits should be acquired (12). As a complex period, there are important transitions between childhood and adulthood, young people experience important changes related to biological, cognitive, social, and emotional development (13). Perils for these young people lie with problems such as the use of drugs, abuse of alcohol, smoking, high-fat high-sugar, diets all of which negatively impact oral health (14-18). Moreover, adolescence is an important transition period that influences mental health, psychosocial factors can thus impact oral health (19-23).

In order to understand the different manifestations of health in adolescents, it is necessary to study the main oral health problems in this group age. Considering this, studying the prevalence's of the main oral health conditions, can allow a better approach aiming to diminish their impact in overall health.

Tooth loss is a powerful marker of oral health in the population. This factor is the result of reduced access to dental care what in turn is an indicator of lower family income and educational level (24). The loss of teeth modifies eating habits regularly resulting in poor nutrition. Personal appearance is also affected by the lack of a complete dentition in adolescents. Much stress may be derived for lack of normal appearance what in turn negatively affects general health and overall well-being

(4). Tooth loss reflects the accumulation of dental care challenges and needs all over the life course, ending in a definitive mutilation of the dental organs (25).

Periodontal diseases, including gingivitis and periodontitis, are the most common inflammatory conditions in humans (26). There is evidence that periodontal diseases may have effects on systemic inflammation (27). Periodontal disease status can be approximated using clinical measures such as periodontal probing depths, clinical attachment loss, bleeding on probing (BOP), and radiographic bone loss (28).

At the World Workshop on Periodontal and Peri-implant Diseases held in 2017 in Chicago, the classification of gingivitis was summarized into two large groups depending on whether or not gingivitis was induced by a dental biofilm (29). Gingivitis induced by a biofilm was the most frequent form of periodontal disease found among the general population (30), with a high prevalence (>80 percent) in children and adolescents (31-33). In addition, concepts such as gingival health, were introduced mainly based on the presence or absence of BOP, which allows, together with other clinical characteristics, to define a case between gingival health and gingivitis (29).

The most common clinical features of gingivitis are edema, redness, and gingival bleeding (32). However, gingival bleeding, according to clinical and histological data, is one of the earliest signs of gingivitis that precedes any visual signs of inflammation (e.g. redness and swelling). Consequently, the absence of BOP suggests healthy sites and normal periodontal stability (34).

Gingival bleeding is a parameter approved by the World Health Organization (WHO) to assess gingival health in epidemiological studies with large samples (35), which is different from diagnosing a case of gingivitis in a specific patient

(36). However, in both scenarios gingival health is defined as <10% bleeding sites (29).

Gingivitis increases during adolescence as a consequence of hormonal changes, unhealthy diets, and insufficient oral hygiene. There are factors that exacerbate this situation that are linked to social environment and behavioral changes (25,37).

Previous studies evaluated the orthodontic needs in different countries. The main benefits of orthodontic treatment are the improvement of masticatory function, the prevention of tissue damage, the improvement of aesthetics and the overall increase in psychosocial well-being (38).

Orthodontic markers are used for the evaluation of malocclusion based on socially defined aesthetic standards, level of severity, aesthetics, and the need for treatments required. The Dental Aesthetic Index (DAI) is a simple, valid and reliable index commonly used for epidemiological studies (39,40). The DAI has been adopted by the WHO as a cross-sectional index applicable between different ethnic groups with stable and comparable results (38,41).

The DAI index was developed for epidemiological studies in Iowa and presented by Cons et al. in 1986 as a tool to classify dental aesthetics and the need for orthodontic treatment. It is based on a scale of social norms for a socially acceptable dental appearance (42). This index consists of the measurement of ten intraoral traits (10,39,42-44): (a) number of visibly missing teeth, (b) presence of crowding per arch, (c) presence of spacing per arch, (d) presence and distance of a diastema between the maxillary central incisors, (e) irregularities in the position of the maxillary teeth, (f) irregularities in the position of the mandibular teeth, (g) overjet in the maxilla (distance between the incisal edge of the incisors most prominent maxillary incisors and the labial surface of the mandibular incisor), (h) overjet

in the mandible (distance between the linguo-incisal edge of the most prominent mandibular incisors to the labial surface of the corresponding maxillary incisors), (i) presence and distance of the anterior open bite, and (j) evaluation of the molar relationship according to its deviation taking Angle's Class I Malocclusion as a reference. It is important to evaluate the prevalence of malocclusion in adolescents who undergo the final steps of bone and dental development prior to adulthood. Studies confirm that treatment during this period helps reduce the number and severity of malocclusions later in life (45,46).

Due to the importance to properly document and develop sensible public policy regarding oral health diseases, this study aims to describe the prevalence of tooth loss, bleeding on probing and malocclusion in Costa Rican male adolescents in the "Colegio Técnico Profesional San Agustín" in Cartago, in 2019.

METHODS

STUDY DESIGN

Data are from a cross-sectional study including Costa Rican male adolescents aged 12-22 years, who attended a nonprofit social welfare school run by the Order of Augustinian Recollects called "Ciudad de los Niños" (Children's City). This organization was created to receive socially and economically deprived children, coming from urban and rural areas from all over the country. The institution functions as a boarding school, and receives public funding from the Ministry of Education (47). The study included 428 adolescents who attended the boarding school in 2019. A clinical examination was run by three examiners: two general dentists, who evaluated BOP and tooth loss, and one orthodontist, who evaluated malocclusion.

PARTICIPANTS

All the students were invited to participate, representing an initial population of 499 persons in 2019. Thirty-one persons decided not to participate, forty were excluded 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. The data collection was carried out at three different times during 2019, between February and July. The examination was performed in a well-ventilated and well-illuminated large room. The examiners systematically performed dental examination using a sterile mouth mirror and the WHO Community Periodontal Index probe recommended for clinical examination in periodontal tissues (48). All instruments used were sterilized following the infection protocol control of the University of Costa Rica Dentistry Faculty, using external and internal controls in each cycle of sterilization (49). The subjects with dental emergencies were immediately referred to the Faculty of Dentistry for dental care.

For additional information regarding the participants and the study design, please see (50).

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 willingness 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

A. PREVALENCE OF TOOTH LOSS

The prevalence of tooth loss was calculated as the number of individuals having lost at least one tooth (Table 1). The average number of teeth lost by individuals was also recorded. Prevalence of tooth loss was determined by two trained general dentists in 428 participants. The total of permanent teeth evaluated was 11.916. Temporary teeth were excluded (n=68).

B. BLEEDING ON PROBING (BOP)

There are different methods to evaluate gingival bleeding, the one used in this study was the BOP method, as a diagnostic tool it is a simple, objective, and inexpensive procedure, if performed with adequate probing force. Gingival bleeding is also a diagnostic test that used to determine a patient's periodontal health (36).

This was an indicator used as a proxy parameter for monitoring periodontal conditions. The absence of BOP indicated a healthy periodontal structure. Three sites (mesial, middle and distal) were evaluated for each lingual and buccal/vestibular surface of the following index teeth 16, 36, 21, 41, 24, 44 according to Ramfjord (51).

The following formula was applied to calculate the percentage of BOP:

Bleeding on Probing=(Total number of bleeding sites)/(Total number of sites evaluated) x 100

Two trained general dentists recorded the BOP in 388 individuals.

A final categorization of gingival health, considering the presence of BOP and calculus was recorded as follows: i) No periodontal problems; ii) Bleeding at probing; iii) Presence of localized calculus; iv) Presence of generalized calculus; v) Bleeding on probing and presence of localized calculus; vi) Bleeding on probing and presence of generalized calculus. These categories were the one used to calculate the prevalence of gingival problems.

C. PREVALENCE OF MALOCCLUSION

To measure malocclusion, the Dental Aesthetic Index (DAI) (38,40,44) was used. The DAI score is based on the calculation of a linear regression that estimates the average number of people with malocclusion problems, reflecting both severity and treatment needs in a single score (38). It is an indicator adopted by the WHO and assesses 10 different characteristics in the anterior segment: overjet, negative overjet, tooth loss, diastema, anterior open bite, anterior crowding, anterior diastema, width of the anterior irregularities (mandible and maxilla) and antero-posterior spring relationship (52). After the application of the correspondent linear coefficient, the DAI establishes four categories: i) a score <=25 indicating normal or minor malocclusion, where no or slight treatment is needed; ii) a score between 26-30 for a definite malocclusion, where an elective treatment is suggested; iii) a score between 31 and 35 for severe malocclusion, where treatment is highly desirable; and iv) a score >=36 classified as a very severe malocclusion, where treatment is mandatory (52).

The DAI was recorded by a single trained orthodontist and included 383 adolescents.

STATISTICAL ANALYSES

Descriptive statistics were carried out using STATA V14.

RESULTS

Table 1 shows the prevalence of tooth loss in male adolescents stratified by age. The group of patients under study was made up of 428 young male students aged 12-22 years-old, with an average of 15 years of age. The average prevalence of tooth loss was 26% at age 12-13, 18% at age 14-15, 11% at age 16-17, 22% at age 18-22. 19 Nineteen percent (19%) of the total individuals examined had at least one tooth lost. It is worth mentioning that 81% of the participants had all their teeth, 11% had lost 1 tooth, 8% had lost more than one tooth, of which 0.5% had lost more than 5 teeth. The total number of expected teeth in the sample was 11.916, of which 140 had been lost (Table 2). This indicates that the prevalence of tooth loss with respect to the total number of expected, using as statistical unit the tooth is 1.2%.

Regarding BOP, from a sample of 388 individuals, 24 had a BOP index of 0%, 27 a BOP index of 2.78% (Table 3), with a total average of 19.6% of sites presenting bleeding from the total sites evaluates by person (Table 4). The minimum percentage of BOP found was 0% and the maximum 83.3% (Table 4). In the present research, following the recommendation in WHO epidemiological studies, we determined a BOP>10% as the prevalence of gingivitis, which was obtained in 270 participants, for a prevalence of 70%.

The general classification of periodontal problems based on BOP and presence of calculus is presented for 304 adolescents in Table 5. The main periodontal problem identified was the combinations of BOP and presence of localized calculus in 203 individuals, representing a 66.78% of this sample. Overall, 92% of the participants showed a bleeding during the examination if their periodontal health.

The results for each category of DAI score according to the need for orthodontic treatment in male adolescents is shown in Table 6 for 383 individuals. It was found that only 1.6% of the sample was classified as having a normal occlusion. 2.6% was identified as having definite malocclusion with an elective treatment suggested. 8.3% presented severe malocclusion, where an orthodontic treatment is desirable. For the majority of the adolescents examined (87.5%), the DAI score showed a very severe malocclusion, where a mandatory orthodontic treatment is recommended. Overall, 98.4% of the sample showed some degree of malocclusion.

Table 1. Prevalence of tooth loss in male adolescents stratified by age attending the San Agustín Professional Technical College-Ciudad de los Niños 2019 (statistical unit: the individual for N=423).

Variable	12-13 y % (n)*	14-15 y % (n)	16-17 y % (n)	18-22 y % (n)	Total
Tooth loss	26%	18%	11%	22%	19%
	(25)	(28)	(14)	(11)	(81)
N	97	153	123	50	423

*Interpretation: 25 individuals aged 12-13y had lost at least one tooth, representing 26% of the sample. Note: 5 missing values.

Table 2. Prevalence of tooth loss according to the total of present teeth (statistical unit: the tooth for N=11.916).

Variable	Number of teeth	Percentage
Number of teeth absent	140	1.1%
Total of permanent teeth evaluated	11.916*	100,00%

*Interpretation: 11.916 corresponds to the total number of permanent teeth evaluated in the sample. Temporary teeth were excluded from the analyses (n=68).

Table 3. Percentage and frequency of bleeding on probing (N=388).

Total of bleeding sites/Total of sites evaluated * 100	Absolute frecuency (n)	Percentage (%)
≤ 10% (WHO threshold for considering the absence of gingivitis)	118	30.4%
>10% - ≤25%	167	43.0%
>25% - ≤50%	86	22.2%
>50%	17	4.4%
Total	388	100%

Interpretation: 118 persons (30.4% of the sample) is considered as healthy when it comes to analyzing WHO threshold for gingivitis based on the measure of bleeding on probing. 70% is the prevalence of gingivitis in this study.

Table 4. Average percentage of bleeding on probing in male adolescents attending the San Agustín Professional Technical College - Ciudad de los Niños 2019 (N=388)

Variable	N	Mean (SD*)	Min - Max
Bleeding on Probing (BOP)	388	19.6 (15.3)	0-83.3

Interpretation: Adolescents had on average 19.6% of the total sites evaluated with periodontal bleeding.
*Standard Deviation

Table 5. General classification of periodontal problems based on bleeding on probing and presence of calculus in male adolescents attending the San Agustín Professional Technical College-Ciudad de los Niños 2019 (N=304.

Category	Absolute frecuency (n)	Percentage (%)
No periodontal problems	18	6%
Bleeding at probing	71	23%
Presence of localized calculus	6	2%
Presence of generalized calculus	1	<1%
Bleeding on probing and presence of localized calculus	203	67%
Bleeding on probing and presence of generalized calculus	5	2%
Total	304	100%

Table 6. Absolute and relative frequency by category of the Dental Aesthetics Index (DAI score) according to the need for orthodontic treatment in male adolescents attending the San Agustín Professional Technical College-Ciudad de los Niños 2019 (N=383).

DAI Category	N	Percentage
<=25: Normal or minor malocclusion. No or slight treatment is needed.	6	2%
26 - 30: Definite malocclusion. Elective treatment is suggested	10	3%
31 – 35: Severe malocclusion. Treatment is highly desirable.	32	8%
>36: Very severe malocclusion. Treatment is mandatory.	335	87%
Total	383	100%

DISCUSSION

This study showed that prevalence of tooth loss, BOP and malocclusion was 19%, 70.0% and 98.4% respectively. Considering a general classification of periodontal problems based on BOP and presence of calculus, the prevalence of periodontal problems increases to 92%. These findings are in consistence with previous studies, except for malocclusion, and where the results are higher compared to previous data reported.

Regarding tooth loss, a previous study performed in Brazil in 2010 by Peres *et al.*, in 5,445 adolescents aged 15 to 19 years, showed similar results with a prevalence of 17.4% (25). The authors found that tooth loss increases with age. However, in this study, the age groups who showed the absolute highest prevalence were in the 11-13 and 14-15 years old. The loss of permanent teeth in these age groups mainly associates with the dental caries progression. A previous study that focused on the analyze of dental caries experience in this population, showed that molar and premolars were the most affected by dental caries (50). However, these teeth have a relatively short eruption age. This can explain why we observed higher prevalence's in the youngest category, suggesting that tooth loss at this age was associated with earlier caries experiences in life. Another explanation can relate to dental extractions for orthodontic treatment. Indeed, it is possible that younger participants had better access to orthodontic evaluations due to the democratization in recent years of these services. This may not be the case for the older participants.

Concerning BOP examination showed an important impact of periodontal health. Only a 6% of the sample was categorized as healthy. Our study is consistent with previous national findings. Murillo *et al.*, performed a study in adults and urban areas in Costa Rica, 99% of the persons examined were diagnosed with gingivitis (30) Chiapinotto *et al.*, analyzed cross-sectional data from 1,211 schoolchildren aged 8 to 12 years from southern Brazil in 20 public and private schools. Oral examination evaluated the presence of dental biofilm, crowding, and gingivitis. The prevalence of BOP was 78.4%. However, regarding the extent of gingivitis, the mean number of bleeding points on probing was 3.10 (32), quite lower compared to the present study, where BOP mean was 19.6.

Olczak-Kowalczyk et al published the results of a national study in Poland in 2015, among 615 15-year-olds of both sexes who lived in urban and rural areas. Subjects were selected by cluster sampling. The prevalence of gingival BOP showed 37.4% (53), which is much lower compared to our findings. When observing that previous studies in Costa Rican and Colombian adults, reveling that almost 100% of the population suffers from gingivitis, a hypothesis that can explain these differences is that gingivitis can be one of the major public health problems in the region. Latin American countries figure in the most unequal in the world (54). Important health inequalities in general and oral health have already been found (55). In a nationally representative study implemented in Costa Rican adults, it was showed the importance of the social determinants of health early in life, having long-term consequences on adult oral health (55).

Until 2017 there is a slightly clearer definition of what gingival health is and therefore there are different clinical methods to evaluate it, which can complicate the comparison of some studies, in the case of Fan *et al*. in China, they used the evaluation of the gingival bleeding instead of BOP in a population of 7680, where the prevalence of gingivitis was 29.6% (calculated as a proportion of gingival bleeding score ≥10% without or pocket depth). We determined a BOP>10% as the threshold to calculate the prevalence of gingivitis, which was obtained in 270 participants, for a prevalence of 70% (35).

In contrast, Silveira *et al*. carried out a study in Minas Gerais, Brazil in 763 adolescents aged 15-19 years, where they observed periodontal changes including BOP (14.1%) and the presence of dental calculus (14%), these data differ of those found in the present study, where adolescents presented a BOP of 70.0% and 70.72% of them had dental calculus (56).

In Costa Rica, some studies of malocclusion have been made, one of them carried out in the schools of Tacares, Grecia in 2011. In a population of 88 children, with an average age of 7.01 years. It was found that 48.9% of patients had dental crowding, 10.1% had posterior crossbites, 19.3% had anterior crossbites, and 14.8% had anterior open bites. Regarding the Angle malocclusion classification, 10.2% of the patients were classified as Class II and 11.3% as Class III (57). However, this study was not performed with trained specialist in orthodontics and has a small sample.

A descriptive study carried out by the Costa Rican Social Fund-Caja Costarricense del Seguro Social (CCSS for its Spanish acronym) in 2017, including 104 691 adolescents who attended the CCSS in the dentistry services for clinical attention all over the country. The authors reported a national prevalence of dental crowding of 10%. Being less than 1% in the group of 0-5 years, 15% between 13-19 years, and 2.5% in the elderly (58). Similarly, in 2017, a study was carried from the CCSS included 911 830 adolescents between 10 and 19 years old, who consulted the dental services. In this investigation, the DAI was used. In that study, a normal occlusion was observed for 68.20% of the patients, definitive malocclusion for 12.50%, severe malocclusion for 11.60% and very severe malocclusion for 7.70%. Nevertheless, this study comes from administrative data, performed by non-trained dentist, and the indicators were transformed from general clinical examination. No specific indicator for research purposes was directly measured in the patients. The methodology does not mention important data collection, such as, the way in which the DAI criteria were standardized (10). Due to the characteristics mentioned above, it is difficult to compare the results of the present study with this institutional report.

However, in contrast to the results obtained by the CCSS in 2017 (10), the present study shows

1.6% of patients with normal or minor malocclusion, 2.6% definitive malocclusion, 8.4% severe malocclusion and 87.5% very severe malocclusion. It is important to mention that the data was collected by a single researcher, a dentist specialized in orthodontics.

This study has several limitations. It is a non-representative study of adolescents in Costa Rica. As a pilot study, it was designed to better conceptualize future national studies in this population. However, the findings cannot be extrapolated to Costa Rican adolescents. Additionally, it was performed in only men; the prevalence's in women can show different results. Another limitation relates to the indictors selected themselves. They were chosen based on their feasibility and practicability. The decision was made on the bases that simple indicators can be easily reproducible by general dentist in a large population, as well as easy to interpret. The measurements were taken only clinically, which can add diagnostic error in the analyses. However, in a social context where studies are difficult to develop due to the lack of funding and human resources availability, it was imperative to choose health indicators with the characteristics mentioned above. However, these variables can underestimate the extent of oral diseases.

Despite these limitations, the study has strengths. It was performed in an important sample of adolescents, using a methodology that can be replicated in different contexts and in larger populations.

CONCLUSION

We found high prevalence's of tooth loss, bleeding on probing and malocclusions in a sample of Costa Rican male adolescents, compared to similar studies in other countries. Despites the fact that Costa Rica has a national health care system, constitutionally conceptualized as universal, mandatory and solidarity for all citizens, adolescents, and young person's encounter important barriers to access dental health care.

This study shows that dental problems may represent the most important health burden in Costa Rica, which requires special attention from public health care institutions. Additionally, these findings can allow access to better funding for future research, based on a validated protocol, in a representative sample of young persons.

Finally, our study shows the urgency for the social security system to prioritize real access to dental healthcare for young people and adolescents in the country.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

SUBMISSION DECLARATION AND VERIFICATION

AUTHOR CONTIBUTION STATEMENT

Conceptualization and design: J.B.B.C., C.R.B., S.S.G. and C.B.S.
Formal analysis: C.B.S.
Investigation and data collection: J.B.B.C., C.R.B., T.S.A., S.S.G. and C.B.S.
Data analysis and interpretation: C.B.S.
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