Prevalence and severity of carious lesions in children from 5 to 9 years old of the Remigio Crespo Toral Basic Education School, Cayambe, Ecuador*

Prevalencia y severidad de lesiones cariosas en niños de 5 a 9 años de la Escuela de Educación Básica Remigio Crespo Toral, Cayambe, Ecuador*

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ABSTRACT

*Introduction: Dental caries is a chronic non-communicable disease and a global public health problem that affects human well-being and development. Its multifactorial origin involves biological, psychological and social factors. In Ecuador, data on its prevalence are limited. The aim of the present study was to determine the prevalence and severity of carious lesions in children aged 5 to 9 years from the "Remigio Crespo Toral" elementary school in Cayambe, Ecuador, using the International Caries Detection and Assessment System (ICDAS II). **Methods:** A cross-sectional study was carried out in 229 children, with prior authorization from CEISH - UNIANDES, Ecuador, whose parents authorized their participation by means of informed consent. Intraoral clinical examinations were carried out using portable equipment and following biosafety standards. Data were collected using alphanumeric cards, recording age, sex, presence and severity of carious lesions according to ICDAS II codes. Statistical analysis was performed with R software (v4.4.4.1) using median tests and 95 % confidence intervals. **Results:** There was an increase in carious lesions in the primary teeth with age. ICDAS code 2 was the most prevalent. Temporal molars and first permanent molars were the most affected teeth. **Conclusion:** The prevalence of dental caries increases with age in the primary dentition, with ICDAS code 2 being the most prevalent. In the permanent dentition, the first molars were the most affected. No significant differences were observed according to sex.*

Keywords: dental caries, dental health surveys, epidemiology, child

Resumen

*Introducción: la caries dental es una enfermedad crónica no transmisible y un problema de salud pública mundial que afecta el bienestar y el desarrollo humano. Su origen involucra factores biológicos, psicológicos y sociales. En Ecuador, los datos sobre su prevalencia son limitados. El objetivo de este estudio fue determinar la prevalencia y severidad de las lesiones cariosas en niños de 5 a 9 años de la escuela primaria "Remigio Crespo Toral"·en Cayambe, Ecuador, utilizando el Sistema Internacional de Detección y Evaluación de Caries (ICDAS II). **Métodos:** se realizó un estudio transversal en 229 niños, con autorización previa del CEISH - UNIANDES, Ecuador, cuyos padres autorizaron su participación mediante consentimiento informado. Los exámenes clínicos intraorales se realizaron con equipos portátiles y siguiendo las normas de bioseguridad. Los datos se recolectaron mediante tarjetas alfanuméricas, registrándose edad, sexo, presencia y severidad de las lesiones cariosas según los códigos ICDAS II. El análisis estadístico se realizó con el software R (v4.4.4.1) utilizando pruebas de mediana e intervalos de confianza del 95 %. **Resultados:** se observó un aumento de las lesiones cariosas en la dentición temporal con la edad. El código ICDAS 2 fue el más prevalente. Los molares temporales y los primeros molares definitivos fueron los dientes más afectados. **Conclusión:** la prevalencia de caries dental aumenta con la edad en la dentición temporal, siendo el código ICDAS 2 el más prevalente. En la dentición permanente, los primeros molares fueron los más afectados. No se observaron diferencias significativas según el sexo.*

Palabras clave: caries dental, encuestas de salud bucal, epidemiología, niños

INTRODUCTION

Dental caries is considered as a global health problem, as it is a chronic non-communicable disease that affects the development and well-being of the individual who suffers from it; therefore, it constitutes a public health problem that affects the quality of life[1]. Since it is a multifactorial disease, the result of the interaction between different factors where the host, microorganisms and the oral substrate act as determinants for the appearance of the disease[2]. The adhesion of bacteria to the surface of the tooth is the starting point of the pathology, where the adhesion of saliva proteins to the tooth surface is responsible for this adhesion to the surface[3]. In this process, the inadequate intake of food and drinks, especially carbonated beverages, is closely related to socioeconomic conditions and has a high influence[4].

Considering this process of oral imbalance, early childhood has a crucial role for the correct integral development of the child, because during this period the first foundations for correct oral hygiene are established. The excessive and constant consumption of free sugars in the infant population makes them a highly susceptible group[5] and a priority for attention[6]. Dental caries is a dysbiosis in which saliva, with the imbalances produced after food consumption, plays a determining role[7]. In the oral cavity, there is a diverse ecosystem where S. mutans constitutes a small fraction of the bacterial community, nevertheless acts synergistically to initiate the disease, requiring time and specific conditions to do so[8].

In this context, poor hygienic practices, nighttime feeding, excessive tartar accumulation, low socioeconomic level, lack of knowledge on the part of parents about proper brushing, act as triggers of the disease[9] whose presence triggers problems in the development of growth, speech, health, self-esteem and above all the wellbeing of the child and his or her family[10].

Traditionally, caries detection included the use of visual and tactile detection with the use of fine-tipped explorers[11], which triggered many of these incipient lesions to cavitate, and we could find ourselves in the need to enter into the restorative process using the conventional Black classification with its 5 classes according to the surface in which this lesion was found, commonly cavitated, which triggered many of these incipient lesions to cavitate, and we could find ourselves in the need to enter into the restorative process using the conventional Black classification with its 5 classes according to the surface on which this lesion was found, commonly cavitated[12].

The white spot-on enamel becomes the first clinical sign of the disease, appearing when active as a rough, opaque and rough crescent-shaped shadow at the level of the gingival third[13]. The International Caries Detection and Assessment System (ICDAS) is an evidence-based method used for caries classification that provides a standardized and detailed approach to assess the extent and severity of caries. The International Caries Detection and Assessment System (ICDAS) is an evidence-based method used for caries classification that provides a standardized and detailed approach to assess the extent and severity of carious lesions, from the first signs of demineralization to advanced cavities, providing an accurate diagnosis and allowing effective interventions[14].

Oral health care systems worldwide face several challenges to ensure equitable, accessible and affordable services, with high treatment costs making it difficult to provide efficient and widespread oral health care[15], in this context, preventive care and oral health promotion becomes one of the best disease controls strategies[16].

The ICDAS system is closely intertwined with the International Caries Classification and Management System (ICCMS™) that applies the current international knowledge on pathogenesis, pre-

vention and control, with the purpose of providing the best individual treatments[14], in that process mass fluoridation through drinking water has been considered as one of the most efficient, especially when combined with teaching, education, early detection and control of dental plaque[17].

In Ecuador, epidemiological studies show a high prevalence of carious lesions as the age of the individual increases. The Ministry of Public Health, the body responsible for regulating health processes and strategies, carried out the last epidemiological study in 2009; however, this was not published. Since then, different isolated studies have been carried out in different cities of Ecuador[18,19], demonstrating the high prevalence of the disease, which increases as the age of the individual increases and is associated with the presence of bacterial plaque and the socioeconomic and cultural conditions of the population evaluated[20].

Cayambe is a town located in the northeast of the province of Pichincha. The main sources of income come from agricultural work, trade, among others that contribute to its economic and social development, and has a population that inhabits both urban and rural areas with a low socioeconomic level that, as indicated by previous studies conducted in the area, needs constant monitoring[21] in terms of oral health due to the relationship between the disease and the knowledge parents have regarding the oral health of their children[22]. Therefore, the present study seeks to determine the prevalence and severity of dental caries in children between 6 and 9 years of age in the Remigio Crespo Toral Basic Educational Unit in the city of Cayambe, Ecuador.

METHODS

A cross-sectional study was conducted, with previous authorization by the CEISH of the UNIANDES with code CAD-N°2024-9-0024. The sample size was determined by taking into consideration the total number of children (510) from 5 to 9 years of age from the Remigio Crespo Toral School belonging to the Cayambe Canton, with a confidence level of 1.96 and an error of estimation of 0.05. A sample consisting of 229 children were included and evaluated between September and October 2024

As an initial step, the researchers involved in the study were trained to perform the activities to be carried out; the analysis of the presence of dental caries using the ICDAS system also required training to standardize the intra- and inter-evaluator observations.

After presenting the project to the school authorities, parents/legal representatives of children attending the Canton's Educational Center were informed about the topic, purpose, and relevance of the project. They were also informed about the informed consent form, which needed to be signed in case they accepted the participation of their children in the study and prior to obtain and/or collect data from them.

The next step was to verify that those who agreed to participate in the study met the inclusion criteria and were in the selected age group. Those who had neurological disorders, systemic or infectious diseases, or those whose parents did not sign the informed consent form were excluded.

To implement the data collection instruments, dental health activities were conducted to guide the space. Children were then grouped according to their ages (table 1).

Table 1. Distribution of children by age and sex

| Age	Male	Female	Total
5	4	4	8
6	24	23	47
7	37	31	68
8	43	39	82
9	12	12	24
Total	120	109	229

Source: by the authors

To protect the confidentiality of the participants, the cards used as instruments where the presence of caries according to the ICDAS index was collected were identified with alphanumeric codes, mentioning the participant's age and gender. The intraoral clinical examination was performed in a portable equipment, a MOICO head lamp, rechargeable, with 1000LM white light, biosafety barriers, latex gloves, mouth mirrors N 5 of 15/16 inches diameter and an OPS probe, the intraoral examination was performed considering the codes: 0 = for healthy surfaces, 1 = white or brown stain on dry enamel, 2 = white or brown stain on wet enamel, 3 = enamel loss (cavity) less than 0.5mm, 4 = dark shade of dentin seen through enamel with or without superficial enamel loss, 5 = loss of enamel and dentin greater than 0. 5mm, less than 50 % of the enamel, 6 = extensive cavity encompassing more than 50 % of the tooth surface following the previously established methodology[15] considering each of the surfaces of each of the teeth present in the mouth, those absent were identified with codes 99, the presence of restorations used the coding of restorative 91, restored but with alterations 92 and restored but filtered with need for change 93.

Bias was controlled in the sample selection and in the analysis carried out, for which prior training was provided to perform the evaluation, for which a person who is the evaluator has the certification and accreditation to evaluate carious lesions through ICDAS. It is also indicated that all age groups in the assigned population were invited to be part of and participate in the study.

The data were entered in an Excel table and then statistically analyzed in the free software R - V4.4.1 available to date; and descriptive tables and graphs are presented as well as results of non-parametric hypothesis tests such as the median test and 95 % confidence intervals. The analysis strategy consisted of considering only the ICDAS codes corresponding to the presence of carious lesion, i.e. from 0 = good condition to 6 with loss of more than 50 % of the surface. For each tooth, the assessed surfaces were considered and among them the highest score was determined, which was the value for the tooth, both in the primary and permanent dentition.

RESULTS

Of the 229 children evaluated, 52.4 % were males and 47.6 % were females. They were predominantly children of 8 years old (35.8 %), followed by children of 7 and 6 years old (29.7 % and 20.5 % respectively). While 10.5 % of the children were 9 years old, only 3.5 % were 5 years old. Regarding the type of dentition, there was a predominance of temporary teeth among the participants. Figure 1 shows the average values obtained in each dentition and each stage according to ICDAS, as well as their confidence intervals.
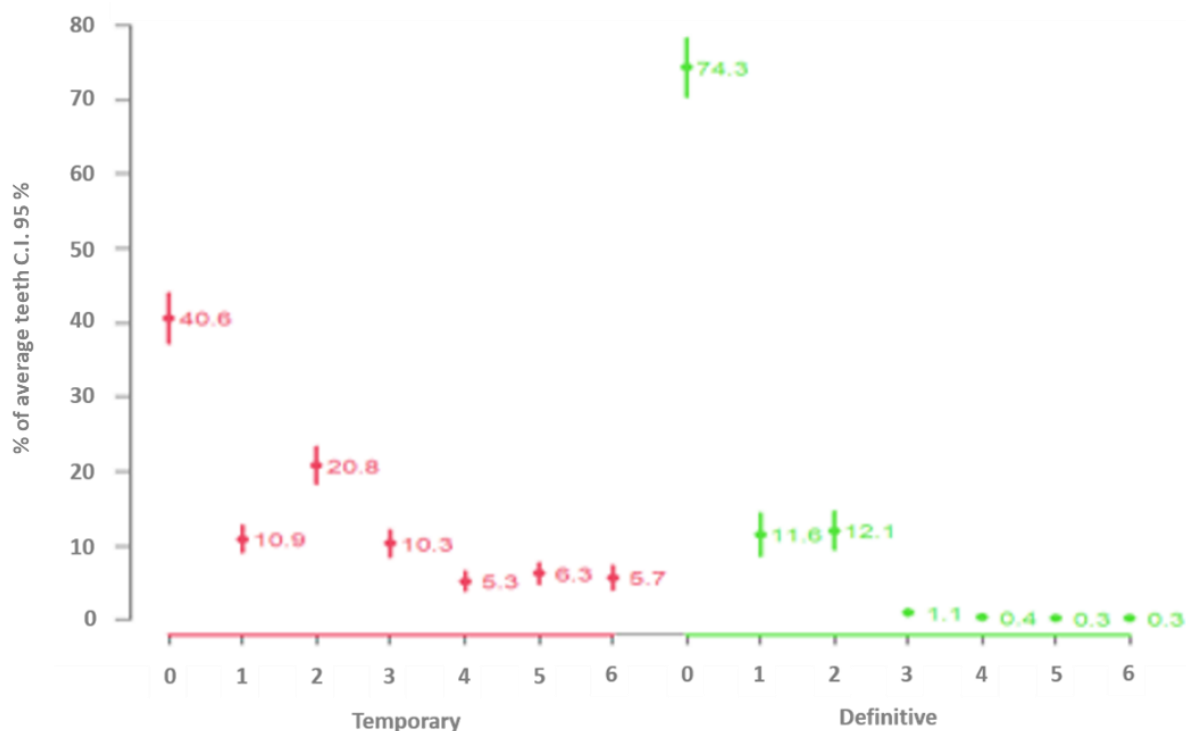
Figure 1. Means and confidence intervals according to ICDAS stages and dentition
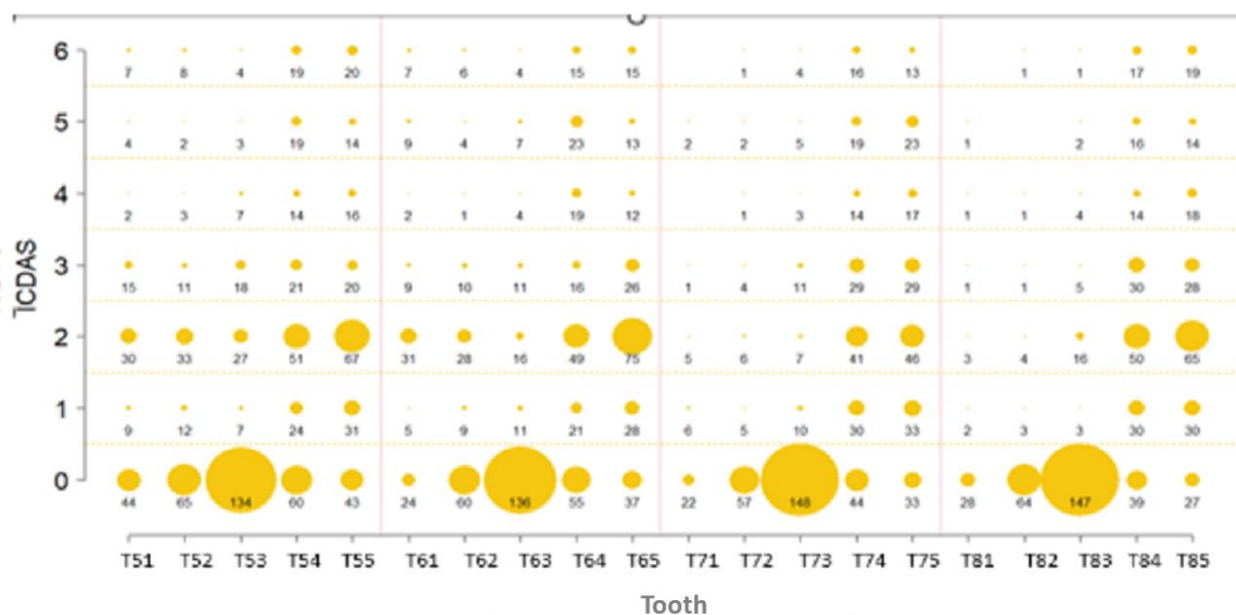**Source:** by the authors

Relating the ICDAS stage, according to whether they are temporary or permanent, considering all the children in the sample, a greater predominance of ICDAS code 2 is observed, with little presence of temporary or permanent teeth in high stages (4, 5 or 6).

When each ICDAS stage is related to the average number of teeth and the 95 % confidence interval for this average, it is confirmed that teeth in stages up to 2 predominate in both primary and permanent dentition; however, teeth with code 0 in both primary and permanent dentition are the most frequent.

When considering the percentage of teeth, according to ICDAS code and dentition, it is observed that in the 215 primary teeth and 210 permanent teeth, there is an average of 40.6 % of primary teeth and 74.3 % of permanent teeth in stage 0, when considering the ICDAS code and the type of dentition, disaggregated by sex, it is observed that there is no significant difference ($p > 0.05$), that is, in all ICDAS stages in both men and women, it is similar.

When considering the six ICDAS codes by dentition and by age, significant differences were found for certain stages and types of dentitions. Thus, in primary teeth, stages 0, 1 and 2 show a significant difference in the number of teeth according to age; it is perceived that as age increases the presence of ICDAS codes increases. In relation to the permanent teeth this does not occur, however, the presence of code 2 is evident in those teeth that are present, especially molars.

When severity is considered, evaluating the ICDAS stage in each tooth in the two dentitions, a predominance of codes 0 is observed; however, in the primary dentition the primary molars are the most frequently affected teeth with different codes, including code 6, but the most frequent affected code was 2. In the permanent dentition the first molars are also affected with code 2, without the presence of other codes in this dentition (figure 2).

Figure 2. Children according to ICDAS and tooth (Temporary)
Source: by the authors

This behavior is observed in both men and women and by age group in both primary and permanent dentition, thus it is observed that men with primary dentition the highest number of teeth affected in grade 0 is observed, with a slightly high number in grade 2 with the most frequent affected tooth being 55, 65, 85 (figure 3) in the same way in permanent dentition the most frequent grade is 0 with few cases of grade 2 where the most frequent affected tooth in this grade is 16, 26, 36 and 46 (figure 4).
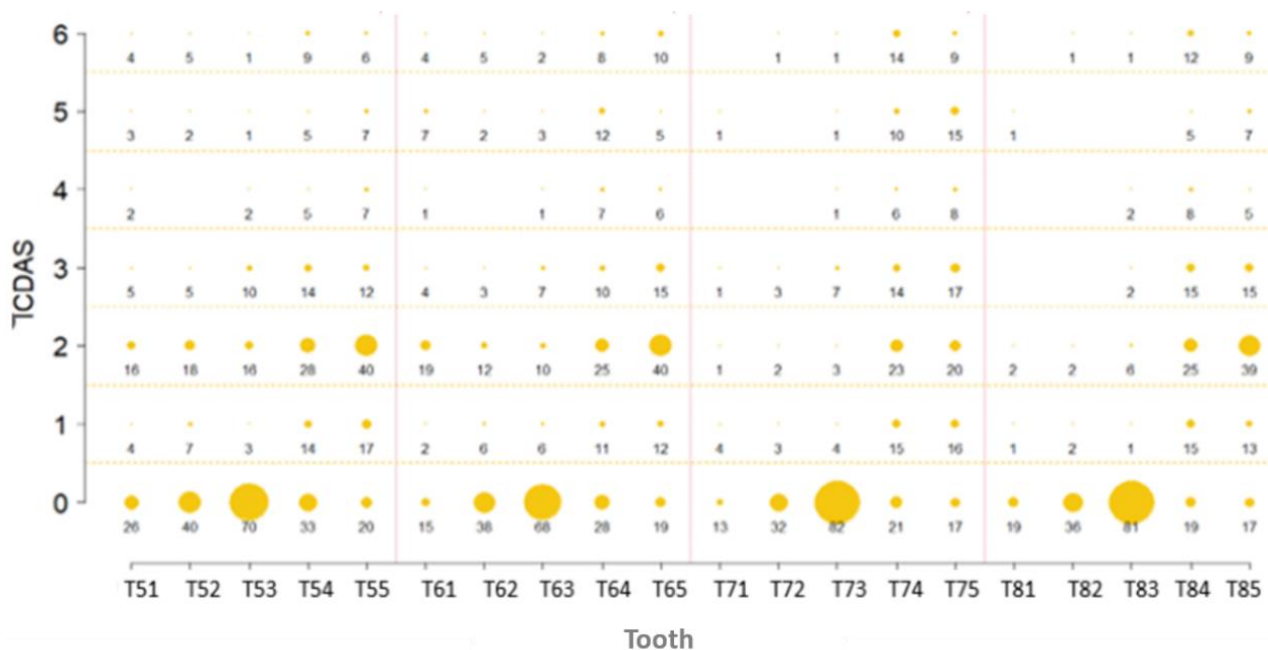
Figure 3. Ratio of Male temporary teeth and ICDAS grades
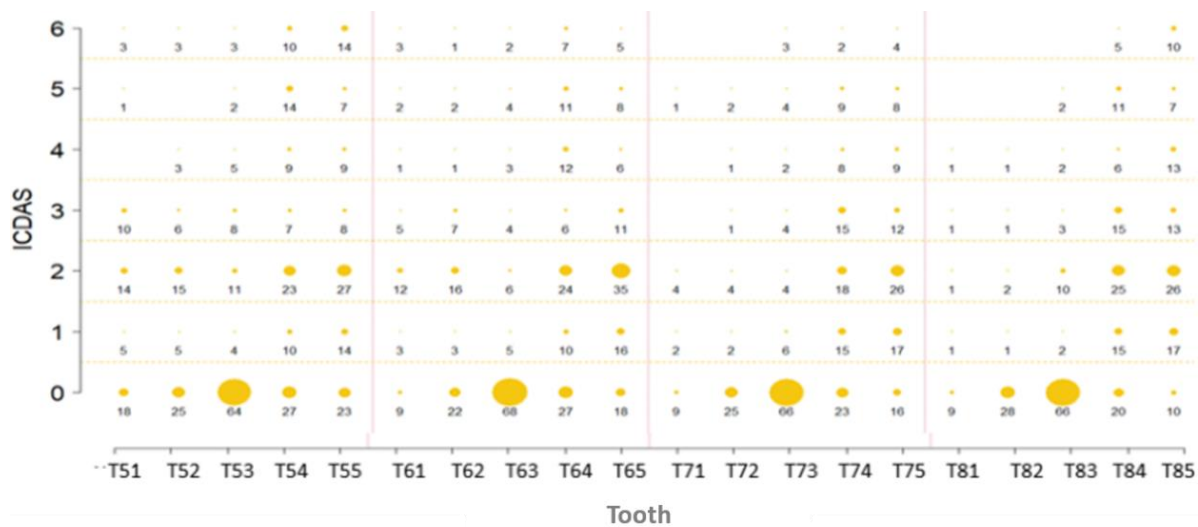**Source:** by the authors
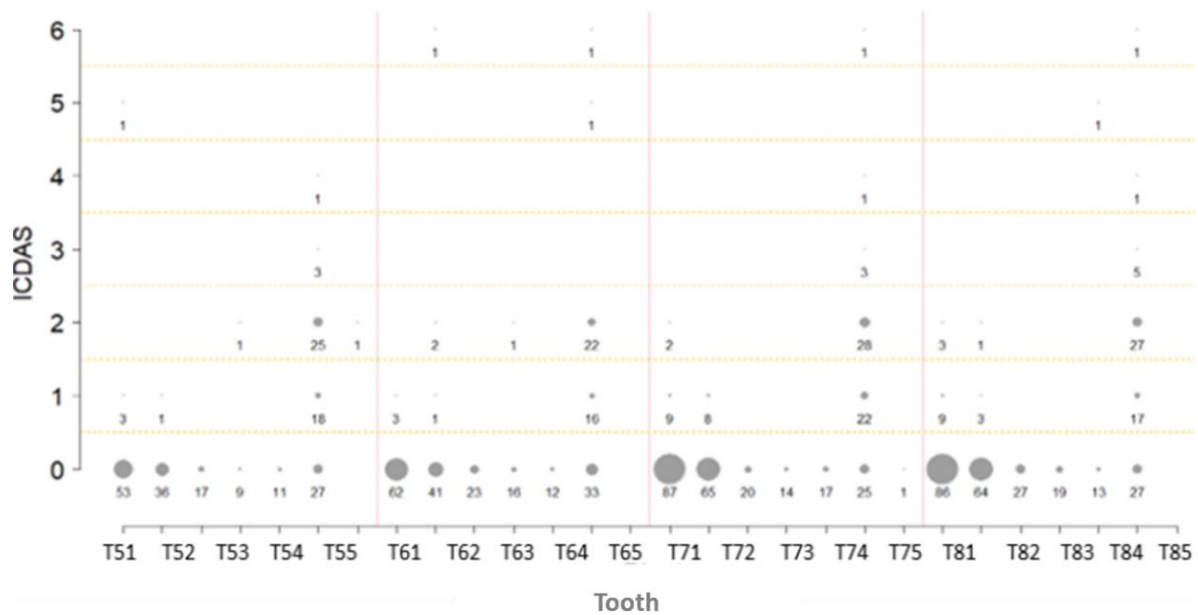
Figure 4. Ratio of men with permanent teeth and ICDAS grades
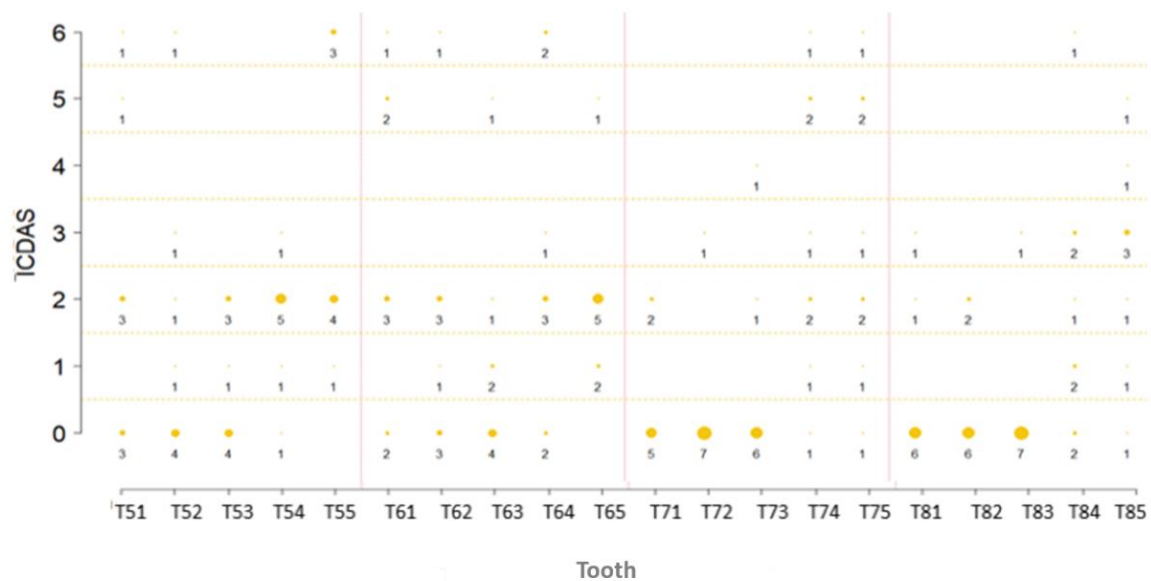**Source:** by the authors

In relation to the group of women with primary dentition, the highest number of teeth affected in grade 0 is observed, with a slightly high number in grade 2, with the most frequent affected tooth being 55, 65, 85, 75, 54, 64, 74, 84; likewise, in the permanent dentition, the most frequent grade is 0, with few cases of grade 2, where the most frequent affected tooth in this grade is 16, 26, 36 and 46 (figure 5).

Figure 5. Relationship of female Temporary teeth and ICDAS grade
Source: by the authors

In relation to age, when considering all participants in relation to the primary dentition and the degree of severity according to ICDAS, at 5 years of age in the primary dentition there is a high percentage of teeth with codes 0; however, a significant number of teeth are affected with codes 2, with 54, 55 and 65 being the most affected teeth (figure 6).

Figure 6. Ratio of all 5-year-old participants with primary teeth and ICDAS grades
Source: by the authors

At 6 years of age in the primary dentition there was a high percentage of teeth with codes 0; however, a significant number of teeth 51,52, 54, 55, 61, 62, 64, 65 were affected with codes 2, when considering the permanent dentition there was a reduced number of participants with this dentition and the existing teeth presented code 0. When considering the participants at 7 years of age in the primary dentition, the tendency is maintained with teeth with codes 0 and an important number of teeth affected with codes 2, with 54, 55, 64, 65, 74, 75, 84, 85 being the most affected teeth as for the permanent dentition the tendency is like the participants with younger age.

At 8 years of age in the primary dentition a high percentage of teeth with code 0 is observed; however, a significant number of teeth are affected with code 2 where 55, 65, 85 are the most affected teeth; when considering the permanent dentition, teeth with code 0 are observed, however, 16, 26, 36, 46 are already affected with code 2. Regarding the participants at 9 years of age, a reduced number of primary teeth are observed and those existing are in code 0, observing in a similar way that in the permanent dentition the teeth present and those are in code 0.

DISCUSSION

The results obtained show a high prevalence of carious lesions in children between 6 and 9 years of age in the "Remigio Crespo Toral" Basic Educational Unit in the city of Cayambe, Ecuador, with ICDAS grade 2 as the most frequent in both primary and permanent dentition. These results coincide with those reported in previous studies carried out in other regions of Ecuador[18,19], in which poor oral hygiene, type of diet and socioeconomic factors are determinants of the presence of the disease, considering that Cayambe is a particularly agricultural mestizo population, which could explain the presence of these results. The results obtained show a high prevalence of carious lesions in children aged 6 to 9 years, with ICDAS grade 2 being the most frequent, both in primary and permanent dentition. These findings coincide with those reported in previous studies carried out in other regions of Ecuador[18,22].

In Ecuador, a few studies have considered the prevalence of dental caries using the ICDAS system[19,22,23]. Its specificity allows the detection of lesions from their early stages and makes it a reliable tool; therefore, new research needs to be carried out using this system. In relation to age, when considering dentition and degree of severity, it is evident how from the age of 7, temporal molar teeth already show evidence of carious lesions, in early stages, mainly ICDAS 2, results that coincide with other studies[24], associating this result with physiology and the eruption process itself, reinforcing the fact of carrying out an accompaniment with elements of hygiene and education[25].

Caries continues to be one of the most frequent pathologies in the world[21], its high presence, above all in economically unprotected sectors[2] and it was observed that recently erupted teeth are more susceptible to caries than those with a longer eruption time[26], which coincides with the results obtained in our study, whereas the teeth increase their permanence in the mouth, related to the age of the participants, the ICDAS codes increase. In permanent teeth, specifically in the molars, the most frequent ICDAS code 2, which is of real concern because if age is considered, the permanent tooth has relatively little time in the mouth at the time of the evaluation.

When considering the sex of the participant and the presence of dental caries disease, the results showed no relationship between prevalence and severity, that is, the presence of caries was similar in male and female participants. This similarity could be related to the age of the sample, which, being children, is not influenced by hormonal factors that at older ages do trigger an important difference[27]. The observation that caries rates increase with age is a result that coincides with previous studies in communities with similar economic, social and cultural conditions in Ecuador[20,23,28], and not different from those reported in other Latin American countries[2]. This reflects the importance of an early intervention that matches the specificities of each population and in which parents and educators play a fundamental role in the transmission of knowledge regarding the oral health of their children.

The fact of using a system as specific as ICDAS makes our results differ in terms of the prevalence obtained in other studies carried out in Ecuador[29] where the CPO index was used to code the presence of the disease.

Technological advances in the diagnosis of dental caries, specifically in the use of the ICDAS systems, have allowed more precise studies to be carried out for the detection of carious lesions[30]. Their high sensitivity and specificity allow reliable results to be obtained, so that similar studies need to be reproduced using this coding, especially because by assessing the lesion in its initial stages of disease, preventive practices can be carried out early, which together with advice on the practice of continuous eating habits and hygiene can lead to good results[31].

The high prevalence of caries in the primary teeth the population evaluated indicates a clear lack of knowledge of the importance of keeping the primary teeth healthy, which has already been confirmed by previous studies[1,13] and reflects the need to establish health education measures for parents. When considering the severity in each tooth, considering the entire sample, without distinction of sex, in the two dentitions, it is observed that both the first and second upper and lower primary molars are the teeth most frequently affected by carious lesions, stage 2 being the most frequent, which shows the need for education in brushing techniques for children and parents as a strategy to control the disease[3].

It is evident the influence that maternal education has on children's dental health[31], in view of this, disease control strategies cannot underestimate maternal education and the positive impact that

these can generate, so it is essential to involve parents, teachers and health professionals, to address the high prevalence of dental caries and promote oral health in the population[22], in Cayambe being an agricultural population where father and mother generally work in field activities, these educational processes become a challenge that needs to be overcome. The high presence of carious lesions in our results show the absence of a participatory commitment of parents, representatives and the community in dental care, showing a disregard for the true importance of oral health and the establishment of preventive strategies towards the control of dental caries and its development in the early stages of childhood[24].

In relation to age, when considering dentition and degree of severity, it is evident that from the age of 7 years the primary molar teeth already show evidence of carious lesions in incipient stages, mainly ICDAS 2, results that coincide with other studies[27], associating this result with physiology and the eruption process itself, reinforcing the fact that a follow-up with elements of hygiene and education should be carried out to those already carried out of fluoridation and sealants of occlusal surfaces with ionomeric or resinous materials[17].

The dental brushing with fluorinated pastes with 1100 ppm of fluoride is shown as one of the strategies of greatest evidence[5] in Ecuador health agencies such as the Ministry of Public Health have developed different strategies where the school health programme[5] as one of the most successful, unfortunately, dental caries disease being multifactorial[4] requires to be approached from different aspects, and these educational strategies of habits and hygiene need to be strengthened and accompanied also from the house[32] give responsibility for health specific activities, as the dental brushing and sealant placement performed by health personnel is not the best strategy.

One of the limitations of this study is related to the lack of relationship with the design of the study itself, being a multifactorial disease, there are many elements that trigger the presence of the disease[4]; however, as this study is part of a macro project, these elements have been considered in complementary reports. The implications of an epidemiological study requiring consideration as a baseline, particularly because the population included is a child, confined to a certain territory and in specific conditions, what leads us also to analyze their results as well as the applicability of them, has to be limited to the population evaluated, however they are projected to be replicated in other populations of Ecuador, so that together the data, They would become tools to support decision-making on state policies at the oral health level.

The high presence of incipient lesions, ICDAS grade 2 in the population evaluated, regardless of sex, suggests the need to reinforce the educational strategies and habits implemented so far, which in previous results in similar contexts, highlight the beneficial effect of daily brushing in controlling plaque[28,33,34] and therefore the disease, through lectures and monitoring, with directed brushing strategies, fluoridation using elements with proven adherence capacity and therefore effectiveness, such as fluoride varnish[6], extending the work to the parents and/or caregivers of the child[23]. Those who, at this stage of children's development, are responsible for creating and transmitting healthy habits to them.

CONCLUSIONS

Under the conditions this study was carried out, it is feasible to conclude that the prevalence of dental caries, in primary dentition, in children from 6 to 9 years of age at the "Remigio Crespo Toral" Basic Educational Unit in the city of Cayambe, Ecuador, increased with age, code 2 of ICDAS is observed as the most frequent in temporary molars and in the first molar in permanent dentition.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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