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Prevalence of dental caries and its relationship with sociodemographic factors in children 5-9 years old in Cayambe, Ecuador: A cross-sectional study using ICDAS

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Abstract
The present study analyzed the relationship between sociodemographic factors and the prevalence of dental caries in children aged 5 to 9 years in Cayambe, Ecuador, using the International Caries Detection and Assessment System (ICDAS). An observational, analytical, cross-sectional study was carried out with a sample of 229 children. The analysis included clinical evaluation using the ICDAS system, analysis of sociodemographic factors and statistical models to establish associations. The results showed that 54.22% of the surfaces presented initial lesions, while only 16.90% remained healthy. A significant association was found between the caregiver's educational level and caries severity (OR=2.84, CI:1.86-4.32, p=0.001), as well as with housing conditions (OR=1.92, CI:1.24-2.98) and access to health services (OR=1.76, CI:1.15-2.69). The primary dentition showed greater susceptibility to severe injuries (14.51%) compared to the permanent dentition (0.51%). The results demonstrate a significant impact of socioeconomic factors on children's oral health, suggesting the need for interventions that consider social determinants in the prevention and treatment of dental caries.

Keywords: Dental caries, ICDAS, sociodemographic factors, children's oral health

Introduction

Oral health is an essential component of integral health, encompassing the condition of teeth, gums and other oral structures [1]. Its detriment can cause nutritional, cognitive, psychological and respiratory repercussions [2]. Good oral health implies the absence of dental caries and other oral conditions [3]. Dental caries is an infectious disease characterized by the destruction of dental hard tissues due to acids produced by microorganisms [4]. Early childhood caries (ECC) is a rapidly progressing form in young toddlers [5]. *Streptococcus mutans* is the main associated pathogenic microorganism, along with other species such as *S. sobrinus* and *lactobacilli* [6].

Socioeconomic factors play a crucial role in oral health. Individuals of lower socioeconomic levels frequently experience worse oral conditions due to lack of access to preventive programs [7]. Socioeconomic inequality is associated with higher caries prevalence [8]. Parents' oral health habits significantly influence their children, including the transmission of cariogenic bacteria [9]. The International Caries Detection and Assessment System (ICDAS II) classifies carious lesions into different stages, allowing the detection of incipient lesions in the enamel [10]. Unlike the WHO criteria, the ICDAS allows a more detailed estimation of lesions [11].

Research indicates that oral health is profoundly influenced by various sociodemographic elements, including family income, parental education levels and migration background [12]. Children from economically disadvantaged backgrounds have a higher incidence of caries, influenced by limited access to dental care and parental education level (13,14). According to WHO (2021), early childhood caries affects more than 530 million children worldwide. In Ecuador, previous studies have shown a high prevalence of caries, with approximately 79.4% in some groups [13]. Low family socioeconomic status and poor oral health habits of parents contribute directly to the development of these pathologies [9].

The present study aims to evaluate the relationship between caries prevalence and sociodemographic factors in Ecuadorian children in Cayambe, using the ICDAS system, addressing an important gap in the regional scientific literature.

Materials and Methods

An observational, analytical, cross-sectional study was conducted in Cayambe, Pichincha, Ecuador, with children from 5 to 9 years of age from the "Remigio Crespo Toral" School. The research was approved by the CEISH-UNIANDES Ethics Committee (code 2024-EXT-OB-0015), applying data protection protocols.

The universe comprised 510 children, determining a sample of 229 participants using a finite population formula (confidence level 1.96, estimation error 0.05). Inclusion criteria: Children aged 5-9 years living in Cayambe, enrolled in the aftermentioned school, with informed consent signed by parents/guardians and their own assent. Exclusion criteria: Participants with neurological disorders, systemic or infectious diseases, or without informed consent.

The research team was calibrated through a standardization process conducted by an ICDAS-certified professional. The calibration included theoretical sessions, practical exercises and inter-examiner concordance evaluation. Carious lesions were recorded according to the ICDAS system, using codes from 0 to 6:

- Healthy surface (0)
- White/brown stain on dry enamel (1)
- White/brown stain on wet enamel (2)
- Enamel loss <0.5mm (3)
- Dark shade of dentin through enamel (4)

- Enamel/dentin loss >0.5mm but <50% of surface area (5)
- Extensive cavity >50% of surface (6)

For the analysis, these codes were grouped into four levels: healthy (code 0), initial injuries (codes 1-2), moderate injuries (codes 3-4) and severe injuries (codes 5-6).

Statistical analysis was performed using SPSS v26.0, including descriptive statistics, analysis of nutritional status using growth curves compared with WHO standards, and distribution of lesions according to ICDAS codes. Bivariate analysis used Chi-square to examine associations between sociodemographic factors and presence of caries ($p<0.05$). A multivariate logistic regression model was developed to identify factors associated with severe caries, expressing results as adjusted Odds Ratio with 95%CI.

Results

The population was evenly distributed by sex (52.40% male, 47.60% female), with a predominance of children born in Cayambe (51.53%). The predominant age group was 7-8 years (68.56%). The main caregiver was mostly the mother (74.67%), followed by the father (16.16%). The predominant educational level was completed secondary school (35.81%), followed by completed university (15.28%) and completed elementary school (14.41%).

In terms of housing, houses/villas (41.05%), shacks (20.52%) and apartments (19.65%) predominated, with materials such as brick/block (82.53%) and ceramic/tile/vinyl floors (61.57%). There was high access to internet (91.70%) and refrigerator (90.83%), while 58.95% had social security IESS/ISSFA/ISSPOL.

Table 1: Sociodemographic characteristics of the study population

Characteristics of the child			**Characteristics of the house**		
Sex	f	%	Type	f	%
Man	120	52.40%	House/Villa	94	41.05%
Woman	109	47.60%	Mediagua	47	20.52%
Place of birth			Department	45	19.65%
Cayambe	118	51.53%	Room in tenement	42	18.34%
Quito	42	18.34%	Housing material		
Ibarra	36	15.72%	Brick or block	189	82.53%
Others	33	14.41%	Concrete	35	15.28%
Age groups			Adobe/Tapia	5	2.18%
7-8 years	157	68.56%	Floor material		
5-6 years	36	15.72%	Ceramic/Tile/Vinyl	141	61.57%
9 or more years	36	15.72%	Brick or cement	62	27.07%
Caregiver information			Others	26	11.35%
Relationship			Basic services and technology		
Mother	171	74.67%	Services and infrastructure		
Father	37	16.16%	Internet	210	91.70%
Grandmother	9	3.93%	Refrigerator	208	90.83%
Others	12	5.24%	Washing machine	161	70.31%
Level of education			Kitchen with oven	158	69.00%
High school completed	82	35.81%	Conventional telephone	30	13.10%
Full university education	35	15.28%	Electronic devices		
Completed elementary school	33	14.41%	Television	195	85.15%
Incomplete university	32	13.97%	Laptop computer	97	42.36%
Incomplete high school	23	10.04%	Desktop computer	80	34.93%
Incomplete elementary school	21	9.17%	Sound equipment	96	41.92%
No education	3	1.31%	Socioeconomic indicators		
Marital status			Insurance and services		
Married	114	49.78%	IESS/ISSFA/ISSPOL Insurance	135	58.95%
Single	101	44.10%	Private insurance	31	13.54%
Divorced	7	3.06%	Shopping in malls	65	28.38%
Others	7	3.06%			
Age group					
18-24 years old	112	48.91%			
25-34 years	60	26.20%			
35-44 years	28	12.23%			
45-54 years	15	6.55%			
55 years of age or older	14	6.11%			

Nutritional status

The growth curves showed a tendency to overweight at early ages (5-6 years) (Figure 1), with values between the 85th and 97th percentiles of the WHO curves. This trend normalized around 7 years of age, approaching the 50th percentile, and then showed a new increase towards the 85th percentile at 8 years of age. At 9 years of age there was a drop below the 50th percentile.

Children

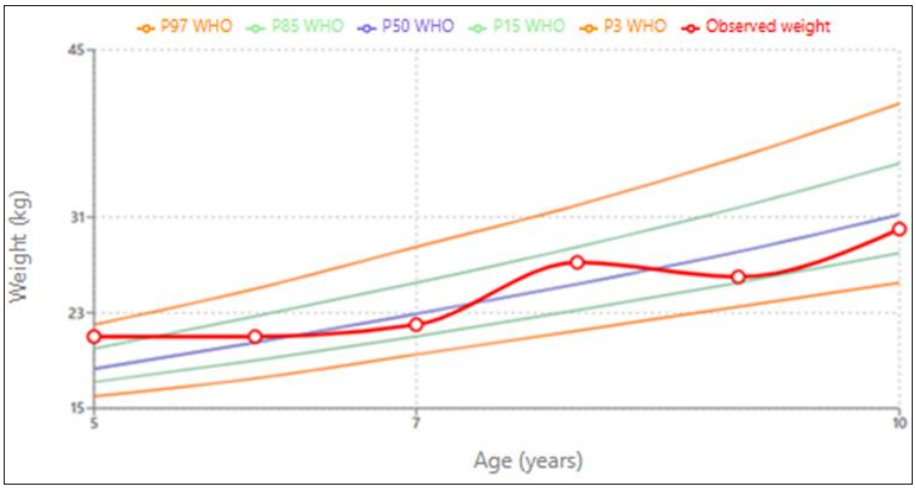
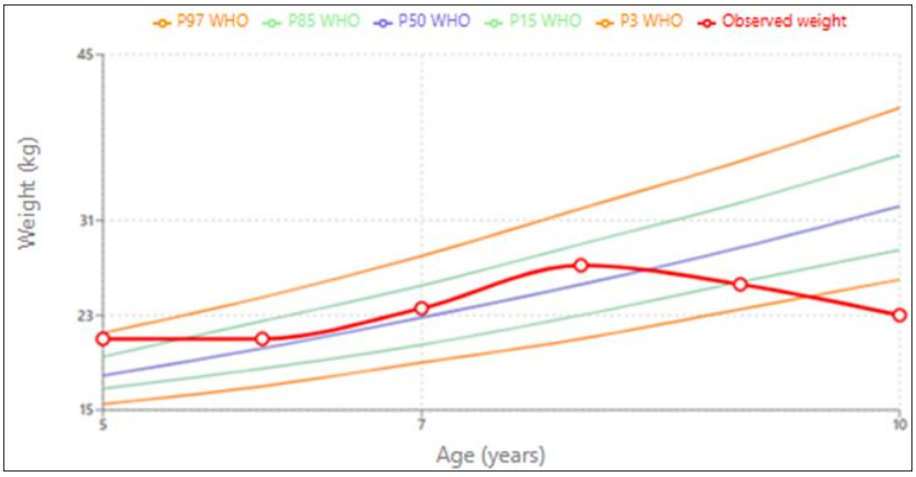


Fig 1: Population growth curves

Girls



Caries severity analysis (ICDAS)

The distribution of lesions showed that 54.22% of the surfaces presented initial lesions, while only 16.90% remained healthy. Moderate and severe lesions represented 17.85% and 11.04% respectively.

The detailed breakdown (Table 2) showed a predominance of distinctive visual changes in enamel (code 2: 32.85%) and first visual changes (code 1: 21.37%). Moderate lesions were distributed between localized enamel breaks (12.55%) and underlying dark shadows (5.30%). Severe lesions included distinct (6.31%) and extensive (4.73%) cavities, both with visible dentin.

Table 2: Detailed breakdown by code

Code	Description	f	%
0	Healthy tooth surface	268	16.90%
1	First visual change in enamel	339	21.37%
2	Distinctive visual change in enamel	521	32.85%
3	Localized enamel breakage	199	12.55%
4	Underlying dark shadow	84	5.30%
5	Distinct cavity with visible dentin	100	6.31%
6	Extensive cavity with visible dentin	75	4.73%

Comparing dentitions, the primary dentition (1,192 surfaces) showed heterogeneous distribution with a predominance of initial lesions (48.66%), and significant presence of moderate (21.06%) and severe (14.51%) lesions. The permanent dentition (394 surfaces) showed a more favorable pattern, with a predominance of initial lesions (71.07%), a higher proportion of healthy surfaces (20.30%), and minimal severe lesions (0.50%).

Table 3: General distribution of injuries

Severity level	ICDAS codes	f	%
Healthy	0	268	16.90%
Initial injuries	1-2	860	54.22%
Moderate injuries	3-4	283	17.85%
Severe injuries	5-6	175	11.04%

The correlation between ICDAS index and socioeconomic variables showed moderate negative associations with educational level of the caregiver (rs=-0.452, p=0.001), family income (rs=-0.386, p=0.003) and access to services (rs=-0.324, p=0.008).

Table 4: Correlation of ICDAS indices and socioeconomic variables

Variable	Spearman Coefficient	p
Educational level of the caregiver	-0.452	0.001*
Family income	-0.386	0.003*
Access to services	-0.324	0.008*

*p<0.05 significant

Table 5: Comparison of ICDAS involvement by type of dentition

Code	Description	Temporary (%)	Permanent (%)	Severity level
0	Healthy tooth surface	268	16.90%	Healthy
1	First visual change in enamel	339	21.37%	Initial
2	Distinctive visual change in enamel	521	32.85%	Initial
3	Localized enamel breakage	199	12.55%	Moderate
4	Underlying dark shadow	84	5.30%	Moderate
5	Distinct cavity with visible dentin	100	6.31%	Severa
6	Extensive cavity with visible dentin	75	4.73%	Severa
Total, of evaluated surfaces		1192	394	

Analysis of sociodemographic factors

Bivariate analysis showed significant associations between presence of caries and educational level of the caregiver (X^2=15.43, p=0.001), type of housing (X^2=12.76, p=0.005), access to basic services (X^2=10.92, p=0.012) and health insurance affiliation (X^2=9.84, p=0.023). The logistic regression model identified as factors associated with severe caries: low educational level of the caregiver (OR=2.84, IC95%:1.86-4.32, p=0.001), poor housing (OR=1.92, 95%CI:1.24-2.98, p=0.008), lack of health insurance (OR=1.76, 95%CI:1.15-2.69, p=0.015) and limited basic services (OR=1.68, 95%CI:1.12-2.52, p=0.018).

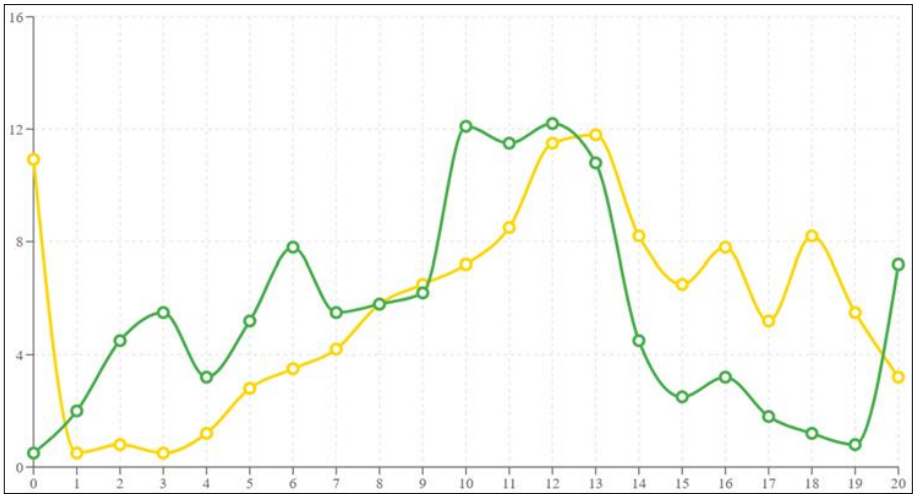


Fig 2: Percentage of girls/boys by specific number of healthy teeth (primary and permanent)

Number of pieces

-o-Temporal Healthy -o- Definitive Healthy

Discussion

The severity distribution according to ICDAS, with 54.22% of early lesions and only 16.90% of healthy surfaces, reveals a worrying situation in terms of public health, in agreement with similar patterns reported by (11) in other Ecuadorian regions. This high proportion of early lesions represents an opportunity for preventive interventions, as pointed out by (15).

The marked difference between primary dentition (14.51% severe lesions) and permanent dentition (0.51% severe lesions) could be explained by longer exposure to risk factors, structural differences in enamel mineralization, more challenging oral hygiene patterns in younger children and socioeconomic variables that affect access to early preventive care, findings consistent with (5).

The educational level of the caregiver emerged as a crucial determinant (OR=2.84), supporting previous research such as (16) on the influence of parental education on children's oral health. The negative correlation between educational level and caries severity (rs=-0.452) shows that education acts as a significant protective factor.

Housing conditions and access to basic services also showed significant associations with severe caries. Poor housing increased the risk almost twice (OR=1.92), while limited access to basic services showed significant negative correlation (rs=-0.324), consistent with (17). Health insurance affiliation proved to be a significant protective factor, consistent with (18).

Clinical implications

The high proportion of initial lesions (54.22%) suggests prioritizing preventive interventions such as fluoride varnish application and dental sealants, especially in primary dentition where severe lesions are more common (3) (19)

The impact of caregiver education level (OR=2.84) indicates the need to incorporate educational sessions during consultations, focusing on oral hygiene techniques and reduction of sugar consumption (20)(21). At the community level, the results underscore the need for programs that address adverse socioeconomic conditions. Poor housing (OR=1.92) and limited access to basic services (rs=-0.324) could be mitigated by mobile dental visits and distribution of oral hygiene kits in schools (15).

Conclusions

This study showed that socioeconomic factors have a determining influence on the development of childhood dental caries, with the educational level of the caregiver being the most significant factor (OR=2.84, CI:1.86-4.32, p=0.001). This strong association suggests that interventions should consider not only clinical aspects but also the social and educational context of the families, providing adequate knowledge tools to the main caregivers.

The prevalence of caries assessed by ICDAS showed a high frequency of initial lesions (54.22%), with a marked

difference between primary dentition (14.51% severe lesions) and permanent dentition (0.51% severe lesions). This distribution reveals a crucial window of opportunity for early preventive interventions that could stop the progression of these lesions, especially in the primary dentition that showed greater vulnerability to severe conditions.

Adverse socioeconomic conditions were shown to have a significant impact on children's oral health. Poor housing almost doubled the risk of developing severe caries (OR=1.92, CI:1.24-2.98), while limited access to basic services showed a significant negative correlation with oral health (rs=-0.324, p=0.008). These findings reinforce the need for public policies that address social inequalities as an integral part of oral health strategies.

In clinical practice, these results have important implications that suggest a multifaceted approach to dental caries. Dentists should prioritize early detection using systems such as ICDAS, implement preventive interventions adapted to the type of dentition, incorporate educational components aimed at parents during consultations, and collaborate with other sectors to develop community programs that reach the most vulnerable families. Only through an approach that considers both clinical aspects and social determinants will it be possible to make effective progress in reducing this public health problem.

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