

# Early childhood caries and risk factors in young children of medium-low socioeconomic status, Ecuador

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## ABSTRACT

**Introduction.** Early childhood caries (ECC) is one of the most common infectious diseases for infants and preschool children.

**Objective:** To evaluate early childhood caries and risk factors associated with dietary practices and nutritional status in children of 10-48 months old.

**Materials and Methods:** A cross-sectional study was performed on 142 children of medium-low socio-economic status from a governmental child-care center in Cuenca, Ecuador. Dental health, nutritional status and dietary patterns were assessed through clinical examination, anthropometric measurements and 24-hours dietary recalls, respectively.

**Results:** Early childhood caries prevalence was high (95.8%) mostly of advanced stage (83.1%). No associations with nutritional status. Daily consumption of cariogenic foods was significantly higher during weekdays ( $11.1 \pm 1.4$ ) ( $p < 0.001$ ). The diet was categorized as low cariogenic risk ( $< 34$ ). Child's age (OR=1.1; 95% CI: 1.041, 1.160,  $p = 0.001$ ) and the plaque index (OR=4.9; 95% CI: 1.331, 17.82;  $p = 0.017$ ) were positive determinants for advanced caries.

**Conclusions:** The deteriorated dental health of this population was evidenced, being worse at older ages without any association with dietary patterns.

**Key words:** dental caries, nutritional status, child, diet, cariogenic agents.

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### Citar este artículo así:

Parra-Coronel J, Astudillo-Neira D, Ortiz-Ulloa J. Early childhood caries and risk factors in young children of medium-low socioeconomic status, Ecuador. *Revista Investig Salud Univ Boyacá*. 2020;7(1): 52-70. doi: <https://doi.org/10.24267/23897325.451>

## Caries de la temprana infancia y factores de riesgo en niños de nivel socioeconómico medio-bajo, Ecuador

### RESUMEN

**Introducción:** La caries de la temprana infancia (CTI) es una de las enfermedades infecciosas más comunes en infantes y niños preescolares.

**Objetivo:** Evaluar la caries de la temprana infancia y los factores de riesgo asociados con prácticas dietarias y el estado nutricional en niños de 10-48 meses de edad.

**Materiales y Métodos:** Se realizó un estudio transversal en 142 niños de nivel socioeconómico medio-bajo de un centro infantil gubernamental en Cuenca, Ecuador. La salud dental, estado nutricional y patrones dietarios se evaluaron mediante exámenes clínicos, mediciones antropométricas y recordatorios de 24 horas, respectivamente.

**Resultados:** La prevalencia de caries de la temprana infancia fue alta (95.8%) mayoritariamente en etapa avanzada (83.1%). No se observaron asociaciones con el estado nutricional. El consumo diario de alimentos cariogénicos fue significativamente mayor entre semana ( $11,1 \pm 1,4$ ) ( $p < 0,001$ ). La dieta fue categorizada como de bajo riesgo cariogénico ( $< 34$ ). La edad del niño ( $OR = 1.1$ ; IC 95%: 1.041, 1.160,  $p = 0.001$ ) y el índice de placa ( $OR = 4.9$ ; IC 95%: 1.331, 17.82;  $p = 0.017$ ) fueron determinantes positivos de caries avanzada.

**Conclusión:** El deterioro de la salud dental de esta población se evidenció, empeorando a edades mayores sin asociación con los patrones dietarios.

**Palabras clave:** caries dental, estado nutricional, niño, dieta, agentes cariogénicos.

## Cárie na primeira infância e fatores de risco em crianças de nível socioeconômico médio-baixo, Equador

### RESUMO

**Introdução.** A cárie da primeira infância (CPI) é uma das enfermidades infecciosas mais comuns em crianças pre-escolares.

**Objetivo:** Avaliar a cárie da primeira infância e fatores de risco associados com práticas dietárias e estado nutricional de crianças de 10-48 meses.

**Materiais e métodos.** Realizou-se um estudo transversal em 142 crianças de nível socioeconômico médio-baixo do centro infantil governamental em Cuenca, Equador. A saúde dental, estado nutricional e padrões dietários se avaliaram mediante exames clínicos, medições antropométricas e lembretes de 24 horas respectivamente.

**Resultados:** A prevalência de cárie da primeira infância foi alta (95.8%) principalmente em estágio avançado (83.1%). Não se observaram relações com o estado nutricional. O consumo diário de alimentos cariogênicos foi significativamente maior entre semana ( $11,1 \pm 1,4$ ) ( $p < 0,001$ ). A dieta foi categorizada como de baixo risco cariogênico ( $< 34$ ). A idade das crianças ( $OR = 1.1$ ; IC 95%: 1.041, 1.160,  $p = 0.001$ ) e o índice de placa ( $OR = 4.9$ ; IC 95%: 1.331, 17.82;  $p = 0.017$ ) foi determinante em cárie avançada positiva.

**Conclusão:** O deterioro da saúde dental dessa população se evidenciou, piorando as idades mais velhas sem relação com os padrões dietários.

**Palavras-Chave:** cárie dental, estado nutricional, criança, dieta, agente cariogênicos

## INTRODUCTION

Early childhood caries (ECC) is one of the most common infectious diseases affecting dentition of 60-90% of infants and preschool children (1). In addition, ECC is considered a good marker of social inequalities, being a common health problem among vulnerable communities such as indigenous and ethnic minority groups (2). In Latin America, ECC prevalence fluctuates between 44-93 % (3-6). ECC is mainly a result of the presence of bacterial plaque in combination with other factors such as deficient oral hygiene practices, lack of knowledge of the parents and child caring personnel and deprived socioeconomic conditions (7-10). Moreover, cariogenic diet is one of the major etiological factors of ECC.

The cariogenic risk increases according to food pH, adhesiveness, consistency, occasion and frequency of consumption of cariogenic foods (11-13). In addition, the contribution of breastfeeding to ECC development is controversial (14). Some reports have suggested prolonged and nocturnal breastfeeding as risk factor of ECC (15-17) yet relatively few cohort studies have examined potential dietary risk factors at this age. This study aimed to investigate the associations between feeding frequency at age 12 months and caries prevalence at age 3 years. Methods: In this prospective birth cohort of 345 Brazilian children, all foods and drinks consumed at age

12 months, including bottle-use and breastfeeding, were recorded using two 24-hour infant dietary recalls with mothers. The prevalence of early childhood caries (ECC, meanwhile others have not observed such negative dental effects (18). Considering the lack of evidence, actions towards dental caries prevention are only limited to suggest less frequent breastfeeding intervals once complementary foods have been introduced (15) yet relatively few cohort studies have examined potential dietary risk factors at this age. This study aimed to investigate the associations between feeding frequency at age 12 months and caries prevalence at age 3 years. Methods: In this prospective birth cohort of 345 Brazilian children, all foods and drinks consumed at age 12 months, including bottle-use and breastfeeding, were recorded using two 24-hour infant dietary recalls with mothers. The prevalence of early childhood caries (ECC).

The assessment of the oral health status is the first step for health planners according to the goals of the World Health Organization (WHO) set by 2020 (19). In Ecuador, few studies on ECC have been performed reporting rates up to 52% (20). The design of regional ECC prevention programs requires research evidence on risk factors associated to this public health problem. In order to contribute to this evidence, this study aimed to evaluate the prevalence and severity of ECC and the risk factors associated with dietary practices

and nutritional status in infants and preschool children from 10 to 48 months old in Cuenca, Ecuador.

## MATERIAL & METHODS

The observational study was based on a descriptive cross-sectional design. It was conducted between May 2013 and December 2014 in 142 children of 10-48 months old enrolled at the governmental Child Care Centre (CCC) "Perpetuo Socorro", located in the urban area of Cuenca, Ecuador. All children were eligible, except for those under dental treatment at the time of the study or prolonged antibiotic treatment, and to present tooth enamel defects, mental disabilities and systemic diseases.

Socioeconomic status was assessed applying a survey of the National Institute of Statistics and Censuses of Ecuador (21). Anthropometric measurements were taken in duplicate by trained personnel following standardized methods (22). Weight was measured using an electronic scale SECA model 803 (Hanover, USA) with an accuracy of 0.1 kg. Infant length was measured with a length board SECA model 210 (Hanover, USA) and height of older children was measured using a stadiometer HEALTH-O-METER model Portrod (Alsip, USA), both with an accuracy of 0.1 cm. Z-scores for length-for-age (LAZ), weight-for-age (WAZ) and BMI-for-age were calculated using

the WHO 2006 growth standard references (23) and stunting, underweight and overweight were defined following the WHO criteria (24).

To assess dietary patterns and cariogenic foods, parents and home caregivers were surveyed. Information about bottle foods (type and utensils) and added sugar was assessed based on the recommendations of Becerra et al (1,25). Habitual dietary intake was determined by two 24-hours recalls applied on a week and weekend days to the caregivers. Quantification of consumption amounts was performed by comparison with a standardized kit of household containers (26). Food recipes (ingredients, quantities and preparation) served at the CCC followed a set menu that was obtained from the staff. In addition, ingredients were weighted during food preparation as well as the portion served to the child. Information of food recipes received at home was collected from the parents. Food cariogenicity was categorized based on consistency, occasion and frequency of consumption (12,27). For consistency, individual foods and/or recipes were classified by their moisture content as dry (0-25%), semi-humid (25.1-62.5%) and humid (62.6-100%) (3,11). Foods were also classified according to the moment of consumption, i.e. periods with an interval of at least 2 hours of fasting to allow recovering a normal pH of the saliva (25). Moments of consumption at the CCC were defined as consumption at arrival (around 08h00 to 09h00), at

mid-morning (10h00-11h00), at lunch (11h30-12h30) and at mid-afternoon (15h00-16h00). Moments of consumption outside the CCC corresponded to the period from the exit of the CCC to the arrival next day. Foods were classified according to the frequency of consumption based on the cariogenic potential value (CAP). This was determined using a daily-consumption frequency survey based on a list of foods containing fermentable sugars which lead to a pH decrease, enamel demineralization and proliferation of cariogenic bacteria (12,27). The individual cariogenic potential value (CAP) score was calculated using the formula  $CAP = (A \times B) + (A \times C)$  (12,27), being A the consumption (sugary drinks, unsweetened masses, candies, sugary masses, sugar); B the frequency (0: no consumption; 1: consumption of two or more times a week, 2: consumption once a day, and 3: consumption twice or more times a day), and C the occasion (1: cariogenic foods consumption during meals time, and 5: if the consumption was between meals). Based on the CAP scores, cariogenic risk was categorized as low (10-33); moderate (34-79), and high (80-144) (12,27).

Oral-dental examination was carried out by last-year Dentistry students under continuous supervision of the researchers that acted as external observers. Followed methods were validated according to WHO criteria (4,28), and an intra- and extra-observer concordance of 0.80 of Kappa

index was obtained (5,29). Dental examination was performed through clinical observation and exploration with natural light (30) using a standardized diagnostic kit containing a flat mirror # 5, blunt browser (Medro-german brand), and a WHO periodontal probe (Proclinc) Michigan calibrated with a 0.5 mm sphere. Children were examined in dorsal-decubitus position, using the knee-knee technique for younger children. After examination, dental plaque was removed with sterile gauze or dental brushing according to the child's age and their collaboration. Flossing was also performed. Löe Silness plaque index (PII) was evaluated after a relative isolation for caries risk categorization (31). Oral cavity was divided into six parts and the free surfaces were inspected: (5-5) (6-1) (6-4) (7- 5) (8-1) (8-4). Tooth in eruption process was discarded from the examination and it was substituted by the contiguous tooth. If one of the target teeth for evaluation was absent, if was subtracted from the total number of surfaces considered for PII calculation. Values assigned to the presence of plaque were 0 (no plaque), 1 (no visible plaque but evidenced with the explorer), 2 (visible plaque) and 3 (visible plaque around the tooth). PII was obtained dividing the total surface score by the total number of surfaces evaluated (4 surfaces x number of teeth). A PII greater than or equal to 1 is considered a caries risk (32).

Presence of dental caries was evaluated according to the clinical criteria of ECC of the Ame-

rican Academy of Paediatric Dentistry (AAPD) (33) and the International Caries Detection and Assessment System (ICDAS II) (30). ICDAS II diagnosis criteria consider 6 codes: code 0 (sound tooth surface or no evidence of caries after air drying for 5 seconds; surfaces with developmental defects); code 1 (first visual change in enamel characterized as carious opacity or discoloration -white or brown lesion-); code 2 (surfaces with carious opacity -white spot lesion- and/or brown carious discoloration in wet conditions), code 3 (superficial enamel loss of <0.5 mm or microcavity on dry enamel, without visible dentin); code 4 (dark dentin shade seen through wet enamel, with or without superficial enamel loss); code 5 (cavity with visible dentin >0.5mm up to 50% of the dental surface); and code 6 (extensive cavity more than 50% of the dental surface or crowns destroyed by caries) (34). Incipient or initial caries was defined as the sum of the codes 1 and 2; meanwhile codes 3-6 were considered as cavitated caries (35). Dental caries was also evaluated according to the AAPD criteria that define ECC as the presence of one or more surfaces with caries (cavitated or non-cavitated) or sealed/lost due to caries in children until 71 months old. Additionally, severe ECC was defined as any caries sign on smooth surfaces in children under 3 years-old, when one or more smooth surfaces of upper anterior primary teeth have cavitary lesions, sealed or lost by caries, or when the number of decayed, sealed or lost teeth due to caries was  $\geq 4$  teeth at

3 years-old,  $\geq 5$  at 4 years-old and  $\geq 6$  at 5 years-old (36).

Descriptive analysis was applied to present the distribution of the participants according to age and sex, nutritional status according to sex, and dietary patterns and dental health according to the child's age. Chi-square tests for categorical variables, meanwhile two sided Student's t-test and analysis of variance were applied for continuous variables. Associations of the studied variables with caries were assessed through bivariate regression models. A linear regression model was used for the continuous ICDAS 3-6 score, whereas a logistic regression model was used for the binary outcomes of initial caries (ICDAS 1-2) and advance caries (ICDAS 3-6).

Data entry was done in duplicate using EpiData software 3.1 (EpiData Association, Odense, Denmark). Lucille food intake 0.1 program was used to process consumption data at individual and group levels, and at the level of total intake, by recipe and by ingredients (37) Data management and analysis were performed in Stata 10.0 (Stata Corporation, College Station, TX) setting statistical significance at p-value less than 0.05.

The study was approved by the Ethical Committee of the Faculty of Dentistry in Cuenca University (2012), Cuenca, Ecuador (Code number: UC-SFOD-2013-0033-M). After explaining the

objectives of the study to the CCC authorities, workers and to the parents/caregivers, signed informed consents were obtained prior to the execution of the study. At the end of the study, informative workshops about preventive health and dental hygiene measures were organized for the parents.

## RESULTS

The socioeconomic status of an initial population of 150 participants' households was categorized as 6.7% medium-high, 25.3% medium, 46% medium-low and 22% low. From it, 142 households decided to participate in the study. The main characteristics of the participants and nutritional status are presented in Table 1. The distribution according to the child's age categories and sex was not homogenous ( $p=0.004$ ). Regarding nutritional status, a relatively high prevalence of possible risk of overweight in female (17.7 %) and male children (23.8 %) ( $p=0.668$ ) was remarkable.

Child dietary practices according to age are presented in Table 2. The consumption of bottle foods (milk and substitutes) was diverse and varied according to the child's age ( $p=0.010$ ). Remarkably, cow's milk was the highest consumed beverage (80.4 %); while very low consumption of breastmilk mixed with cow's milk (8 %) and formula (1 %) was observed, which hindered its

**Table 1.** Main characteristics and nutritional status of the participants (n=142).

Characteristics	Pooled (n=142)	Male (n=80)	Female (n=62)	p-value
Child's age (months) (mean ± SD)	31.8 ± 10.4	30.7 ± 10.8	33.1 ± 9.7	0.169
10-23 months (%)	24.7 %	35 %	11.3 %	
24-35 months (%)	36.6 %	30 %	45.2 %	0.004
36-48 months (%)	38.7 %	35 %	43.5 %	
<b>Nutritional status</b>				
Length-for-age Z-score (mean ± SD)	-1.1 ± 1.1	-1.2 ± 1.2	-1.0 ± 0.9	0.245
Stunted (<-2SD) (%)	15.5 %	21.3 %	8.1 %	0.031
Weight-for-age Z-score (mean ± SD)	0.4 ± 0.8	-0.5 ± 0.9	-0.3 ± 0.8	0.153
Underweight (<-2SD) (%)	2.8 %	3.8 %	1.6 %	0.445
BMI-for-age Z-score (mean ± SD)	0.5 ± 0.9	0.4 ± 0.9	0.5 ± 0.9	0.771
Possible risk of over- weight (1-2SD) (%)	21.1 %	23.8 %	17.7 %	0.668
Overweight (2-3SD) (%)	4.2 %	3.8 %	4.8 %	

Fuente:



further assessment. The utensils used for bottle foods were also diverse but not significantly different according to age ( $p=0.063$ ). Caregivers referred that almost all children (92%) surpassed the global recommendation of limiting sucrose intake to maximum three times a day (38). This sugar consumption showed a slight but not significant increase according to age ( $p=0.118$ ). In addition, most children received foods with added sugar at night, independently of the child's age (84 %,  $p=0.885$ ). Daily consumption of cariogenic foods was significantly different between weekdays ( $11.1 \pm 1.4$  foods) compared to the intake during the weekends ( $7.5 \pm 1.8$  foods) ( $p<0.001$ ). Even though, consumption patterns based on food consistency were similar and considered of low cariogenicity. Watery foods were the most consumed (73.3 % weekday and 64 % weekend) followed by soft foods (19.8 % weekday and 26 % weekend) without differing significantly according to the child's age ( $p=0.454$  and  $p=0.323$ , respectively). Moreover, the CAP of the weekdays' diet ( $33.4 \pm 17.3$ ) was also significantly higher than the CAP of the weekends' diet ( $28.2 \pm 16.6$ ) ( $p=0.011$ ). However, this was predominantly categorized as low. The number of moments of consumption of cariogenic foods also differed significantly according the main care place of the child, i.e. weekday ( $5.1 \pm 0.7$ ) vs. weekend ( $4.3 \pm 0.9$ ) ( $p<0.001$ ), being similar across age categories ( $p=0.495$  weekday and  $p=0.796$  weekend).

The dental health was assessed according to the child's age and these results are presented in Table 3. The prevalence of ECC was remarkably high (95.8%). Most children (83.1%) presented advanced caries (ICDAS 3-6). Initial caries decreased statistically according to age ( $p=0.004$ ), from 33.3 % in the youngest children (10-23 months) to 5.6% in the oldest group (36-48 months). This matched with the gradual increase of advanced caries prevalence. Code 2 was the most abundant lesion ( $6.2 \pm 5.4$ ) followed by code 3 ( $3.3 \pm 3.3$ ) that increases significantly according to the age ( $p=0.029$  and  $p=0.0001$ , respectively). In average, two dental surfaces with serious deterioration were observed in children from 10-35 months old, and three surfaces in children from 36-48 months old. Gradual increase of dental surfaces with non-cavitated and cavitated caries was also dependent of the child's age, reaching an average of  $7.1 \pm 6.4$  and  $11.1 \pm 9.8$  surfaces at 36-48 months old, respectively.

**Table 2.** Child dietary practices according to age categories.

Characteristics	Pooled (%)	10-23 mo (%)	24-35 mo (%)	36-48 mo (%)	p-value
<b>Bottle foods given at home (n=138)</b>					
Cow's milk	80.4	70.6	82.4	84.9	
Human and cow's milk	8	23.5	3.9	1.9	
Soy and cow's milk	8	2.9	11.8	7.6	
Formula	1.5	0	0	3.8	0.010
Formula and cow's milk	1.5	0	2	1.9	
Formula and human milk	0.7	2.9	0	0	
<b>Utensil used for bottle foods (n=138)</b>					
Cup	61.6	47.1	68.6	64.2	
Cup and bottle	32.6	35.3	29.4	34	
Cup and breast feeding	3.6	11.8	2	0	0.063
Cup, bottle and breast feeding	1.5	2.9	0	1.9	
Bottle and breast feeding	0.7	2.9	0	0	
<b>Sugar intake throughout the day (n=138)</b>					
2 times	2.2	5.9	2	0	
3 times	5.8	11.8	5.9	1.9	0.118
> 3 times	92	82.3	92.1	98.1	
<b>Sugar added at night (n=117)</b>					
Yes	84.8	82.4	86.3	84.9	0.885
<b>Daily consumption of cariogenic foods during weekday (mostly at the care centre) (n=121)</b>					
Total number of foods (mean ± SD)	11.1 ± 1.4	11.3 ± 1.7	10.9 ± 1.4	11.1 ± 1.2	0.454
Dried foods (0-25 %H)	6.9	5.3	7.0	7.7	
Soft foods (25-62.5 %H)	19.8	22.8	20.0	18.8	
Watery foods (62.5-100 %H)	73.3	71.9	73.0	73.5	

Characteristics	Pooled (%)	10-23 mo (%)	24-35 mo (%)	36-48 mo (%)	p-value
<b>Daily consumption of cariogenic foods during weekend (at home) (n=121)</b>					
Total number of foods (mean ± SD)	7.5 ± 1.8	7.9 ± 1.7	7.3 ± 1.9	7.3 ± 1.7	0.323
Dried foods (0-25 %H)	10	13	8	10	
Soft foods (25-62.5 %H)	26	25	27	25	
Watery foods (62.5-100 %H)	64	62	65	65	
<b>Daily CPV – recall from weekday (mostly at the care centre) (n=142) (mean ± SD)</b>					
Low (<33)	52.8	48.6	53.9	54.6	
Medium (34-79)	46.5	51.4	46.2	43.6	0.731
High (80-144)	0.7	0	0	1.8	
<b>Daily CPV – recall from weekend (at home) (n=142) (mean ± SD)</b>					
Low (<33)	64.8	77.1	61.5	60	
Medium (34-79)	35.2	22.9	38.5	40	0.209
High (80-144)	-	-	-	-	
<b>Moments of consumption of cariogenic foods</b>					
During weekday (mostly at the care centre) (n=103) (mean ± SD)	5.1 ± 0.7	5.1 ± 0.7 24 %	5.2 ± 0.7 34 %	5.1 ± 0.6 42 %	0.495
During weekend (at home) (n=105) (mean ± SD)	4.3 ± 0.9	4.2 ± 0.7 26 %	4.3 ± 0.9 35 %	4.4 ± 0.9 39 %	0.796

**Table 3.** Dental health of the participants according to age categories (n=142).

Characteristics	Pooled (n=142) (%)	10-23 mo (n=35) (%)	24-35 mo (n=52) (%)	36-48 mo (n=55) (%)	p-value
<b>Early childhood caries by ADA</b>					
Healthy children	4.3	14.3	0	1.8	0.003
Severe caries	95.8	85.7	100	98.2	
<b>Early childhood caries by ICDAS 1-6</b>	95.8	85.7	100	98.2	0.003

Characteristics	Pooled (n=142) (%)	10-23 mo (n=35) (%)	24-35 mo (n=52) (%)	36-48 mo (n=55) (%)	p-value
Initial caries (ICDAS 1-2)	16.9	33.3	19.2	5.6	0.004
Advanced caries (ICDAS 3-6)	83.1	66.7	80.8	94.4	
ICDAS 0 (n=6) <sup>a,b</sup>	42.0 ± 29.9	32.8 ± 22.0	-	88 <sup>c</sup>	-
ICDAS 1 (n=66)	1.6 ± 2.5	0.5 ± 1.2	2.0 ± 3.0	1.8 ± 2.5	0.015
ICDAS 2 (n=128)	6.2 ± 5.4	4.1 ± 4.4	6.7 ± 4.4	7.1 ± 6.4	0.029
ICDAS 3 (n=104)	3.3 ± 3.3	1.8 ± 2.9	3.0 ± 2.8	4.6 ± 3.4	0.0001
ICDAS 4 (n=43)	0.7 ± 1.4	0.4 ± 1.1	0.8 ± 1.5	0.8 ± 1.3	0.314
ICDAS 5 (n=47)	0.9 ± 1.6	0.6 ± 1.5	0.8 ± 1.5	1.1 ± 1.7	0.265
ICDAS 6 (n=47)	2.3 ± 6.7	1.7 ± 6.0	1.8 ± 5.5	3.1 ± 7.7	0.498
Caries by dental surface and white spot	95.8	85.7	100	98.2	0.003
Number of surfaces with caries	7.8 ± 8.9	4.5 ± 7.4	6.5 ± 7.9	11.1 ± 9.8	0.0009
Number of surfaces with white spot	6.2 ± 5.3	4.2 ± 4.3	6.7 ± 4.4	7.1 ± 6.4	0.035
Löe -Silness plaque index (PII ≥ 1)	95.1	88.6	94.2	100	0.048

a ICDAS values are presented as mean ± SD of number of dental surfaces.

b Number of children that presented a specific ICDAS value. A child could present more than one type of lesion.

c Unique value.

Associations of caries with anthropometric, dietary and dental health-related variables were assessed through bivariate regression models (Table 4). From all tested factors, they showed positive associations with ICDAS 3-6 scores were observed only with the Löe Silness plaque index ( $p=0.010$ ; 95% CI: 1.177, 8.666) and child's age ( $p=0.016$ ; 95% CI: 0.032, 0.306). High plaque index was the most important determinant for the occurrence of advanced caries (OR=4.9; 95% CI: 1.331, 17.82;  $p=0.017$ ). Moreover, most children showed caries risk (95.1%) with a significant

increase according to age ( $p=0.048$ ), rising up to 100% for children of 36-48 months old. The increment of the child's age was also a positive determinant for the occurrence of advanced caries (OR=1.1; 95% CI: 1.041, 1.160,  $p=0.001$ ). Besides, a multiple regression model was constructed with all demographic, nutritional status, dietary factors and plaque index (data not shown). In this adjusted model, child's age increment was the only statistical significant determinant for occurrence of advanced caries (OR=1.1; 95% CI: 1.036, 1.223,  $p=0.005$ ).

**Table 4.** Bivariate regression models for ICDAS 3-6 score (linear regression) and for advanced caries (ICDAS 3-6) (logistic regression) (n=136)

	ICDAS 3-6 score			Advanced caries		
	Coefficient	95% CI	p-value	Odds ratio (OR)	95% CI	p-value
Child age (months)	0.17	0.032; 0.306	0.016	1.1	1.041; 1.160	0.001
Female gender	-2.32	-5.113; 0.472	0.103	0.8	0.327; 1.980	0.637
BMI-for-age Z-score	-0.51	-2.089; 1.074	0.527	1.4	0.827; 2.336	0.214
Length-for-age Z-score	0.80	-0.651; 2.250	0.278	1.0	0.617; 1.567	0.942
Weight-for-age Z-score	0.27	-1.461; 2.008	0.755	1.2	0.714; 2.177	0.438
Löe Silness plaque index	4.92	1.177; 8.666	0.010	4.9	1.331; 17.82	0.017
Utensil used for bottle foods: Cup & bottle vs. Cup <sup>a</sup>	1.50	-0.282; 3.285	0.098	1.3	0.450; 3.580	0.652
Sugar intake throughout the day	3.71	-0.142; 7.555	0.059	2.3	0.869; 6.225	0.093
Sugar added at night	0.23	-3.762; 4.212	0.911	1.3	0.391; 4.361	0.665
Daily CPV - weekday	-0.002	-0.083; 0.078	0.950	1.0	0.973; 1.024	0.891
Daily CPV - weekend	0.016	-0.070; 0.101	0.713	1.0	0.982; 1.041	0.455
<b>Cariogenic foods:</b>						
Daily consumption - weekday						
Dried foods	1.38	-0.381; 3.150	0.123	1.3	0.711; 2.383	0.393
Soft foods	-0.035	-0.956; 0.886	0.940	0.9	0.703; 1.236	0.625
Watery foods	-0.009	-0.762; 0.745	0.982	1.1	0.845; 1.351	0.580
Daily consumption - weekend						
Dried foods	0.92	-0.580; 2.418	0.228	1.2	0.696; 1.969	0.552
Soft foods	0.29	-0.693; 1.265	0.565	0.8	0.571; 1.072	0.126
Watery foods	0.44	-0.233; 1.110	0.199	1.2	0.941; 1.525	0.143
Moments of consumption						
During weekday	0.42	-1.827; 2.670	0.711	1.1	0.470; 2.408	0.881
During weekend	0.39	-1.573; 2.357	0.693	1.5	0.791; 2.662	0.229

<sup>a</sup> Regression models were constructed for the most common utensils used for bottle foods: cup & bottle vs. solely cup (n=125)

## DISCUSSION

In this study, ECC and associated risk factors (nutritional status and dietary patterns) in Ecuadorian children were evaluated. High prevalence of ECC and Löe Silness plaque index evidenced the deteriorated dental health of the studied population. A similar ECC prevalence has been reported among studies carried out in different developing countries, particularly in vulnerable populations of low socio-economical level (39). Similarly to this study, a high ECC prevalence has been reported in the Peruvian Amazon region (97%) (40) and it was much higher than in other studies carried out in neighbor regions, such as in La Boquilla, Cartagena, Colombia (60%) (3); in Calbuco, Chile (53%)(5) and in Quito, Ecuador (52%) (20).

ECC occurrence has been previously associated to the number of teeth erupted, child's age, dietary habits and hygiene practices, as well as social and behavioural determinants such as use of bottle, ethnicity and socio-economic status (39)The increased severity of ECC at older ages has been reported in several publications (3,5,20,35,40). In the present study, the association of child's age with ECC was very remarkable. However, the particular occurrence of non-cavitated lesions (ICDAS 1-2) seemed to follow an opposite trend but it denoted lesions' worsening and a marked increment of cavitated lesions in older children. Irregular oral hygienic practices are also consi-

dered as critical risk factors in ECC development (41,42). This is even worsened with high frequency of sugary drinks intake at bedtime (42). Oral hygienic practices could not be successfully assessed in this study due to social constrains. When surveying, caregivers referred to follow the best practices while the opposite was evidenced by clinical examination. To avoid or diminish such social bias, more sensitive strategies to assess oral hygienic practices should be developed and tested.

Dietary habits, especially sugar intake, have an important impact in the development of ECC (11,17,43). It has also been reported that caries development is related to high carbohydrate-low fat diet intake (44). In particular, the influence of the frequent consumption of sucrose between main meals on the initiation and progression of ECC has been highlighted elsewhere (44); meanwhile cow's milk is considered the least cariogenic food (13). In general, the studied dietary practices were considered of low cariogenic risk and no association with ECC was observed. Nevertheless, the delivered diet at childcare center, which is very generic among different public and private care centers, could be improved since this was more cariogenic in comparison to the weekend practices (i.e. mainly at home).

In this study, dietary practices and nutritional status of young children of medium-low socio-economic status were assessed as risk factors of

early childhood caries. Advanced caries and white spot were determining epidemiological indicators in this child community. Furthermore, the diagnosis of incipient injuries allowed a complete assessment of dental health, which are not evident by using other indexes.

Child's age and plaque index were identified as determinants of advanced caries, meanwhile diverse aspects that define diet cariogenicity were not associated. Nevertheless, more cariogenic diets might impact considerably on the occurrence of advanced caries and it should be further assessed. Different strategies to improve oral hygiene and dietary practices should be designed and proposed to childcare centres, which are daily sharing school environments that could offer good opportunities to apply those strategies with closely parental involvement.

### ACKNOWLEDGEMENTS

The authors are grateful to the Faculties of Dentistry and Chemical Sciences of Cuenca University for their support to develop this study. We are also grateful with the thesis students that contributed with data collection.

### DECLARATION OF CONFLICT OF INTEREST

The authors hereby declare that there are not conflicts of interest.

### FINANCIAL SUPPORT

This manuscript is a result of a non-financed supported research project.

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