Rev AMOP 37 (2), 2025, 22-27
DOI:https://doi.org/10.63609/n0ay4j25

Scoping Review of Early Childhood Caries Prevalence in Mexico

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Abstract

Background. Dental caries during childhood has been identified as a widespread public health problem due to its high prevalence, impact on quality of life, potential for increased risk of caries in the permanent dentition, and its negative role in general health. Although largely preventable, more effective prevention strategies are still required. In Mexico, a great variation of prevalence has been reported from 22.1% to 77.2%. Thus, we performed a scoping review to identify the prevalence of ECC in Mexico. **Study design:** A search was performed in PubMed, Scopus, Latin American and Caribbean Health Sciences Literature (LILACS), Medigraphic, and EBSCO from 2000 to 2021. A total of 837 documents were identified, 43 full-text articles were assessed for eligibility, and 24 were included. **Results.** University clinics had the highest prevalence, 79.81%. Day Care Centers ranged from 17.9%-82.2% (mean = 64.3%). Risk factors included bottle content, ad-lib breastfeeding, mothers' caries index, and socioeconomic covariates. **Conclusions.** Early Childhood Caries (ECC) and Severe Early Childhood Caries (SECC) remain a health problem. High variability of prevalence was noted, with treatment centers presenting the highest rates. Future protocols should determine adequate sample sizes, ensure examiner calibration, and employ contemporary caries detection indices. The consistent global use of standardized criteria is essential.

Manuscrito recibido 20 de marzo de 2025.
Revisión aceptada 23 de agosto de 2025.

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Introduction

Early childhood caries (ECC) is a significant public health problem due to its high prevalence, the potential for increased risk of caries in the permanent dentition, and complications such as increased hospitalizations and emergency room visits, high treatment costs, loss of school days, diminished ability to learn, and affecting oral health-related quality of life.

It is considered the most common chronic disease in childhood, with a mean worldwide prevalence of 55% for children aged 4 years old and 63% for children aged 5 years old.

The American Academy of Pediatric Dentistry defines ECC as: "the presence of one or more decayed (non-cavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth" in a child under the age of six. " Severe early childhood caries (S-ECC) considers 1) any sign of smooth – surface caries in a child younger than three years of age, 2) from ages three through five, one or more cavitated, missing (due to caries), or filled smooth surfaces in primary maxillary anterior teeth, or 3) decayed, missing or filled score of greater than or equal to four (age three), greater than or equal to five (age four), or greater than or equal to six (age five)".

The Bangkok Global Summit on ECC (2019) described this problem as "common", often untreated cavitated lesions in preschool children have an impact on children's lives.

Common risk factors for ECC are identifiable, major contributing factors for its high prevalence are improper feeding practices, familial socioeconomic background, other risk indicators include: Type of microbiome[6], presence of candida albicans[7], frequent consumption of fermentable carbohydrates[8], bottle feeding with sugar containing liquids[9], breastfeeding on demand[10], developmental defects of enamel[1,11], nursing beyond the recommended age[12], socioeconomic status (SES)[13], body mass and nutrition[14], parental education and awareness[15], ethnicity· family size, and marital status[16], moderate to late preterm birth[17], and prenatal maternal cigarette smoking.[18]

Understanding the prevalence of a disease is crucial for improving our comprehension of its distribution, causation, and contributing factors. Such knowledge allows us to enhance public health policies and management strategies, which may contribute to improving people´s health. Understanding the epidemiology of ECC continues to be a challenge because of the different issues that affect its measurement, like the inconsistencies in the use of diagnostic criteria and the lack of reporting standards for quality assurance.[19] Its prevalence may fluctuate according to the diagnostic criteria and case definitions employed; consequently, the rigorous application of standardized defi-

nitions and diagnostic frameworks for the assessment of carious lesions is fundamental to ensuring methodological soundness and the overall validity of epidemiological investigations of this nature. [20]

In Mexico, the Health Department has performed Oral Health Surveys through the Sistema de Vigilancia Epidemiológica de Patologías Bucales [Epidemiological Surveillance System of Oral Pathologies] (SIVEPAB). Data on ECC from the Mexican government for 2018 indicates that oral exams were performed in all 32 states by 451 dental professionals following the guidelines from the Mexican health department. 11,977 oral exams were performed on children aged two to five years of age. 8,665 or 77.2% of them presented at least one decayed tooth. [21] For the 2022 SIVEPAB reports, a 73.2% prevalence was found from oral exams performed on 5090 children from 2 to 5 years of age. No explanation is offered for this 4% decline. As for SECC, a 41.2% prevalence is presented in a sample of 6,259 three to five years of children.[22]

Nevertheless, data from other regional studies in Mexico offer lower prevalence, ranging from 17.9% to 22.1% in samples of 1160 and 934 participants, respectively.[23,24] We assume that this great variation is the consequence of the lack of application of standardized methodology, such as caries index, examiner calibration, sample size determination, etc.

The purpose of the present scoping review was to assess ECC prevalence studies in Mexico for variations in definition, diagnostic criteria, and methodology.

Methods

Focused Question

To better understand the widespread prevalence of ECC and analyze reports from Mexico during the 2000 to 2021 period, this scoping review was performed following Arksey and O'Malley's recommendations.[25]

Eligibility Criteria

Scoping reviews aim to summarize existing evidence on a broad and complex theme, providing an overview of the existing body of literature. This scoping review analyses the various criteria used to recognize dental caries in the primary dentition, different research methodologies, the number of reports, and study sites for ECC prevalence in Mexico.[26]

The primary search term was "Early Childhood Caries in Mexico". Other keywords included "dental caries", "baby bottle tooth decay", "nursing caries", "caries in preschool children", all followed by "in Mexico". Associated terms included "epidemiology and prevalence". The search terms in Spanish were: "Caries de la infancia temprana en México, caries dental, caries de biberón, caries de la lactancia, caries en niños preescolares". The Spanish terms for the search were: "epidemiología y prevalencia". The study population was preschool children, younger than six years of age. Inclusion criteria in this review were: clinical trials, cross-sectional, and prospective. Studies in Spanish or English language, reporting diagnostic criteria for dental caries and both prevalence and dental caries appraised in children younger than six years of age. Exclusion criteria included: Case reports, reviews, and documents (guidelines/guidance/policies) about ECC, reports that did not indicate diagnostic criteria and/or proper methodology, case definition, or clinical exam performed by non-dental professionals.

Search Strategy

To identify studies, the following electronic databases were searched in February 2019: PubMed, Scopus, Latin American and Caribbean Health Sciences Literature (LILACS), Medigraphic, and EBSCO. The search strategy included Medical Heading Subject (MeSH) terms, similar and related terms, and free terms. The articles selected were published between 2000 and 2022. Data were extracted from the selected articles between February 2023 and May 2023. The literature search was independently conducted by two reviewers (JLRA and JLUC). Disagreements and discrepancies were resolved by consensus. Collected articles' titles and abstracts were carefully analyzed, excluding non-relevant studies. The full texts of all pertinent papers were reviewed by analyzing their findings and detecting, if possible, any similar studies that followed the inclusion criteria adopted. The search was complemented by the snowball technique.

Results

A total of 837 documents were identified after electronic (database) and manual searches. 795 studies were removed due to duplication and non-relevant themes based on the exclusion criteria. Forty-two studies remained for full-text assessment; 10 case reports were excluded, and another 8 lacked reporting on prevalence, age, gender of participants, or the type of examination criteria used. Consequently, data from 24 studies meeting the criteria were reviewed and summarized. (Fig. 1) Most of these studies, 16 in total, were published in Spanish, and 8 in English, between 2000 and 2020. The data originated from 10 out of 32 states.

Socioeconomic Status (SES) associations and ECC. Factors such as low SES, low parental education, bottle contents, and oral hygiene practices were evaluated in 10 studies.

Examination sites and ECC. Nurseries or Day Care Centers (public or private, 20 sites) were the most common examination sites; three reports came from university clinics, and one from a rural community. No significant gender differences were observed. Dental caries prevalence varied based on examination site: reports from university dental clinics showed a mean prevalence of 79.81%, while studies conducted in nurseries and Day Care Centers ranged from 17.9% to 82.2% (range = 64.3%).

Caries detection methods. The most common method was the visual-tactile exam using WHO criteria; some reports included detection of initial caries lesions (formerly known

as white spot lesions), and two studies used the ICDAS index. When the study objectives included perspectives beyond epidemiological data, such as "Determinants of oral health care related to the frequency and severity of dental caries in preschool children" or "Prevalence of early childhood caries and associated risk factors" (14 reports), caries prevalence ranged from over 50% in 9 reports to over 40% in 5 studies (Table 1 includes all 24 references). The mean number of lesions per child (dmft) was 2.68. Thirteen studies reported data on examiner calibration. (Table 1)

ECC was associated with various factors: Ten studies identified links between ECC and inadequate feeding and oral hygiene behaviors, as well as parental Socio-Economic Status (SES) and education. One study found an association with pacifier use and allergic rhinitis, which doubled the risk for dental caries development. No association was observed in four studies between overweight and ECC [27,33 35,38]. One report documented a decrease in dental caries prevalence and severity over an eleven-year interval in a preschool children from a low-income area; however, the prevalence and severity remained high [30] . A Mexican index for oral health related to quality of life (M-ECOHIS) was significantly associated with different stages of carious lesions. Several socioeconomic variables correlated with caries, indicating that specific risk indicators were linked to different stages of lesion progression. M-ECOHIS is reported as a useful tool to establish risk profiles [31] . The most common study type was cross-sectional descriptive, with an average sample size of 625 participants, ranging from 46 to 1,303. Convenience sampling was employed in 14 studies, probabilistic sampling in 6, while 4 did not specify the sampling method.

Discussion

In Mexico, as in other parts of the world, there is a lack of a clear case definition for ECC.

Therefore, a paucity of standard methodology for epidemiological research makes it difficult to compare the results of published papers. A difference in prevalence of ECC or SECC was observed depending on geographical location and examination site; university dental clinics had the highest prevalence values (79.81%) as compared to day care centers with a range of 64.3%. Ismail and Sohn observed that ECC prevalence varied from 2.1% in Sweden to 85.5% in rural China.[50] The figures reported in this review are considerably high. Whether the examination site difference may be explained by patients' caregivers' search for health services for a visible condition, such as ECC, remains to be determined.

Regardless of the carious lesion index used, ECC studies could be enhanced by including different elements for analysis, such as lesion activity, evaluating lesions that extended into the pulp, causing pain and abscesses that require urgent care, such as the PUFA index and/or a need for treatment, as in the CAST index [51,52]. Examiner calibration is mentioned in 13 of 22 studies in which might be interpreted as lower quality for data collecting and reporting. Ten studies showed an association between ECC and inadequate feeding and oral hygiene behaviors, as well as parental SES and education, which is in accordance with worldwide literature [53]. High *mutans streptococci* levels have been reported to be a strong risk indicator for ECC [54]. In this report, three publications, excluded from the final analysis, described microorganisms (MO) associated with ECC development utilizing different sampling and MO analysis, much like has been done previously in the literature.[55,56,57] One study found an association with pacifier use and allergic rhinitis, with more than double the risk of dental caries development [23], as has been reported by Wongkamhareng,[58] with a stronger relationship between allergic rhinitis than asthma to dental caries. As for overweight concerning dental caries in children, there appears to be no significant association after controlling for age, race, and poverty/income ratio. The four studies in this review did not observe such an association [28,33,35,38] consistent with reports from different countries.[60, 61] One study, not included in the review, analyzed alterations of cytokines in the saliva of children with dental caries and obesity and observed that overweight children have elevated levels of IL-6 and IL-8.[57] Some interest was observed with new directions in ECC research, such as its impact on quality of life. The Lara et al report showed that more extensive carious lesions negatively affect the quality of life, and several socioeconomic covariates were correlated with caries [31]. Public health concerns on issues such as maternal oral health, biological and social risk determinants show similar results from ECC research as in other parts of the world[62]. With a recent tendency trying to understand dental caries etiology beyond an exclusively diet-bacterial induced disease to a complex one with social and behavioral factors involved, such as family structure; where the larger the family size, the higher the birth rank of the child and the younger the parent's age at birth of the child the greater the risk of developing dental caries in preschool children.[63]

In many countries, dental caries has been declining since the late 1980s, while the prevalence of early childhood caries has remained rather steady. ECC is highly prevalent, worldwide data from several studies suggest a current prevalence between 10% and 15% in industrialized countries. The large variability of data available from this report cannot support specific prevalence numbers for ECC and SECC in Mexico. Nevertheless, they might likely affect over 50% of infants, which coincides with the SES status of almost half the population in Mexico [63] . A contributing factor may include the low rates of breastfeeding in Mexico as compared to Latin American countries [65] and among the members of the Organization for Economic Cooperation and Development.[66] Exclusive breastfeeding in infants has decreased from 21% in 2006 to 14% in 2012 [67]. In Mexico, a double burden of public health issues exists: obesity and micronutrient undernutrition. Preschoolers and school-age children consume the highest documented levels of calories from beverages as a proportion of total energy intake (27.8 and 20.7% respectively). Calories from beverages increased significantly from 1999 to 2006, while energy from non-beverage food calories remained constant.[68,69]

Table 1. Scoping Review of Early Childhood Caries Prevalence in Mexico

Author/Year	State	Sample size	Dx Criteria	Examiners' calibration Kappa	Prevalence %/Conclusions
Cuellar-González, *et al.*, 2000. [24]	Mexico City	934	DCC dmft	0.96 - 0.97 intra-interexaminer	22.0% - Parental lower education levels associated with caries. 77.9% of sample were caries free
Medina-Solís, *et al.*, 2004.[39]	Campeche	109	DCC dmft	> 0.85	11.9% - Tooth loss was higher compared to samples from Mexico and other countries.
Juárez López, *et al.*, 2006.[29]	Mexico City	189	DCC dmft	0.88	80.0% - No association between ECC and overweight and/or obesity.
Juárez López, *et al.*, 2010.[33]	Mexico City	373	University Clinic dmft	0.89	78.0% - No association between ECC and overweight and/or obesity.
Segovia-Villanueva, *et al.*, 2007. [29]	Campeche	1303	dmft	Not mentioned	44.1% - - Tooth decay associated to low SES, poor oral hygiene, attitude towards oral health and DDEs.
Vázquez-Nava, *et al.*, 2008. [23]	Tamaulipas,	1160	DCC dmfs	No mentioned	17.9% - Pacifier use and allergic rhinitis were associated with a higher risk for caries.
Irigoyen Camacho, *et al.*, 2008. [31]	México City	102	DCC dmft	0.88	42.2 and 34.9% - 11-year interval dental caries decreases in prevalence and severity, in low-income area. Mothers' high caries experience was associated with children's oral health.
Joya TC y Anaya M 2009.[32]	Mexico City	344	DCC dmft	0.80	65.0% - Parental occupation and level of education were related to children's caries index.
Montero Canseco, *et al.*, 2011. [34]	Mexico City	100	University Clinic dmft	0.80	78 % - ECC associated with the presence of biofilm in over 20% of surfaces. Late introduction to oral hygiene procedures.
Martina Luna 2011. [35]	State of Mexico	61	dmft	Not mentioned	54.0% Only undernutrition was associated with tooth decay.
Favela Ortiz *et al* 2012. [36]	Guadalajara	51	University Clinic dmft	Not mentioned	100.0% - ECC associated with breast feeing lenght, sugary bottel contgnts, pore oral hygiene and sugar snack ingested 2 or >/day.
Zúñiga Manríquez, *et al* ., 2013. [37]	Hidalgo	152	DCC dmft	0.90 - 0.82 intra-interexaminer	48.0% - No Association was observed between nutritional sttus and dental caries, a high need for oral health preventive and restorative programs.
García-Padilla, *et al.*, 2013.[38]	Jalisco	348	DCC Visual exam	Not mentioned	75.3% - High treatment needs, only 0.4 + 0.05 filled teet. No association between overweight and caries.
Aguilar-Ayala, *et al.*, 2014. [39]	Yucatán	63	DCC dmft	Not mentioned	35.0% - 73% prevalence of early caries lesions (formerly known as white spot lesion). Authors call for educational programs for parents and caregivers.
Molina-Frechero, *et al.*, 2015. [40]	State of Mexico	82	DCC dmft	> 0.86	69.5% - Caries experience was associated with poor oral hygiene and low SES.
Medina Aguilar, *et al.*, 2015. [41]	Jalisco	445	DCC dmft	Not mentioned	60.6% - Unrestored decayed teeth prevail over filled and extracted, high need for restorative care.
Ramírez Maldonado, *et al.*, 2016.[46]	Tamaulipas	164	DCC dmft	0.85	19.3% - Breast-fed infants from 6 to 48 months were caries free. Only 6% of sample was breast fed exclusively. Proper oral hygiene for most participants provided for the low ECC prevalence.
Caudillo Joya, *et al.*, 2019. [43]	Mexico City	344	DCC dmft	0.80	65.0% - Authors contend thath oral research should include social variables in order to better explain, undestand and promote oral health.
Guizar Mendoza, *et al.*, 2019.[44]	Guanajuato	292	DCC ICDAS	Not mentioned	98.0% - Severity of caries lesions was associated to caregiver's level of education, self-efficacy and a acriogenic diet.
Miguelena Muro, *et al.*, 2019.[45]	Mexico City	133	DCC dmft	Not mencioned	73.5% - ECC is highly prevalent and increases as participants age. No association was observed between ECC and body mass.
Olivas-Velazquez, *et al.*, 2019.[46]	Sinaloa	142	Rural community dmft	No mentioned	54.9% - Lesions were more prevalent as age of participants increased.
Santos Madrigal, *et al.*, 2021. [48]	Mexico City	213	DCC dfmt	Not mentioned	69.0% - Caries prevalence was asssociated to low SES and mother´s perception of orla health. Participants' mothers identified dental caries but not at early stages. Preventive strategies are needed, emphasizing the relevance of oral health in infants.
Lara JS, *et al.*, 2021.[31]	Jalisco	409	DCC ICDAS	0.73-0.84 intra e interexaminer	82.2% - Authors present an Oral Health-Related -Quality of life format for Mexican children. Various SES covariates correlated with caries. Particular risk indicators were associated with diferent stages of the caries process.
Martinez, *et al.*, 2021.[9]	Mexico City	136	DCC dmft	0.89	62.2% - Descriptive analysis of most affected teeth and surfaces.

Diagnostic criteria: dmfs (decayed, missing, filled, surfaces). ICDAS (International Caries Detection and Assessment System).
Dx – diagnosis. DCC – Day Care Center

The strengths of this scoping review are that it evaluated the variations in methodology and reporting of ECC over the past 20 years in Mexico using a reliable methodology. This study has limitations; the initial search was performed on academic databases, and some grey literature may have been left behind. This study summarizes the knowledge and identifies gaps in current methodology that affect our understanding of ECC prevalence in Mexico, as well as its burden. We could have smaller gaps in knowledge if protocols were developed and standardized for epidemiological research in Mexico.

When we encounter children with ECC, the first question that comes to mind is whether it was preventable. Data proves it is preventable. At least one systematic review suggests that there is a protective effect for ECC from prenatal oral health procedures performed on the expectant mother.[70] As clinicians with infants in our practices, we must understand the disease burden and how interventions impact it. However, we do not participate in how the state allocates resources for the prevention and management of the disease. Our main goal is to provide safe, effective, and compassionate care while guiding the family and child toward excellent oral health.

Conclusions

Based on this study's results, we offer the following conclusions

ECC and SECC have been studied consistently in Mexico in the last 20 years. Some very high-quality publications have appeared. There seems to be a need for standardized research. Nevertheless, some fine documents were excluded due to the focus of this project, but publications on microbiology and immunology were noteworthy findings.

The most commonly used criteria for ECC detection were the World Health Organization, and this might indicate a need for detecting early lesions.

Further information is needed regarding ECC etiology, particularly of social components, at-risk population, and population needs, as well as the effectiveness of caries preventive programs that need to be reassessed.

A specific prevalence of the infant population affected by ECC cannot be offered, however, as data from reviewed reports indicates it is acknowledged as extremely high.

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