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CARRERA DE ODONTOLOGÍA

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MOLAR: A DETAILED STUDY IN ECUADORIAN
PEDIATRIC POPULATION**

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TÍTULO DE ODONTÓLOGO**

AUTOR: LIZBETH SELENA VERDUGO GARCÍA

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Caries Experience in the First Permanent Molar: A Detailed Study in Ecuadorian Pediatric Population

Eleonor Vélez-León^a, Alberto Albaladejo^b, Patricia Pinos-Narváez^a, María Augusta Cordero-López^a, Katherine Cuenca-León^a, Selena Verdugo^d, María Melo^c.

^a Universidad Católica de Cuenca

^b Universidad de Salamanca

^c Universidad de Valencia

^d Ministerio de Salud Pública del Ecuador.

Corresponding author. Universidad Católica de Cuenca, Cuenca, 010107, Ecuador.

E-mail address: mvelezi@ucacue.edu.ec (E.Vélez-León).

RESUMEN

El presente estudio investiga la prevalencia y los factores asociados a la caries en los primeros molares permanentes (PMP) entre niños ecuatorianos de 8 a 12 años.

Métodos: Se utilizó el Sistema Internacional de Detección y Evaluación de Caries (ICDAS) para analizar datos de una muestra de niños, enfocándose en la distribución de caries en los PMP y su correlación con variables como la edad y la ubicación geográfica. El análisis estadístico incluyó pruebas de asociación como el test Chi-cuadrado y correlaciones para examinar las relaciones entre variables.

Resultados: Se encontró una alta prevalencia de caries en los PMP (60.5%), con una mayor incidencia en niños mayores y aquellos que residen en áreas rurales. Los molares inferiores fueron los más afectados, y se observaron asociaciones significativas entre la presencia de caries y la edad, la provincia y el entorno rural/urbano. El índice de dientes cariados, perdidos y obturados (CPOD) fue de 1.02 (DE = 0.8), con una mayor presencia de dientes tratados en niños de 10 y 11 años y más extracciones en la provincia de Morona Santiago. La prevalencia de caries aumentó con la edad y fue mayor en áreas rurales.

Conclusiones: La alta prevalencia de caries en los PMP destaca un desafío significativo en la salud oral de los niños ecuatorianos, enfatizando la importancia de intervenciones preventivas y tratamientos dirigidos para abordar este problema. El estudio también subraya la utilidad del sistema ICDAS para una evaluación detallada de la caries, aunque se recomienda cautela debido a la falta de datos sobre la efectividad de las intervenciones implementadas.

Palabras clave: Caries dental, molares permanentes, población pediátrica, Ecuador, sistema ICDAS

ABSTRACT

Aim: This study sought to ascertain the prevalence and factors linked to caries in the first permanent molars (FPM) among 8 to 12-year-old children in Ecuador.

Methods: A descriptive cross-sectional study was carried out; wherein dental caries was assessed in 1287 children utilizing the International Caries Detection and Assessment System (ICDAS). Furthermore, filled and missing teeth were evaluated using the Decayed, Missing, and Filled Teeth (DMFT) index.

Results: The findings revealed a notably high prevalence of caries (60.5%), correlating with factors such as age, province, and rural-urban setting. Specifically, dental caries exhibited higher prevalence among children residing in rural areas. The lower first molars were most affected, with considerable differences in caries prevalence between the upper and lower jaws.

Conclusion: The results underscored the significant oral health challenge posed by dental caries among Ecuadorian children, particularly emphasizing the susceptibility of the first permanent molars. The study concluded that early preventive interventions and targeted treatments are essential to address caries prevalence, especially within rural communities, in order to enhance oral health outcomes.

Keywords: Dental caries, molar, child, ICDAS, DMFT index, prevalence

1. Introduction

The first permanent molars (FPM), typically erupting between the ages of 6 and 7 years, play a pivotal role in maintaining proper masticatory function and dental facial aesthetics (Piovesan et al., 2013; Saber et al., 2018; Songur et al., 2019). Their emergence during an early phase of patient development, coupled with their irregular and intricate dental morphology, makes them particularly prone to early onset of dental caries, influenced by various factors such as consumption of carbohydrate-rich diets, poor oral hygiene practices, and parental lack of knowledge regarding FPM eruption timing. It is crucial to note that the first molars do not replace any primary teeth; rather, they erupt subsequent to the primary second molars, which may lead parents to mistakenly perceive them as spare teeth, resulting in predisposition to prior experiences of caries and challenges in hygiene and debris removal (Divaris, 2016; Jetpurwala et al., 2020; Songur et al., 2019).

The variability in the occurrence and seriousness of caries in the first permanent molars (FPM) has been extensively explored in numerous scientific investigations, revealing a broad spectrum of rates, ranging from 13.7% to 66.4% (Divaris, 2016; Jetpurwala et al., 2020). This diversity highlights the intricate array of factors influencing dental health within the population and underscores the need for comprehensive approaches to caries prevention and treatment. In the realm of oral health, comprehending the prevalence and severity of dental caries in the first permanent molars (FPM) holds vital importance at both individual and community levels (Chouchene et al., 2023; Jetpurwala et al., 2020; Siddiqui et al., 2021). However, the accuracy of diagnosis can significantly fluctuate based on the methodology employed. While the Decayed, Missing, and Filled Teeth (DMFT) index, established by the World Health Organization (WHO), has been widely utilized for assessing dental caries, it lacks the capacity to specifically inform clinical treatments based on lesion severity or individual patient risk (Arrow, 2008, 2009; Gudipani et al., 2022).

The evolution in dental caries assessment methodologies is clearly exemplified by comparing the DMFT index with the International Caries Detection and Assessment System (ICDAS) (Tellez & Lim, 2020; Wu et al., 2020). The DMFT, a longstanding standard for

over five decades, embodies a more traditional paradigm, centered on tallying teeth affected by caries, lost, or restored. Conversely, the ICDAS, emerging in the last decade, heralds a revolution in caries detection and management, advocating a comprehensive approach for early and meticulous evaluation of carious lesions. The preference for the ICDAS system over the DMFT is justified for several key reasons. Firstly, the ICDAS enables more precise and detailed detection and assessment of carious lesions in their nascent stages, facilitating early and potentially less invasive interventions. Unlike the DMFT, which primarily focuses on quantifying decayed, missing, and filled teeth without delineating between different stages of caries, the ICDAS provides a nuanced grading of the disease. This facilitates the adoption of more effective preventive and therapeutic management strategies based on the severity of dental caries. Moreover, utilizing ICDAS promotes standardization in caries assessment on an international scale, enhancing study comparability and fostering a more comprehensive global understanding of this pathology. Thus, the ICDAS represents a more contemporary and discerning approach to the diagnosis and management of dental caries, aligning with the current imperatives of preventive and restorative dentistry (Chouchene et al., 2023; Jetpurwala et al., 2020; Siddiqui et al., 2021).

In Ecuador, a national epidemiological study conducted in 2009 provided valuable insights into the prevalence of caries in the first permanent molars across different age groups (Raza, n.d.). The findings exhibited significant variation in caries prevalence in these molars, ranging from a modest 5% at 6 years old to a substantial 51.7% at 12 years old. In response to this data, the health authorities of the Ecuadorian government have implemented measures aimed at tackling this public health concern. These initiatives include sealing programs for the occlusal surfaces of the first permanent molars using resinous or ionomeric restorative materials, alongside large-scale fluoridation campaigns (Emmanuelli et al., 2023; Lin et al., 2021). However, it's imperative to acknowledge that the absence of updated data on the incidence of caries in the first permanent molars poses a limitation in evaluating the effectiveness of these interventions.

Against this backdrop, the objective of the current study is to ascertain the prevalence of dental caries in the first permanent molars among 8 to 12-year-old children residing in

urban and rural environments across three provinces of Ecuador (Azuay, Morona Santiago, and Cañar), employing the standardized criteria of the ICDAS. This methodology will enable a more accurate and thorough assessment of dental caries in this demographic, thus facilitating the implementation of suitable preventive and therapeutic measures to enhance the oral health of children in these areas.

2. Materials and methods

The current descriptive, observational, and cross-sectional study was approved by the University Council of the Catholic University of Cuenca-Ecuador, under code No. 048 C.D-2019, adhering to the ethical principles outlined in the Declaration of Helsinki. This investigation encompassed rural and urban settings across three provinces of Ecuador: Azuay, Cañar, and Morona Santiago. Before data collection, the legal guardians of the participants were briefed on the study's objectives, and their informed consent was obtained through the signing of a form.

The aim of this study was to establish the prevalence of caries in the first permanent molars (FPM). To achieve this, the ICDAS classification system was utilized, wherein participating schoolchildren were assessed and grouped based on the condition of their FPM into the following categories:

- Sound (code 0)
- Incipient caries (codes 1-2)
- Moderate caries (codes 3-4)
- Severe caries (codes 5-6)

The Decayed, Missing, and Filled Teeth Index (DMFT) was also utilized as an outcome measure. Furthermore, independent variables including gender, age, province of residence (Azuay, Cañar, Morona-Santiago), and environment (urban/rural) were taken into consideration.

2.1. Sample:

The sample size was calculated based on a population of 183,081 individuals aged between 6 and 12 years, estimated according to the 2010 census (INEC, n.d.). The

sample size was determined with a confidence level of 99% and a margin of error of 2.5% (Villavicencio Caparó, 2018). With an effect size of 0.3 and a statistical power of 99.9%, the probability of error was 0.043 (Villavicencio Caparó, 2018). A total of 1,938 schoolchildren aged between 6 and 12 years were proportionally stratified according to the environment in each province, with 48% coming from urban areas and 52% from rural areas.

The inclusion criteria stipulated those children had intact first permanent molars without shape anomalies and resided within the study area. Children whose behavior impeded intraoral examination, those with challenges in assessing partially erupted or non-erupted permanent molars, and/or those with any legal or systemic impediment were excluded from the study. Following the exclusion criteria, 200 students were not examined, and 124 did not attend. The final sample comprised 1700 students.

2.2. Calibration

The calibration of the 6 examiners tasked with diagnosing dental caries using the ICDAS criteria (Vélez-León, Albaladejo, et al., 2022) was conducted by subject matter experts. This crucial process, aimed at guaranteeing the consistency and dependability of the diagnoses, was thorough and comprehensive. It involved both theoretical and practical sessions, wherein examiners were educated on the precise evaluation criteria set forth by the ICDAS system. Furthermore, a clinical assessment of 15 schoolchildren in each age group, drawn from local institutions, was carried out to apply the acquired knowledge in real-world scenarios and observe the examiners' application of the criteria in practical settings.

It's worth mentioning that the schoolchildren underwent two rounds of examination, with a one-week interval between them, to evaluate the consistency of diagnoses made by each examiner at different times. This approach enabled the identification of potential discrepancies and ensured consistency in the application of diagnostic criteria over time.

To bolster the reliability of the findings, the inter- and intra-examiner kappa coefficient was computed, resulting in a notably high value of 0.86. This coefficient offers a quantitative gauge of agreement between diagnoses made by different examiners, both

in comparison to each other and in the consistency of diagnoses made by the same examiner at different points in time. Consequently, the coherence and validity of the study results were assured.

In terms of classifying caries lesions, the following criteria were adhered to:

- Sound (code 0): Denotes a dental surface devoid of visible caries, appearing clean after prolonged air drying (5 seconds).
- Incipient caries (codes 1-2): Encompasses visible opacity or discolouration lesions that do not correspond with the clinical appearance of sound enamel, without evidence of enamel wear or underlying dentin tone.
- Moderate caries (codes 3-4): Consists of white or brown spot lesions with localised enamel breakdown, lacking visible dentin exposure, or enamel opacity with an underlying dentin tone.
- Severe caries (codes 5-6): Indicates opaque or discoloured enamel with visible dentin exposure.

2.3. *Examination*

In order to carry out the evaluation of the children, it was essential for the participants to have a formal consent form signed by their legal guardian. Before the examination, pertinent demographic information such as environment, age, and gender were gathered through the completion of a pre-examination form. Furthermore, participants in this study received comprehensive instruction on proper dental brushing technique from experienced dental students.

School-age children underwent examination in an optimally illuminated environment, illuminated with natural light and adequately ventilated, while seated in an upright position. Instruments utilised for assessment included a forward-facing white light, a periodontal probe meeting WHO specifications (Hu-Friedy), and a disposable dental mirror No. 5. All recommended biosafety guidelines by WHO were strictly adhered to. The intraoral clinical examination was conducted in a sequential and systematic manner, encompassing all first molars, commencing with tooth 1.6,

followed by 2.6, 3.6, and lastly tooth 4.6. Throughout the diagnostic process led by the calibrated examiner, a senior student meticulously recorded the data on the odontogram, adhering to the criteria established by the ICDAS.

2.4. *Statistical Analysis:*

All the data was analysed using SPSS Statistics Version 25.0 (IBM, Chicago, IL, USA) with the Chi-square test and mean comparison utilising the Mann-Whitney U test. Age and DMFT correlations were evaluated using Spearman's rho correlation coefficient, and related means in the maxillaries were compared using the Wilcoxon test.

3. Results

In the study, 1287 boys and girls aged between 8 and 12 years from the provinces of Azuay, Cañar, and Morona Santiago participated in equal proportions, based on environment, province, age, and gender. (Table 1)

3.1. *Participant distribution and key caries indicators:*

The prevalence of caries reached 60.5%, with a proportion of 15.1% of filled teeth and a minimal 0.5% of missing teeth. The DMFT index recorded for the first molars was 1.02 (SD = 0.8). Significant associations were observed between caries prevalence, participants' age, and institutional environment ($p < 0.05$). It was noted that children aged 11 years (60.7%) and 12 years (73.7%) exhibited a higher incidence of caries, while in rural environments, a percentage of 64.1% was observed. Concerning filled teeth, a significantly higher prevalence was observed in children aged 10 years (19.3%) and 11 years (19.7%) ($X^2 = 25.50$; $p < 0.001$). Additionally, a higher prevalence of missing teeth was evident in the Morona Santiago province ($X^2 = 7.480$; $p < 0.024$). The DMFT index showed a slight correlation with age, with an increase from 0.83 to 1.29 in children aged 8 to 12 years ($r_s = 0.190$; $p < 0.001$). Similarly, a significantly higher DMFT index was observed in rural areas (DMFT = 1.05; SD = 0.83).

Table 1

Participants and main caries indicators

	n	%	Decayed	Filled	Lost
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				%	%	%	CPOD (DE) U/p
Sex	Man	669	52.0	60.4	16.3	0.3	1.03 (0.84)
	Woman	618	48.0	60.7	13.8	0.8	1.01 (0.85)
	X ² (p)			0.11 (0.915)	1.618 (0.203)	1.545 (0.214)	2035.5 / 0.575
Age	8 years	253	19.7	54.2	7.1	0.0	0.83 (0.83)
	9 years	255	19.8	54.9	11.0	0.4	0.85 (0.81)
	10 years	243	18.9	57.6	19.3	1.2	0.99 (0.80)
	11 years	244	19.0	60.7	19.7	1.2	1.10 (0.84)
	12 years	292	22.7	73.3	18.2	0.0	1.29 (0.83)
	X ² (p)			28.45 (<0.001**)	25.50 (<0.001**)	7.352 (0.118)	47.3 / <0.001**
Province	Azuay	439	34.1	59.9	15.9	0.0	1.03 (0.85)
	Cañar	493	38.3	60.4	15.8	0.4	0.98 (0.84)
	Morona Santiago	355	27.6	61.4	13.0	1.4	1.06 (0.83)
	X ² (p)			0.187 (0.911)	1.171 (0.424)	7.480 (0.024*)	0.05 / 0.976
Environment	Urban	626	48.6	56.7	15.2	0.2	0.99 (0.85)
	Rural	661	51.4	64.1	15.0	0.9	1.05 (0.83)
	X ² (p)			7.441 (0.006*)	0.010 (0.921)	3.325 (0.068)	1928.5 / 0.014
Total		1287	100	60.5	15.1	0.5	1.02 (0.84)

Note: X2= Chi Square; p= Statistical significance; *p < 0.05; **p < 0.01

3.2. Caries Indicators by Tooth

Table 2 provides a breakdown of children's distribution according to the categories established by the ICDAS and their corresponding DMFT index. It was observed that tooth 46 had the highest prevalence of caries (31.2%), closely followed by tooth 26 (28.4%). Conversely, caries prevalence was found to be below 21% in teeth 36 and 16.

Moreover, tooth 36 had the highest proportion of fillings, and teeth 36 and 46 were most frequently extracted due to caries.

Table 2.

Caries indicators according to the affected molar.

Cod. ICDA S	Cod. CPOD	P16Max		P26Max		P36Max		P46Max	
		ICDA	CPO	ICDA	CPO	ICDA	CPO	ICDA	CPO
		S	D	S	D	S	D	S	D
		(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
0.		67.4		60.5		70.5		53.5	
1.	0. Healthy	0.4	77.5	0.4	67.1	0.0	73.3	0.6	64.2
2.		9.8		6.2		2.8		10.1	
3.		8.6		15.3		2.8		24.2	
4.	1.	2.4	17.6	7.8	28.4	7.7	20.7	2.7	31.2
5.	Decayed	4.1		2.6		5.9		1.4	
6.		2.5		2.6		4.4		2.8	
7. RP	2.	0.0	4.8	0.1	4.5	0.0	5.7	0.7	4.3
8. RT	Restored	4.8		4.4		5.7		3.6	
9. DE	3. Lost		-		-	0.3	0.3	0.4	0.4

Note: International Caries Detection and Assessment System (ICDAS); decayed, missing, and filled teeth (DMFT); RP = Restored lost or fractured; RT = Temporary restoration (Glass ionomer, firm); DE = Tooth extracted due to caries; DMFT = rate of decayed, missing, and filled teeth in permanent teeth.

3.3. Dental arch-specific caries indicators (upper jaw, lower jaw)

The caries indicators, segregated by jaw (upper jaw, lower jaw), revealed that in the upper jaw, a caries prevalence of 37.8% and an 8.2% prevalence of filled teeth were recorded. Conversely, in the lower jaw, a notably higher prevalence of caries was observed, reaching 46.4% ($p < 0.01$). Additionally, it was noted that all teeth lost due to caries belonged to the lower jaw, while the prevalence of filled teeth was similar in both

jaws. The DMFT index exhibited a significant increase in the lower jaw (M=0.56; SD=0.54).

Table 3.

Caries indicators by jaw.

	Decayed		Filled		Missing		CPOD (DE)
	N	%	n	%	n	%	
Upper jaw	487	37.8	106	8.2	0	0.0	0.46 (0.53)
Lower jaw	600	46.6	110	8.5	7	0.5	0.56 (0.54)
P	<0.001**		0.819		-		Z= -5.091 p<0.001

4. Discussion

The first molar is one of the pivotal teeth in the craniofacial development of an individual (Jacob et al., 2019). Its presence forms the fundamental axis in occlusion and serves as the foundational basis for the position of permanent teeth. However, as the first definitive posterior teeth to appear in the mouth, it is frequently mistaken for a primary tooth (Rashed et al., 2022).

When the first permanent molar erupts in the mouth, while the child still has deciduous dentition and remains in it until the physiological exfoliation process of the primary teeth occurs, the presence of signs of disease on the dental surfaces of these teeth often goes unnoticed. However, the presence of disease in this tooth serves as an indicator of the effectiveness of various strategies established for protection by healthcare systems (Kashbour et al., 2020).

The prevalence of caries in the first permanent molar is a common issue during the mixed dentition stage. The results indicated a high prevalence of carious lesions, present in at least one of the first molars among those analyzed, consistent with previous studies conducted in populations of similar ages (Que et al., 2021). Tooth 46 emerged as

the first molar with the highest prevalence of dental caries, while tooth 36 had the highest presence of fillings. Traditionally, these teeth are preventively treated by applying pit and fissure sealants on their occlusal surfaces (Dan et al., 2019) . However, due to the precise placement required, other preventive measures such as periodic fluoride applications and dental brushing need to be considered for their protection. The study revealed a close relationship between the prevalence of dental caries and the age of the participant. The population aged between 8 and 12 years was examined, showing a higher presence of caries with increasing age, consistent with previous epidemiological studies conducted in Ecuador (Vélez-León, Albaladejo, et al., 2022). These studies highlight the lack of a clear and precise strategy regarding the implemented prevention protocols. The study encompassed urban and rural populations from three provinces in southern Ecuador. The findings revealed a high presence of carious lesions among participants from rural areas, with the highest number of lost teeth observed in Morona Santiago, aligning with previous studies (Al-Samadani & Ahmad, 2012). This trend may be associated with limited access to healthcare services and a deficient understanding of oral hygiene and nutrition habits by parents or caregivers (Lévesque et al., 2015), reinforcing the significant influence of socioeconomic and cultural factors on health and disease processes. (STOICA et al., 2023)

The findings emphasize the significance of early detection of dental caries, with strategies that integrate comprehensive preventive and interceptive measures from early childhood (Fraihat et al., 2019) . This approach involves both the family and healthcare personnel, even before the child's birth, (Pisarnturakit & Detsomboonrat, 2020) taking into account the various risk factors associated with the onset of the disease (Vélez-León, Albaladejo-Martínez, et al., 2022).

One of the notable limitations of the study is the lack of previous studies conducted in Ecuador, which would enable comparison. Hence, there's a need to plan and design standardized studies to acquire epidemiological data informing state policies aimed at enhancing health and ensuring the success of implemented public health measures. The literature underscores the importance of regular tooth brushing paired with fluoride toothpaste as the cornerstone of health initiatives (Dan et al., 2019), which have proven

effective in reducing disease and generating significant cost savings in addressing common oral issues like caries and periodontal disease on a larger scale (Kashbour et al., 2020). Additionally, it's worth noting the absence of an assessment of the knowledge of parents and/or caregivers in the study, which, if conducted, could offer further insights and bolster the results. Among the strategies for managing dental caries, analyzing the previous presence of the disease emerges as a crucial aspect for its control. Previous studies conducted in pediatric populations from similar geographical areas unveil a troubling prevalence of the disease and tooth loss in deciduous teeth (Al-Samadani & Ahmad, 2012). The results paint a concerning picture regarding the condition of the permanent first molars.

As dentists, it's imperative to urgently engage our patients, their parents, and healthcare personnel in all health-related initiatives, starting from the early years of the patient's life. This involves educating and motivating them to preserve the permanent first molar in the mouth. Alongside adjustments in student curricula, this will enable them to recognize the significance of establishing appropriate strategies, transforming them into effective conveyors of knowledge to their patients in adopting healthy nutritional and hygiene habits.

5. Conclusion

The current study unveils a high prevalence of dental caries in the first permanent molars among paediatric patients aged 8 to 12 in Ecuador, accentuating a significant public health challenge in the country. It's clear that early detection and preventive interventions are pivotal in tackling this issue. The utilisation of the ICDAS system has proven to be a valuable tool for precise diagnosis of dental caries, highlighting the importance of embracing advanced diagnostic techniques in dental practice. This study advocates for targeted and personalised approaches to caries prevention, particularly among vulnerable populations in rural areas. It's imperative to reformulate new health policies in our country to implement effective strategies that promote oral health and prevent dental caries in the first permanent molars. This study not only underscores the current state of oral health in Ecuadorian children but also calls for collaborative efforts to enhance and safeguard the dental health of future generations.

Declaration of competing interest

The authors disclose no competing interests.

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6. References

- Al-Samadani, K. H. M., & Ahmad, M. S. (2012). Prevalence of First Permanent Molar Caries in and Its Relationship to the Dental Knowledge of 9–12-Year Olds from Jeddah, Kingdom of Saudi Arabia. *ISRN Dentistry*, 2012, 1–6. <https://doi.org/10.5402/2012/391068>
- Arrow, P. (2008). Prevalence of developmental enamel defects of the first permanent molars among school children in Western Australia. *Australian Dental Journal*, 53(3), 250–259. <https://doi.org/10.1111/j.1834-7819.2008.00057.x>
- Arrow, P. (2009). Risk factors in the occurrence of enamel defects of the first permanent molars among schoolchildren in Western Australia. *Community Dentistry and Oral Epidemiology*, 37(5), 405–415. <https://doi.org/10.1111/j.1600-0528.2009.00480.x>
- Chouchene, F., Masmoudi, F., Baaziz, A., Maatouk, F., & Ghedira, H. (2023). Clinical status and assessment of caries on first permanent molars in a group of 6- to 13-year-old Tunisian school children. *Clinical and Experimental Dental Research*, 9(1), 240–248. <https://doi.org/10.1002/cre2.676>
- Dan, Q., Haofeng, J., Lu, S., Cai, Z., Zhaowu, C., & Jinhua, W. (2019). Prevalence of dental caries and associated factors among 10-12-year-old students in Chongqing. *Hua Xi Kou Qiang Yi Xue Za Zhi / West China Journal of Stomatology*, 37(6), 608–614. <https://doi.org/10.7518/hxkq.2019.06.007>
- Divaris, K. (2016). Predicting Dental Caries Outcomes in Children. *Journal of Dental Research*, 95(3), 248–254. <https://doi.org/10.1177/0022034515620779>
- Emmanuelli, B., Knorst, J. K., Menegazzo, G. R., Mendes, F. M., & Ardenghi, T. M. (2023). Dental caries prediction and the indication of pit and fissure sealant in children first permanent molars: A prospective study. *Journal of Dentistry*, 135, 104557. <https://doi.org/10.1016/j.jdent.2023.104557>
- Fraihat, N., Madae'en, S., Bencze, Z., Herczeg, A., & Varga, O. (2019). Clinical Effectiveness and Cost-Effectiveness of Oral-Health Promotion in Dental Caries Prevention among Children: Systematic Review and Meta-Analysis. *International Journal of Environmental Research and Public Health*, 16(15), 2668. <https://doi.org/10.3390/ijerph16152668>

- Gudipani, R. K., Alkuwaykibi, A. S., Ganji, K. K., Bandela, V., Karobari, M. I., Hsiao, C.-Y., Kulkarni, S., & Thambar, S. (2022). Assessment of caries diagnostic thresholds of DMFT, ICDAS II and CAST in the estimation of caries prevalence rate in first permanent molars in early permanent dentition—a cross-sectional study. *BMC Oral Health*, 22(1), 133. <https://doi.org/10.1186/s12903-022-02134-0>
- INEC. (n.d.). *Instituto Nacional de Estadísticas y Censos*. Retrieved 25 February 2024, from https://www.ecuadorencifras.gob.ec/documentos/web-inec/Poblacion_y_Demografia/Proyecciones_Poblacionales/presentacion.pdf
- Jacob, H. B., Ribeiro, G. L. U., English, J. D., Pereira, J. da S., & Brunetto, M. (2019). A 3-D evaluation of transverse dentoalveolar changes and maxillary first molar root length after rapid or slow maxillary expansion in children. *Dental Press Journal of Orthodontics*, 24(3), 79–87. <https://doi.org/10.1590/2177-6709.24.3.079-087.oar>
- Jetpurwala, M., Sawant, K. R., Jain, P. S., & Dedhia, S. P. (2020). Parental Perception of the Importance of the Permanent First Molar in Their Children. *Journal of Dentistry for Children (Chicago, Ill.)*, 87(1), 26–30.
- Kashbour, W., Gupta, P., Worthington, H. V., & Boyers, D. (2020). Pit and fissure sealants versus fluoride varnishes for preventing dental decay in the permanent teeth of children and adolescents. *Cochrane Database of Systematic Reviews*, 2020(12). <https://doi.org/10.1002/14651858.CD003067.pub5>
- Lévesque, M. C., Levine, A., & Bedos, C. (2015). Ideological roadblocks to humanizing dentistry, an evaluative case study of a continuing education course on social determinants of health. *International Journal for Equity in Health*, 14(1), 41. <https://doi.org/10.1186/s12939-015-0170-2>
- Lin, Y.-T., Chou, C.-C., & Lin, Y.-T. J. (2021). Caries experience between primary teeth at 3–5 years of age and future caries in the permanent first molars. *Journal of Dental Sciences*, 16(3), 899–904. <https://doi.org/10.1016/j.jds.2020.11.014>
- Piovesan, C., Ardenghi, T. M., Guedes, R. S., Ekstrand, K. R., Braga, M. M., & Mendes, F. M. (2013). Activity assessment has little impact on caries parameters reduction in epidemiological surveys with preschool children. *Community Dentistry and Oral Epidemiology*, 41(3), 204–211. <https://doi.org/10.1111/cdoe.12004>
- Pisartnurakit, P., & Detsomboonrat, P. (2020). Comparison of two caries prevention programs among Thai kindergarten: a randomized controlled trial. *BMC Oral Health*, 20(1), 119. <https://doi.org/10.1186/s12903-020-01107-5>
- Que, L., Jia, M., You, Z., Jiang, L. cheng, Yang, C. guang, Quaresma, A. A. d'Oliveira, & das Neves, E. M. A. (2021). Prevalence of dental caries in the first permanent molar and associated risk factors among sixth-grade students in São Tomé Island. *BMC Oral Health*, 21(1). <https://doi.org/10.1186/s12903-021-01846-z>
- Rashed, T., Alkhalefa, N., Adam, A., & AlKheraif, A. (2022). Pit and Fissure Sealant versus Fluoride Varnish for the Prevention of Dental Caries in School Children: A Systematic Review and Meta-Analysis. *International Journal of Clinical Practice*, 2022, 1–7. <https://doi.org/10.1155/2022/8635254>

- Raza, X. (n.d.). *Estudio Epidemiológico Nacional de Salud Bucal en Escolares Menores de 15 Años del Ecuador*. MSP/OPS. Retrieved 25 February 2024, from https://www3.paho.org/hq/dmdocuments/2009/OH_ECU_EpidemEscolDesc1996.pdf
- Saber, A. M., Altoukhi, D. H., Horaib, M. F., El-Housseiny, A. A., Alamoudi, N. M., & Sabbagh, H. J. (2018). Consequences of early extraction of compromised first permanent molar: A systematic review. *BMC Oral Health*, 18(1). <https://doi.org/10.1186/s12903-018-0516-4>
- Siddiqui, A. A., Alshammary, F., Mulla, M., Al-Zubaidi, S. M., Afroze, E., Amin, J., Amin, S., Shaikh, S., Madfa, A. A., & Alam, M. K. (2021). Prevalence of dental caries in Pakistan: a systematic review and meta-analysis. *BMC Oral Health*, 21(1), 450. <https://doi.org/10.1186/s12903-021-01802-x>
- Songur, F., Simsek Derelioglu, S., Yilmaz, S., & Koşan, Z. (2019). Assessing the impact of early childhood caries on the development of first permanent molar decays. *Frontiers in Public Health*, 7(JUL). <https://doi.org/10.3389/fpubh.2019.00186>
- STOICA, S. N., MORARU, S. A., NIMIGEAN, V. R., & NIMIGEAN, V. (2023). Dental Caries in the First Permanent Molar during the Mixed Dentition Stage. *Maedica - A Journal of Clinical Medicine*, 18(2). <https://doi.org/10.26574/maedica.2023.18.2.246>
- Tellez, M., & Lim, S. (2020). ICDAS Is Widely Used as Standardized and Reliable Caries Detection Criteria, but Its Reporting Varies Widely. *Journal of Evidence Based Dental Practice*, 20(1), 101409. <https://doi.org/10.1016/j.jebdp.2020.101409>
- Vélez-León, E., Albaladejo, A., Cuenca-León, K., Jiménez-Romero, M., Armas-Vega, A., & Melo, M. (2022). Prevalence of Caries According to the ICDAS II in Children from 6 and 12 Years of Age from Southern Ecuadorian Regions. *International Journal of Environmental Research and Public Health*, 19(12), 7266. <https://doi.org/10.3390/ijerph19127266>
- Vélez-León, E., Albaladejo-Martínez, A., Pacheco-Quito, E.-M., Armas-Vega, A., Delgado-Gaete, A., Pesántez-Ochoa, D., & Melo, M. (2022). Developmental Enamel Defects in Children from the Southern Region of Ecuador. *Children*, 9(11), 1755. <https://doi.org/10.3390/children9111755>
- Villavicencio Caparó, E. (2018). EL TAMAÑO MUESTRAL PARA LA TESIS.¿CUÁNTAS PERSONAS DEBO ENCUESTAR? *Odontología Activa Revista Científica*, 2(1), 59–62. <https://doi.org/10.31984/oactiva.v2i1.175>
- Wu, S., Zhang, T., Liu, Q., Yu, X., & Zeng, X. (2020). Effectiveness of fluoride varnish on caries in the first molars of primary schoolchildren: a 3-year longitudinal study in Guangxi Province, China. *International Dental Journal*, 70(2), 108–115. <https://doi.org/10.1111/idj.12528>