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Factores asociados a caries del primer molar permanente: estudio transversal en niños escolares de Acapulco, Guerrero

Artículo Original

Factors associated with permanent first molar caries: a cross-sectional study among schoolchildren from Acapulco, Guerrero

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RESUMEN

Introducción: El primer molar permanente es susceptible a infectarse a caries, debido a su cronología, morfodiferenciación, características funcionales y por ley de gravedad. Objetivo: Identificar factores asociados a caries del primer molar permanente en niños escolares de una escuela primaria de Acapulco, Guerrero. Material y métodos: Durante los meses de febrero-agosto del 2019, fueron revisados 568 primeros molares permanentes en 142 escolares de segundo a sexto grado de primaria. El instrumento de medición obtuvo datos sociodemográficos, hábitos de higiene oral y de dieta. En un odontograma se categorizaron los códigos del Sistema Internacional de Clasificación y Gestión de Caries. Se usó la razón de momios con su intervalo de confianza del 95% como medida de asociación con el software estadístico de MedCalc's. Resultados: El 79% (112/142) de los niños tuvo caries en al menos un molar. Las mujeres fueron más afectadas con 51% (57/112). El grupo de seis a nueve años el más recurrente con 54% (60/112). El primer molar inferior derecho fue el más afectado. Fueron identificados cuatro factores asociados, la edad, (RM=3.46; $p=0.01$); compartir el cepillo dental (RM=10.09; $p=0.002$); consumo de alimentos ricos en carbohidratos (RM=12.09; $p<0.0001$) y la frecuencia de cepillado (RM=0.35; $p=0.02$). Conclusión: La prevalencia de caries en primeros molares permanentes fue alta, comparada a otros estudios. La educación de salud resulta imprescindible con diligencia a escolares y padres de familia.

Palabras clave: diente molar, dentición permanente, caries dental

SUMMARY

Introduction: The first permanent molar is susceptible to caries infection, due to its chronology, morphodifferentiation, functional characteristics and by the law of gravity. Objective: To identify factors associated with caries of the first permanent molar among schoolchildren of a elementary school from Acapulco, Guerrero. Material and methods: During the months of February-August 2019, 568 permanent first molars were examined in 142 schoolchildren from second to sixth grade of primary school. The measurement instrument obtained sociodemographic data, oral hygiene and diet habits. International Caries Classification and Management System codes were categorized in an odontogram. The odds ratio with its 95% confidence interval was used as a measure of association with MedCalc's statistical software. Results: 79% (112/142) of the children had caries in at least one molar. Females were more affected with 51% (57/112). The six to nine years age group was the most recurrent with 54% (60/112). The lower right first molar was the most affected. Four associated factors were identified, age, (OR=3.46; $p=0.01$); sharing a toothbrush (OR=10.09; $p=0.002$); consumption of carbohydrate rich foods (OR=12.09; $p<0.0001$) and frequency of brushing (OR=0.35; $p=0.02$). Conclusion: The prevalence of caries in permanent first molars was high compared to other studies. Health education is essential for school children and parents.

Key words: molar tooth, permanent dentition, dental caries.

INTRODUCTION

Worldwide, nearly 3.5 billion people suffer from oral diseases, including caries.¹ This is a multifactorial, non-communicable disease that affects more than 530 million children in the deciduous dentition.^{2,3} It is considered a public health problem and represents an economic burden in several countries.⁴ According to the International Dental Federation (FDI), untreated caries in permanent teeth has a global prevalence of 40% and affects seven out of every ten infants.⁵ In Mexico, the Epidemiologic Surveillance System for Oral Pathologies (SIVEPAB) estimates that 60% to 76% of six-year-old schoolchildren suffer from caries.⁶

One of the dental organs most affected by caries is the first permanent molar, which erupts at six years of age and has no temporary predecessor.⁷ It represents 50% of masticatory efficiency, guide for the eruption of the remaining permanent organs, maxillary development and occlusion key.^{8,9} It has a biological disadvantage, since it has greater exposure to the oral environment with factors involved in the cariogenic process, compared to other dental organs.^{10,11} Based on the above, the early loss of these dental organs has negative consequences.¹²

The prevalence of permanent first molar caries in schoolchildren varies in different regions of the world. In some schools in Middle Eastern countries, it has been reported to affect almost half of schoolchildren.¹¹ In Latin America, figures ranging from 23% to 41% are reported;^{13,14,15,16} and in others, it affects more than 50% of schoolchildren in public sector schools and dental care centers, respectively.^{17,18,19,20,21}

The microorganism that acts as the causal agent of caries is *Streptococcus mutans*.²² This microorganism acts in an acidic environment, under favorable conditions for its development.²³ Some associated factors that favor the appearance of caries in permanent first molars are: poor dental hygiene,^{11,14,17,24} frequency of brushing,^{25,26} crowding,^{22,24} excessive consumption of sugary drinks,²⁵ low salivary excretion,²⁵ nocturnal diet rich in sugars,²⁶ parents' work situation, hypomineralization,^{27,28} parents' level of education, and harmful habits during gestation.²⁹

As age increases, there is seven times the risk that the first permanent molar will suffer from caries,¹⁷ between the ages of 7 and 13 years.^{14,15,16,26,29} Regarding sex, males present a higher percentage of caries,^{13,14,16,17} compared to females.^{18,19,20}

To prevent the appearance of caries in schoolchildren, topical fluoride treatment and regular visits to the dentist are used.^{11,26} It is important to apply fissure sealants, which reduce the appearance of caries by up to 37%.³⁰ In Mexico, the Ministry of Health establishes education and prevention actions that promote the improvement of the oral health of the population by age groups in dental offices through Official Mexican Standard 013.³¹ The promotion of oral health among school children is necessary to prevent various ailments.^{12,32}

The objective of this research was to identify factors associated with permanent first molar caries among schoolchildren of a public elementary school from Acapulco, Guerrero.

MATERIAL AND METHODS

A cross-sectional study was conducted among schoolchildren of the Francisco Figueroa Mata Elementary School from Acapulco, during February-August 2019. From a universe of 240 schoolchildren, a stratified sample of 142 children was obtained, using a finite population formula, with a confidence level of 95% and a margin of error of 5%. Prior to the field work, two dental interns were calibrated by means of a theoretical test and Cohen's Kappa test (0.75),³³ in a dental clinic with the observation of a sample with similar characteristics.

The measurement instrument was validated by a round of experts,³⁴ which included a master of science in epidemiology, a public health master science, a pediatric dentist and a general dental surgeon. A questionnaire was used to obtain sociodemographic data such as age and school grade. Information on hygienic habits included: frequency of brushing, use of toothpaste and consumption of cariogenic foods. An odontogram with the FDI nomenclature was included for the identification of the first permanent molars. The clinical examination was performed in an illuminated room during the early morning hours. A ball-ended probe (PWB Osung), a three-bulb miner's lamp (LJK) and primary biosafety barriers were used.

The outcome variable was the prevalence of caries in the first permanent molars. A caries case was defined as a schoolchild who presented codes 2 to 6 of the International Caries Classification and Management System (ICCMS)³⁵ in at least one molar during the clinical examination. The ICCMS criteria followed the nominal scale: code 0, healthy molars; and codes 2 to 6 caries stages. Inclusion criteria were schoolchildren with the first four permanent molars; exclusion criteria were children with any syndrome, cases of true or false anodontia, shape anomalies in the dental crown, presence of orthodontic appliances and dental agenesis; and elimination criteria were schoolchildren who did not present informed parental consent, incomplete questionnaires and those who refused to undergo clinical examination.

The age variable was dichotomized into two groups, one with the range of 6 to 9 years and the other of 10 to 12 years. Regarding the variable on the consumption of carbohydrate-rich foods, a general question item was elaborated on the frequency of daily consumption of juices, soft drinks, cookies and bread. Responses were handled with the following nominal scale: low frequency of ≤ 3 ; and high frequency of ≥ 4 .

The research protocol was approved by the research and teaching department of the Health Jurisdiction of Acapulco, Guerrero. The school administration was in charge of requesting informed consent from the parents by means of a circular letter.

During the clinical evaluation of the children, their refusal was respected. This research did not involve risk to schoolchildren. The questionnaire was answered freely and voluntarily. The clinical inspection did not involve health risks, and was subject to the bioethical codes of epidemiological research on human subjects of the Declaration of Helsinki of the World Medical Association (WMA).³⁶ At the end of the study, health education was provided to all schoolchildren.

Data collection was performed with the Limesurvey software.³⁷ For the database analysis, the statistical program MedCalc's version number 19.2.6 was used.³⁸ Simple frequencies were obtained through univariate analysis. In order to quantify the association of the variables, the odds ratio with 95% confidence intervals using as an estimator.

RESULTS

Sociodemographic data

A stratified sample of 145 schoolchildren from second to sixth grade of the Francisco Figueroa Mata Elementary School was obtained. Two with orthodontic treatment were excluded and one was eliminated because he did not have informed consent. A total of 142 schoolchildren participated, of whom 55% (78/142) were females and the rest were males. In terms of age, the 59% (84/142) of the schoolchildren were aged 6 to 9 years, the rest were aged 10 to 12 years.

Oral hygiene habits

The 91% (129/142) of schoolchildren had their own toothbrush, the rest shared it with a family member. Brushing frequency ranged from 1 to 5 times, with a mean of 3.1 (SD 1.3). The 47% (67/142) brushed their teeth three times a day, 25% (35/142) two-times, 17% (24/142) once and 11% (16/142) more than three times. The 89% (126/142) use toothpaste and the rest only water.

Cariogenic diet habits

The 77% (109/142) of children consume sugar-sweetened beverages, cookies, bread and soft drinks four or more times a day and 23% (33/142) one to three times.

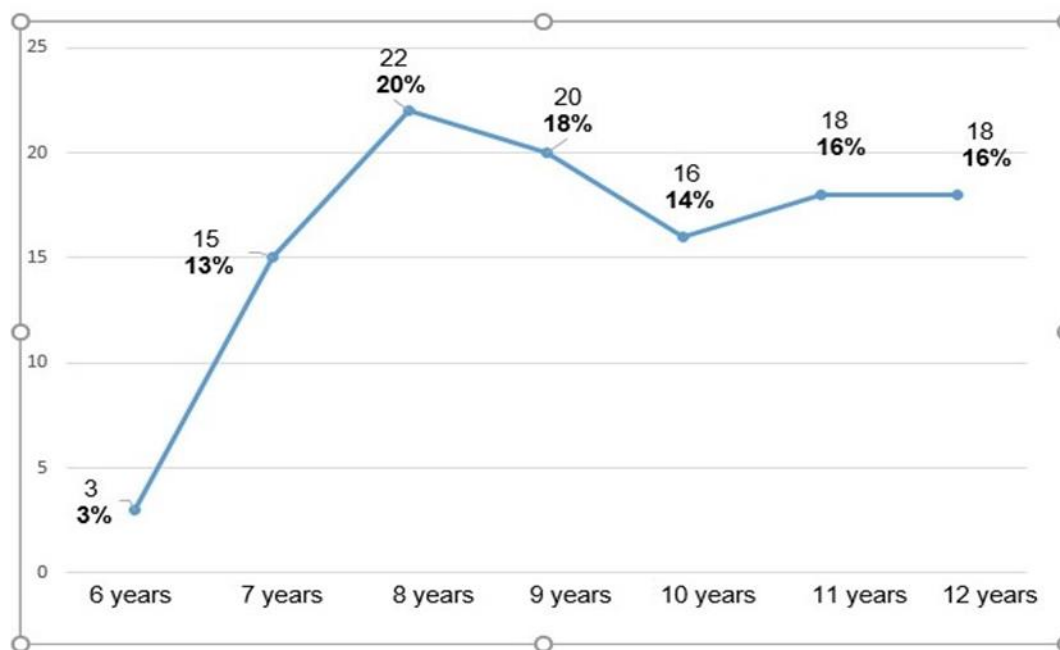
Caries in the first permanent molar

The presence of caries in at least one molar tooth was of 79% (112/142). The 51% (57/112) occurred in females and the rest in males. A total of 568 permanent first molars were inspected. The 51% (289/568) had caries and the rest were caries-free (Table 1).

¹ ICCMS criteria	Stage	First permanent molars				n	%
		16	26	36	46		
0	Healthy	126	122	67	11	326	57%
2-6	Caries	16	20	75	131	242	43%
Total		142	142	142	142	568	100%

Table 1. Caries stage of the first permanent molar among schoolchildren, by dental organ.

In terms of age, the proportion of caries in the 6-9 years age group was 54% (60/112) and 46% (52/112) in the 10-12 years age group. Graph 1 shows that acme point of caries experience increases with age.



Graph 1. Caries experience of the first permanent molar among schoolchildren.

Risk Factors

Four factors associated with the presence of permanent first molar caries in schoolchildren were identified. Three of them were risk factors, age 10-12 years (OR=3.46; 95%CI=1.31-9.13); toothbrush sharing (OR=10.09; 95%CI=2.21-45.95); and frequency of

consumption of carbohydrate-rich foods four or more times a day (OR=12.09; 95%CI=4.77-30.64).

The other factor was protective, the frequency of brushing three or more times a day (OR=0.35; 95%CI= 0.13 - 0.88). The association estimate and 95% confidence interval are shown in Table 2

Factor		Caries n (%)		Healthy n (%)		OR ¹	95% CI ²	p ³
Gender	Male	55	39	9	10	1.60	0.65 – 3.97	0.30
	Female	57	36	21	15			
Age	10-12	52	37	6	4	3.46	1.31 – 9.13	0.01
	6-9	60	42	24	17			
Toothbrush ownership	Yes	109	77	25	18	10.09	2.21 – 45.95	0.002
	No	3	2	5	3			
Brushing frequency	≥ 3	60	42	23	16	0.35	0.13 – 0.88	0.02
	< 3	52	37	7	5			
Toothpaste use	Yes	98	69	28	18	0.50	0.10 – 2.33	0.37
	No	14	10	2	3			
Frequency of carbohydrate consumption	High ≥4 per day	98	69	11	8	12.09	4.77 – 30.64	< 0.0001
	Low ≤3 per day	14	10	19	13			

¹OR= odds ratio

² 95% IC= confidence interval of 95%

³ p= p value

Table 2. Risk factors for permanent first molar caries among schoolchildren.

DISCUSSION

The prevalence of permanent first molar caries among schoolchildren at the Francisco Figueroa Mata Elementary School was 79%. The condition was more frequent in females,

and regarding the age group, the occurrence was higher in the 6 to 9 year olds. Four factors associated with the presence of caries were identified, three in the sense of risk (age, sharing a toothbrush and consumption of carbohydrate-rich foods four or more times a day) and the other was protective (frequency of brushing three or more times a day).

The study generated information on the caries landscape in schoolchildren. The main objective was to estimate the prevalence of caries in first permanent molars and to identify risk factors. The results of the study will contribute to the improvement of strategies to reduce caries in the school population.

One of the limitations of the study was the cross-sectional design. It is difficult to establish the temporality criteria as to whether the cause precedes the effect. Regarding age, children ten years of age or older have a higher risk of caries. It is possible that dichotomizing this variable generates a non-differential selection bias, since the older the age, the greater the exposure to factors involved in caries. However, multiple investigations conclude that the peak of caries ascent is almost at the age of eight years, similar to that reported in this investigation.^{14,15,16,26,29} Taboada-Arantza et al., document that the time of exposure through age in schoolchildren over seven years of age increases the risk of caries eight times.¹⁸

As for sharing a toothbrush, it increases the risk of tooth decay. Several types of bacteria reside in the mouth, with *Streptococcus mutans*, the caries-causing agent, being highly contagious. Sharing personal hygiene items increases the chances of caries infection.³⁹ This could be explained in terms of the transfer of microorganisms from one host to another when these objects are shared, where the toothbrush would be a fomite.

Regarding the frequency of carbohydrate consumption, it is difficult to deduce causality. Since it is not possible to establish a time interval between the consumption of these foods and the appearance of caries, the phenomenon of reverse causality could occur. Perhaps the presence of caries came first and the high frequency of consumption is recent, or the other way around. Llano et al., mentioned that excessive consumption of sugar-sweetened beverages increases the risk of caries in dental organs.²⁵ Other studies report that other causes related to the presence of caries are poor dental hygiene,^{11,14,17,24} crowding,^{22,24} low salivary excretion²⁵, nocturnal diet rich in sugars,²⁶ and hypomineralization.²⁷

As for the protective factor, the frequency of brushing three or more times a day reduces the risk of caries infection. In other studies carried out in Spanish and Korean children, it was found that brushing more than once a day reduces the rates of decayed, missing and filled permanent teeth (DMFT).^{25,26} Toothbrushing is one of the specific primary protective measures, and its habit is reasonably inculcated during childhood, therefore, brushing precedes caries infection.

The prevalence of first molar caries reported was high compared to other studies.^{17,19,20,21} Regarding gender, females were the most affected, similar to that reported by other researchers.^{18,19,20,20} The most affected dental organs were the lower molars, similar to others.^{14,19,21} The lower right first molar was the most frequent, similar to Oropeza et al., among schoolchildren in Tláhuac;¹⁹ and different to that described by Valdés-Martínez et al., who report the lower left first molar in Cuban schoolchildren.¹⁵ Ochoa et al., mention that

the upper left first molar is the most affected.¹³ The lower first permanent molars are more susceptible to caries, due to their chronology of eruption, morphology, functional characteristics and the law of gravity.^{10,11,17,18}

There are preventive factors to avoid the development of caries. Some are regular visits to the dentist every six months, efficient oral hygiene and fluoride topicalization.^{11,26} The placement of fissure and fissure sealants in the first permanent molars is an alternative, where toothbrushing is not enough to eliminate the dentobacterial plaque residues. The use of this type of material prevents the appearance of caries.³⁰

One of the complications of using the ICCMS system for the identification of caries progression is to have a suitable site for oral inspection. It is possible that there is a potential observation bias by examiners because of the great difficulty in diagnosing early stage lesions due to the lack of an appropriate diagnostic site. In this study, it is likely that these lesions were missed by the diagnostic conditions, and were counted as healthy molars. In future research, we recommend having an appropriate site to screen the population when using this type of criteria.

Parents should be made aware of the consequences of the progressive development of carious lesions in permanent dental organs and the importance of preserving them until the last instances. It reflects the need to perform minimally invasive therapeutic procedures in early stages and conservative in moderate to severe progression of the disease.

Analytical studies are needed to find associations with the presence of caries in these dental organs. Caries is associated with multiple biological, systemic and socioeconomic risk factors. The combination of these can vary the course and aggressiveness of the disease. A cohort study would help to know the relative risk and establish the temporality of the associated factors.

The data obtained in this study will contribute to the reduction of caries and the improvement of oral health conditions in this population. Caries affects from a very early age. Prevention is the first step to stop any oral disease. It is necessary to implement prevention campaigns in schools that provide information on oral health care aimed in schoolchildren and parents.

The stratified study sample represents a part of the schoolchildren. The results of the study only reflect the caries situation among schoolchildren of the Francisco Figueroa Mata Elementary School. However, the results can be used to evaluate the situation in other public sector elementary schools with similar characteristics.

The prevalence of permanent first molar caries among schoolchildren at the Francisco Figueroa Mata Elementary School was 79%. The condition was more frequent in females, and regarding the age group, the occurrence was higher in the 6 to 9 year olds. Four factors associated with the presence of caries were identified, three in the sense of risk (age, sharing

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Analytical studies are needed to find associations with the presence of caries in these dental organs. Caries is associated with multiple biological, systemic and socioeconomic risk factors. The combination of these can vary the course and aggressiveness of the disease. A cohort study would help to know the relative risk and establish the temporality of the associated factors.

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The stratified study sample represents a part of the schoolchildren. The results of the study only reflect the caries situation among schoolchildren of the Francisco Figueroa Mata Elementary School. However, the results can be used to evaluate the situation in other public sector elementary schools with similar characteristics.

The reported prevalence of 79% of permanent first molar caries in school children is high compared to other investigations. According to sex, caries was more prevalent in

females with a proportion of 51% (57/112). As for the age group, the occurrence was higher in children aged 6 to 9 years with a proportion of 54% (60/112).

Four factors associated with the presence of caries were identified, three in the sense of risk (age, sharing a toothbrush and consumption of carbohydrate-rich foods four or more times a day) and the other was protective (frequency of brushing three or more times a day). With the information denoted on the related factors, it will be important to create dental health strategies for school children and parents. Due to the fact that some of the variables included are modifiable over time, it will be necessary to carry out studies with greater methodological robustness that establish the criterion of temporality.

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