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Factors associated with severe permanent first molar caries among adolescents from Acapulco, Guerrero.

Factores asociados a caries severa del primer molar permanente en adolescentes de Acapulco, Guerrero.

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ABSTRACT

Objective: To identify the factors associated with severe caries of the first permanent molar among adolescents from Acapulco, Guerrero, Mexico. ***Material and methods:*** Cross-sectional study in a sample of 173 adolescents from first to third grade of a public middle school. A self-administered questionnaire was used to obtain sociodemographic data, socioeconomic level, oral health, toxic and dietary habits. Severe caries was identified based on the combined codes 5-6 of the International Caries Classification and Management System. A multivariate analysis was performed with CIETmap statistical software, which identified factors associated with severe caries with the prevalence ratio and its 95% confidence interval as an estimate of the strength of association. ***Results:*** A total of 692 permanent first molars were examined. The 54% of the adolescents (94/173) presented severe caries in at least one molar. Two associated factors were found, consumption of 6 or more cigarettes per day (RPa: 5.48; IC95%a= 2.01 - 17.87), and use of oral hygiene aids (RPa: 0.41; IC95%a= 0.34 - 0.78). ***Conclusion:*** The prevalence of severe caries was similar to that reported in other studies. Health promotion actions should be carried out to help reduce caries in this population.

KEY WORDS: molar tooth, caries, permanent dentition.

RESUMEN

Objetivo: Identificar los factores asociados a caries severa del primer molar permanente en adolescentes de Acapulco, Guerrero, México. ***Material y métodos:*** Estudio transversal en una muestra de 173 adolescentes de primer a tercer grado de una secundaria pública. Se usó un cuestionario autoadministrado que obtuvo datos sociodemográficos, nivel socioeconómico, salud oral, hábitos tóxicos y dietéticos. Se identificó la caries severa con base en los códigos combinado 5-6 del Sistema Internacional de Clasificación y Gestión de Caries. Se

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realizó un análisis multivariado con el software estadísitico CIETmap, el cual identificó factores asociados a caries severa con la razón de prevalencia y su intervalo de confianza del 95% como estimación de la fuerza de asociación. ***Resultados:*** Fueron revisados 692 primeros molares permanentes. El 54% de los adolescentes (94/173) presentó caries severa en al menos un molar. Se encontraron dos factores asociados, consumo de 6 o más cigarros al día (RPa: 5.48; IC95%a= 2.01 – 17.87) y el uso de auxiliares en la higiene oral (RPa: 0.41; IC95%a= 0.34 – 0.78). ***Conclusión:*** La prevalencia de caries severa fue similar a la reportada a otros estudios. Se deben realizar acciones de promoción de la salud que ayuden a disminuir la afección en esta población.

PALABRAS CLAVE: Diente molar, caries, dentición permanente.

INTRODUCTION

Dental caries is the most common condition in the oral cavity and is described as a sequence of processes that destroy the hard tissues that make up the dental organs (1,2). It is a chronic and transmissible disease that affects people of different ages (3). It is estimated that 37% to 59% of adolescents between 12 and 19 years of age suffer from caries in the permanent dentition, especially in low-income hispanics (4,5). One of the dental organs most affected by caries is the first permanent molar (6). This organ has no temporary predecessor and erupts at six years of age on average, which leaves it exposed to the exogenous agents of the oral environment (7,8).

Morbidity of this dental organ among adolescents is high in different regions of the world. In Asia and the Middle East, a prevalence of 54% to 83% has been found (9,10,11). In South America, 14% to 58% is reported among adolescents in public and private schools (12,13,14). In schools in Cuba, it affects 30% to 74% (15,16); and Mexico, the caries experience of 43% is reported among adolescents in some communities (17). The Epidemiological Surveillance System for Oral Pathologies (SIVEPAB) estimates that 26% of children and adolescents under one year to 19 years of age are free of caries (18).

By consensus, it has been documented that the main etiology for the appearance of caries among adolescents is poor oral higiene (1,5,19). Other studies mention cariogenic diet (1), malpositions (1), lack of social security (13), schooling (13), ethnicity (14), presence of gingival disease (14), level of education (15), and level of knowledge of the parents (15). In terms of gender, a slight predilection is described in females with a range of 46% to 88% (9,16,17,19). Regarding the most affected quadrant, the lower left first molar has a greater degree of involvement with a range of 14% to 28% (13,15,16,17). Harmful habits at an early age, such as smoking and alcoholism, increase the risk of caries (20,21).

A balanced diet, efficient oral hygiene, fluoride topicalization and visits with health professionals ensure the reduction of oral diseases (14,22,23). It is important to know the factors associated with severe caries in permanent first molars. There are guidelines established through the Mexican Official Standard 013 of the Ministry of Health (24), for the prevention and control of oral diseases. This promotes preventive health education in public and private dental services in order to reduce oral disease rates. The promotion of oral health in adolescents helps to avoid premature loss of dental organs (25).

In our region there is no study that deals with the classification of caries in severe stages in the adolescent population. The aim of the study was to estimate the prevalence of severe caries of the first permanent molar and to identify associated factors among adolescents from a public middle school in Acapulco, Guerrero state, Mexico.

MATERIAL AND METHODS

Cross-sectional study among adolescents of Secondary School No.6 from Acapulco, during August 2019 to February 2020. A sample of 186 adolescents was obtained, using the finite population formula with a power of 95% and a margin of error of 5%, out of a universe of 384 adolescents. Four adolescents with orthodontic treatment and two with an absent molar were excluded, as well as three who refused to participate and four incomplete questionnaires were eliminated. The final total sample

was 173 adolescents with four permanent first molars without restorations and structural or morphological alterations on the occlusal surface.

The measuring instrument was a 21-item self-administered questionnaire validated by a round of experts (26). The questionnaire was administered to the adolescents in the classroom, followed by a clinical oral examination, where forms were filled out to record the clinical observation of the first molars. Four dental interns collected the information and performed the dental examination. The calibration of the examiners started with theoretical training, continued with clinical practice in a health center and was validated in the pilot test, with the diagnostic agreement of the principal investigator, which was of a moderate overall parameter (Fleiss' Kappa=0.60) (27).

The questionnaire collected sociodemographic data, socioeconomic level, oral hygiene, toxic and dietary habits. The dependent variable was severe caries and a case was defined as an adolescent with a detectable cavity in opaque or discolored enamel with visible dentin by the dental explorer test in at least one permanent molar, based on the combined codes 5 and 6 of the International Caries Classification and Management System criteria (ICCMS) (28). The identification of the first permanent teeth was based on the nomenclature of the International Dental Federation (29).

Socioeconomic level was determined based on the number of sleeping quarters, type of floor, access to technology such as computers, cell phones and internet services. The responses followed three ordinal categories, where scores of six to seven points were considered high socioeconomic level; middle class from four to five points and low class from one to three points.

Regarding smoking habits, the classification of cigarette consumption based on the World Health Organization citeria was used (30). The classification of smoking followed three ordinal categories: light smoker, consumption of less than 5 cigarettes per day; moderate smoker, 6 to 15 cigarettes per day; and severe smoker, more than 16 cigarettes per day.

For the evaluation of dietary habits, it was obtained from the analysis of the diet, which includes the type of diet, frequency and occasion of consumption (31). The scores for frequency and occasion of consumption were multiplied by the value of the type of food, the individual values for frequency-occasion were added together and a single value of consumption per frequency and a value of consumption per occasion were obtained; the cariogenic potential was the sum of these two values. The score obtained was placed in the ordinal values: low cariogenic risk from 1 to 33 points; moderate from 34 to 79 and high from 80 to 144.

The data collection and validation was done twice with the program EpiData V3.1 (32), in order to avoid typo mistakes. The program CIETmap (33), was used for the statistic analysis. An univariate analysis was done to obtain simple frequencies in the study variables. The prevalence ratio with its 95% confidence interval was calculated as a measure of association between the possible associated factors and the outcome variable.

Through multivariate explanatory analysis, a model of factors associated with severe caries of the first permanent molar was produced with the simultaneous analysis of the Mantel-Haenszel procedure (34). The initial saturated model included all the variables with statistical significance in the bivariate analysis, plus those variables added for plausibility criteria that served as adjustment. All variables were eliminated one by one, until only those with a significance level of <0.05 remained.

The project was approved by the Ethics Committee of the Health Jurisdiction 07 of the Secretariat of Health of Acapulco. The school authority obtained the permission of the parents or guardians by means of a circular letter and allowed data collection, in addition to requesting verbal informed consent from each participant. The adolescents responded to the questionnaire freely and voluntarily. The clinical examination was non invasive, without any health risk, and at the end the diagnosis found was shared with them.

RESULTS

A total of 173 adolescents between 12 and 15 years of age participated, with a mean of 14.02 years

(SD 0.68). Table 1 shows the other characteristics in detail of the sociodemographic data of the study sample. As for the socioeconomic level, the 70% (n=122) of the adolescents were lower class, 28% (n=49) middle class and 2% (n=2) high class.

Table 1. Sociodemographic characteristics among adolescents.

Feature		n	%
Gender	Females	91	53
	Males	82	47
Family member living	Both parents	138	80%
	Mother	27	16%
	Other relative	8	4%
Being an only child	Yes	62	36%
	No	111	64%
Schooling of parents or guardians	No estudies	42	24%
	Basic level	115	66%
	Upper middle	12	7%
	Higher education	4	3%
	Total:	**173**	

About the oral hygiene data, the 52% (n=89) of the adolescents reported brushing their teeth three times a day, 21% (n=37) two times, 18% (n=31) one time and 9% (n=16) four or more times. The range of brushing frequency was 1 to 5 times with a mean of 2.5 (SD 0.96). The 68% (n=135) used toothpaste for cleaning and the rest only water. Regarding hygiene aids, 38% (n=66) used mouthwash, 7% (n=12) floss and the rest did not use any. In terms of health promotion instruction, 89% (n=154) had never received any oral health education and the rest had. The 52% (n=91) had not attended a dental appointment, 32% (n=55) between one and three years ago and 16% (n=27) in the last six months.

With regard to toxic habits, the 37% (n=65) of the adolescents consumed cigarettes. When classifying frequency, 65% (n=42/65) were light smokers, 28% (n=18/65) moderate smokers and 7% (n=5/65) severe smokers. Regarding alcohol consumption, 29% (n=51) consumed alcoholic beverages. When stratified, 53% (n=27/51) consumed 1 to 7 drinks per week, 29% (n=15/51) 8 to 15 and 18% (n=8/51) 16 or more. Data on cariogenic risk showed that 57% (n=98) had moderate risk dietary habits, 38% (n=66) low and 5% (n=9) high.

The 54% (n=94) of adolescents had severe caries in at least one permanent molar, and the rest had other uncounted or healthy categories. Table 2 shows that a total of 692 permanent first molars were examined, of which 396 were identified with severe caries. When distributed by jaw, the proportion of molars with mandibular caries was 80% (n=301/376), and the rest were from the upper jaw. As for the first permanent molar with the most severe caries was the lower right molar, with a proportion of 44% (n=167/376).

Table 2. Distribution of permanent first molars among adolescents

ICCMS criteria*	First permanent molars					
	16	**26**	**36**	**46**	**n**	**%**
Healthy	96	57	73	90	316	46%
Severe	52	23	134	167	376	54%
Total	**148**	**80**	**207**	**257**	**692**	**100%**

* The definition of severe caries was established based on codes 5 and 6 of the International Caries Classification and Management System

The bivariate analysis identified six factors associated with having severe permanent first molar caries among adolescents. The estimated unadjusted prevalence ratio and its 95% confidence interval are shown in Table 3. The six relevant factors from the bivariate analysis, adjusted for the gender variable, were included in the initial saturated model of the multivariate analysis.

Table 3. Bivariate analysis of factors associated with severe permanent first molar caries among adolescents.

Variable	Factor	Severe caries		No caries		PRna	CI 95%	p
		n	(%)	n	(%)			
Gender	Man [Ref.]	38	(22%)	44	(25%)	0.76	0.57 – 1.01	0.055
	Female	56	(32%)	35	(21%)			
Age	14-15 years [Ref.]	61	(35%)	31	(18%)	1.65	1.21 – 2.25	0.001*
	12-13 years	33	(19%)	48	(28%)			
School year	2nd 3rd grade [Ref.]	69	(40%)	47	(27%)	1.23	0.99 – 1.53	0.059
	1st grade	25	(14%)	32	(19%)			
Schooling of parents or guardians	No education and basic level [Ref.]	88	(51%)	69	(40%)	1.07	0.97 – 1.18	0.170
	Upper middle and high school level	6	(3%)	10	(6%)			
Socio-economic level	Low [Ref.]	71	(41%)	51	(29%)	1.17	0.95 – 1.42	0.123
	Middle-high	23	(14%)	28	(16%)			
Toothbrushing	≥ 3 times a day [Ref.]	39	(22%)	66	(38%)	0.49	0.32 – 0.64	< 0.0001*
	< 3 times a day	55	(32%)	13	(8%)			
Oral hygiene aids	Use [Ref.]	19	(11%)	59	(34%)	0.27	0.17 – 0.41	< 0.0001*
	Does not use	75	(43%)	20	(12%)			
Health Promotion	Received [Ref.]	8	(5%)	11	(6%)	0.61	0.25 – 1.44	0.262
	Not received	86	(50%)	68	(39%)			
Cigarette consumption	≥ 6 times a day [Ref.]	20	(11%)	3	(2%)	5.60	1.72 – 18.16	0.004*
	≤ 5 times a day-no smoking	74	(43%)	76	(44%)			
Alcohol consumption	Yes [Ref.]	36	(21%)	15	(9%)	2.01	1.19 – 3.40	0.008*
	No	58	(33%)	64	(37%)			
Cariogenic diet	Moderate-high [Ref.]	66	(38%)	41	(24%)	1.35	1.05 – 1.73	0.017*
	Low	28	(16%)	38	(22%)			
	Total	**94**	**(54%)**	**79**	**(46%)**			

PRna = unadjusted prevalence ratio.
CI 95% = confidence interval of 95%
p= p value of the X^2 test.

The main strength of association was found in the variable compsumption of six or more cigarretes (PRa= 5.48), and the other was the use of oral hygiene aids (PRa= 0.41). Table 4 shows the adjusted estimate of the prevalence ratio of severe caries with its 95% confidence interval. The findings exclude distractor effect (counfounder) and the X^2 test for heterogeneity was greater than 0.05 in all the associations of the final model, which excludes the existence of effect modification between the strata of the variables included.

Table 4. Final model of the multivariate analysis of factors associated with severe caries of the first permanent molar among adolescents.

Factors	PRa	CIa 95%	$X^{2\ het}$
Use of oral hygiene aids	0.41	0.34 – 0.78	1.08
Cigarette consumption ≥ 6 times a day	5.48	2.01 – 17.87	1.17

PRa = adjusted prevalence ratio.
CIa 95% = adjusted confidence interval of 95%.
$X^{2\ het}$ = chi-square of heterogeneity to evaluate effect modifiers.
*The initial saturated model included the following variables: age, toothbrushing, oral hygiene aids, cigarette consumption, alcohol consumption and cariogenic diet; they were adjusted for gender.

DISCUSSION

Two factors were associated with severe permanent first molar caries in adolescents. One factor was in the sense of risk, the consumption of six or more cigarettes a day. The other factor was protective, the use of oral hygiene aids.

This study, being of cross-sectional design, has limitations with respect to the temporality of the association between exposure factors and the effect. It is important to point out that there is a possible observation bias due to the moderate concordance obtained. The importance of carrying out an inter-examiner calibration based on the opinion of pediatric dentists is emphasized, aiming at a fine-tuned diagnostic system in future research.

A further important point was the operational definition of case, since only the category of severe caries was counted, leaving the initial and moderate stages as healthy cases, which underestimates the essence of the caries condition. Another issue was to carry out the study in the middle school facilities, when ICCMS recommendations are to carry out the inspection in a comfortable cubicle with good light intensity, which allows to establish the categorization with the minimum margin of error.

Regarding the dental organs, the lower molars were the most affected, similar to what has been reported in several studies (13,15,16). This could be influenced by their chronology, since they erupt earlier than the upper ones. An additional reason is the morphology, because the cusps of the lower teeth are rounded, which allows the cusps of the upper teeth to occlude in front of them, therefore, there is a greater probability that food remains stagnant. Also, the force of gravity contributes to the fact that the food debris does not remain in the upper molars and due to the force of the tongue it is retained in the lower part.

It was found that the lower right first molar was the most frequently affected by severe caries. Valdes-Martínez *et al*., described that the left one is more affected in the Cuban population (15). One difference is that they evaluated the situation with the Clune index, therefore, they describe the situation of the event by affected surface.

The prevalence of severe caries of 54% in the first permanent molar reported in this study was similar to that reported in the Palestinian and Venezuelan adolescent population (9,12). Other studies report high morbidity in more than three quarters of the adolescent population (11,16). One of the differences between our study and others was the operational definition, which encompassed the progression of caries to a certain category (severe). Other studies only evaluate the caries count, without the use of criteria that establish a categorization.

Cigarette smoking was found to be a risk factor contributing to the presence of severe caries of the first permanent molar. However, it is possible that the adolescents may have acquired the habit recently, so it is difficult to establish which came first, caries or smoking, thus presenting the phenomenon of reverse

causality. Another fact is that in these questions there is a non-response bias, since adolescents deny the habit for fear that the information will be communicated to parents or guardians. There is probably an underestimation in the cases of this habit, so it is necessary to use other scales that have fixed parameters to establish an exact frequency of cigarette consumption.

Concerning the protection factor, the use of oral hygiene aids seems to reflect the attitude of adolescents to reinforce their cleanliness and to extend it to avoid infections. If this assumption is true, then the attitude precedes the appearance of caries. The use of hygiene aids enters a primary level of specific protection, together with frequency of dental visits, diet and fluoride topicalization (14,22,23).

Regarding gender, females were the most affected by caries, in agreement with other studies (9,16,17,19). This variable was included in the multivariate model for plausibility criteria; however, no association was found. Khorasani *et al*., mention that Iranian females have a higher occurrence of caries and Brito *et al*., report males in a study among the Brazilian population (10,14).

The results obtained show that severe caries was associated with various factors. Studies with greater methodological robustness, such as a cohort, are needed to clarify the factors involved in this population through follow-up. Dental organs with severe caries should be treated with damage-limiting procedures, and those in early or moderate stages with minimally invasive dentistry.

The simple selection study sample reflects a portion of adolescents from a public sector secondary school. The private sector secondary schools have different characteristics, therefore, they are not comparable. Nevertheless, the results of the study can be contrasted with a population of middle school adolescents with similar characteristics.

In this study, consuming six or more cigarettes per day has about five times the risk of developing severe caries in the first permanent molar. Smoking is a deeply rooted habit in adolescents, therefore, it is necessary to address this problem with health education interventions. As for the protective factor, the use of hygiene aids has a 41% probability of avoiding caries infection, therefore, we suggest reinforcing primary strategies through health promotion. In spite of finding these associated factors, it will be necessary to carry out longitudinal research (cohort), with the advantage that in these studies the exposure is not present and establishes the temporality with the decrease of biases.

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