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Caries prevalence and some associated factors in 6-9-year-old schoolchildren in Campeche, Mexico.

Original Article

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SUMMARY.

Introduction. The purpose of this study was to determine the prevalence of caries in primary and permanent teeth, and to identify variables associated with experience of caries in the permanent dentition.

Subjects and methods. Children (n=320) aged 6-9 years (mean 6.99 ± 1.00) were examined from three public schools selected randomly in Campeche, Mexico in 2001. A questionnaire was sent to the children's parents to measure socioeconomic, socio-demographic, and behavioral variables. Dental caries was measured using the WHO indices. Caries experience (DMFT, dmft) and caries prevalence (% DMFT>0, % dmft>0) were calculated. We also created a multivariate binary logistic regression model.

Results. Overall caries prevalence was dmft>0=53.1% (6-7 years old = 50.2%; 8-9 years old = 63.0%) and DMFT > 0 = 18.4% (6-7 years old = 13.8%; 8-9 years old = 34.3%). The overall mean dmft and DMFT index were 1.78 ± 2.41 (6-7 years old = 1.77± 2.46; 8-9 years old = 1.83± 2.22) and 0.34 ± 0.83 (6-7 years old = 0.23± 0.66; 8-9 years old = 0.71± 1.17), respectively. Multivariate analysis showed that older age (OR= 3.19), female sex (OR= 2.06), presence of enamel defects (OR= 4.11), and caries in the primary teeth (OR=2.95) were associated with DMFT>0.

Discussion. This study confirmed that caries status in the primary teeth could be used as a risk indicator for caries in the permanent teeth of Mexican school-age children. The collected epidemiological data may be used to improve public oral health service planning and resource allocation.

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Key words: dental caries, epidemiology, primary dentition, permanent dentition, Mexico.

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RESUMEN.

Prevalencia de caries y algunos factores asociados en escolares de 6-9 años de edad en Campeche, México.

Introducción. El objetivo de este estudio fue determinar la prevalencia de caries en la dentición primaria y permanente e identificar las variables asociadas con la experiencia de caries en la dentición permanente.

Sujetos y métodos. Se examinaron 320 niños de 6-9 años de edad de tres escuelas de la ciudad de Campeche, México en 2001. Se envió un cuestionario a las madres de los niños para medir variables socioeconómicas, sociodemográficas y conductuales. La caries dental fue medida usando los índices de la OMS y se calcularon la prevalencia (% CPOD > 0, % ceod > 0) y experiencia (CPOD, ceod) de caries. El análisis estadístico se realizó con regresión logística binaria.

Resultados. La prevalencia de caries en dentición primaria fue de 53.1% (en los de 6-7 años = 50.2%; y 8-9 años = 63.0%) y en la dentición permanente fue de 18.4% (en los de 6-7 años = 13.8%; y 8-9 años = 34.3%). La media de los índices ceod y CPOD fueron 1.78± 2.41 (en los de 6-7 años de edad = 1.77 ± 2.46; y 8-9 años = 1.83± 2.22) y 0.34 ± 0.83 (en los de 6-7 años de edad = 0.23 ± 0.66; y 8-9 años = 0.71± 1.17), respectivamente. El análisis multivariado mostró que la edad (RM= 3.19), el sexo femenino (RM= 2.06), la presencia de defectos del esmalte (RM= 4.11), y la presencia de caries en la dentición primaria (razón de momios, RM= 2.95) estuvieron asociadas con el CPOD>0.

Discusión. Este estudio confirma que la caries en dentición primaria puede usarse como un indicador de riesgo para la caries en dentición permanente de niños mexicanos de edad escolar. ***(Rev Biomed 2006; 17:25-33)***

Palabras clave: caries dental, epidemiología, dentición primaria, dentición permanente, México.

INTRODUCTION.

Dental caries is known as the principal problem in public oral health. There is ample evidence that prevalence of dental caries has been declining over the last two decades for the majority of young population groups in many developed countries. While scientists disagree when it comes to specific ranking of the factors responsible for such decline, widespread exposure to different fluoride technologies is often credited for playing a substantial role (1-3). A decline in some Latin American countries has also been reported recently (4, 5). Epidemiological surveys can improve the monitoring of population-level trends of important oral health conditions, so that morbidity and treatment needs can help tailor oral health programs to meet real-life health needs.

An expanding number of epidemiological studies around the world have demonstrated a direct relationship between various behavioral, social, economic, and clinical factors and dental caries. Among these factors, studies have shown that tooth brushing and oral hygiene behavior in children is associated with dental caries experience (6-8). Kanchanakamol *et al*. (9), in Tailand, Lo *et al*. (10), in China, Montero *et al*. (11), and Casanova *et al*. (8), in Mexico found that children with demarcated opacities and enamel hypoplasia had higher caries levels. Others found that older age is determinant for dental caries (8, 12-14). Several longitudinal (15-18) and transversal (8, 19) studies have shown that caries experience in primary teeth is correlated with caries in permanent teeth in diverse countries and ethnic groups, with a relatively strong association compared to other variables. Such relations are modified by associations between socioeconomic variables and dental caries (8, 14, 20-22). Various authors reported a difference between sexes, observing that boys have higher dental caries experience in primary dentition than girls (13, 14, 21). This situation was reversed in permanent teeth (23-26).

Because epidemiological data may be used for improved public oral health service planning, recent

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studies have been conducted to determine the oral status in the population in Mexico; an array of studies examined the epidemiological profiles of dental caries and caries-treatment experience in one state of the country: Campeche. To continue expanding our understanding of the factors modifying the oral health of groups at risk, information on factors associated with increased caries experience is needed. The aim of this investigation was to determine the caries experience (mean of dmft and DMFT) and prevalence (dmft>0 and DMFT>0) in primary and permanent teeth of children 6-9 years of age, and to identify variables associated with prevalence of caries in the permanent dentition.

MATERIAL AND METHODS.

Design, population and sample of study.

The design and undertaking of the study followed the ethical guidelines for research studies at the Universidad Autónoma de Campeche. Campeche is one of 32 States of the Mexican Republic. Its capital has the same name and is located in the southeast, on the Gulf of México coast.

The present study has two components; the "dental fluorosis" component and the "dental caries" component. The methodology has been informed in a previous report on dental fluorosis (27). Briefly, a cross sectional study was carried out on all schoolchildren aged 6-9 years old attending public schools in Campeche City, Mexico in 2001. The program consists in the periodic application (every six months) of topic fluoride and the teaching of correct toothbrushing. As Campeche is a non-fluoridated town, in this population the program of salt fluoridation started in 1991. Children were selected from a pool of 30 elementary schools included in a preventive dentistry program managed by a federally funded, medical insurance system in Campeche City (Instituto Mexicano del Seguro Social, or IMSS). On average, the schools had 73-81 children aged 6-9 years (n~2250). The socio-economic conditions in these public schools were presumed to be similar. The sample included three randomly selected schools from an urban area of Campeche City, and included all first, second, and third grade children (336 schoolchildren). The mothers of the children were approached and informed in a letter about the study design, the need to fill out questionnaires, and the planned dental examinations.

Variables and data collection.

We distributed structured questionnaires in the schools to mothers who agreed to participate and signed informed consent letters, and collected them in the same locations. The instruments were used to determine demographic, socioeconomic, and behavioral variables. The dependent variable was dental caries. Caries prevalence was expressed as the percentage of individuals in a given group with experience of caries in their permanent and/or primary teeth (DMFT>0 and dmft>0). The averages of decayed, missing, and filled teeth (DMFT and dmft indices) were used to express the caries experience of a given group. The independent variables were age, sex, toothbrushing frequency, and presence of enamel defects. Specifically, these were enamel opacities and they were classified as: demarcated or diffuse, and enamel hypoplasia (28), in the child. Other variables were highest level of schooling in the mother, as well as her attitude toward the oral health of her child. Subjects were classified as having defects present if one or more teeth were affected. The importance ascribed by the mother to the oral health of her child was reduced to a simple positive (1) or negative (0) attitude, on the basis of combined responses to two questions: Do you consider it important for your child to keep his/her teeth in good condition?, and Have you ever examined his/her teeth to check if they are healthy? (27, 29, 30).

Clinical exams.

The visual dental examination was conducted by four examiners previously trained to use standardized detection criteria, by an investigator (AAVS) with experience in oral epidemiologic surveys, (inter-examiner agreement at child level,

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kappa>0.90 for caries and 0.80 for enamel defects). The children didn´t brush their teeth prior to clinic exams. However, the teeth were dried with sterilized gauze. Exams were conducted using flat mirrors and probes under natural light conditions, in suitable places at the schools. No radiographs were used.

Statistical analysis.

The data were entered in SPSS 10.0© and analyzed in STATA 7®. An exploratory analysis was first carried out to describe the sample and to evaluate the data. The mean DMFT, dmft, and DMFT+dmft were calculated. The dependent variable was dental caries in permanent teeth and was dichotomized as: (0) DMFT=0 and (1) DMFT>1. All categories of the independent variables were entered as dummy variables in the analysis. A bivariate analysis was first carried out; variables were analyzed by Pearson's X^2 test or by Fisher exact test, when appropriate (i.e., expected cell value <5). Statistical significance was assumed when $p<0.05$.

We created a multivariate binary logistic regression model with the purpose of obtaining the best variables associated with the experience of caries (DMFT>0). The strength of the association of our model was expressed as odds ratios (OR) with 95% confidence intervals (95%CI). In the final model we included the variables from the bivariate analysis that had a pvalue <0.25 (31). We conducted a variance inflation factor test with the purpose of analyzing and avoiding multicolinearity between independent variables. Due to small numbers in some categories of independent variables, no interactions were tested. The adjustment of this model was verified with the goodness-of-fit test using $p>0.10$ as a cutoff point to consider the adjustment to be adequate. Specification error test (*linktest*) was used to verify the assumption that the outcome *logit* was a linear combination of the independent variables (32).

RESULTS.

We clinically evaluated 320 children aged 6-9 years and applied an identical number of questionnaires. Response rate for questionnaires and participation rate in exams was 95.2%. The mean age was 6.99 ± 1.00 years, 52.5% were boys and 47.5% girls. Table 1 presents the distribution of children across the variables of interest including socio-demographic, socioeconomic, and behavioral factors. The mean number of years of schooling of the mothers was 9.56 ± 4.55 years.

Table 1
Characteristics of subjects included in the study.

Variables	n	Percentage
Age		
6-7 years	245	77.2
8-9 years	73	22.8
Sex		
Boys	168	52.5
Girls	152	47.5
Tooth brushing frequency		
At least once a day	261	81.6
Fewer than 7 times/week	59	18.4
Mother's attitude to child's oral health		
Positive	197	61.6
Negative	123	38.4
Schooling of mothers		
> 6 years	228	71.3
< 6 years	71	28.2
Enamel defects		
Without	309	96.6
With	11	3.4

Caries prevalence and experience.

Overall caries prevalence was dmft>0=53.1% (6-7 years old = 50.2%; 8-9 years old = 63.0%) and DMFT>0=18.4% (6-7 years old = 13.8%; 8-9 years old = 34.3%). The overall mean dmft and DMFT index were 1.78± 2.41 (6-7 years old = 1.77 ± 2.46; 8-9 years old = 0.23± 0.66) and 0.34 ± 0.83 (6-7 years old = 0.23± 0.66; 8-9 years old = 0.71± 1.17), respectively. The percentage of caries-free children in both dentitions was 41.9%. Caries experience – expressed as mean DMFT and mean dmft -- and prevalence of caries -- expressed

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Table 2
Mean DMFT/dmft values (± Standard deviation), absolute number of children with DMFT/ dmft>0 and the proportion of the total number of children (%).

Age (n)	DMFT (SD)*	dmft (SD) †	DMFT>0 (%)	dmft> (%)
6 (119)	0.22 (0.61)	1.92 (2.62)	16 (13.5)	62 (52.1)
7 (129)	0.25 (0.71)	1.63 (2.32)	18 (14.1)	62 (48.4)
8 (29)	0.59 (1.05)	1.79 (1.93)	9 (31.0)	18 (62.1)
9 (44)	0.80 (1.25)	1.86 (2.41)	16 (36.4)	28 (63.6)
Total	0.34 (0.83)	1.78 (2.41)	59 (18.4)	170 (53.1)

DMFT= Decay, Missing, and Filled teeth in permanent dentition.
dmft= decay, missing, and filled teeth in primary dentition.
* Non-parametric test z=3.79; p<0.01
† Non-parametric test z=0.67; p=0.50

as the percentage of children with DMFT>0 and dmft>0 -- by age are shown in Table 2. Caries prevalences in permanent and primary teeth in 6-year-olds were 13.5% and 52.1%, respectively, and for children aged 9 years, 36.4% and 53.1%, respectively. Data analyses showed that the DMFT, dmft and DMFT+dmft indices were 0.34±0.83, 1.78±2.41, and 2.13±2.73, respectively. For 6 and 9 year-olds, the values were DMFT=0.22±0.61, dmft=1.92±2.62, and DMFT=0.80±1.25, dmft=1.86 ± 2.41, respectively.

Bivariate analyses.

In a non-parametric test for trends we found an increase in the DMFT index and caries prevalence in permanent dentition (p<0.01) by age. No differences in the caries experience and caries prevalence in the primary dentition were found in bivariate analyses for all independent variables. Table 3 presents bivariate analysis between caries experience (DMFT>0) and independent variables included in the study. Bivariate logistic regression revealed that DMFT>0 was positively associated with higher age (OR=3.26; 95% CI = 1.78 – 5.97), caries experience in primary teeth (OR=2.84; 95% CI = 1.52 – 5.29), female gender (OR=1.80; 95% CI = 1.01 – 3.19), and had a borderline association with decreasing tooth brushing frequency (P=0.057).

Multivariate results.

Table 4 presents a multivariate logistic regression analysis for caries experience (DMFT=0 vs. DMFT>0). The set of four dummy variables was statistically significant (X^2 (4)=32.51; p<0.0001). Controlling for demographic and clinical factors, children with caries experience in

Table 3
Bivariate analysis between caries experience (DMFT>0) and independent variables included in the study.

Variables	OR (95% CI)	P value
Age		
6-7 years	1*	X^2 =15.718
8-9 years	3.26 (1.78 – 5.97)	p=0.000
Sex		
Boys	1*	X^2 =4.054
Girls	1.80 (1.01 – 3.19)	p=0.044
Tooth brushing frequency		
At least once a day	1*	X^2 =3.625
Fewer than 7 times/week	1.89 (0.97 – 3.65)	p=0.057
Mother's attitude to child's oral health		
Positive	1*	X^2 =1.188
Negative	0.72 (0.39 – 1.31)	p=0.276
Schooling of mothers		
> 6 years	1*	X^2 =1.654
< 6 years	1.48 (0.81 – 2.69)	p=0.198
Enamel defects		
Without	1*	Fisher test
With	2.64 (0.75 – 9.33)	p=0.125
Caries in primary teeth		
dmft=0	1*	X^2 =11.338
dmft>0	2.84 (1.52 – 5.29)	p=0.001

* Reference category

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Table 4
Final model of logistic regression between caries experience (DMFT>0) and independent variables included in the study (n=320).

Variables	AOR	(95% CI)	P value
Age			
6-7 years	1*		
8-9 years	3.19	1.70 – 6.01	0.000
Sex			
Boys	1*		
Girls	2.06	1.12 – 3.78	0.020
Enamel defects			
Without	1*		
With	4.11	1.05 – 16.06	0.042
Caries in primary teeth			
dmft=0	1*		
dmft>0	2.95	1.53 – 5.68	0.001

AOR, Adjusted Odds Ratio for all variables shown in the table.
* Reference category
Log likelihood= -136.69, $X^2(4)=32.51$, p=0.0000
Goodness-of-fit statistic for the model, $X^2(8)=4.44$; p=0.8155
Specification error (linktest): predictor p=0.042, predictor^2 p=0.970

primary teeth were more likely (OR=2.95; 95%CI=1.53 – 5.68) to have DMFT>0 than children without caries in primary dentition. In addition, the odds of having DMFT>0 were significantly greater among girls (OR=2.06; 95%CI=1.12 – 3.78) than among boys. Older children were 3.19 times (95%CI=1.70 – 6.01) more likely than younger children to have caries experience in permanent dentition. In contrast to the bivariate results, after adjusting for other variables, children with enamel defects were significantly more likely (OR=4.11; 95%CI =1.05 – 16.06) to have DMFT>0 than children without enamel defects in the multivariate analysis.

The model adjustment was tested with the goodness-of-fit test and was not found to be significant (X^2 (8)=4.44; p=0.8155). This suggests that the observed probabilities were similar to the predicted probabilities by the logistic model. In the specification error test, we obtained satisfactory results; the outcome *logit* was a linear combination of the independent variables.

DISCUSSION.

The present study added to the expanding body of data that has accrued over the past 5-10 years, which documents the current state of dental health in the child population in Mexico. Interestingly, the rates reported in the present study are lower than those observed in other groups of Mexican schoolchildren in the past – studies mostly from Central Mexico (26, 33-35). Mean indices and caries prevalence in both dentitions were lower than figures reported by Herrera *et al* (14). in Campeche (located on the Gulf of México coast), comparing children of similar age. A likely explanation for such decline is the implementation of oral health programs benefiting our study population but not the group investigated by Herrera *et al*. (14), (hence being the most important explanation for the disparate results in the Campeche environment), or widespread use of fluorides through different vehicles at the national level. However, it is necessary to take into account that local variations in caries experience and prevalence can be large within a single country.

Mean dmft, mean DMFT, and the proportion of children with caries were more favorable in the present study than figures reported for similar age groups in other less-developed countries (36, 37), and compared advantageously or similarly to certain reports from developed countries (21, 38). Regardless of such positive contrasts, the present study suggested that early initiation of tooth decay in Mexican schoolchildren is common: 52% of children had caries at age six. This level of prevalence failed to meet the first oral health goal of FDI/WHO (40) for the year 2000 (50% of children free of caries at this age) by a small margen.

The study supplied some of the first evidence confirming the close association between experience of decay in the primary and the permanent dentitions for this age group (6-9 years)

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in Mexico in a cross sectional study. The experience of caries in primary dentition was a factor associated with caries in permanent teeth; this finding supports results reported recently in longitudinal (7, 15-18) studies in diverse settings. This observation could also be seen in children with mixed dentition in cross-sectional studies (8, 19). Such results emphasize the need for, and the feasibility to attain, the early identification of children at high risk of caries, as suggested by other authors (13, 14). In turn, the process of early identification would open the possibility of implementing oral health programs targeting school age children.

The present study demonstrated a significant relationship between age and caries experience in permanent teeth. This occurrence was in line with previous findings, both in younger and older children (12,13, 21, 26, 34, 35). The difference could be explained by a number of factors that include the time span since eruption of teeth, and the change of dietary habits as children become older (21).

A difference in the prevalence of caries existed when the data were examined across sexes; these results showed girls having more caries in permanent teeth than boys, in agreement with other studies both in Mexico and elsewhere (23-26). Differences in the prevalence of caries in the permanent dentition could be explained by the fact that girls begin to change their teeth at an earlier age than boys, but further research of sex-specific biological and behavioral mechanisms of dental caries initiation is required to accurately identify causal relationships (21). No significant difference existed in primary teeth. A similar confirmation of earlier reports linking enamel defects and dental caries was supported by our study (8-11).

This study had certain limitations that should be taken into account when interpreting the results. One of them arises from the nature of a cross-sectional design that attempts to measure cause and effect at the same time; such an approach leads to the problem of temporal ambiguity and thus makes it unfeasible to discern causal relationships. On the other hand, this study uses a *proxy* variable of socioeconomic level (schooling of the mother), that could explain the absence of differences in this variable; in addition, this variable was observed to be very homogeneous in the sample. Another limitation in this study was that only the schools that have a preventive oral programs were selected.

The overall conclusion from the study is that the oral health status in this population group of Mexican children, as measured by caries prevalence and caries experience, is generally better when compared to data from similar age groups in diverse Mexican communities, and in other countries. The findings fitted the statistical model well. Caries experience was modified by socio-demographic and clinical factors, and was shown to be closely associated from the primary dentition to the permanent dentition. The low prevalence of dental caries observed in this sample could be due to the fluoride exposure of the national salt program or to preventive programs carried out in Mexican schools. The implementation of an oral health program for school children to identify individuals at high risk of caries is necessary.

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