Socioeconomic and Sociodemographic Variables Associated With Oral Hygiene Status in Mexican Schoolchildren Aged 6 to 12 Years

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Background: The purpose of this study was to identify the socioeconomic and sociodemographic variables associated with oral hygiene status in schoolchildren aged 6 to 12 years in Navolato, Sinaloa, Mexico.

Methods: A cross-sectional study was carried out in 3,048 schoolchildren. A questionnaire was used to determine socioeconomic and sociodemographic variables, and a clinical oral examination was carried out to establish oral hygiene status. The "plaque" component of the simplified oral hygiene index (S-OHI) was the criterion used to determine oral hygiene status in children. Using principal component analysis, five socioeconomic factors were streamlined to one principal component to determine the individual socioeconomic level. Data were analyzed with non-parametric tests and multivariable logistic regression.

Results: The population included 1,456 boys and 1,592 girls. The mean value for S-OHI was 1.10 ± 0.34. The largest percentage (50.8%) of the S-OHI scores ranged between 0 and 1. In the multivariate model, younger age, male gender, and lower toothbrushing frequency ($P<0.05$) were associated with poor oral hygiene. Children with better socioeconomic status had better oral hygiene ($P<0.05$).

Conclusions: Most children (~60%) had an acceptable level of oral hygiene. Diverse variables were associated with oral hygiene in these Mexican children, highlighting a gradient distribution throughout the socioeconomic spectrum. It is necessary to implement strategies that would help to diminish the disparities observed across diverse socioeconomic groups. *J Periodontol 2007;78:816-822.*

KEY WORDS

Epidemiology; oral hygiene; plaque index; socioeconomic status; toothbrushing.

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The most common oral diseases in Mexico, as in the rest of the world, are dental caries and chronic periodontal diseases. Certain types of biofilm are among the clinical etiological factors that play a predominant role in the initiation and progression of these two diseases. Dental plaque largely is made up of commensal species in the mouth. However, under poor oral hygiene conditions, certain factors promote the retention and accumulation of plaque on the surface of the teeth and on surrounding tissues.[1-3] Dental plaque formation involves an ordered pattern of colonization (microbial succession) by many different bacteria.[4] Immediately after dental eruption or prophylaxis, saliva proteins adsorb rapidly and selectively to the surface of the enamel to form a thin film. This event is followed by adherence of various oral microorganisms. Gram-negative bacteria are the first organisms to colonize and adhere to the film, with filamentous bacteria gradually dominating its maturation process.[5] The accumulation of plaque is considered a complex and multifactorial process overall.[6] These changes in the specific composition and quantity of plaque alter its potential to cause periodontal and dental problems. Common sense and long-held beliefs among dental professionals suggest that adequate

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oral hygiene generally is considered a substantial component in maintaining good oral health.

The most common procedure to remove dental plaque involves using a toothbrush and toothpaste.[7] Although using a toothbrush (manual or electric[8-13]) significantly improves the level of adequacy of oral hygiene, there are many other contributing factors. These variables have not been well characterized from an epidemiological perspective. Research that explores the sociodemographic and socioeconomic factors that modify the adequacy of oral hygiene is of interest for many reasons. Most importantly, it could provide the opportunity to identify at-risk populations to target preventive dental programs at the individual and community levels. Several studies[6,14-16] undertaken in different parts of the world identified diverse variables associated with better or worse oral hygiene. Among these variables are gender, age, frequency of toothbrushing, daily consumption of sugared beverages, age when toothbrushing began, and the amount of toothpaste used. As expected, there is a great deal of variation in these patterns. The objective of this study was to identify the socioeconomic and sociodemographic variables that were associated with oral hygiene patterns among schoolchildren aged 6 to 12 years in a mid-size city in Northern Mexico.

MATERIALS AND METHODS

The study complied with the specifications for protecting participants and adhered to the regulations for research and ethics set by the National Institute of Public Health in Mexico.

Study Design and Population

This report is part of a comprehensive overview of the oral health in schoolchildren in Navolato, Sinaloa, Mexico. Oral health was evaluated in terms of dental caries, premature tooth loss, oral hygiene, use of dental health services, and dental pain, among other aspects. A cross-sectional study was undertaken in children aged 6 to 12 years who were attending any one of 18 elementary schools in the city of Navolato in 2003.[17] The original population consisted of 3,547 children. First, meetings were held with representatives of the health and education organizations in the city; then, mothers/guardians of the children were invited to have their children participate in the study. In the first phase of the study, 75% of the children targeted responded (N = 2,674), and after a follow-up contact, the final response rate was 87.0% (N = 3,086). Thirty-eight children were excluded from the study because they were younger than 6 years of age or older than 12 years of age, had an illness that compromised the mouth, refused to consent to the oral examination, and/or had fixed orthodontic appliances. The final sample size was 3,048 (85.9%) schoolchildren.

Study Variables and Data Collection

Before collecting data, a pilot study was completed to standardize the criteria to be used and to test the questionnaires administered. All participants were examined clinically by one of three examiners in a suitable location within their school, using a chair, a dental mirror, and a probe. The criterion used to ascertain oral hygiene (the dependent variable) was the "plaque" component from the simplified oral hygiene index (S-OHI).[18] In children with primary teeth or with mixed dentition, the modified S-OHI was used.[19] Six tooth surfaces were examined in each participant. The hygiene variable was categorized into five groups,[15] using the following scoring system of S-OHI: very good, 0.0 to 05 (0); good, 0.6 to 1.0 (1); moderate, 1.1 to 1.5 (2); poor, 1.6 to 2.0 (3); and very poor, 2.1 to 3.0 (4). To collect sociodemographic and socioeconomic information, the mothers/guardians of the children were asked to fill out a questionnaire after signing an informed consent form. The independent variables included were age; gender; toothbrushing frequency; use of preventive dental services; sugared soft drink frequency; and socioeconomic variables, such as availability of health insurance, type of school, family size, and socioeconomic status (SES) of the family.

Statistical Analysis

All analyses were carried out using a statistical package.‖ First, principal components analysis was done, specifically polychoric correlation,[20] to reduce the dimensions of certain variables and to construct the SES. SES was determined by using the maximum level of schooling and occupation of both parents, as well as owning an automobile; these variables have been used to determine SES in various health surveys involving children and adolescents in Mexico.[21-23] Five correlated socioeconomic factors were streamlined to one principal component, which explained 52.8% of the variability in SES.

Second, a univariate analysis calculated measures of central tendency and dispersion for continuous variables and percentages for categorical variables. Bivariate analyses were performed using χ^2, Mann-Whitney, Kruskal-Wallis, and Spearman correlation tests, depending on the measurement scale of the variables. For the multivariate analysis, the dependent variable (presence of plaque) was dichotomized as very good/good (0) versus regular/poor/very poor (1) using the binary logistic regression model. For the construction of the final model, variables were included if they had a P value <0.25 in the bivariate analyses. The continuous independent variable age was tested to see if for every unit increase, the increment in the logit

‖ STATA 8.2, Stata, College Station, TX.

of the response variable would remain constant (Box-Tidwell test). Age categories were introduced (0 = 6 to 9 years and 2 = 10 to 12 years) because there was no difference in the probability of having a less adequate degree of oral hygiene between these age groups (lincom test). The test for variance inflation factor was done to analyze (and to avoid as needed) multicollinearity between independent variables.[24,25] In the bivariate and multivariate analyses, the standard errors were adjusted for the correlation that existed between the children of the same school (intraschool cluster) and were distinct between clusters.[26] In the final model, the specification error test (link test) was done to verify the assumption that the response variable was a linear combination of the independent variables. After finding the principal effects, interactions between variables were tested, but none of those tests was significant to $P < 0.15$. Finally, we used the goodness-of-fit test to evaluate the global fit of the model.[24,25]

RESULTS

Table 1 presents the characteristics the study population. The mean age of the children was 8.8 ± 1.8 years. The population included 1,456 boys and 1,592 girls. The permanent dentition of 3,018 children and the primary dentition of 2,623 children were examined; 30 participants had only primary dentition, 425 had only permanent dentition, and 2,593 had mixed dentition. The number of permanent teeth examined was 43,670 and the number of primary teeth examined was 29,104. The mean number of teeth in the mouth of each participant was 14.3 ± 6.9 permanent teeth and 9.5 ± 5.8 primary teeth. The mean plaque index was 1.1 ± 0.3. For the majority of the population (58.8%), the S-OHI values ranged from 0 to 1.

Bivariate Results

Table 2 presents the results of the bivariate analysis when the dependent variable was analyzed at three levels. Table 3 shows the bivariate logistic regression model when it was analyzed in two categories. The age of the child was associated ($P < 0.05$) with oral hygiene. When the non-parametric test for trends was undertaken, a negative trend was observed ($z = -2.13$; $P = 0.033$); the youngest children had the worst oral hygiene (odds ratio [OR], 1.33). Boys had worse oral hygiene than girls (OR = 1.35). Children who had the lowest frequency of brushing per week had the worst oral hygiene (OR = 1.51). With regard to socioeconomic variables and their association with oral hygiene, children assigned to quartiles two (OR = 0.70), three (OR = 0.60), and four (OR = 0.55) had better oral hygiene compared to children in the first quartile of SES, which was the lowest level of SES.

Table 1.

Sociodemographic and Socioeconomic Characteristics of the Children Included in the Study

Variable	Mean ± SD	Range
Child's age (years)	8.81 ± 1.79	6 to 12
Father's age (years)	37.71 ± 6.54	20 to 68
Mother's age (years)	34.64 ± 5.72	20 to 67
Permanent teeth (N)	14.33 ± 6.98	0 to 28
Primary teeth (N)	9.55 ± 5.82	0 to 20
Variable	**N**	**%**
Gender		
Girls	1,592	52.2
Boys	1,456	47.8
Toothbrushing frequency		
≥7 times/week	1,716	56.3
<7 times/week	1,332	43.7
Started toothbrushing		
≤2 years of age	679	22.3
>2 years of age	2,361	77.7
Sugared soft drink consumption		
≤7 times/week	2,636	88.7
>7 times/week	336	11.3
Preventive dental care (last year)		
No	2,415	79.3
Yes	629	20.7
School type		
Private	472	15.5
Public	2,576	84.5
Type of insurance		
Public insurance	2,027	66.6
Not insured	511	16.8
Private insurance	506	16.6
Family size (number of children)		
≤3	2,394	78.6
>3	652	21.4
SES		
First quartile (lowest)	771	25.4
Second quartile	750	24.7
Third quartile	757	24.9
Fourth quartile (highest)	759	25.0

There were no statistically significant differences ($P > 0.05$) in the variables concerning the age at which toothbrushing began, family size, consumption patterns of sugared soft drinks, having preventive care in the preceding year, the type of school attended, or type of health insurance. Having had at least one preventive dental appointment in the preceding year became significant only when oral hygiene was

Table 2.

Bivariate Analyses Between Oral Hygiene (in three levels) and Selected Independent Variables

Variable	Oral Hygiene (S-OHI)			*P* Value
	Good	Moderate	Bad	
Children's age (years)	8.88 ± 1.84	8.67 ± 1.74	8.81 ± 1.63	0.0093* 0.0119†
Gender				
Girls	991	462	139	
Boys	801	481	174	0.0000‡
Toothbrushing frequency				
≥7 times/week	1,084	471	161	
<7 times/week	708	472	152	0.0000‡
Started toothbrushing				
≤2 years of age	410	200	69	
>2 years of age	1,379	740	342	0.4108‡
Sugared soft drink consumption				
≤7 times/week	1,564	814	258	
>7 times/week	184	107	45	0.0562‡
Preventive dental care (last year)				
No	1,396	750	269	
Yes	393	192	44	0.0091‡
School type				
Private	322	132	18	
Public	1,470	811	295	0.0000‡
Type of insurance				
Public insurance	1,208	619	200	
Not insured	270	176	65	
Private insurance	311	147	48	0.0062*
Family size (number of children)				
≤3	1,423	735	236	
>3	368	207	77	0.1175‡
SES				
First quartile (lowest)	373	276	91	
Second quartile	413	224	68	
Third quartile	449	194	78	0.0001*
Fourth quartile (highest)	466	202	54	0.0001†

Good = included very good/good (S-OHI = 0.0 to 1.0); bad = included bad/very bad (S-OHI = 1.1 to 3.0).
* Kruskal-Wallis test.
† Spearman correlation.
‡ Mann-Whitney test.

disaggregated in three levels. These variables were taken into account in the construction of the multivariate model if they fulfilled the $P < 0.25$ criterion.

Multivariate Results

When the sociodemographic and socioeconomic variables were combined in the multivariate logistic regression model, four variables had an independent effect on oral hygiene ($P < 0.05$; Table 4). Children who brushed fewer than seven times a week had a higher probability (OR, 1.42; 95% confidence interval [CI], 1.20 to 1.67) of having inadequate oral hygiene. The estimated increment in the odds of having worse levels of oral hygiene in children 6 to 9 years of age was 34% (95% CI, 1.03 to 1.73) compared to 10- to 12-year-old children. Boys had worse oral hygiene than girls (OR, 1.20; 95% CI, 1.06 to 1.58). Children with higher SES had better oral hygiene (second quartile: OR, 0.68; 95% CI, 0.51 to 0.90; third quartile: OR, 0.58; 95% CI, 0.36 to 0.97; and fourth quartile: OR, 0.56; 95% CI, 0.33 to 0.94).

DISCUSSION

The purpose of this investigation was to determine the oral hygiene level and the factors associated with oral hygiene in a group of Mexican children. This study demonstrated that >50% of the 6- to 12-year-old children had adequate levels of oral hygiene, as established under the current oral examination conditions and with these data collection methods. Although many studies in Mexico and elsewhere documented the negative effect of low SES on some oral diseases, such as the prevalence and severity of dental caries[21,22,27-29] and chronic periodontal disease,[30-32] few studies have explored the effect (if any) of SES on oral hygiene.[16] The results of the present study demonstrated that oral hygiene is associated with SES, after adjusting for other variables. However, the exact mechanism by which such an association occurs is not clear. One reason is that SES is a multidimensional theoretical construct that incorporates a wide diversity of economic and social situations. These circumstances may be mediated through various indicators, which represent many different dimensions.[33] A probable explanation of the present results is that children from the poorest families receive significantly less instruction on oral hygiene from dentists or other knowledgeable sources

Table 3.

Bivariate Analyses of Logistic Regression for Oral Hygiene

Variable	S-OHI (mean ± SD)	OR (95% CI)	*P* Value
Children's age			
6 to 9 years	1.12 ± 0.33	1.33 (1.04-1.70)	0.025
10 to 12 years	1.07 ± 0.34	1*	
Gender			
Girls	1.07 ± 0.33	1*	
Boys	1.13 ± 0.35	1.35 (1.11-1.64)	0.003
Toothbrushing frequency			
≥7 times/week	1.06 ± 0.33	1*	
<7 times/week	1.14 ± 0.34	1.51 (1.28-1.79)	0.000
Started toothbrushing			
≤2 years of age	1.09 ± 0.32	1*	
>2 years of age	1.10 ± 0.34	1.08 (0.92-1.28)	0.328
Sugared soft drink consumption			
≤7 times/week	1.09 ± 0.33	1*	
>7 times/week	1.14 ± 0.38	1.21 (0.92-1.58)	0.173
Preventive dental care (last year)			
No	1.11 ± 0.34	1*	
Yes	1.06 ± 0.33	0.82 (0.62-1.09)	0.179
School type			
Private	0.98 ± 0.31	1*	
Public	1.12 ± 0.34	1.62 (0.72-3.61)	0.243
Type of insurance			
Public insurance	1.09 ± 0.33	0.76 (0.52-1.12)	0.164
Not insured	1.15 ± 0.35	1*	
Private insurance	1.07 ± 0.33	0.70 (0.43-1.14)	0.154
Family size (number of children)			
≤3	1.09 ± 0.33	1*	
>3	1.12 ± 0.34	1.13 (0.89-1.44)	0.312
SES†			
First quartile (lowest)	1.15 ± 0.34	1*	
Second quartile	1.10 ± 0.32	0.70 (0.53-0.94)	0.016
Third quartile	1.09 ± 0.35	0.60 (0.36-0.98)	0.041
Fourth quartile (highest)	1.04 ± 0.33	0.55 (0.33-0.93)	0.026

0 = very good/good versus 1 = moderate/bad/very bad.
95% CIs estimated with robust standard errors.
* Reference category.
† Score test for trend of odds ($\chi^2 = 32.23$; $P = 0.0000$).

than their more affluent peers. Furthermore, in Mexico, people used fewer dental health services and had less coverage from the healthcare system.[34-36] Besides SES, none of the other socioeconomic variables that were included in the study had a statistically significant association with oral hygiene.

The relationship between oral hygiene and sociodemographic factors, such as age and gender, was reported by other investigators.[6,14] We found that boys had worse oral hygiene. This result may be related to what has been documented in previous studies about knowledge, attitudes, beliefs, and oral hygiene practices: girls show better understanding than boys.[14,37,38] In the final logistic regression model, younger children had worse levels of oral hygiene. The explanation may be that younger children are less skilled at removing dental plaque than older children. It was observed that older children brush more often, which also may help to explain why younger children have worse levels of oral hygiene.[39] However, these trends are not universal; some investigators found that older children had more dental plaque.[6]

Various clinical and epidemiological studies[7-13] around the world showed that the best way to eliminate dental plaque is by brushing one's teeth with a manual or electric toothbrush. In agreement with these studies, the findings from the present study showed that less frequent toothbrushing was associated with a higher probability of having poor oral hygiene. However, other factors in the literature that were shown to be associated with effective removal of dental plaque were not measured in the present study. Some of these factors include the individual's ability to brush one's own teeth, the time invested in brushing, and even toothbrush design.[40] We acknowledge the difficulty in controlling for these variables, especially in epidemiological studies in which a large number of individuals is included.[40] However, other investigators posited that dental plaque removal is related directly to the amount of wear of the toothbrush and with individual brushing technique.[41,42] In an epidemiological study such as ours, it is not feasible to evaluate these variables reliably.

CONCLUSIONS

The majority of children (~60%) had an acceptable level of oral hygiene. Diverse variables were associated with better oral hygiene in this population of Mexican children, and adequacy of oral hygiene was distributed along a gradient of socioeconomic levels. If we are to assume that adequate oral hygiene customs are a desirable component of dental health strategies (as it would be in the case of caries control[43]), specific, culturally appropriate methods to support and stimulate adherence to these practices should be introduced. Such implementation ought to

Table 4.

Multivariate Model of Logistic Regression for Oral Hygiene

Variable	OR (95% CI)	*P* Value
Children's age		
6 to 9 years	1.34 (1.03-1.73)	0.029
10 to 12 years	1*	
Gender		
Girls	1*	
Boys	1.29 (1.06-1.58)	0.013
Toothbrushing frequency		
≥7 times/week	1*	
<7 times/week	1.42 (1.20-1.67)	0.000
SES		
First quartile (lowest)	1*	
Second quartile	0.68 (0.51-0.90)	0.007
Third quartile	0.58 (0.36-0.97)	0.036
Fourth quartile (highest)	0.56 (0.33-0.94)	0.030

0 = very good/good versus 1 = moderate/bad/very bad.
95% CI estimated with robust standard errors.
Goodness-of-fit test: Pearson χ^2 (25) = 31.02; P = 0.1884. Link test (specification error): predictor = 0.000; predictor^2 = 0.220.
* Reference category.

take into account measures to ameliorate the inequalities in oral hygiene across different socioeconomic groups. Ideally, the strategies should incorporate those variables allowing a better understanding of why and how some segments of the general population are disadvantaged in their ability to adopt appropriate oral hygiene habits. In terms of supporting the dissemination of such strategies through a concerted effort in developing countries, such as Mexico, it seems appropriate to incorporate a (supervised) toothbrushing program into elementary school curricula.

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