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Sociobehavioral factors influencing toothbrushing frequency among schoolchildren

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Toothbrushing programs may alleviate certain oral diseases, such as chronic periodontitis and caries, that are considered public health problems.¹ However, self-reported adherence to toothbrushing regimens among children and adolescents varies markedly: a study of 32 countries in Europe and North America found that 16 to 80 percent of boys practiced toothbrushing more than once daily, while girls reported better compliance (26 to 89 percent).² Another multinational study (22 countries) reported similar results.³ Despite the importance of toothbrushing (with toothpaste) to dental practice, few studies have examined the clinical and nonclinical variables associated closely with oral hygiene practices among schoolchildren.

Because of the paucity of data pertinent to the Mexican population, as well as the sustained immigration stream of people of Mexican origin to the United States, we conducted a study to identify variables associated with increased toothbrushing frequency (with toothpaste) among Mexican schoolchildren, as well as to place the findings in the context of oral health policies in Mexico.

ABSTRACT

Background. Toothbrushing may help prevent some oral health diseases considered to be public health problems—in particular, certain presentations of chronic periodontal diseases and dental caries. The authors conducted a study to identify variables associated with frequency of toothbrushing with toothpaste among schoolchildren aged 6 to 12 years.

Methods. The authors collected data regarding sociodemographic, socioeconomic, oral hygiene and attitudinal variables through a cross-sectional questionnaire administered to 1,373 schoolchildren from Campeche, Mexico. They categorized toothbrushing frequency as “two times a day or fewer” and “three times a day or more.” The authors used logistic regression to analyze the data.

Results. Multivariate analyses showed that girls (odds ratio [OR] = 1.41), older children (OR = 1.07) and offspring of mothers with higher levels of schooling (OR = 1.07) were more likely to brush more frequently. The results showed an interaction between the attitude of the mother toward oral health and the use of dental care in the previous 12 months. When mothers had a positive attitude, the likelihood of their children’s brushing more frequently was higher among those who received dental care in the previous 12 months (OR = 2.43; $P \leq .001$) than among those who did not receive dental care.

Conclusions. Mothers’ characteristics were associated with more favorable patterns of toothbrushing in children. Thus, targeting the linkages between mothers’ characteristics and children’s behaviors could lead to more effective health promotion and preventive efforts among this population.

Clinical Implications. Clinicians should take into account that certain characteristics of mothers are associated with more desirable habits in their children. Future research should try to fully characterize these family linkages and determine how to support them.

Key Words. Toothbrushing; dental public health; prevention; hygiene practices; schoolchildren.

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PUBLIC HEALTH POLICIES

Public health policies constitute the larger framework that guides the general actions of people, organizations, businesses and other societal entities in health-related dimensions. Although health policies reflect the resources and ideas of a given society, the application and adaptation of policies across diverse domains (for example, within organizations, across levels of government) reflect the constraints and priorities at micro and macro levels. Examples of these are the clinical and lifestyle recommendations given to people, as well as overall legislative provisions.

Oral health policies in Mexico depend largely on public health interventions, such as the fluoridated domestic salt program, national oral health weeks and dental health education programs targeting schoolchildren,⁴ to reduce dental caries rates. Several of these strategies are carried out in schools because they are considered appropriate settings for health promotion in children. In addition, the school may provide an environment in which health, self-esteem, health-related behaviors and life skills are enhanced.⁵ A consistent message of these public health communications is the importance of maintaining an appropriate oral hygiene regimen by eliminating dental plaque through toothbrushing with a fluoridated toothpaste among people of all ages.⁶ At the individual, non-professional-care level, toothbrushing constitutes the backbone of preventive strategies in Mexico.

SUBJECTS, MATERIALS AND METHODS

The design and undertaking of this study followed the ethical guidelines for conducting studies at the Autonomous University of Campeche in Mexico.

Study population, sample and design. The study design and population have been outlined elsewhere.^{7,8} Briefly, we conducted a cross-sectional study of 6- to 12-year-olds attending elementary schools in Campeche (the capital city of the state of Campeche in the southeast littoral of the Gulf of Mexico). We randomly selected four public schools with an enrollment of 1,603 students. After reaching an agreement with teachers and principals, we distributed informed consent letters to all parents of children attending the schools. After applying the inclusion criteria (chil-

dren born in Campeche City and residing there all of their lives, between 6 and 12 years of age, attending any of the selected schools and having a mother or guardian who signed the letter of informed consent) and exclusion criteria (the mother refused to participate in the study or the child was outside the age range), 1,373 children were included in the study (85.7 percent of the original sample of 1,603).

Study variables and data collection. We collected data regarding variables via a structured questionnaire addressed to the mothers (disseminated and retrieved through the schools). The dependent variable was toothbrushing frequency, which we categorized as 0 (fewer than three times per day) and 1 (\geq three times per day). Independent variables were year of birth,

sex, whether the child had received any type of dental care in the 12 months preceding data collection, the overall attitude of the mother toward the importance of the child's oral health (a variable previously designed and validated in relevant population groups)⁹⁻¹¹ and the mother's highest level of education. The questionnaire also collected data regarding the child's dental

health and oral health status, but these variables are not relevant to the analyses in this report.

Statistical analyses. *Descriptive and bivariate analyses.* We performed an exploratory analysis for each variable to evaluate data integrity and to describe the study population in general. We calculated estimates of central tendency and dispersion measures for continuous variables. In the case of categorical variables, we calculated frequencies and percentages for each category. For the bivariate analyses, we performed the χ^2 test, Mann-Whitney test and/or non-parametric tests for trend, depending on the measurement scales (that is, ordinal, categorical, continuous scales) for each variable. In addition, we used bivariate logistic regression to analyze all variables to determine which ones were associated with toothbrushing frequency.

Multivariate analysis. To determine which variables were more closely associated with toothbrushing frequency and to control for potential confounding variables, we created a logistic binary regression multivariate model. The associative strength of the model is expressed in odds ratios (ORs), with 95 percent confidence intervals

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TABLE 1

Characteristics of study population and bivariate analyses for self-reported toothbrushing frequency.

VARIABLE	NO. (%) OF CHILDREN* (N = 1,373)	PERCENTAGE OF CHILDREN WHO BRUSHED TEETH ≥ THREE TIMES/DAY†	OR‡ (95% CI§¶)	P VALUE
Child's Age (Years)	8.83 ± 1.80#	81.7	1.06 (0.97 - 1.16)	.181
Mother's Highest Level of Education (Years)	8.91 ± 4.12#	81.7	1.08 (1.05 - 1.11)	≤ .001
Sex				
Male	669 (48.7)	79.5	1**	
Female	704 (51.3)	83.8	1.33 (1.05 - 1.70)	.020
Mother's Attitude Toward Oral Health of Child				
Negative	373 (27.2)	75.3	1**	
Positive	1,000 (72.8)	84.1	1.73 (1.12 - 2.67)	.013
Child Received Dental Care in Previous 12 Months				
No	473 (34.5)	74.4	1**	
Yes	900 (65.5)	85.6	2.04 (1.48 - 2.80)	≤ .001
School				
1	473 (34.4)	86.9	NA††	—
2	259 (18.9)	75.7	NA	
3	310 (22.6)	76.1	NA	
4	331 (24.1)	84.3	NA	

* Unless otherwise stated.
† As reported by their mothers.
‡ OR: Odds ratio.
§ CI: Confidence interval.
¶ Confidence intervals were calculated with robust standard errors, according to school cluster.
Data are mean ± standard deviation.
** Reference category.
†† NA: Not applicable.

(CIs). We included only those variables with bivariate analysis results ($P < .20$) in the final model. We conducted the variance inflation factor test to analyze the data and avoid multicollinearity, if any, on independent variables. We tested all interactions of theoretical interest and included them if the statistical significance was less than .15. In addition, we performed link tests to determine if the logit of the variable was a linear combination of independent variables. We conducted the Hosmer-Lemeshow goodness-of-fit test in the final model, with $P > .10$ as the cutoff-point statistic.¹² In both bivariate and multivariate analyses, we estimated the CIs with robust standard errors. The reason we did this is because the observed data were children at school (cluster); therefore, observations within a cluster could be correlated (because the children were exposed to the same factors, such as environment, food, beverages), whereas observations across clusters were not necessarily correlated.¹³ We con-

ducted the statistical analyses by using software (STATA 8.2, StataCorp, College Station, Texas).

RESULTS

Table 1 shows the descriptive analyses of variables studied. Bivariate analyses indicated that variables associated with different toothbrushing frequency patterns ($P < .05$) were sex, mother's attitude toward the importance of the child's oral health, having received dental care in the previous 12 months and the mother's level of education. We further ascertained that the mothers' level of schooling was higher among those with a positive attitude than among those with a negative attitude ($P < .001$; mean ± standard deviation, 9.34 ± 4.7 years versus 7.79 ± 4.05 years), as well as among mothers whose children received dental care in the previous 12 months compared with those whose children did not ($P < .001$; 9.23 ± 4.12 years versus 8.31 ± 4.05 years) (data not shown).

TABLE 2

Multivariate model of logistic regression* for self-reported toothbrushing frequency.

VARIABLE	COEFFICIENT	OR† (95% CI‡§)	P VALUE
Child's Age (Years)	0.0643	1.07 (1.01 - 1.13)	.038
Mother's Highest Level of Education (Years)	0.0676	1.07 (1.03 - 1.11)	.001
Sex		¶	
Male			
Female	0.3471	1.41 (1.14 - 1.76)	.020
Mother's Attitude Toward Oral Health of Child		¶	
Negative			
Positive	-0.0756	0.93 (0.55 - 1.56)	.776
Child Received Dental Care in Previous 12 Months		¶	
No			
Yes	-0.0195	0.98 (0.56 - 1.71)	.945
Interaction (Attitude by Care)	0.9621	2.61 (1.61 - 4.25)	≤ .001
Effect of dental care among children whose mothers had negative attitudes toward oral health of child	-0.0195	0.98 (0.56 - 1.71)	.945
Effect of dental care among children whose mothers had positive attitudes toward oral health of child	0.8865	2.43 (1.46 - 4.02)	≤ .001

* The model was adjusted to variables included in the table. Hosmer-Lemeshow goodness of fit: $\chi^2_8 = 3.85$; $P = .871$. Specification error: estimator $P = .005$; estimator² = .231.
 † OR: Odds ratio.
 ‡ CI: Confidence interval.
 § Confidence intervals were calculated with robust standard errors, according to school cluster.
 ¶ Reference category.

Table 2 presents the variables in the final multivariate model. We found that for every year of age, there was a small, yet significant, increase in the likelihood of greater toothbrushing frequency (OR = 1.07; CI = 1.01 to 1.13). (An OR equal to 1.0 would signify that no difference existed, while an OR of 2.0 would mean that for every year of age, toothbrushing was twice as frequent. In other words, OR = 1.07 suggests a 7 percent increase in the likelihood.) We found a similar trend for increasing number of years of schooling among the mothers, indicating that a higher level of educational attainment was associated with more frequent toothbrushing in the child. Girls brushed substantially more frequently than did boys.

An interaction in the model supported the notion that having received dental care in the previous 12 months was associated with more frequent brushing if it was concurrent with a positive attitude of the mother toward the importance of the child's oral health. Specifically, children of mothers with a negative attitude were just as

likely to brush more frequently whether they had or had not received dental care in the previous 12 months (dental care users versus nonusers, OR = 0.98; CI = 0.56 to 1.71). However, when mothers had a positive attitude, the likelihood of their children's brushing more frequently was higher among those who had received dental care in the previous 12 months (OR = 2.43; CI = 1.46 to 4.02) than among those who had not received such care.

DISCUSSION

This study of Mexican schoolchildren found that the overall frequency of toothbrushing (with toothpaste) was relatively high (81.7 percent brushed three or more times per day), and that sociodemographic and behavioral characteristics of the mother were associated with more frequent toothbrushing by the child.

Policy patchwork. As with other national health policies, oral health programs in Mexico could be characterized as a patchwork of initiatives, addressing various public health aspects of oral health. Overall, recent oral health policies have acknowledged that epidemiologically important oral diseases are common.^{14,15} Since 1998, the Oral Health Program has had priority status.¹⁶ Independent evaluations of research in preventive dentistry that pertain directly to Mexico for the last couple of decades substantiate the significance of caries and periodontal diseases as the main challenges to good oral health and function; however, the reviewers reported that the epidemiologic data in this research were limited.^{17,18}

The National Health Program 2001-2006^{14,15} attempted to integrate the diverse aspects of the policy patchwork into a coherent system by emphasizing oral health promotion; strengthening health systems and clinical care delivery throughout the country; expanding activities

envisioned in the biannual national oral health weeks; supporting dental health education programs targeting schoolchildren; calling for support of oral health research; advocating the use of alternative restorative treatment as a means to increase dental services in remote areas (or areas with poor clinical services); and improving the performance of the fluoridated domestic salt program through better coordination across all levels of government and with other institutions. Although these general objectives are, of course, desirable, the lack of specific mechanisms, resources and timelines for attaining specified goals is cause for concern.

Model of oral health care. Among those mechanisms that might not have been defined explicitly is the role of individualized dental hygiene regimens in the overall health policy scenario. In 1990, the general directorate of health promotion from Mexico's Ministry of Health launched a model to improve oral health among schoolchildren, seeking to incorporate into one program the basic programs addressing education, prevention, rehabilitation and health promotion.¹⁹ Within the model, more positive information, attitudes and practices were identified and subsequently put into operation in the National Educational Program Against Caries and Periodontal Pathoses Among School Children and Preschoolers.²⁰

Under the umbrella of the Mexican Official Norm (Norma Oficial Mexicana) NOM-013-SSA2-1994 to prevent and bring under control oral diseases, the health systems had, at least in theory, a unified scheme to identify methods and techniques for preventing and treating oral diseases, as well as to promote and maintain good oral health status.²¹⁻²⁴ However, none of these documents (that is, the NOMs) used, to any measurable extent, the information available to improve individual prevention practices (such as frequency of dental recall appointments, toothbrushing patterns, use of fluoridated toothpastes and dental flossing habits). Cultural or literacy modifiers also were omitted in the plan outlined in NOM-013-SSA2-1994.

We believe that our research data may provide a framework for beginning to determine how

toothbrushing patterns, health education and health promotion should be positioned within national and local programs to make them more relevant, practical and effective across diverse settings. In our study, we found that many children brushed their teeth with considerable frequency; however, because of the lassitude shown in the literature toward classifying age groups, this self-reported practice may or may not be similar to that reported elsewhere.^{2,3} For example, Petersen and colleagues²⁵ reported that 88 percent of Thai children aged 6 to 12 years brushed their teeth at least once a day; by contrast, Villalobos-Rodelo and colleagues⁶ reported that only 54 percent of Mexican children did the same.

In terms of the factors associated with toothbrushing practices, various studies have found that socioeconomic indicators seem to play a leading role in modifying behavioral patterns.^{6,26,27} In this study, we used the mother's highest level of education (an often used and largely valid

proxy of socioeconomic status), which was associated significantly with toothbrushing frequency among children. Our finding that girls brushed more often than boys is coincident with the results of studies in Mexico⁶ and elsewhere.^{2,27} How this sex gap came about is unclear, and the available data do not enable us to identify definitive mechanisms.

International studies. Few studies in the international literature have looked at the clinical and nonclinical variables associated closely with oral hygiene practices in this age group. Although the recency of dental visits (that is, within the previous 12 months) was associated positively with more frequent toothbrushing (just as Al-Shammari and colleagues²⁷ pointed out), we wonder whether this association simply reflects the role of the dentist in providing health and hygiene information to the child. The fact that the mother's attitude toward the importance of her child's dental health was associated with toothbrushing only in conjunction with a recent dental visit suggests that complex events are at play. Future studies should investigate these factors in detail, taking into account differences and interactions across age groups, levels of literacy, socioeconomic levels and regional variations within Mexico, as well as attempt to identify causal relationships.

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We have found that mothers' characteristics may function as predictors of the oral health status of their children^{7-11,28-31}, given the increasing evidence that social factors modify processes and values within health phenomena,²⁸⁻³² it becomes more apparent that mothers (and other primary caregivers) should be involved in planning and implementing the programs and policies that address oral health education and oral health promotion for children.

Study limitations. There are certain caveats to this study. Although they do not undermine its methodological design, they do suggest that direct extrapolations to other Mexican population groups are unwarranted. The schools involved in this study are located in an urban area, and they have ongoing access to a preventive dentistry program. This suggests that toothbrushing patterns and the level of dental awareness in our study population might be more positive compared with those in other populations. On the basis of previous study results, this caveat gains further salience.^{8,11,28,29} Finally, as with any other cross-sectional study, our design may have been affected by temporal ambiguity, thus making it difficult to draw firm conclusions about which variables precede other variables. Consequently, readers should not derive any direct cause-and-effect relationships from this study.

CONCLUSION

Clinicians should keep in mind that certain characteristics of mothers are associated strongly with patterns of oral hygiene in their children. We found that toothbrushing patterns in this study population generally were favorable, and they were associated with certain social and socioeconomic factors reported in the literature. Furthermore, features of the mother with regard to the child's oral health are differentially associated with toothbrushing trends, particularly under more desirable patterns of dental attendance. Although we could not determine the reasons for such dental attendance, it seems pertinent to incorporate findings such as ours in the design, planning, implementation and monitoring of programs that support good oral health behaviors among children. ■

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