

# Dental Health Services Utilization and Associated Factors in Children 6 to 12 Years Old in a Low-Income Country

Carlo Eduardo Medina-Solis, DDS, MSc; Gerardo Maupomé, BDS, MSc, PhD; Miriam del Socorro Herrera, DDS, MSc; Ricardo Pérez-Núñez, MD, MSc; Leticia Ávila-Burgos, MD, DSc; Hector Lamadrid-Figueroa, MD, MSc

## Abstract

**Objective:** To determine the factors associated with the dental health services utilization among children ages 6 to 12 in León, Nicaragua. **Material and Methods:** A cross-sectional study was carried out in 1,400 schoolchildren. Using a questionnaire, we determined information related to utilization and independent variables in the previous year. Oral health needs were established by means of a dental examination. To identify the independent variables associated with dental health services utilization, two types of multivariate regression models were used, according to the measurement scale of the outcome variable: a) frequency of utilization as (0) none, (1) one, and (2) two or more, analyzed with the ordered logistic regression and b) the type of service utilized as (0) none, (1) preventive services, (2) curative services, and (3) both services, analyzed with the multinomial logistic regression. **Results:** The proportion of children who received at least one dental service in the 12 months prior to the study was 27.7 percent. The variables associated with utilization in the two models were older age, female sex, more frequent toothbrushing, positive attitude of the mother toward the child's oral health, higher socioeconomic level, and higher oral health needs. **Conclusion:** Various predisposing, enabling, and oral health needs variables were associated with higher dental health services utilization. As in prior reports elsewhere, these results from Nicaragua confirmed that utilization inequalities exist between socioeconomic groups. The multinomial logistic regression model evidenced the association of different variables depending on the type of service used.

**Key Words:** child health services, health services research, multivariate analysis, oral health, Nicaragua

## Introduction

Dental health services utilization represents a part of the use of resources allocated to oral health. The information on dental services utilization can be obtained in diverse ways and from a variety of sources such as administrative reports of productivity as well as through health surveys; this is essential to establish effective health policies (1). Household surveys and specific groups studies are two recommended methods to

collect this information, so that it is possible to ultimately identify demand, the factors associated, and the health care inputs to address the demand (2). Andersen and Newman's model (3), commonly used for dental services, has three types of variables that influence the behavior of the individual while seeking attention are taken into account: a) predisposing variables, for example, sociodemographic variables, beliefs and attitudes about illness, and various

aspects related to the family environment such as family structure and number of members; b) enabling variables, for example, level of income, medical or dental insurance, geographic accessibility, and issues related to the organization of services themselves, including the doctor-patient relationship; and c) need variables, such change can be an ascribed value from the professional point of view (normative assessment) and/or from the perception of the affected individual and the family (subjective or perceived/expressed assessment).

Only a few studies have analyzed dental services utilization in the Latin America context, in children of Mexico (4,5), and adults in Brazil (6,7), in contrast with studies undertaken in developed countries, where diverse variables have been found to be associated with dental services utilization. Building on the fact that there is limited information available about the oral health status of the Nicaraguan population, the objective of this study was to determine the number of dental health care visits and the type of service used in children aged 6 to 12 living in the city of León, Nicaragua, as well as the factors associated.

## Materials and Methods

**Study Design and Selection of Study Sample.** This study complied with the specifications of the

Send correspondence and reprint requests to Carlo Eduardo Medina-Solis, Privada de Altillio s/n entre Av. Central y Pedro Moreno, Colonia San José, CP 24040, Campeche, Campeche, México. Tel/Fax: 52 (981) 8110215; e-mail: cemedinas@yahoo.com. Carlo Eduardo Medina-Solis is with the Área Académica de Odontología del Instituto de Ciencias de la Salud de la Universidad Autónoma del Estado de Hidalgo, Pachuca, Hidalgo, México. Carlo Eduardo Medina-Solis, Ricardo Pérez-Núñez, and Leticia Ávila-Burgos are with the Centro de Investigación en Sistemas de Salud del Instituto Nacional de Salud Pública, Cuernavaca, Morelos, México. Gerardo Maupomé is with the Oral Health Research Institute, Indiana University/Purdue University at Indianapolis School of Dentistry and the Regenstrief Institute, Inc., Indianapolis, IN. Miriam del Socorro Herrera is with the Facultad de Odontología de la Universidad Nacional Autónoma de Nicaragua campus León, León, Nicaragua. Hector Lamadrid-Figueroa is with the Dirección de Evaluación de Programas y Bioestadística, Centro de Investigación en Evaluación y Encuestas del Instituto Nacional de Salud Pública, Cuernavaca, Morelos, México. Manuscript received: 10/3/06; accepted for publication: 6/26/07.

protection of human subjects and ethical regulations of participating institutions. Data were derived from a previously published cross-sectional study on the oral health of children, focusing on dental caries (8). The subject population comprised of 18,574 children, 6 to 12 years old, enrolled in elementary schools of León, Nicaragua, during the 2002-03 school years. Through a simple random sampling, 25 schools were chosen. Using the same sample strategy proposed by the World Health Organization (9), 56 children of each school were selected. The final sample was distributed similarly by age and sex: four boys and four girls in each age group studied, for a total of 1,400 children. The parents provided a written consent that their children could participate in the study; no child had orthodontic appliances. Only one child did not assent to participate in the study and was substituted by another – next one in the roster.

#### **Variables and Data Collection.**

Our dependent variable was dental health services utilization in the 12 months prior to data collection. Mothers/guardians were asked if the children had received any form of dental care, in which case, it was asked the frequency and type of treatment received.

A questionnaire was used to determine the dependent variable (if the child had visited the dentist once, twice, or more than twice in the previous 12 months, as well as the main type of treatment received); it also included questions that addressed socioeconomic variables (schooling and occupation of parents, size of family), sociodemographic variables (age and sex of children, age of parents), and behavioral variables (frequency of toothbrushing and mother's attitude toward oral health). The latter variable has been described previously; it addresses the situation and interactions expected for this type of setting (5,10,11). In brief, the importance ascribed by the mother/caregiver to the child's oral health was derived from the following questions: a) is it important that

your child keeps his/her teeth in good condition and b) have you ever examined his/her teeth to ascertain if they are healthy? Responses were synthesized into a positive attitude (1) if "yes" was answered to both questions or a negative attitude (0) if "no" was answered to any of them.

Principal components analysis was undertaken, specifically polychoric correlation (12), to reduce the dimensions of certain variables and to construct the socioeconomic status (SES) variable. SES was determined by using the level of schooling and occupation of both parents, and were streamlined to one principal component, which explained 47.2 percent of the variability in SES. The component generated was divided into SES quartiles – the first quartile represented the group with the lowest SES and the fourth quartile represented the highest SES. Because of the missing data, we were able to ascertain SES for only 1,353 children (96.6 percent).

Oral health needs were determined through an oral exam – details have been previously described and used in other studies (4,5). All subjects were examined by one of two examiners ( $\kappa > 0.85$ ) to identify dental caries using a flat dental mirror and natural light. In terms of caries detection, we used a validated index that summarizes the presence of lesions in the mouth by assigning the lesions to one of four categories (13): Type 1, pits and fissures or smooth surfaces without softening of hard tissue; Type 2, pits and fissures or smooth surfaces with softening of hard tissue; Type 3, had lost less than two-thirds of the clinical crown of the tooth; and Type 4, when dental tissue lost was greater than two-thirds of the crown of the tooth. Based on the findings, the subject was deemed to have a high-caries or low-caries burden, based on the number and size of lesion(s). The low burden group had a maximum of four lesions Type 1 or at least three lesions Type 2. The high burden group had more than four Type 1, more than three Type 2 lesions, or one or more Type 3 and Type 4 lesions.

**Data Analysis.** Measures of central tendency, dispersion, and frequencies were calculated according to variable scale measure. To identify the independent variables associated with dental services utilization, two types of regression models were used in the bivariate and multivariate analyses. There were two identified response variables: a) frequency of utilization – "0" none, "1" one, or "2" two or more, analyzed through the ordered logistic regression model and b) the type of service utilized – "0" none, "1" preventive services, "2" curative services, and "3" both types of services, analyzed with the multinomial logistic regression model. We included in the multivariate models those variables that yielded a significance  $P < 0.20$  in the bivariate analyses (14). An analysis of variance inflation factor was undertaken to detect and, if necessary, avoid multicollinearity between independent variables. Continuous independent variables were tested to see if for every unit increase in the independent variable, the increment change in the logit of the outcome was not constant (Box-Tidwell test). Age did not fit with this assumption because it was dichotomized (0 = 6 and 7 years, 1 = 8 to 12 years). Both in bivariate analyses and multivariate analyses, the confidence intervals were calculated with robust standard errors, which allowed to obtain valid estimates even in the case of correlation between groups (15). This strategy was adopted because it was assumed that correlation existed within schools. In the final models,  $P > 0.05$  and  $< 0.10$  were considered as tendency. Programs used were Stata 8.2 (StataCorp, College Station, Texas, USA) and SPSS 12.0 (SPSS, Inc., Chicago, IL, USA).

#### **Results**

The variables in the study are described in Table 1. Mean age was  $9.9 \pm 2.0$  years, and 50.1 percent of the population were boys. In the entire sample, 46.1 percent ( $n = 645$ ) had visited a dentist for any reason at least once in their lives. In the 12 months prior to the study, only 388

**Table 1**  
**Distribution of Sociodemographic Characteristics, Socioeconomic Characteristics, and Oral Health Status of Children of León, Nicaragua**

Variables	Frequency	Mean $\pm$ standard deviation; (limits)	Percentage
Child's age (years)	1,400	9.99 $\pm$ 2.00; (6-12)	
Mother's age (years)	1,400	33.03 $\pm$ 6.07; (20-52)	
Mother's schooling (years)	1,400	7.86 $\pm$ 4.22; (0-21)	
Father's schooling (years)	1,353	8.03 $\pm$ 4.40; (0-21)	
Family size (children)	1,400	3.12 $\pm$ 1.58; (1-12)	
Sex			
Boys	702		50.1
Girls	698		49.9
Toothbrushing frequency			
Fewer than seven times per week	676		48.3
At least once a day	724		51.7
Attitude toward oral health			
Negative	600		42.9
Positive	800		57.1
Socioeconomic status			
First quartile (lower)	351		25.9
Second quartile	328		24.3
Third quartile	336		24.8
Fourth quartile (higher)	338		25.0
Caries burden			
Low	693		49.5
High	707		50.5

children out of 1,400 (27.7 percent; 95 percent confidence intervals = 25.4, 30.1) had received some sort of dental care (preventive, curative, or both). The main reason for attending a dental appointment was curative (65.0 percent), while 11.3 percent received preventive care, and 23.7 percent received both types of services at same time.

The prevalence of dental services utilization across children's characteristics is in Table 2. The results of the bivariate analyses are shown in Tables 3 and 4. Of results not shown in these tables, only the number of children per family was associated with dental services utilization; as a family had more children, utilization decreased. However, after adjusting for other variables, the former variable lost its statistical significance.

#### Multivariate Results

*Predisposing variables.* The multivariate results obtained through different models are shown in Tables 3 and 4. Females had a higher probability of utilizing dental services

than males; the odds ratio (OR) was 1.43 in the ordered model. In the multinomial model, this variable turned out to be significant for preventive services (OR = 3.01) and curative services (OR = 1.40) but not when children received both services. With regard to age, the probability of utilization increased in the older group compared to the younger group; children >8 years of age used more dental services than 6- and 7-year-olds. The OR for ordered model was 1.58. Using the estimations obtained in the multinomial model, for preventive services, this variable was not significant; for curative services, it was marginally significant ( $P < 0.10$ ), and attained a  $P < 0.05$  level when both services were used (OR = 1.80).

The highest frequency of toothbrushing (at least once a day) was positively associated with dental services utilization in ordered model models; the OR for utilizing in children that brushed more often was 1.36 (ordered model) times those for

children that brushed fewer than once per day. In the multinomial model, this variable was marginally associated with preventive services (OR = 2.34,  $P = 0.073$ ), while the OR was not significant for those receiving curative or both types of services. When the mother had a positive attitude toward oral health, the rates of dental visits for the child increased. This was demonstrated in the ordered model (OR = 1.56). However, in the multinomial model, a positive maternal attitude was associated with preventive services (OR = 2.50) and for those receiving both types of services (OR = 1.79), although this was not the case for curative services ( $P > 0.05$ ).

*Enabling variables.* Children that were in the higher SES levels (quartiles 2, 3, and 4) used services more than those in the lowest SES quartile (ordered model,  $P < 0.05$ ). When we analyzed the dental health services utilization by type of service, only the highest SES quartile was associated with preventive services (OR = 2.49) compared to the lowest SES level (first quartile). In contrast, the highest three levels (quartiles 2, 3, and 4) used curative services more than the children in the lowest SES level. Also, higher SES levels were more likely to receive both services.

*Needs variables.* Oral health needs, determined by the examiner in terms of caries burden, were positively associated with dental health services utilization. That is, children with higher caries burden used services more than those in the lower caries burden category (ordered model, OR = 1.55). When the type of service was analyzed with the multinomial logistic regression model, higher or lower caries burden were not associated with preventive services ( $P > 0.05$ ), whereas curative services were (OR = 1.74,  $P < 0.05$ ). The significance of the association in those children receiving both types of services was marginal (OR = 1.49,  $P < 0.10$ ).

#### Discussion

The proportion of children who received at least one dental service

**Table 2**  
**Prevalence of Dental Health Services Utilization by Selected Characteristics**

Variables	Preventive only	Curative only	Both preventive and curative*
Predisposing factors			
Child's age			
6 and 7 years	2.3	16.8	23.8
≥8 years	3.5	18.5	29.3
Sex			
Boys	1.9	16.5	24.9
Girls	4.4	19.5	30.5
Family size (children)			
1-3	3.6	18.7	29.6
4 or more	2.0	16.3	23.1
Toothbrushing frequency			
Fewer than seven times per week	1.6	16.0	23.1
At least once a day	4.6	19.9	32.0
Attitude toward oral health			
Negative	1.8	15.3	21.5
Positive	4.1	20.0	32.4
Enabling variables			
Socioeconomic status			
First quartile (lower)	2.3	10.5	15.7
Second quartile	1.2	19.8	26.5
Third quartile	3.3	22.3	33.3
Fourth quartile (higher)	5.6	19.2	35.8
Oral health needs			
Caries burden			
Low	3.5	14.6	24.2
High	2.8	21.4	31.1

\* Includes children that received preventive or curative care and those who received both at the same time.

12 months prior to the study was very low (27.7 percent). No other relevant studies are available in the biomedical literature on Nicaragua. Within the Latin American environment, there have been few studies documenting dental health services utilization in the younger age groups. One of the closest frameworks for contrast may be supplied by reports in children from Mexico (4,5), which suggested that the prevalence observed in the present study was lower. Studies in countries that are substantially wealthier than Nicaragua have reported a prevalence of 40 percent among children of similar age in Spain (16) and over 50 percent in the United States (17-19), including low SES families (17), and even 72 percent for preventive care (20).

Socioeconomic disparities/inequalities refer to differences in

health that are systematically associated with various levels of underlying social advantage or position in a social hierarchy (21). While socioeconomic differences in health, assessed in terms of mortality and morbidity, have been reported in diverse countries, less attention has been paid to patterns of use of oral health care services (22). Although there is scarce scientific evidence that supports a single time interval for dental visits that would be universally appropriate, regular visits to the dentist can result in an improvement of oral health status by helping to timely detect active disease, or by limiting sequels of an ongoing condition (23). Furthermore, regular visits might be an outlet to provide preventive services, which are intuitively desirable, although their effectiveness remains to be established in various levels of

risk and age groups. It is not surprising that even in a less developed country, children who had better SES visited the dentist more frequently. Various authors have observed (4,5,16,24), using various socioeconomic indicators, that children and adolescents of lower SES use dental services less often. In the present study, we enhanced the level of analysis detail of these phenomena through observing different patterns of dental health services utilization. For example, children of the highest SES utilized more *preventive* services than those of the lowest SES, as it has been described in other reports (25). Likewise, it was seen that children of the three highest SES quartiles utilized *curative* dental services more often than those of the lowest level. Davis found that even within curative services the patterns of utilization are different; for example, users in the highest SES mainly receive restorative services, whereas those of lower SES primarily receive extractions (26). The findings presented here suggest that interventions to further reduce dental care inequalities should be broadly targeted to reach everyone across the SES spectrum.

Taking other sociodemographic variables into account, our results confirmed that females used dental services more often than males, both in children and in adolescents. The percentages of utilization were higher in the oldest age group, as it has been noted in previous reports (4,5,18,27). On the other hand, toothbrushing frequency and a positive attitude toward oral health demonstrated a positive relationship with dental health services utilization (4,5,28). It is necessary to emphasize the fact that when the model distinguished across types of services, toothbrushing alone (as *proxy* variable of positive behavioral oral health) was associated with preventive services. While this is interesting from the point of view of attitudes and suggestive of more favorable health behaviors, such interpretation should be cautious. Both attitudes and health behaviours could be influenced by SES of individuals, and

**Table 3**  
**Ordered Logistic Regression Analysis between Independent Variables and Dental Health Services Utilization (0 = No Dental Visits, 1 = One Time, 2 = Two or More) in the 12 Months Prior to the Study (n = 1,353)**

Variables	OR crude (95% CI)	OR adjusted (95% CI)
Predisposing factors		
Child's age		
6 and 7 years	1†	1†
≥8 years	1.37 (0.97, 2.00) <sup>n/s</sup>	1.58 (1.06, 2.35)*
Sex		
Boys	1†	1†
Girls	1.31 (1.02, 1.69)*	1.43 (1.09, 1.87)**
Toothbrushing frequency		
Fewer than seven times per week	1†	1†
At least once a day	1.62 (1.25, 2.09)***	1.36 (1.04, 1.77)*
Attitude toward oral health		
Negative	1†	1†
Positive	1.79 (1.25, 2.56)**	1.56 (1.10, 2.21)*
Enabling variables		
Socioeconomic status		
First quartile (lower)	1†	1†
Second quartile	1.98 (1.37, 2.86)***	1.87 (1.28, 2.73)**
Third quartile	2.68 (1.87, 3.86)***	2.54 (1.75, 3.66)***
Fourth quartile (higher)	2.95 (2.16, 4.02)***	2.63 (1.97, 3.52)***
Oral health needs		
Caries burden		
Low	1†	1†
High	1.39 (1.08, 1.78)*	1.55 (1.22, 1.99)***

Note: In the bivariate tests, all variables reach the odds proportional assumption. Ninety-five percent confidence intervals (CI) estimated with robust standard errors (clustering).

Multivariate model: odds proportional assumption  $\chi^2(8) = 6.36$ ,  $P = 0.6065$ ; goodness-of-fit test Pearson  $\chi^2(242) = 252.93$ ,  $P = 0.302$ .

\*  $P < 0.05$ ; \*\*  $P < 0.01$ ; \*\*\*  $P < 0.001$ ; \*\*\*\*  $P < 0.10$ .

† Reference category.

OR, odds ratio; n/s, not significant.

by the prevalent customs of the health systems and professionals delivering clinical services. Before final conclusions can be reached in terms of the role of toothbrushing being definitely linked to the use of preventive services, studies should be carried out to ascertain the degree of preventive orientation of both the Nicaraguan health system (public and private components) and its health care workers.

Traditionally, there have been two measures for oral health needs: on the one hand, the evaluations made by the patients or their families (subjective or perceived/expressed need), and on the other hand, those assessments carried out by health personnel (normative need). In one of the models we used, caries burden

(which may be considered a form of measurement of oral health need) was associated with dental visits. Such a relationship has been reported by authors who adopted the point of view of the client (17) as well as the normative perspective (4,5) to examine the relationship. In contrast, in another model, we individually analyzed the type of dental service used and found that needs were positively associated with the use of curative services but not with preventive services. This discrepancy could have been because of the fact that mother/guardians believed that the child needed curative services, and therefore identified the need to bring him/her to the dentist. Such situation would seem less likely to occur in the case of preventive services. Given

that the need for preventive services could be less apparent than curative services (29), that preventive services may be related to noncritical clinical situations (30), or that preventive efforts might be deemed futile once the active illness has already been established (29,30), we could postulate that the mechanisms that promote preventive and curative dental services are relatively different. These mechanisms might be modulated by differing parental attitudes toward dental care – as we found, more directly in the case of preventive services. Based on our current understanding of this phenomenon, we cannot offer a definitive model encompassing all of these mechanisms for the Nicaraguan circumstances.

The cross-sectional design of the current study presents a problem of temporal ambiguity, in that both independent and outcome variables were studied at the same time; this is a limitation of our investigation. The small number of children who received “preventive services only” may limit the significance of the analyses, and thus, further studies should ideally analyze a larger population. With regard to its strengths, our approach offered a comparison between diverse analytic models. In particular, the multinomial logistic regression offered estimators of the variables that were in some cases twice as large as in the other model, thus enhancing our ability to distinguish between types of services. In conclusion, the present study is an attempt to explain the use of dental services in a Nicaraguan child population, utilizing the Andersen–Newman model (3). Our results demonstrated that predisposing and enabling variables, as well as oral health needs variables, are associated with dental health services utilization. Although the results are not surprising and are generally in agreement with the literature, the present findings might support policymaking efforts and the design of programs that offer incentives/support for using dental services. Designs should be undertaken to ameliorate the barriers that

**Table 4**  
**Multinomial Logistic Regression Analysis between Independent Variables and Dental Health Services Utilization [(0 = No Dental Visits, 1 = Preventive Care, 2 = Curative Care, 3 = Both Services (Curative and Preventive Services))] in the 12 Months Prior to the Study (n = 1,353)**

Variables	Preventive care		Curative care		Both services	
	ORC	ORA (95% CI)	ORC	ORA (95% CI)	ORC	ORA (95% CI)
<b>Predisposing factors</b>						
Child's age						
6 and 7 years	1†	1†	1†	1†	1†	1†
≥8 years	1.68 <sup>n/s</sup>	1.60 (0.69, 3.71) <sup>n/s</sup>	1.19 <sup>n/s</sup>	1.48 (0.95, 2.28) <sup>****</sup>	1.66 <sup>n/s</sup>	1.80 (1.03, 3.15) <sup>*</sup>
Sex						
Boys	1†	1†	1†	1†	1†	1†
Girls	2.59 <sup>**</sup>	3.01 (1.47, 6.17) <sup>**</sup>	1.27 <sup>****</sup>	1.40 (1.03, 1.90) <sup>*</sup>	1.09 <sup>n/s</sup>	1.19 (0.76, 1.87) <sup>n/s</sup>
Toothbrushing frequency						
Fewer than seven times per week	1†	1†	1†	1†	1†	1†
At least once a day	3.17 <sup>**</sup>	2.34 (0.92, 5.92) <sup>****</sup>	1.41 <sup>*</sup>	1.27 (0.91, 1.78) <sup>n/s</sup>	1.57 <sup>****</sup>	1.17 (0.75, 1.84) <sup>n/s</sup>
Attitude toward oral health						
Negative	1†	1†	1†	1†	1†	1†
Positive	2.61 <sup>*</sup>	2.50 (1.10, 5.68) <sup>*</sup>	1.51 <sup>*</sup>	1.35 (0.90, 2.01) <sup>n/s</sup>	1.21 <sup>**</sup>	1.79 (1.13, 2.83) <sup>*</sup>
<b>Enabling variables</b>						
Socioeconomic status						
First quartile (lower)	1†	1†	1†	1†	1†	1†
Second quartile	0.61 <sup>n/s</sup>	0.56 (0.13, 2.39) <sup>n/s</sup>	2.16 <sup>*</sup>	2.07 (1.30, 3.30) <sup>**</sup>	2.21 <sup>**</sup>	2.05 (1.16, 3.62) <sup>*</sup>
Third quartile	1.82 <sup>n/s</sup>	1.56 (0.60, 4.03) <sup>n/s</sup>	2.68 <sup>**</sup>	2.58 (1.61, 4.12) <sup>***</sup>	3.46 <sup>***</sup>	3.19 (1.72, 5.88) <sup>**</sup>
Fourth quartile (higher)	3.24 <sup>*</sup>	2.49 (1.08, 5.75) <sup>*</sup>	2.40 <sup>**</sup>	2.25 (1.44, 3.52) <sup>***</sup>	5.05 <sup>***</sup>	4.42 (2.73, 7.16) <sup>**</sup>
<b>Oral health needs</b>						
Caries burden						
Low	1†	1†	1†	1†	1†	1†
High	0.90 <sup>n/s</sup>	1.05 (0.56, 1.98) <sup>n/s</sup>	1.61 <sup>**</sup>	1.74 (1.26, 2.40) <sup>**</sup>	1.23 <sup>n/s</sup>	1.49 (0.94, 2.35) <sup>****</sup>

Note: 95% confidence intervals (CI) estimated with robust standard errors (clustering).

\*  $P < 0.05$ ; \*\*  $P < 0.01$ ; \*\*\*  $P < 0.001$ ; \*\*\*\*  $P < 0.10$ .

† Reference category.

ORC, odds ratio crude; ORA, odds ratio adjusted; n/s, not significant.

hinder access to appropriate dental services, as well as to decrease the inequalities affecting the use of dental services. Another important feature of the present study is that it could be used as a framework for comparison of long-term dental health services utilization changes in the Nicaraguan setting.

### Acknowledgments

This research was partially supported by a scholarship given to M. S. H. by the Universidad Autónoma de Campeche and the Universidad Nacional Autónoma de Nicaragua-León. A grant to fieldwork was received from the Switzerland Agency of Cooperation for Development (Styrelsen för Internationellt Utvecklingsamarbete). The analysis was partially supported by the

Council of Science and Technology (CONACYT – 166266) of Mexico scholarship given to C. E. M. S.

### References

1. Van der Heyden J, Tafforeau J, Van Oyen H, Demarest S. Measurement of the use of curative health services: health interview survey versus national registers. *Arch Public Health*. 2003;61:177-90.
2. Cangussu MCT, Cabral MBBS, Liesenfeld MH, Pastor IMO. Profile of infant ambulatory demand at faculty of dentistry of UFBA in 1994 to 1999. *Rev FOB*. 2001;9:151-5.
3. Andersen R, Newman J. Societal and individual determinants of medical care utilization in the United States. *Milbank Mem Fund Q*. 1973;51:95-124.
4. Medina-Solis CE, Casanova-Rosado AJ, Casanova-Rosado JF, Vallejos-Sánchez AA, Maupomé G, Ávila-Burgos L. Socioeconomic and dental factors associated with utilization of dental services in schoolchildren from Campeche, Mexico. *Bol Med Hosp Infant Mex*. 2004;61:324-33.
5. Medina-Solis C, Maupomé G, Ávila-Burgos L, Hajar-Medina M, Segovia-Villanueva A, Perez-Núñez R. Factors influencing the use of dental health services by preschool children in Mexico. *Pediatr Dent*. 2006;28:285-92.
6. Matos DL, Lima-Costa MF, Guerra HL, Marcenes W. The Bambuí Project: a population-based study of factors associated with regular utilization of dental services in adults. *Cad Saude Publica*. 2001;17:661-8.
7. Matos DL, Giatti L, Lima-Costa MF. Socio-demographic factors associated with utilization of dental services among Brazilian older adults: a study based on the National Household Sample Survey. *Cad Saude Publica*. 2004;20:1290-7.
8. Herrera M, Medina-Solis CE, Maupomé G. Prevalence of dental caries in 6-12-year-old schoolchildren in Leon, Nicaragua. *Gac Sanit*. 2005;19:302-6.
9. WHO. Chapter 1: organization of a basic oral health survey. *Oral health survey – basic methods*. 4th ed. Geneva: World Health Organization; 1997. p. 4-9.

10. Beltran-Valladares P, Cocom-Tum H, Casanova-Rosado J, Vallejos-Sánchez A, Medina-Solís CE, Maupomé G. Prevalence of dental fluorosis and additional sources of exposure to fluoride as risk factors to dental fluorosis in schoolchildren of Campeche, Mexico. *Rev Invest Clin.* 2005;57:532-9.
11. Segovia-Villanueva A, Estrella-Rodríguez R, Medina-Solís CE, Maupomé G. Dental caries experience and factors among preschoolers in Southeastern Mexico: a brief communication. *J Public Health Dent.* 2006;66:88-91.
12. Kolenikov S, Angeles G. The use of discrete data in principal component analysis with applications to socio-economic indices. Working paper No. WP-04-85. North Carolina: CPC/MEASURE; 2004.
13. Gutiérrez-Salazar M, Morales RJ. Validation of a predictive indicator of risk for caries in permanent teeth. *Rev Med Dist Fed Mex.* 1987;4:183-7.
14. Hosmer DW, Lemeshow S. *Applied logistic regression.* 2nd edition. New York: John Wiley & Sons Interscience Publication; 2000.
15. Williams RL. A note on robust variance estimation for cluster-correlated data. *Biometrics.* 2000;56:645-6.
16. Jimenez R, Tapias-Ledesma MA, Gallardo-Pino C, Carrasco P, De Miguel AG. Influence of sociodemographic variables on use of dental services oral health and oral hygiene among Spanish children. *Int Dent J.* 2004;54:187-92.
17. Milgrom P, Mancl L, King B, Weinstein P, Wells N, Jeffcott E. An explanatory model of the dental care utilization of low-income children. *Med Care.* 1998;36:554-66.
18. McCormick M, Kass B, Elixhauser A, Thompson J, Simpson L. Annual report on access to and utilization of health care for children and youth in the United States-1999. *Pediatrics.* 2000;105:219-30.
19. Damiano P, Momany ET, Crall JJ. Determining dental utilization rates for children: an analysis of data from the Iowa Medicaid and SCHIP programs. *J Public Health Dent.* 2006;66:97-103.
20. Lewis CW, Johnston BD, Linsenmeyar KA, Williams A, Mouradian W. Preventive dental care for children in the United States: a national perspective. *Pediatrics.* 2007;119:e544-53.
21. Braveman PA, Egerter SA, Cubbin C, Marchi KS. An approach to studying social disparities in health and health care. *Am J Public Health.* 2004;94:2139-48.
22. Fernandez E, Schiaffino A, Rajmil R, Badia J, Segura A. Gender inequalities in health and health care services use in Catalonia (Spain). *J Epidemiol Community Health.* 1999;53:218-22.
23. Okunseri C, Born D. Self-reported dental visits among adults in Benin City, Nigeria. *Int Dent J.* 2004;54:450-6.
24. Sabbah W, Leake JL. Comparing characteristics of Canadians who visited dentists and physicians during 1993/94: a secondary analysis. *J Can Dent Assoc.* 2000;66:90-5.
25. Watson MR, Manski RJ, Macek MD. The impact of income on children's and adolescents' preventive dental visits. *J Am Dent Assoc.* 2001;132:1580-7.
26. Davis P. Culture, inequality and the pattern of dental care in New Zealand. *Soc Sci Med.* 1981;15A:801-5.
27. Manski RJ, Edelstein BL, Moeller JF. The impact of insurance coverage on children's dental visits and expenditures. *J Am Dent Assoc.* 2001;132:1137-45.
28. Murtooma H, Metsaniity M. Trends in tooth brushing and utilization of dental services in Finland. *Community Dent Oral Epidemiol.* 1994;22:231-4.
29. Maupomé G. An introspective qualitative report on dietary patterns and elevated levels of dental decay in a deprived urban population in Northern Mexico. *ASDC J Dent Child.* 1998;65:276-85.
30. Maupomé G, Borges A, Ramírez LE, Diez-de-Bonilla J. Perceptions of tooth loss and periodontal problems in an independent elderly population. Content-analysis of interview discourse. *J Cross Cult Gerontol.* 1999;14:43-63.