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## Oral health assessment in the San Blas and Santa Ana populations of Nicaragua

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**Abstract:** *Aim:* The aim of this study was to assess the oral health of a population in rural Nicaragua. *Methods:* A total of 241 individuals were recruited from areas around San Blas and Santa Ana, Nicaragua. A demographic questionnaire assessing income, access to oral health care, means of transportation and presence of dental/health insurance was collected for each patient. Oral screenings were also conducted to assess for evidence of untreated decayed teeth, restorations, missing/extracted teeth and presence/absence of periodontal disease. *Results:* The majority of residents in San Blas and Santa Ana, Nicaragua, have little income if any, no medical or dental insurance of any kind and no means of transportation. There was a very high prevalence of untreated decayed teeth among the population studied where 51.1% of our sample had three or more dental caries. Children aged fewer than 20 years had five times the prevalence of dental decay than those in the United States. No statistically significant difference was found in untreated decayed teeth by age or gender. A smaller percentage (25.2%) of all patients had restorations with a statistically significant difference found between genders ( $P < 0.0001$ ). There was also a relationship between gender and number of missing/extracted teeth ( $P < 0.001$ ). There was no significant difference in amount of untreated decayed teeth among those who reported having been seen by a dentist within the previous one-to-three, greater than 3 years or never at all. *Conclusion:* Among a population of individuals from San Blas and Santa Ana, Nicaragua, there are major socio-economic barriers present, and a significant burden of oral pathology is evident.

**Key words:** access to health care; dental caries; dental health surveys; dentistry; Nicaragua; oral health; periodontal diseases; world health

## Introduction

Affordable access to dental care is a topic of common discussion and concern around the world for health professionals, especially in developing countries. Globally, the greatest burden of oral disease lies upon disadvantaged and poor populations (1). Oral health barriers across countries are related to living conditions, environmental factors, and oral health systems. In addition, due to a lack of financial resources, provision of care is limited to primarily tertiary treatment (1). Nicaragua is one of the poorest countries of Central America, and individuals there face a plethora of challenges in receiving overall health services (2). Little is documented concerning access to dental services and the overall dental health status of the peoples of this country. In July 2011, a team of American oral

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health providers, which included six registered dental hygienists (RDHs) and one dentist from The University of New Mexico, Albuquerque, NM, USA, travelled to the rural communities of Santa Ana and San Blas, Nicaragua, to evaluate the oral health status and access to care of local individuals. The following is a summary of the findings collected.

## Study population and methodology

Patients were notified of dental and systemic health services via communications through a local healthcare representative in Santa Ana and San Blas, two rural communities approximately 20 miles north of Granada, Nicaragua. These regions were chosen being that they are rural and extremely low income. Our sample population had an average annual income of 22.4 United States dollars (USD) comparing with Nicaragua's national average of 1080 USD (3). No patients were excluded on gender, age, ethnicity or otherwise. Two hundred and forty one patients participated in the services over the course of 5 days. As part of the initial assessment, patients were asked to fill out or verbally answer a dental, health and demographic history form that included additional questions pertaining to their oral health access. The health history questions were comprised of a standard comprehensive inventory of past medical and surgical histories along with current medication lists. Dental history questions inquired if patients had previously been treated by a dental healthcare provider, and what dental treatment they had received in the past. Demographic questions included age, gender, place of residence, presence or absence of dental/health insurance, transportation, income and general access to oral and systemic health care. Health history forms and questionnaires were collected from all patients who received treatment (Table 1).

Patients also underwent a dental screening performed by one of three RDHs as part of an initial triage. The screening involved assessing patients' chief complaints. Screeners assessed patients' mouths using a tongue depressor and a light source and recorded the presence or absence of missing or extracted teeth, untreated dental caries, restorations, sealants, trauma, periodontal disease and infection. Based on these findings, patients went on to a secondary assessment, which included dental radiographs, evaluation by a dentist, followed by treatments as indicated. Charts were reviewed and data were analysed.

Periodontal disease assessments were determined by the presence of visual signs of inflammation and attachment loss. Gingivitis was determined by the presence of erythematous and oedematous gingiva. The presence of periodontitis was determined by visible recession. Periodontal probing was not performed, and periodontal attachment loss was not calculated on these individuals; therefore, the extent of the disease could not be accurately determined.

## Statistical analysis

Descriptive statistics including medians, quartiles, frequencies and percents were calculated to summarize the general

**Table 1. Patient demographic information**

	Median (Q1–Q3)
Age in years ( <i>n</i> = 227)*	15 (9–29)
	<i>n</i> (%)
Sex ( <i>n</i> = 241)*	
Female	146 (60.6)
Male	95 (39.4)
Educational attainment ( <i>n</i> = 216)*	
Elementary	134 (62.0)
Secondary	40 (18.5)
Post-secondary	14 (6.5)
Did not go to school	28 (13.0)
Last dental visit ( <i>n</i> = 221)*	
Never	105 (47.5)
Within last 3 years	84 (38.0)
More than 3 years	32 (14.5)
Access to health care ( <i>n</i> = 221)*	
Yes	8 (3.6)
No	78 (35.3)
No dentist in the area	135 (60.1)
Transportation ( <i>n</i> = 212)*	
Car	6 (2.8)
Animal	68 (32.1)
None	138 (65.1)
Individual annual income† ( <i>n</i> = 178)*	
0–499 córdobas	123 (67.9)
500–1000 córdobas	21 (11.6)
>1000 córdobas	34 (18.8)
Health insurance status ( <i>n</i> = 220)*	
Medical only	13 (5.9)
Dental only	1 (0.5)
None	206 (93.6)

\*The sample size varies for demographic variable due to patient non-response.

†Exchange rate: 22.3 córdobas per 1 USD, as of July 2011.

characteristics of the sampled population. The primary endpoints were number of untreated, decayed teeth, number of tooth restorations and number of missing teeth. *Post hoc* analysis was conducted to test whether any patient characteristics or these endpoints differed by gender or age. Additionally, the study explored whether there was any relationship between the number of untreated caries and last appointment with a dental provider. For data collection, each endpoint was categorized into one of three levels during data collection: (i) none, (ii) one to three teeth and (iii) more than three teeth. Age was analysed as both a continuous variable and as a dichotomous variable where those less than 20 years of age were separated from those 20 years and older. Continuous variables in this study do not meet normality assumptions and as such, non-parametric statistics are presented. Chi-squared tests were performed when comparing two categorical variables, and the Kruskal–Wallis test was used for comparing the continuous variable age to categorical variables. The ages of the participants were documented for 227 people, and the gender information was documented on 241 people; therefore, the numbers (*n*) on Tables 2 and 3 are not the same. Analyses

**Table 2. Oral findings related to gender**

	Females <i>n</i> (%)	Males <i>n</i> (%)	<i>P</i> -value
Patients with decayed teeth ( <i>n</i> = 216)			
No untreated caries	16 (12)	9 (10)	0.15
1–3 untreated caries	51 (39)	24 (28)	
>3 untreated caries	63 (48)	53 (62)	
Patients with missing/extracted teeth ( <i>n</i> = 218)			
None missing	64 (48)	61 (71)	0.001
1–3 missing teeth	28 (21)	16 (19)	
>3 missing teeth	40 (30)	9 (10)	
Patients with restored teeth ( <i>n</i> = 218)			
No restored teeth	77 (58)	77 (90)	<0.0001
1–3 restored teeth	25 (19)	6 (7)	
>3 restored teeth	30 (23)	3 (3)	
Periodontal conditions ( <i>n</i> = 218)			
Healthy	4 (3)	3 (3)	0.39
Gingivitis	76 (58)	57 (66)	
Periodontitis	52 (39)	26 (30)	

*P*-value obtained from the chi-squared test.

**Table 3. Oral findings related to age**

	<i>n</i>	Age (years) Median (Q1–Q3)	<i>P</i> -value
Patients with decayed teeth	204	–	0.36
No untreated caries	22	14 (6–22)	<0.0001
1–3 untreated caries	71	16 (11–30)	
>3 untreated caries	111	15 (9–31)	
Patients with missing/extracted teeth	206	–	<0.0001
None missing	118	11 (7–16)	<0.0001
1–3 missing teeth	42	22.5 (14–28)	
>3 missing teeth	46	39 (31–47)	
Patients with restored teeth	206	–	<0.0001
No restored teeth	145	11 (7–18)	<0.0001
1–3 restored teeth	29	23 (20–31)	
>3 restored teeth	32	40.5 (28.5–49)	
Periodontal conditions	206	–	<0.0001
Healthy	7	6 (1–13)	<0.0001
Gingivitis	125	11 (8–15)	
Periodontitis	74	34 (23–42)	

*P*-value obtained from the Kruskal–Wallis test.

were performed in SAS, version 9.3 (SAS Institute Inc., Cary, NC, USA) and STATA, version 12 (StataCorp LP, College Station, TX, USA).

## Results

Of 241 patients, all 241 responded to some element of the dental and health history questionnaire. Of these, 218 consented to proceed to oral screenings (86 males and 132 females).

### Access to care

Concerning the frequency of evaluation by a dental provider, 221 of 241 patients responded. Of these, 105 (47.5%) reported

having never seen a dental provider in their lifetime. Eighty-four (38.0%) individuals had been seen by a dentist within the past 3 years, and 32 (14.5%) had been seen by a dentist over 3 years ago. Access to and means of transportation were evaluated. Of the 212 patients who answered this question, 138 (65.1%) indicated having no means of transportation. Sixty-eight (32.1%) reported having ‘an animal’ to ride as transportation, and 6 (2.83%) stated the availability of a vehicle as means of transportation.

Of the 241 patients, 220 responded to a question regarding the presence or absence of health insurance coverage (medical and/or dental). Only one male reported having dental insurance coverage, and seven males and six females reported having medical insurance. Two hundred and six (93.6%) of the respondents reported having no health insurance coverage of any kind.

One hundred and seventy-eight individuals reported on their annual incomes (66 males, 44 women). One hundred and twenty-three (67.9%) reported an income between 0 and 500 córdobas [equivalent of 0–22.4 USD, based on exchange rate of 22.3 córdobas/USD as of July 2011], 21 patients (11.6%) had an income ranging from 500 to 1000 córdobas (equivalent of 22.5–44.8 USD), and 34 (18.8%) above 1000 córdobas annually.

### Oral health status

#### Decayed teeth

Of the 218 patients who consented to an oral health screening, two did not have documentation on the number of decayed teeth. Of the remaining 216 191 patients were found to have at least one decayed tooth (88.4%). Seventy-five (34.7%) patients had between one and three untreated teeth with carious lesions. One hundred and sixteen (53.7%) had greater than three untreated decayed teeth. Among those below the age of 20 years, 88.2% presented with one or more decayed teeth. 90.2% of those between the ages of 21 and 64 years had a prevalence of one or more teeth with a cavity. There was no significant relationship between the ages of patients and the number of untreated decayed teeth they had ( $P = 0.36$ ). There was also not a significant difference of untreated decayed teeth between genders ( $P = 0.15$ ). 89.5% of males presented with at least one decayed tooth, while 87.7% of women had the same. Refer to Tables 2 and 3.

#### Missing/extracted permanent teeth

Ninety-three of 218 patients presented with at least one missing or extracted permanent tooth. The median age of those with no missing or extracted permanent teeth was 11.0 (Q1–Q3: 7.0–16.0). There was a statistically significant relationship between age and the presence of at least one missing or extracted tooth ( $P < 0.0001$ ). There was also a statistically significant difference between gender and the presence of at

least one missing or extracted tooth ( $P < 0.001$ ). 51.5% of women with at least one absent tooth, whereas 29.0% of men were found to have the same.

Among the 70 people who had documentation on the number of caries present and had seen a dentist within the past 0–3 years, 8 (10.1%) were found to have no untreated caries, 30 (38.0%) had 1–3 untreated caries, and 41 (51.9%) had more than 3 untreated caries. Those who reported to have been seen by a dentist within more than years were observed to have the following: 4 (13.3%) with no untreated caries, 10 (33.3%) with 1–3 untreated caries, and 16 (53.3%) with more than 3 untreated caries. Finally, among those who reported never having been seen by a dentist, 11 (12.0%) were found to have no untreated caries, 32 (34.8%) had 1–3 untreated caries, and 49 (53.3%) had more than three untreated caries. Those who had never been seen by a dentist had a similar extent of untreated decayed teeth as those who had seen dentists within any period of time ( $P = 0.87$ ).

#### Filled/restored teeth

Of 218 recorded, 64 patients had dental restorations present in their mouth. Only one sealant was detected and recorded. There was a statistically significant relationship between the age of the patients and the number of restorations they had, with older individuals having more restorations than younger individuals ( $P < 0.0001$ ). When controlling for missing/extracted teeth, there remained a statistically significant relationship between the number of filled teeth and decayed teeth ( $P = 0.032$ ). That is to say, those with more restorations actually had a greater number of untreated decayed teeth than those who had fewer restorations.

There was a significant gender difference in the prevalence of restorations, with 41.7% versus 10.5% among women and men, respectively ( $P < 0.0001$ ).

#### Periodontal disease

The vast majority (96.8%) of patients showed visual signs of inflammation of the periodontium upon screening. One hundred and thirty-three patients appeared to have gingivitis, and 78 appeared to have chronic or aggressive periodontitis.

#### Discussions

Nicaragua faces many challenges in numerous aspects of its economy and overall healthcare system. According to the Nicaraguan Statistical Health Care System Analysis 2000–2011, the Ministry of Health, which is the government health sector in Nicaragua, provided health care to the majority of residents. Their statistical analysis conducted and released on May 2011 revealed an overview of the healthcare needs of Nicaraguans categorized by age group and various diseases. It is important to note that even though there was a section for oral health as part of the healthcare statistical analysis, there was no information provided in regard to oral health in the 179 pages of the report (4).

Our study reports data on the prevalence of oral disease and barriers to treatment in a population within San Blas and Santa Ana, Nicaragua. Characteristics analysed included general demographic and socio-economic characteristics, as well as the presence or absence of disease in the oral cavity.

These findings revealed a high prevalence of untreated dental caries across all age groups. Particularly surprising was the high prevalence 88.2% of untreated caries among individuals ages 2–19. As a point of reference, this is significantly greater than the general US population within the same age cohort (5) (Fig. 1). The prevalence of untreated caries in populations in San Blas and Santa Ana between the ages of 20 and 64 was also quite high at 90.2%. In the United States, the prevalence in this age group is 23.7% (6). Gender was not shown to be an indepen-

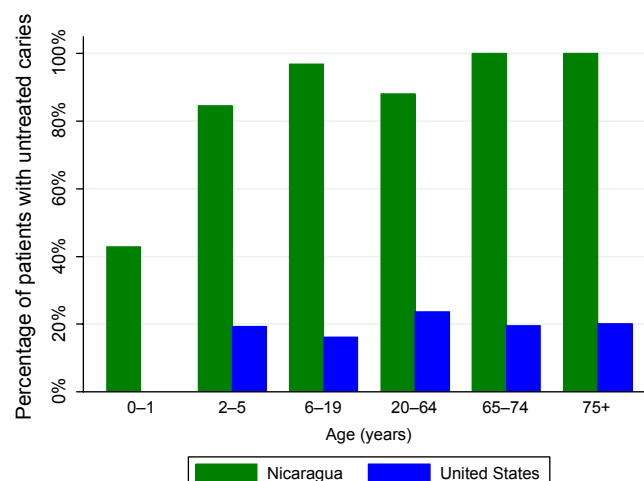


Fig. 1. Data pulled for this figure were taken from: the United States Census Bureau International Data Base (6) and the National Center for Health Statistics' *Health, United States, 2011: With Special Feature on Socioeconomic Status and Health*, Table 76, page 266 (5). There were no data available for the 0–1 age group for the United States.

dent risk factor for number of untreated carious lesions. This is seen also in the United States, where rates for untreated carious lesions are similar between males and females (5).

Assuming similar rates of congenitally missing teeth between genders, women seem to have received more tooth extractions in their lifetimes than men. Similarly, there was a gender difference in prevalence of filled teeth with women having more than men. While it is unclear whether these factors indicate that females seek dental care more regularly than men, the combined facts that a greater percentage of women have restorations and missing permanent teeth than men speak to this possibility.

The prevalence of periodontal disease in patients being screened was quite high. There were limitations to this evaluation. This assessment was determined by the presence of visual signs of inflammation and attachment loss. Gingivitis was determined by the presence of erythematous and oedematous gingiva. The presence of periodontitis was determined by visible recession. Periodontal probing was not performed, and periodontal attachment loss was not calculated on these individuals; therefore, the extent of the disease could not be accurately determined.

Quite interesting is the statistically significant relationship between the total number of restorations and untreated dental caries. While this may be because individuals with more restorations tended to be at higher risk for carious lesions than those with fewer or none, it is plausible that the dental care that these patients previously received was not sufficient to meet their oral health needs. This is further reflected in the fact that those who had been seen by a dental provider within the past 0–3 years had similar rates of decay than those who had been seen by a dental provider within three or more years or never having been seen by a dental provider at all.

## Conclusion

San Blas and Santa Ana are particularly rural areas in the country of Nicaragua. It is evident that there are numerous barriers to care present in these regions, and their oral health needs are great. Reporting on the oral health statuses of these underserved populations is important. Now that these are recognized and documented, further steps can be taken in resolving the oral health disparities of these populations.

## Clinical relevance

### Scientific rationale

Data were collected in San Blas and Santa Ana, Nicaragua, to identify current oral health status and access to oral health care. Currently, literature on these topics is limited to non-existent in these areas.

## Principal findings

There is a significant deficit of access to oral health care in areas of San Blas and Santa Ana, Nicaragua. Residents in these areas have limited income, transportation, insurance, and general frequency of dental evaluation and treatment. There is also substantial oral pathology present in the majority of these populations.

## Practical implications

Accruing such data is helpful in identifying the need for oral health intervention and creating future avenues for provision of care.

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