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DMFT and Its Possible Determinants in the Honduran Population

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Abstract

Objectives: This study was designed to investigate the dental health status of several communities in Honduras in terms of the DMFT index (decayed missing and filled teeth). Specifically the study focused on comparisons of the Garifuna (a maroon community in Tela) with the people of San Jose, Copan, and others who traveled from other regions to come to a medical clinic. These results were also compared to other populations of developing and developed countries. Through looking at each participant's DMFT score, many possible correlations to oral health were explored including region, age, gender, snacking, tobacco use, and oral hygiene.

Study Design: A total of 818 adults (199 males and 619 females) with an age range of 18-65 (Mean 38.1 sd 13.5) attending the Medical Ministry International clinic in San Jose in August 2010 or Tela in August 2011 participated in the study. After agreeing to be in the study, participants were asked a list of questions including the subjects' tobacco use, oral hygiene behaviors, dietary habits, and demographic factors. Descriptive statistics, comparative means, and multiple linear regression analysis were statistical analysis used when necessary.

Results: There were statistically significant differences in DMFT between the Garifuna village and San Jose, gender, age, regular dental visits, and brushing one's teeth daily. The worst DMFT score was found in the oldest age range, from 51-65. The DMFT score was higher in the Honduran sample population for all age ranges compared to a national survey of adults in the United States. The mean DMFT in San Jose and the outlying areas of Honduras were found to be much higher than the mean DMFT of the Garifuna.

Conclusion: It is concluded that the factors gender, age, region, dental care, and oral hygiene may help to understand the differences seen in DMFT scores, but it is important

to note that a more in-depth study of nutrition could be very useful to help explain differences in the mean DMFT of the regions.

Introduction:

Honduras is a Central American country bordering Guatemala and Nicaragua. As of July 2012, Honduras had a population of almost 8.3 million people. There is an increasing population density in urban areas, changing from 440,000 to three million people between 1961-2001 in urban areas, which is higher than the national population growth[1]. Honduras is the second poorest country in Central America, suffering from high unemployment rates going as high as 27.8% in 2007 dropping to 3.5% in 2008 with exceptionally high underemployment rates[2].

Not only does Honduras suffer from great wealth distribution inequalities, but also they have an inadequate healthcare system. The infant mortality rate nearly triples that of the United States, being 20 deaths between birth and the age of 1 per 1000 live births[3]. In addition, in 2003 it was found that the adolescent fertility rate (per 1000 girls aged 15-19 years) was a stifling 107.9 compared to 40.0 in the United States.

There is an uneven distribution of healthcare services with the majority of healthcare providers in urban areas. In 1986, it was found that over half the physicians and 75% of dentists work in the capital, Tegucigalpa, which represents only 12% of the Honduran population[4]. Although the Ministry of Health in Honduras has done much reform, it can still be seen through the medical brigades that have been done by Medical Ministry International that remote areas are not fully reached by physicians or dentists. .

Reports on oral health status in Central America, especially Honduras, are scarce. Most reports on oral health in Central America only record data of children, leaving

knowledge about adult dental care absent. However, this data does show a need for increased dental care for children, since it shows that 12 year old Honduran children have a DMFT score of 4.0 compared to a score of 1.4 for the same age children in the United States and a score of 2.8 in Nicaragua, which borders Honduras[5]. While access to dental care has increased in Honduras as ascertained from Medical Ministry International, there is still much that needs to be done to increase the oral health status.

 The remote village of San Jose, Copan was the location of one clinic where enrollment was done for the study. The population of San Jose is comprised of indigenous people of Honduras of possible Mayan decent from the Copan ruins located very close by. Amenities are scarce, but most houses have access to water and electricity.

Our brigade through Medical Ministry International (MMI) is the only brigade that visits San Jose, setting up a clinic once a year. It was ascertained that a dentist started coming to San Jose weekly, starting in the beginning of 2010. However the dentist charges higher prices than the prices of the MMI clinic, costing 20 lempira per extraction and 40 lempira per filling compared to 15 lempira for as many extractions as necessary at the MMI clinic in 2010. There were also many participants who traveled great distances to this MMI clinic in San Jose, Copan to receive medical and dental treatment.

The regular diet in San Jose is comprised of tortillas, beans, rice, and sometimes chicken. However, in recent decades snacking has become a much larger part of their society, with many sodas, sweets, and bagged chips being sold at multiple stores in the village. While San Jose can be seen as the center of many of the outlying villages, there isn't a sense of community in the area, with each smaller village mainly taking care of

themselves. While there is a mayor in San Jose, his main jobs involve maintenance of San Jose rather than uniting the area.

Tela has a population comprised of the maroon community known as the Garifuna who mostly speak Spanish as well as Garifuna. The Garifuna are an African-Amerindian people native to Central America's Atlantic coast who were deported from the Eastern Carribean island of St. Vincent in 1797, leading to a boat crash on the shores of Central America[6]. Being a Maroon society in Central America, the group stayed together in small villages along the coast keeping minimal interaction with most other groups around them, retaining their African identity for centuries. Nowadays, since it is growing to become a tourist area in Honduras because it is located along the coast, a handful of individuals could speak English. Overall, the Garifuna have a very closed community and a very proud identity.

The Garifuna have retained their African roots through their language, dances, music, stories, and religious beliefs (similar to that of Santeria). In addition, they still have traditional foods, medicinal herbs, and farming and fishing methods[7]. In addition to accepting regular medical treatment, the Garifuna also believe in Garifuna illnesses that only a doctor Moreno, a Garifuna healer, can diagnose and treat[8]. From field experience, it was ascertained that they have a village head who is a male who helps organize the community. The Garifuna have a historically strong sense of community and tie to their traditions.

Sexually transmitted diseases and HIV are growing issues for the Garifuna people. Garifuna have among the highest rates of HIV in all of Central America, estimated between 8 and 14 percent[9] and a syphilis seroprevalence rate of 11 percent[10].

An exact percentage is difficult to determine without a regular medical center for Garifuna; this is complicated by the stigmatization of HIV. HIV in Tela is predominantly passed through heterosexual unprotected sex. HIV can cause oral health issues, like oral lesions, gingivitis, and dry mouth[11], and those least healthy with HIV (elevated viral load and diminished CD4+ count) have found to have a high DMFT score, meaning worse oral health[12].

Poor oral health is a large issue in Honduras. There can be many reasons why poor oral health can occur. These reasons include a lack of sanitary drinking water, tobacco use, poor snacking habits, and a slowly developing dental system. It is also important to note the vast difference in oral healthcare in the urban areas compared to the rural villages examined in this study. In Latin America, only 24% of the urban population has a water quality control surveillance system, and in Honduras over 50% of the population has access to piped drinking water less than 50% of the time[13]. "Poor access to safe water or sanitary facilities are environmental risk factors to oral health"[14]. In both of the villages they had access to a well, but the wells were not fluoridated and contain parasites. Fluoridation of water has been found to decrease dental caries. This is because dental caries occur as bacteria dissolve the enamel surface of a tooth. Fluoride works in three ways to stop this process: it stops the demineralization process, enhances remineralization, and decreases the activity of the bacteria in dental plaque[15].

Gender may play a part in oral health through socio-economic status as well as possible systemic differences. "In a comparative study of the health determinants of indigenous women of the Americas based on data from seven countries (Canada, Ecuador, Guatemala, Mexico, Nicaragua, Peru, and USA), researches have called

attention to the centrality of gender to the understanding of health differences in indigenous communities"[16]. This may be related to factors like reproductive roles and access to education and health services in indigenous communities. Clinical studies have also found that oral tissues may be affect by pregnancy due to hormonal changes increasing susceptibility of oral tissue to irritants[17]. In addition, there is a positive correlation between the female gender and systemic diseases, and it has been found that systemic diseases can cause oral diseases, which could affect oral health status[18].

Tobacco use has also been correlated to worse oral health. Smoking has been found to increase tooth loss, and long duration of tobacco use may increase the odds of caries[19]. In 2003, it was found that 25% of students between the ages of 12 and 19 living in an urban environment in Honduras have already started smoking[20]. Although the populations examined in this study are almost all from rural areas, it is pertinent to understand the national culture, which deems smoking as acceptable. However, in 2011 Honduras passed an anti-smoking law where citizens are no longer allowed to smoke in many public areas and people can file complaints about secondhand smoke, hoping to lower the prevalence of smoking.

Poor snacking has also been found to affect oral health. As mentioned earlier, dental caries occur because of demineralization of tooth issues at a lowered pH following bacterial fermentation of dietary carbohydrates[21]. The lowered pH can be caused by a higher frequency of carbohydrates consumed, like monosaccharides and sucrose regularly found in soft drinks, chips, and candies. Because of this, snacking has now grown to have a larger role as a critical indicator for caries development[22]. However, it is still inconclusive of the effects of products with excessive hydrolyzed starch, such as chips.

Overall, influencing the dietary habits of Hondurans could help decreasing dental caries and therefore increasing their overall health. Generally, improving nutrition would more so help improve oral health, but a push to decrease snacking in the population would be a start towards better oral health.

As one might expect, oral hygiene has been found to be one of the most important behaviors to prevent dental caries. Proper brushing at least once a day can help remove dental plaque that can lead to the development of caries[23]. Dental plaque can have the most significant effect on the DMFT index[24]. It has been found in Finland that through a greater dental education and oral hygiene, there has been a significant decrease in children with caries, and Finland nationally achieved one of the lowest levels of the DMFT index even among developed countries[25].

Methods/Results:

Consent to solicit participation was obtained through Medical Missions International who had organized the two clinics. The Institutional Review Board (IRB) of the University of Connecticut approved the study and verbal consent was obtained from every prospective participant. The only exclusion criterion was age specifications (Under the age of 18 or over the age of 65). The study was conducted in San Jose Copan in August 2010 as well as in Tela, Atlántida in August 2011 during medical missions trips.

Participants were chosen from those who were attended the health clinic for medical care because this group was the easiest group to enroll in the study. Subjects were recruited in the beginning of the medical clinic after they had received medicine for parasites and were waiting to see a doctor. This provided a few minutes for subjects to be

questioned and a quick oral exam to be done. Subjects received no monetary compensation for enrolling in the study, and were told that not participating had no effect on the medical or dental treatment at the clinic. I worked as the single examiner after being trained by the dentists on staff about how to inspect the teeth for decay and fillings on permanent teeth as well as noting missing teeth. Because of a lack of time, an expedited version of the WHO criteria was used during all examinations where only the sum of the decayed, missing, and filled teeth was recorded instead of cataloging each tooth separately and finding the score later[26]. Examinations were made inside the clinic under natural light as well as with the aid of a standard flashlight. Caries probes and plane mouth mirrors were also used to aid in the examination of subjects.

Subject histories were taken in Spanish with the aid of an interpreter when necessary. In those cases where the participant spoke only the language of the Garifuna, a local interpreter from the village aided. Information regarding living location, poor snacking habits, tobacco use, previous dental treatment, and oral hygiene was also recorded.

Figure 1

Villages in Honduras

- Santa Rosa
- Dulce Nombre
- Dolores
- Veracruz
- Quezailica
- Bijao
- Tela
- Tornabe
- Juticalpa
- El Porvenir
- Yaruconte
- Miami
- Pasquingual
- San Jose
- Vivistorio
- Buena Vista
- Roatan
- Triunfo de la Cruz
- Las Brisas
- Las Pilas
- San Pedro Sula
- Rancho
- Camalote
- Agua Buena
- Agua Caliente
- El Conal
- Ocotepeque
- San Juan
- La Esperanza
- San Antonio
- Santa Cruz
- Los Planes
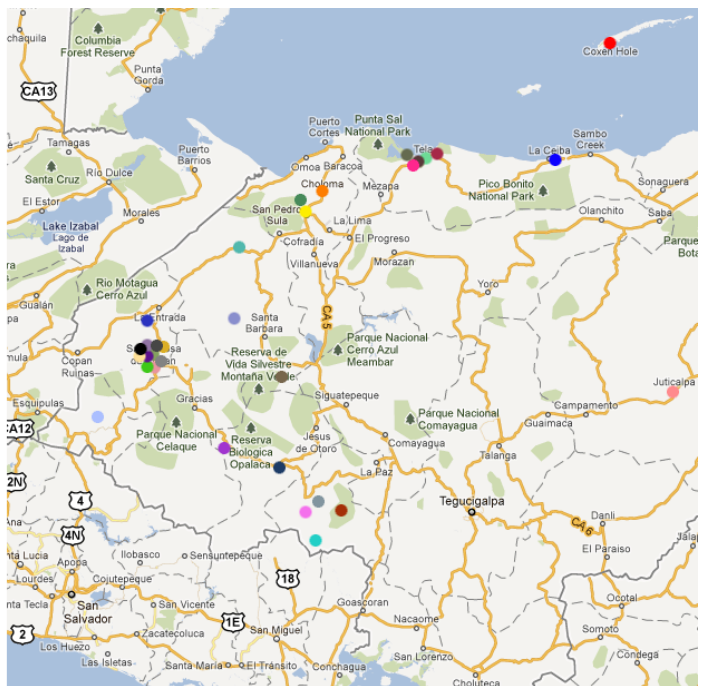
The study population was a convenience sample of 818 persons, (199 males and 619 females) with an age range of 18-85 (Mean 38.1 sd 13.5). It was assumed that all permanent teeth, including the wisdom teeth, had erupted for all age groups in the study. The population can be further broken up into 200 people from Tela, Antlantida and the surrounding area (Garifuna), 544 from San Jose, Copan and the surrounding villages, and 71 from farther villages who attended either clinic, as seen in Figure **1**. The Garifuna are labeled as "Population 1," those in the San Jose area are labeled "Population 2" and those not located in either of these regions are labeled "Population 3." Almost all of the subjects were from rural villages. The sample size and the distribution of subjects by age, gender, and living location can be found in Table 1.

The decayed, missed, or filled permanent teeth index (DMFT) were calculated for each subject as the dependent variable for the study. "A tooth was categorized as decayed if it had an unmistakable cavity, undermined enamel, or a detectably softened floor or wall, filled if it had one or more permanent restorations, and missing if it had been extracted previously because of caries"[16]. In severe cases, missing teeth were also calculated through counting the number of remaining teeth in the mouth, and subtracting that from 32, the standard number of permanent teeth in an adult person. The worst possible value of the DMFT index is 32.

Data analysis was performed using the SPSS program (Apple, version 19.0). Multiple linear regression analysis was applied to determine the best predictors among the independent variables gender, age, region, snacking habits, brushing, smoking, and professional oral healthcare (Dental visits per ten years) on the DMFT index. The significance level was sated as $p < .01$.

Results

        Table 1 shows the population divided into four age brackets by percentile of the

subject pool: 18-26, 27-35, 36-50, and 51-65 years of age. As expected this shows an

increase in DMFT score comparing each age range at an alarming rate, which has also

been seen in other studies in developing countries[16]. In the last age bracket, ages 51-65,

the mean DMFT was found to be 26.59, meaning that the average person within this age

had less that six teeth remaining at this point in their life. Many people were able to get

full or partial dentures to deal with this issue, however they were not form-fitted to their

mouth in any way.

Table 1 Number of subjects and Mean DMFT Index examined by Age Cohort, N = 818

Age Range	Mean DMFT	N	Std. Deviation
18-26	7.69	200	6.720
27-35	12.29	212	9.537
36-50	20.05	194	9.805
51-65	26.59	212	8.092
Total	16.71	818	11.274

        Table 2 shows descriptive statistics for the list of variables used in the analysis.

As shown, there was a much higher prevalence of missing permanent teeth compared to

decayed teeth, and fillings were rarely seen. 76% (N=619) of the participants were

female. This happened for multiple reasons. First, many more women attended the clinic

with their children than men, mainly because many of the men were working during the

day. In addition, of the men who attended the clinic, many of them chose not to

participate in the study.

Population 2 was the largest population in the study. This is because the medical team saw the most people during this week. Also, a large portion of Population 1 was not willing to participate in the study. Historically, Population 1 is known to not trust white men, and as a white male it was difficult to enroll people from this area into the study. Over half of the population snacked on sweets, soda, or chips daily.

While this study shows that only 6 percent of the sample population regularly smokes, it is believed that this value was distorted. This distortion occurred because the participants' main purpose for being in the location was for medical treatment at a Christian clinic where tobacco use is looked down on. This may have affected the answer to the question of tobacco use swaying them to say that they regularly don't smoke tobacco.

The same theory that participants are giving "social acceptable answers" applies to the result of 93% of participants saying that they brush their teeth daily. With the generally high level of dental caries of the population sample, it is unlikely that 93% actually brushed their teeth daily. Dental visits were assessed per ten years to rid the chance at creating a direct correlation to age because it is expected that an older person would have visited the dentist more times than a younger person.

Table 2: Descriptive Statistics

	Mean	Std. Dev.	Minimum	Maximum
Dependent Variable				
DMFT Index				
Decayed	3.67	4.76	0.00	1.00
Missing	12.36	12.16	0.00	32.00
Filled	.67	1.99	0.00	15.00
Overall	16.71	11.27	0.00	32.00
Independent Variables				
Age	38.04	13.54	18	65.00
% Female	.76			
% Pop. 1	.245	.431	0.00	1.00
% Pop. 2	.665	.472	0.00	1.00
% Pop. 3	.091	.287	0.00	1.00
Daily Poor Snacking	.58	.494	0.00	1.00
Regular Smoking	.06	.242	0.00	1.00
Daily Brush Teeth	.93	.253	0.00	1.00
Dental Visits/10 years	.895	.993	0.00	8.47

Table 3 shows a comparison of oral health of the sample population in Honduras compared to national data in the United States by age cohort. In addition the DMFT score was broken down into its parts: decayed permanent teeth (DT), missing permanent teeth (MT), and filled permanent teeth (FT). For the overall DMFT index, the Honduran sample population surpasses the USA population in each age bracket. This trend continues in the DT and MT population between the two different population groups. Interestingly, the DT of the sample Honduran population decreases between the 35-49 and 50-64 age brackets. This could possibly be explained because many of the oldest population had dentures and all of their teeth removed; therefore, without any teeth their DT score would be 0. The FT for the USA population is much higher than that of the Honduran sample population. This could be because of the lower standard of dental care that medical brigades are able to offer to the rural villages because of a lack of advanced

tools in the clinic. In the past seven years of field experience I have had on medical trips to Honduras, only last year did the dentists have the ability to do fillings and the cleaning of teeth. Previously, the dentists only had the ability to pull teeth.

Table 3: Comparison of DT, MT, FT, & DMFT scores between USA and Honduran Sample Population by Age Cohort

	DMFT		DT		MT		FT	
Age	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error
20-34								
USA	6.16	.016	.93	.08	.62	.05	4.61	.13
Sample Honduran Pop.	10.32	8.54	3.43	4.10	6.06	8.32	.82	2.14
35-49								
USA	10.91	.14	.75	.05	2.39	.11	7.78	.15
Sample Honduran Pop.	19.32	10.12	4.23	5.05	14.53	11.61	.56	1.71
50-64								
USA	15.05	.21	.55	.04	5.30	.22	9.20	.19
Sample Honduran Pop.	26.45	11.17	3.56	5.41	12.74	12.16	.67	2.02

NOTES: DMFT = Sum of Decayed, Missing, and Filled Permanent Teeth, DT = Decayed Permanent Teeth, MT = Missing Permanent Teeth, FT = Filled Permanent Teeth

[27] SOURCE of USA Statistics: http://www.cdc.gov/nchs/data/series/sr_11/sr11_248.pdf

Figure 2 and Table 4 show the vast differences in DMFT score between the different populations. Figure 2 shows not only that the average mean DMFT scores are different, but also that the differences between the 25th - 75th percentiles are large. Also, within the 75th percentile of population 2 and 3, it still reaches the maximum of the DMFT score 32. In addition, this shows that people not around either San Jose or Tela who were willing to travel to these locations from far areas had the highest DMFT score and therefore the worst overall oral health. This makes sense because people in more need would be more likely to travel farther for the medical help. The clinics were advertised through word of mouth as well as through the church system where pastors let

other pastors know about the clinics in case their congregation was in need of medical help.
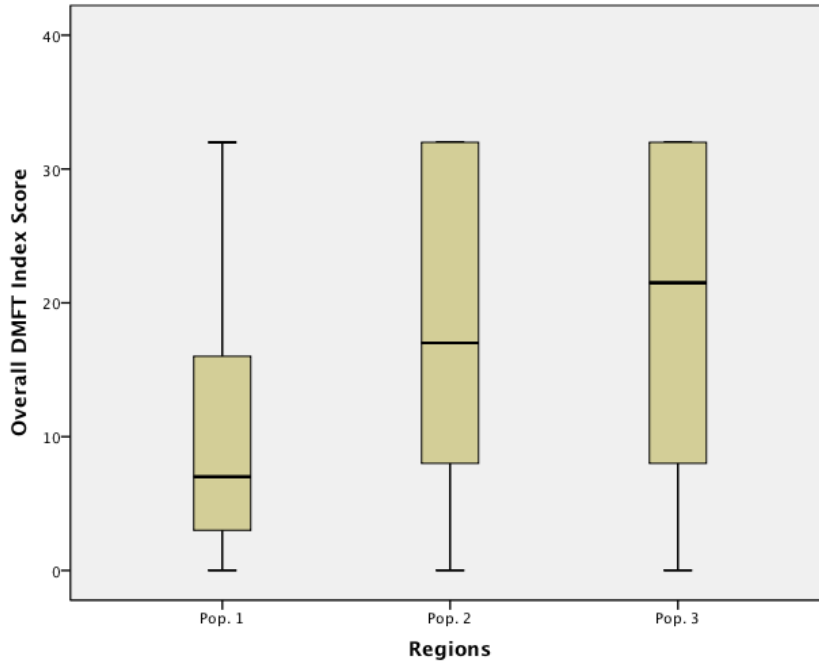
Figure 2: Mean DMFT By Region (N=818)

Table 4: Number of subjects and Mean DMFT Index examined by Region Cohort, N = 818

Region	Mean DMFT	N	Std. Deviation
Pop. 1	10.22	200	9.244
Pop. 2	18.64	544	10.990
Pop. 3	20.08	74	11.689
Total	16.71	818	11.274

NOTE: Pop. 1: Garifuna, Pop. 2: San Jose, Pop. 3: Other

The results of our regression model of the overall DMFT score are shown in table 5. This shows the significance of each variable with all others considered ($p < .01$). As shown, there is significance in DMFT for multiple different variables, including gender, age, between population 1 and 2, dental visits / ten years and daily brushing of teeth ($p < .01$). The variables: difference between population 2 and 3, poor snacking, and regular

smoking shows no significance (p >.01). Gender shows a significant positive effect so females had significantly worse oral health compared to males, all variables considered. Comparing population 1 and 2 shows a significant negative effect, meaning better oral health for population 1 (Garifuna) than population 2 (San Jose) all variables considered. Dental visits per ten years showed positive significance meaning that a greater number of dental visits per year actually cause a higher DMFT score, meaning worse oral health. This makes sense for the fact that people usually went to the dentists only in cases of dental crisis, and not for regular check-ups. Again, this can be related to the primitive instruments and methods used at these medical and dental clinics set up for a brief period of time in rural villages. Lastly, as expected, daily brushing of teeth is negatively significant, meaning that brushing your teeth daily lowers DMFT score, all other variables considered

Table 5: Regression of Determinants of the Overall DMFT Index, N= 818

Independent Variables	b	β	Sig.
Female Gender	3.281	.125	.000
Age	.544	.653	.000
Population 1	-7.863	-.300	.000
Population 3	.290	.007	.758
Daily Poor Snacking	-.374	-.016	.498
Regular Smoking	1.601	.034	.173
Dental Visits / 10 years	1.083	.095	.000
Daily Brush Teeth	-4.684	-.105	.000
Constant	.495		
R squared	.551		
Adjusted R squared	.547		

Discussion and Conclusion

Recent data on the oral health status of Hondurans is very limited, especially in rural areas and within the adult population. While this study starts to address the problem, it is important to note that this study was a secondary purpose of being in Honduras, while the primary purpose was to aid those in need of medical or dental help through Medical Ministry International. Being a convenience sample restricts generalizations that can be made about the overall population in Honduras. This is evident by the predominance of females in the study since more females came to the medical clinics. Sampling only occurred in the two clinics, so it is necessary that a countrywide survey would need to be done to substantiate the findings. In addition, there may be other reasons why the Garifuna differ so much from the other sample populations, including their diet or genetics, which are topics that could also be interesting to research.

The DMFT score of the sample population was high for all age cohorts, especially in San Jose and those that traveled farther distances to the clinics. A second study looking into more of the sociological and nutritional differences between the Garifuna and the community of San Jose could prove to be extremely useful. Sadly, because of time constraint in the medical clinic, a more in-depth analysis of diet was not possible. While this study didn't show significance in snacking, this may be because only one basic question was asked about the snacking of sweets and chips and drinking soda. The difference in diets in the two areas for regular meals could be a much larger factor than just looking at the difference in snacking. Also, from a sociological standpoint, looking at the function of the different communities and the support system offered from being part of each community could have an effect on general health as well as oral health. Lastly, it

would be useful comparing this data to data found in an urban area to see the difference in being in an area where dental care is much more prevalent.

Extreme dental needs in rural areas with limited educational and financial resources and an unequal distribution of dentists comparing the rural and urban areas are considerable challenges for the Honduran people. Although medical and dental missions trips by international organizations do provide some assistance, it is important that Honduras does not base their system off of this help and create an overall better domestic support system. Ways to improve oral health in Honduras could include creating a greater national importance in dental education, a change in nutrition, as well as expanding the dental programs so that there are more dental care providers closer to the rural areas.

Acknowledgements

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