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Prevalence of Caries and Malocclusion in an Indigenous Population in Chiapas, Mexico

by

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THESIS

Submitted in partial satisfaction of the requirements for the degree of

MASTER OF SCIENCE

in

Oral and Craniofacial Sciences

in the

GRADUATE DIVISION

of the

Acknowledgements

The text of this thesis/dissertation/manuscript is a reprint of the material as it appears in the International Dental Journal. (doi: 10.1111/idj.12170). The co-author listed in this publication co-directed and supervised the research that forms the basis for the thesis. We are grateful for the enthusiasm and support we received throughout this great undertaking. The citation for this manuscript appears below. This work is supported by UC-MEXUS grant to MFO. There are no conflicts of interests.

K Aamodt, MF Orellana (2015) Prevalence of Caries and Malocclusion in an Indigenous Population in Chiapas, Mexico. International Dental Journal. doi: 10.1111/idj.12170

Prevalence of Caries and Malocclusion in an Indigenous Population in Chiapas, Mexico

Abstract

Objectives: To assess the prevalence of caries and malocclusion in 14-20 year old Mayan Mexican adolescents living in Chiapas, Mexico.

Methods: This is a cross-sectional, population-based, quantitative, epidemiological study. Sites were chosen to capture subjects representative of the state's Mayan population. A combined total of 354 subjects were recruited. Caries experience was quantified via visual inspection using the Decayed, Missing, and Filled Surface index (DMFS). Malocclusion was quantified using the Index of Complexity, Outcome, and Need (ICON).

Results: Our data showed 99% of the population had caries experience, with a median DMFS score of 8. Out of the 99% with caries experience over half had caries affecting more than 5 tooth surfaces. Thirty seven percent of the students had unmet orthodontic treatment need, 46.46 % presented a class II anterior-posterior relationship whereas 39.09% presented a class III.

Conclusions: Less than 1% of the population had any exposure to orthodontics demonstrating the lack of access to care. Likewise, only 1% of the population was found to have no caries experience, exhibiting a large unmet treatment need. The median DMFS score of 8 was also high in comparison to DMFS of the US at 6. Our data suggests a correlation between the lack of access to care and high prevalence in caries and malocclusion in Mexican Mayans that inhabit Chiapas Mexico.

TABLE OF CONTENTS **PAGE**

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Dental caries and malocclusion are common oral disorders among children and adolescents that affect their quality of life (1). Dental Caries is the single most common chronic childhood disease; it is five times more common than asthma and seven times more common than hay fever. (2, 3)

Malocclusion refers to the abnormal relationship of the maxillary teeth to the mandibular teeth; correction of malocclusion usually involves orthodontic treatment during late childhood and adolescence.(4) The World Health Organization (WHO) regards malocclusion the third highest oral-health priority.(5).

Dental caries and malocclusion can affect self-esteem, social interactions, and communication. (2)

Several developed countries have experienced a steady reduction in dental caries. However, trends in developing and underdeveloped countries are unclear. For instance, the lowest caries rates were found in Africa and the highest in Latin America. (6)

In Mexico dental caries is considered a public health problem. It is estimated that 99% of the population has had dental caries; this constitutes the main reason for teeth being extracted in patients younger than 35 years.(7) The prevalence of dental caries in adolescents is higher than 70%, and the mean decayed, missing, and filled teeth (DMFT) is higher than 1.5 (8). In a national surveyed, decayed teeth accounted for 90% of the index for DMFT in four states, Colima, Chiapas, Guerrero, and Yucatan. (9)

In terms of malocclusion, a study of Mexico City students showed that almost one third of the teenage studied presented occlusal anomalies leading to orthodontic treatment needs; amongst them, 43% had severe occlusal anomalies.(10) Treatment need for orthodontic care is a complex issue to quantify due to the psychosocial aspect of malocclusion.(7, 11-19) Therefore, epidemiologists have developed evidence-based tools to evaluate orthodontic treatment need that aim to account for these manifold influences including the perception of aesthetics. (11)

In general, oral diseases are considered public health problems in Latin American countries and disproportionately affect the poor and disadvantaged (20-22). Indigenous populations in Latin American are among the most disadvantaged economically and socially. Moreover, they are worse off in terms of health for most indicators (23-26).

According to the 2005 census, Mexico's indigenous population numbers 12.7 million people representing up to 13% of the national population. The majority of these indigenous populations are concentrated in the southern and south-central region of Mexico. Almost 80% of those who speak an indigenous language live in eight of Mexico's 31 states, Chiapas holding the second largest population size.(27, 28).

44.2% of those residing in indigenous municipalities suffered from extreme poverty. (29-31).

The region of Siltepec., with a population of 3181 people holds a naturally isolated self-identified indigenous community. (32)

Chiapas was among the areas most burdened by caries Mexico throughout the last 27 years. (9) The state of Chiapas and the region of Siltipec, have unanswered questions in regard to the distribution of caries and malocclusion within the indigenous population.

While some studies on the prevalence of caries and malocclusion in Latin America and Mexico, there is a paucity of studies focusing specifically on the oral health of the indigenous populations in Mexico. This scarcity of standardized methodological studies leaves the indigenous sector of the population epidemiologically invisible. This lack of information on their oral health status is likely preventing the development of strategies for oral disease prevention and health promotion in these populations.

The objective of the present study was to assess the prevalence of caries and malocclusion in an indigenous adolescent population living in the southeastern Mexican state of Chiapas. This state has a population of around 5 million, 30% are indigenous.(31)

An understanding of the extent of caries and malocclusion in this population would help design the appropriate interventions. Without this basic assessment, inequalities cannot be addressed.

METHODS

This is a cross-sectional, population-based, quantitative, epidemiological study. Ethical approval was granted by the Committee for Human Research at UCSF and by the University of Nuevo Leon in Mexico and was conducted in full accordance with the World Medical Association Declaration of Helsinki. Written consent was obtained from the adolescents and their parents/caregivers as well as participants aged 18 and above in Spanish. Members of the research team explained the study and its voluntary nature thoroughly in Spanish.

The target population of the study included subjects between the ages of 14 and 20 years of age who were attending the only high school in the town of Siltepec, Chiapas, Mexico (table 1).

Table 1 Age and Gender of Participants

Age	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**Total**
Females	3	67	59	28	10	7	2	176
Males	2	40	61	55	14	4	2	178
Total	5	107	120	83	24	11	4	**354**

Classes within the school were sampled systematically, and all students attending school and who met the inclusion criteria were examined (table 2).

Table 2 Inclusion and Exclusion Criteria

Inclusion Criteria
Students ages 14 to 20 years old
Self-identified as indigenous (Mayan)
Students with parent inform consent
Exclusion Criteria
Students younger than 14 and older than 20 years old
Self-identified as non-indigenous
No inform consent from parents
Presents of craniofacial anomalies
History or presence of orthodontic treatment

We determined indigenous status of the students according to the Mexican National Commission of Indigenous Peoples Development, an indigenous person is defined as someone "living in a household whose head of the family, a spouse and/or an ascendant self-identifies and is a speaker of an indigenous language." (33)
The dental examination was comprised of an extra oral assessment of the student's smile and an intraoral examination of the teeth and occlusion. The DMFS index was used to assess the presence of dental caries (34, 35) and index of complexity outcome and need (ICON index) to assess malocclusion (11). No insight can be gained about type of decay (pit/fissure or smooth surface) because the DMFS index was recorded in the digital forms as a single sum total of all categories without reference to the individual D/M/F categories. Occlusal anteroposterior relationship was determined according to Angle classification(36). Students with a different Angle classification on each side were categorized into a single class based on the predominant pattern of occlusion and/or canine relationship (37).

The students were examined at the schools, in a quiet classroom without external interference, under natural or artificial illumination. The examination lasted approximately 15 minutes per child, following the World Health Organization (2013) guidelines. (38) No radiographs, study casts, or previous written records were used. Personal data and information about orthodontic treatment were obtained directly from the students. Treatment urgency was dental examiner-determined by status of oral disease present at the time of dental exam. The

responses were scored by the dental examiner for treatment urgency as: (1) See a dentist immediately, (2) See a dentist within two weeks, (3) See a dentist at earliest convenience, (4) Continue with routine care. Information on treatment urgency was given to participants for their benefit; however, this data was not recorded. Each participant was given a toothbrush and oral hygiene instructions. The family was informed about their child's oral health status. All exam data was directly entered into an electronic form on a secured, encrypted, laptop and transmitted to UCSF.

The clinical examination was carried out by three examiners (MFO, ORB, KA), who had previously undergone calibration to standardize their procedures. Calibration exercises for raters of DMFS and ICON were performed using 10 casts and photos from UCSF orthodontic clinic patients that were not participating in the study.

Intra and inter-rater reliability was assessed using 10 additional casts and photos from UCSF orthodontic clinic patients that were not part of the calibration exercises. These records were used to test and retest each examiner for at least three times, administered at 3-4 weeks apart between retests.

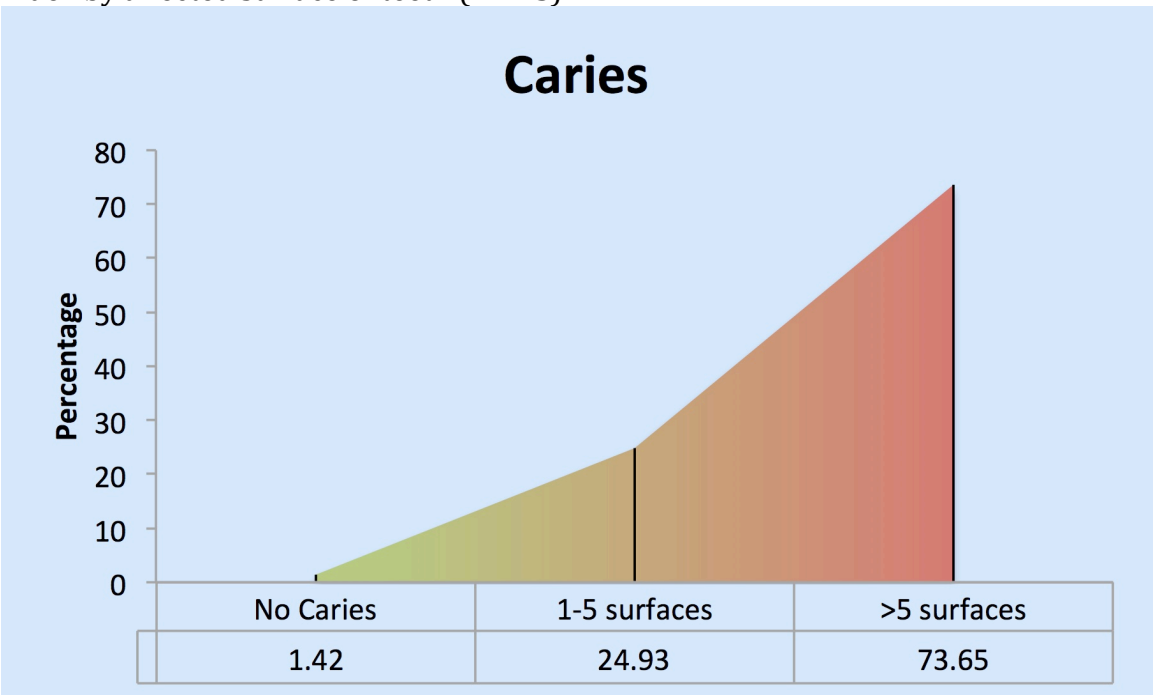
Descriptive statistics including medians, quartiles, frequencies, and percents were calculated to summarize the general characteristics of the sampled population. Treatment severity for caries was determined as follow: 0 DMFS (no caries) DMFS 1 to 5 (moderate) DMFS >5 (severe)(39). Malocclusion severity was assessed as described in the ICON index as treatment complexity. The significance of differences for DMFS and ICON grades between genders was assessed by means of chi-square tests ($P < 0.05$). The intra-class correlation coefficient (ICC) was used to evaluate

the intra- and inter-examiner reliability. ICC values equal to 0 represent agreement equivalent to that expected by chance, while 1 represents perfect agreement. All statistical analyses were performed using STATA (Stata Corp LP, College Station, Texas)

RESULTS

A total of 354 subjects, 176 female (49.7%) and 178 males (50.3%), were examined to participate in this study. After the application of both inclusionary and exclusionary criteria, the final sample consisted of 351 subjects, 99.2% of the original sample population.

Figure 1: Prevalence of Dental Caries assessed by the decayed missing and filled index by affected surface of teeth (DMFS)



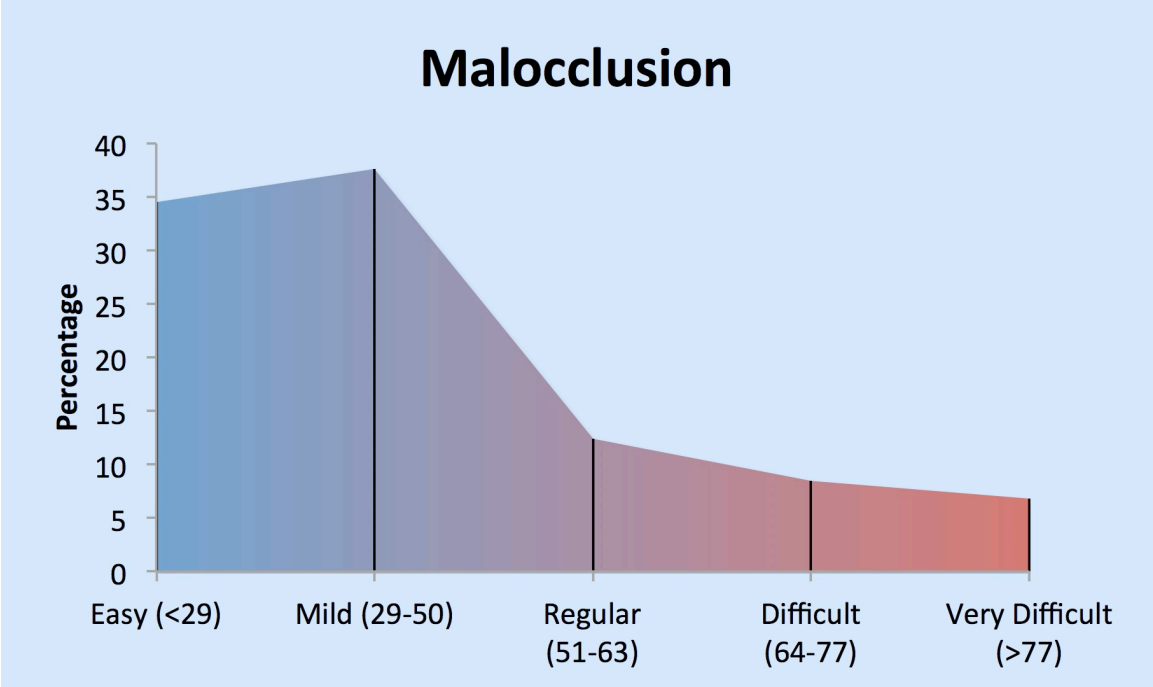
The prevalence of caries is depicted in Figure 1. Out of the 351 students, only 5

(1.4%) presented with no caries. The median DMFS was 8, whereas more than half of our sample had more than 5 affected surfaces. There weren't statistical significant differences between boys and girls' caries experience (p=0.4627) (table 3).

Table 3 Caries Experience

Caries DMFS	Boys		Girls		Total		P
	N	%	N	%	N	%	
0	2	1.12	3	1.73	5	1.42	
1-5	49	27.53	39	22.54	88	25.07	
>5	127	71.35	131	75.72	258	73.50	
TOTAL	178		173		351		**0.4627**

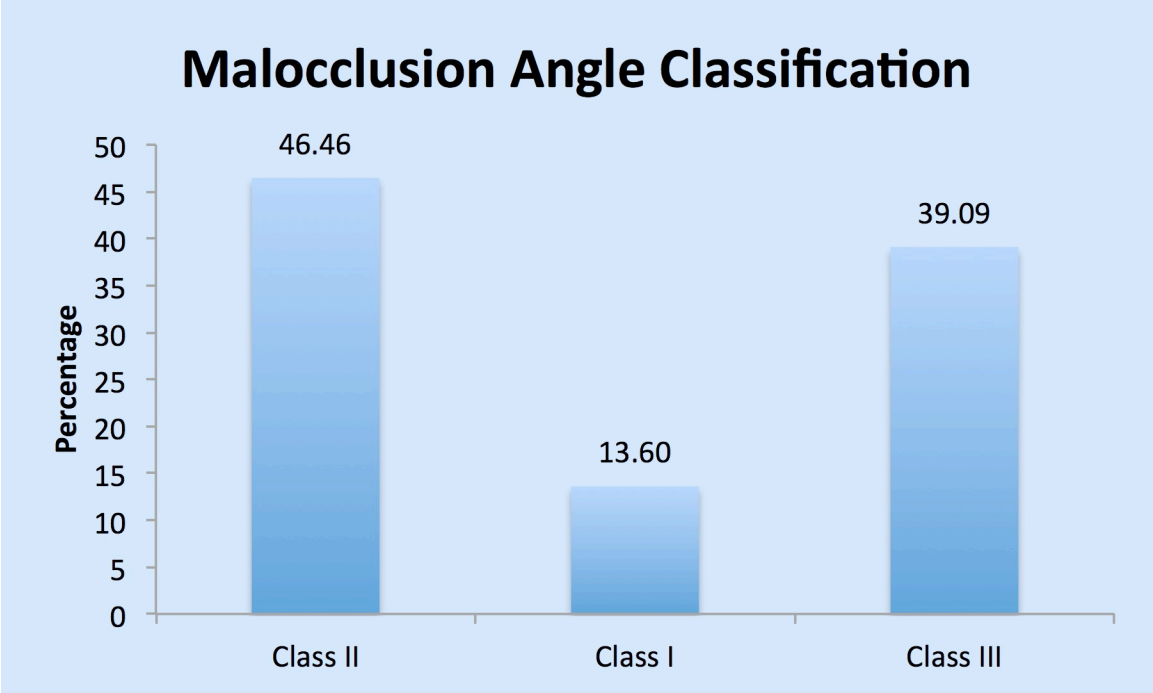
Figure 2: Prevalence of Malocclusion assessed by the index of complexity, outcome and need (ICON)



From the total sample, 129 subjects (37%) needed orthodontic treatment. Our results show that 119 students (34.1% of the total sample) had an easy malocclusion, according to the ICON index; 132 students (37.8%) had mild malocclusion and moderate malocclusion was present in 45 students (12.9%).

Difficult malocclusion was evident in 30 students (8.6%) whereas 23 students presented with very difficult malocclusion (6.6%) (Figure 2). As depicted in Figure 3, 13.6 percent presented with a class I malocclusion, 46.46 percent class II and 39.09 percent class III.

Figure 3: Distribution of anterior posterior relationship according to the Angle classification



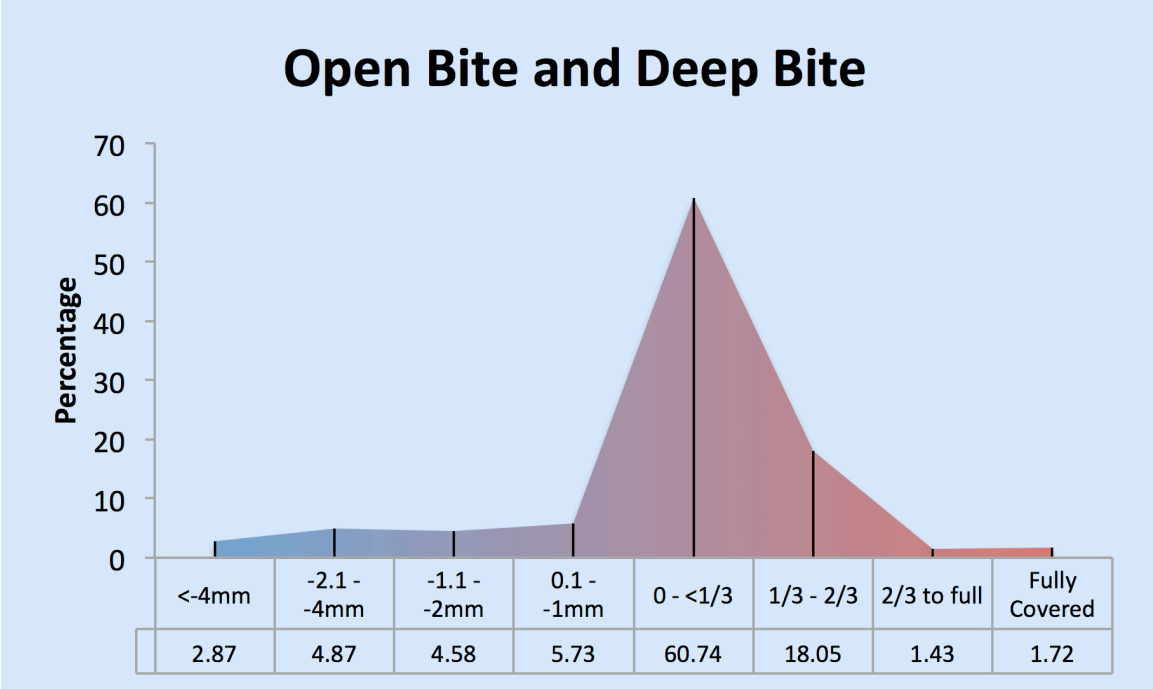
There weren't statistical differences between boys and girls in terms of anterior-posterior occlusion (p=0.4484) (table 4).

Table 4 Occlusal Classification

Angle Classification	Boys		Girls		Total		P
	N	%	N	%	N	%	
I	86	49.14	78	44.83	164	46.99	
II	26	14.86	22	12.64	48	13.75	
III	63	36.00	74	42.53	137	39.26	
TOTAL	175		174		349		**0.4484**

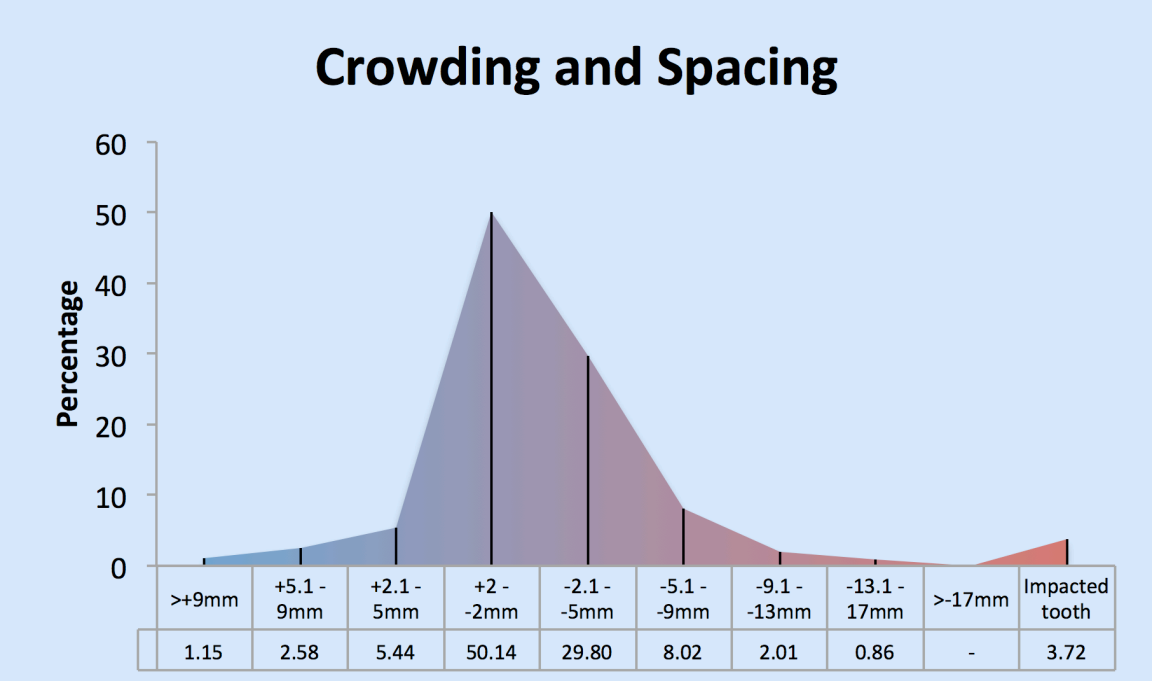
The majority of the students (60.7%) had an edge to edge or less than 1/3 coverage overbite, whereas 18% had different degrees of open bites (Fig. 4).

Figure 4: Open /deep bite distribution in mm for open bite and in thirds for deep bite according to the index of complexity, outcome and need (ICON)



As shown in Figure 5, almost 40% of the students had mild to moderate crowding.

Figure 5: Space and crowding distribution in mm according to the index of complexity, outcome and need (ICON)



The three raters for this study exhibited a high level of inter-rater reliability; the overall Fleiss' kappa value was 0.87 (95%CI: 0.86-0.88). For intra-rater reliability, the three raters achieved high levels of reliability. The overall weighted kappa value was 0.95 (0.93, 0.96) for the ten cases that were evaluated three times separated by three weeks by each rater.

DISCUSSION

The present study is one of few epidemiology analyses carried out in a Mayan Mexican population.

The state of Chiapas was selected for this study since it is the second largest indigenous population in Mexico. Moreover, the specific site of this study was selected due to the presence of a relatively intact geographically isolated indigenous population. For convenience, all of the students who met inclusion criteria attending the single school in the area were screened. This school is the only school of the region and integrates over a large geographic area.

The location that this community inhabits is consistent with other Latin American indigenous populations that are often relegated to less desirable lands; mountains and jungle instead of proximity to rivers and flatlands. The isolation of these communities plays a role on their ethnic homogeneity and the narrow range of socioeconomic status.(40)

The Mames population is one of the largest indigenous groups directly descended from the Mayan people. They occupy the highlands and jungles of the Chiapas region and extend into Guatemala's Western Highlands; forming a continuum of territory, culture, and linguistics.(41). There are numerous indigenous populations in Mexico that are known to be dissimilar in appearance, behavior, and genetics. Therefore, this study has a limited ability to extrapolate these data to other possibly disparate groups. However, insights gained here may incrementally add to

the body of knowledge of these groups.

Even though this population has access to government sponsored public clinics, the Mames group still retain their indigenous traditional remedies, languages and mythology. A remarkable 85% of the population has less than a middle school education level. In addition, 55.7% of Mames households report not having a consistent income. (41)

Previous studies have shown a high presence of oral disorders in areas of social inequalities, such as the area in which the present study was conducted. The prevalence of caries observed in this population was extremely high. With 99% of the population having caries and a median DMFS score of 8, the severe caries experience and the large unmet treatment need is evident. Several studies in rural Mexican communities have shown varying prevalence of caries ranging from 43% to 100%. It is notable that that not all of these studies used the same caries index (9, 40, 42, 43). Our results showed no statistical differences between boys and girls; this is in contrast to other studies on Mexican adolescents that showed a higher prevalence of caries in girls.(44)

Access to government sponsored dental care is limited. The town has one dentist.. There are no other clinics available in the area and the closest clinic is 6 hours away by car. Car ownership in this area is rare.

The expansion of roadways may be a contributor to caries experience as the increase of access to junk foods and deteriorating diets, which depart from

traditional sources of nutrition (40). After all, Mexico is now the second soft drink consumption country worldwide (45).

However, the patterns of beverage intake are complex. Although associated to caries presence, there are other variables related to the relationship between diet, sugars and oral carious lesions that need further elucidation (46, 47)

Moreover, the increased accessibility of decay-inducing food items often accompanies the process of increasing access to potable water in these remote communities. For this reason, further studies are warranted to elucidate the contributing social factors to the heavy burden of caries in this indigenous population.

Potential limitations of this study include: lack of recording treatment urgency, limitations of DMFS index including measuring the severity of active decay.

Approximately one third of the students were considered in need of Orthodontic treatment, but less than 1% had any orthodontic treatment experience. Of particular note is that more than 15% of the students presented with a difficult or very difficult type of malocclusion. This may be due to the high prevalence of Angle's class III malocclusion that was observed in this sample. One limitation of the Angle's classification is that it does not incorporate vertical and transverse abnormalities, however, it is a universally accepted system that is reliable and that minimizes examiner subjectivity. In our study, almost 40% of the students presented with a class III. This percentage is much higher than that the prevalence shown in other populations as evidenced by a recent systematic review that showed class III malocclusion prevalence worldwide ranging from 0% to 26.7% [44]. Latinos living in

the US, self described as Mexican or Mexican descents, showed a prevalence of 8% to 9 % of class III malocclusion (37, 48)

Class III relationship is most often cited as being an inherited trait. Human studies support an autosomal-dominant mode of inheritance of the Class III phenotype(49-51). The ethnical homogeneity of the Mames together with the inherited trait of this type of malocclusion could partially explain our findings.

Class II Angle's type of malocclusion was also high in this population, 46% percent. Class II malocclusion in other ethnic groups including Latinos ranged from 16% to 22%(37, 48, 52-54). Low socioeconomic status, caries experience, premature loss of deciduous teeth, prolonged habits, might increase susceptibility to Class II malocclusion as seen in this population. (55-57)

Further, changes from a hard to a soft diet may constitute an important etiologic factor for the increased prevalence of Class II malocclusion. This is most likely due to a decrease in dental attrition and a lack of compensatory tooth mesial migration associated with softer diets.(58)

We didn't identify differences in anterior posterior relationship between boys and girls (Table 4).

CONCLUSIONS

The high prevalence of caries and malocclusion observed in Mames adolescents reflects the social inequality that is present in this community. The high prevalence of caries in this population could explain, in part, the high class II and class III molar relationship prevalence. Early loss of primary molars, due to

caries, may lead to non-class I molar relationships. Due to the 99%+ prevalence of caries within this group, no statistically significant relationships can be inferred between caries and malocclusion

Although health indicators have improved over the years among indigenous population groups (54), our results indicate that health inequalities still persist among indigenous populations in Mexico.

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