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Dental caries experience and association to risk indicators of remote rural populations

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Background. Dental caries continues to be the most common infectious disease of childhood; however, it is no longer pandemic, but endemic in specific sectors of populations. Therefore, it is important to identify and target patients at risk of developing caries in order to develop specific preventive measures.
Aim. This study aims to test dental caries risk indicators for significant associations with caries severity.
Design. Five separate, small, isolated rural villages in Mexico with varying degrees of caries prevalence were selected for this observational study. A total of 248 children were examined. Risk indicators were assessed via questionnaire and water and salt fluoride analysis. Caries severity was measured by the International Caries Detection and Assessment System (ICDAS-I).
Results. Prevalence of caries ranged from 95% to 100% for the five villages. Mean total DMFS (decayed, missing, or filled surfaces–permanent teeth) and dmfs (decayed, missing, or filled surfaces–primary teeth) scores ranged from 2.5 to 5.0 and from 11.3 to 16.9, respectively. Multivariable models showed age and drinking soda between meals to be significantly associated with DMFS, and drinking juice and being female were significantly associated with dmfs.
Conclusion. DMFS and dmfs were high in each village, significantly different between villages, and associated with specific risk indicators.

Introduction

Dental caries continues to be the most common infectious disease of childhood[1]; however, this infectious disease process is no longer pandemic, but rather endemic in specific sectors of populations. It is therefore important to identify and target patients at high risk of developing caries in order to develop specific preventive measures[2].

Several authors have attempted to define what constitutes a risk indicator[3,4]. Zero defined the term 'risk indicator' as variables currently thought to both cause and predict disease. Correctly identifying caries risk indicators is important to the clinical management of caries by helping dental professionals identify high-risk patients and potentially guiding treatment decisions[3].

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Different caries risk indicators have already been studied: sugar consumption, tooth brushing, and socioeconomic status (SES). Burt found that sugar consumption is likely to be a more powerful indicator of a caries risk in persons who do not have regular exposure to fluoride[5]. Sugared drinks in many areas of the world are primary components of a child's total sugar intake. The amount and frequency of consumption between meals are significantly associated with high DMFT scores[6,7]. On the other hand, consumption of real fruit juice may be associated with lower risk of caries[8]. Low SES has been shown as a possible marker for increased risk of caries[9]. Some studies investigating toothbrushing and/or oral hygiene have found a strong, consistent relationship with caries incidence/prevalence, while other studies do not find this association[9]. Although recommendations about toothbrushing as a strategy in managing caries are not well supported by the literature, frequent toothbrushing with a fluoride dentifrice and good oral hygiene seem to be associated with a reduced caries risk[9].

In many less-developed countries, dental caries is a highly prevalent disease oftentimes characterized by substantial differences in morbidity within the same country[10]. Several reports have indicated that the experience of dental diseases in modern Mexico is high and increasing; nevertheless, this is only documented in partial form[10,11]. The few studies previously conducted in Mexico have shown caries prevalence to range between 43% and 91%[10,12], depending on which area was studied. Differences in prevalence have been attributed to variation in risk indicators, such as fluoride in water coupled with differences in dietary patterns[13]. Previous studies have examined caries risk for subsets of populations that had similar risk indicators. The five villages selected for this study were chosen because they differed in risk indicators and this variation allows for better estimation of the nature of associations with caries severity.

The aim of this study was therefore to test dental caries risk indicators, such as SES, consumption of refined carbohydrates, oral hygiene habits, and exposure to fluoride, which were different in these five villages, for significant associations with the number of decayed, missing, and filled surfaces.

Materials and methods

Community and participant selection

The communities selected and studied are located in the municipality of Calnali, in the state of Hidalgo, Mexico. The municipality of Calnali is comprised of 81 villages or towns. The study was conducted in Calnali because of the availability of small isolated communities that were suitable to our study design and because of previous collaborations. The villages were prescreened for caries prevalence using data obtained from previous studies conducted by our group in six villages, and the results of community health assessments conducted by the local town government and healthcare workers. As part of the prescreening process, data for SES (at the community level) were gathered. The local government compiles an index of poverty for each community based on income per capita. SES was considered an indicator of a participant's ability to afford refined carbohydrates, toothpaste, and determine type of access to water. The final selection of study sites included two villages that had high SES (relative to the mean SES of the rural region) and two villages that had low SES. Of the two villages selected with low SES, our preliminary data indicated that one village had a previous record of a lower than the mean caries prevalence and the other village had a previous record of a higher than the mean caries rate (villages 3 and 4, respectively). The same criteria were applied to villages with high SES (villages 1 and 2, respectively). The fifth village selected was the town of Calnali, which is the head of the municipality. The municipality and the town are both named Calnali.

All children in the village were invited to attend clinics via Institutional Review Board-approved flyers and town hall meeting announcements. Those parents who attended the clinic to have their children seen were invited to participate. At that time, they were informed that their participation was voluntary and that treatment would not be denied if they declined to participate in the study. No parent declined to participate in the study. Children examined were between 2 and 18 years old, lifetime residents of the village, and had no medical condition that would contraindicate receiving a dental exam. Parents or legal guardian signed a consent form, filled out a medical history, and answered a questionnaire.

Questionnaire and SES

The questionnaire assessed each child's frequency, time of day, and type of fermentable carbohydrates consumed. It asked parents about the child's oral hygiene habits, use of dentifrice, and availability of water. The children and at least one parent were present at the time of the interview. The questionnaire was formatted from a list of products available in each village from the sole distributor and was tested utilizing focus groups selected from Mexico. SES was evaluated on an individual level utilizing the Socioeconomic Level Index (SLI) for Mexico developed by Bronfman[14]. Questions used to calculate in the index inquire about size of and materials used to build the subjects household, availability of tap water and indoor restroom

Table 1. International Caries Detection and Assessment System criteria for lesion severity.

Code no.	Code description
0	**Sound**: no caries change after air drying (5 s); or stain, hypoplasia, wear, erosion and other non-caries phenomena.
1	**First visual change in enamel**: seen after air drying, or coloured change limited to the confines of the pit and fissure area.
2	**Distinct visual change in enamel**: seen when wet, white or coloured, wider than the fissure/fossa area.
3	**Localized enamel breakdown**: with no visible dentin, discontinuity of surface enamel, widening of fissure. Ball-end probe may be used to confirm.
4	**Underlying dark shadow from dentin +/– localized enamel breakdown**: seen as a shadow through the overlying enamel
5	**Distinct cavity**: with dentin exposed at the base of the cavity.
6	**Extensive cavity**: with dentin visible at base and walls of the cavity.

facilities in the house, number of people who live in the household, and educational level of the head of household. This index is sensitive to measuring differences within a population that is, by definition, extremely homogenous. Test–retest reliability was assessed for 5% of questionnaires.

Dental examination

Prior to the initiation of the study, the single dental examiner used in this study was trained in using the International Caries Detection and Assessment System (ICDAS-I) (Table 1). Training was provided by a 2-day *in vitro* exercise using extracted teeth mounted in dentoform models. *In vivo* training consisted of 1 day examination of 20 subjects during regular dental screening. Scores were compared with a senior examiner who was previously trained in using the criteria.

Prior to the ICDAS-I exam, the examiner brushed subjects' teeth using a soft toothbrush. Flossing was not performed. The dental exams were performed by having subjects seated in a school chair, leaning backwards with their heads resting on the examiner's lap. Lighting was provided by a headlamp worn by the examiner. Cotton rolls were used for isolation, and teeth were dried using compressed air. Examination was done with the aid of a front surface mirror, and a blunt explorer was available to clean the pits and fissures as well as evaluate cavitations. The examiner evaluated each tooth surface according to the ICDAS-I index. ICDAS-I classifies the severity of dental lesions from the earliest stages of visual demineralization to frank cavitations. Information on lesion severity and activity and presence of fillings and extracted/exfoliated teeth is recorded as part of the index. Approximately 5% of children were re-examined to evaluate repeatability of the examinations. Standard infection control was followed for each examination. Repeatability of the examination was good for all surfaces combined and for occlusal surfaces only (weighted kappas 0.93 and 0.92, respectively).

Collection of water and salt samples and analysis

One of the parents of each child examined was asked to collect water and salt from the source used for their daily consumption. Water samples were analysed using a combination fluoride ion-specific electrode (Orion #96-909-00) and an Orion 720 pH/ion meter (Fisher Scientific Co., Itasca, IL, USA) following standard operation procedures. For salt samples, a modification to the hexamethyldisiloxane (Sigma Chemical Co., St. Louis, MO, USA) microdiffusion method of Taves was used[15].

Statistical analysis

DMFS (decayed, missing, or filled surfaces–permanent teeth) count was defined as the count of surfaces in permanent teeth per subject with either a lesion score greater than 0, a filling code greater than or equal to 3, or a lesion score indicating a missing tooth; dmfs was defined similarly for primary teeth.

Separate analyses were conducted for these two outcomes. Prevalence of caries was also defined separately for these two outcomes. For each of DMFS and dmfs, caries was identified by a count greater than 0 and was compared between villages by using Fisher's exact test. Differences in categorical risk indicators between villages were compared by using a logistic model

Table 2. Demographics, prevalence, and mean outcomes by village.

Village	1	2	3	4	5	*P*-value
No. of children	26	40	45	35	40	
Age (mean ± SD)	7.7 ± 3.2	9.0 ± 2.9	7.8 ± 2.7	8.7 ± 2.8	7.8 ± 2.9	0.1654‡
Males, *n* (%)	15 (57.7)	22 (55.0)	24 (53.3)	19 (54.3)	22 (55.0)	0.9979†
Bronfman index (mean ± SD)	6.1 ± 2.1	5.2 ± 1.3	3.8 ± 1.2	4.7 ± 1.0	4.9 ± 1.5	< 0.001‡
Parent's education level, *n* (%)						
Primary	8 (30.8)	25 (73.5)	39 (95.1)	19 (95.0)	30 (76.9)	< 0.0001†
Secondary	4 (15.4)	5 (14.7)	2 (4.9)	0 (0.0)	5 (12.8)	
Preparatory	14 (53.9)	4 (11.8)	0 (0.0)	1 (5.0)	4 (10.3)	
Prevalence caries, *n* (%)	26 (100.0)	39 (97.5)	43 (95.6)	35 (100.0)	38 (95.0)	0.7085*
Primary dentition, *n/N* (%)	24/24 (100.0)	28/28 (100.0)	39/42 (92.9)	27/27 (100.0)	31/33 (93.9)	0.2919*
Permanent dentition, *n/N* (%)	15/18 (83.3)	27/35 (77.1)	25/34 (73.5)	25/29 (86.2)	21/32 (65.6)	0.4003*
Percentage of primary teeth/child with restorations (mean ± SD)	3.9 ± 8.6	0.7 ± 2.9	0.0 ± 0.0	0.5 ± 2.6	0.6 ± 2.1	
Percentage of permanent teeth/child with restorations (mean ± SD)	0.3 ± 1.5	0.6 ± 2.1	0.0 ± 0.0	0.0 ± 0.0	0.3 ± 1.8	
Percentage of primary teeth missing due to caries/child (mean ± SD)	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.2 ± 1.1	0.0 ± 0.0	
Percentage of permanent teeth missing due to caries/child (mean ± SD)	0.0 ± 0.0	0.0 ± 0.0	0.1 ± 0.7	0.1 ± 0.7	0.0 ± 0.0	
DMFS + dmfs (mean ± SD)	13.6 ± 14.5	12.2 ± 8.7	12.4 ± 9.2	18.5 ± 12.2	13.6 ± 14.0	0.1749‡
dmfs (mean ± SD)	12.5 ± 15.3	11.2 ± 9.8	11.3 ± 9.3	16.9 ± 13.8	13.3 ± 14.3	0.4251‡
DMFS (mean ± SD)	2.9 ± 2.8	5.0 ± 4.7	2.5 ± 2.7	6.6 ± 6.0	3.2 ± 3.8	0.0111‡

*Fisher's exact test.
†Chi-squared test.
‡ANOVA.

with a repeated effect for family, estimated using generalized estimating equation methodology. The family effect allowed for incorporation of the correlation of data for children from the same family. If there was difficulty in estimation due to 0 counts in a cell, then Fisher's exact test was used instead. Village differences in mean outcomes were tested by a linear model with a term for village and a random family effect. Pairwise comparisons of villages were adjusted by the Sidak method to control the type I error rate. A similar model was used to compare continuous risk indicators between villages. Associations of outcomes with risk indicators were univariately tested in linear models with effects for village, the risk indicator, the village by risk indicator interaction, and a random family effect. Risk indicators whose interactions were significant at the 0.1 level were eligible for inclusion in a multivariable model. Remaining risk indicators were tested for associations in models that only included village and family. If these main effects were significant at the 0.3 level, they were eligible for inclusion in the multivariable model. This multivariable model always included village, so that associations would be adjusted for a village effect. Backwards selection was used to reduce the model until all main effects (except village) or their interactions with village were significant at the 0.05 level. SAS® version 8.2 (Cary, NC, USA) was used for all analyses.

Results

The percentage of children age 2–18 examined from each village ranged from 73% (village 5) to 94% (village 2). Two hundred and sixty children had parents who answered surveys about their children's diet. Two hundred and forty-eight children had dental examinations performed by a dentist. Demographic data were collected on 233 children; however, only 226 children were between the ages of 2 and 18 years, which was the inclusion criterion for this study. Demographic data and means outcomes by village are presented in Table 2.

Since models were to be adjusted for age and gender, the analysis set consisted of the 208 subjects who had survey responses, examination, and demographic data. There were only seven children between the ages of 2 and 3 years

Table 3. Risk indicators and tests of differences between villages.

Village	1 *N* = 26	2 *N* = 40	3 *N* = 45	4 *N* = 35	5 *N* = 40	*P*-value
Consume fermentable carbohydrates, *N* (%)						
Candy	24 (92.3)	40 (100.0)	39 (97.5)	30 (85.7)	25 (78.1)	0.0032*
Soda	24 (92.3)	33 (84.6)	41 (93.2)	31 (100.0)	32 (80.0)	0.0415*
Gum	22 (84.6)	35 (94.6)	37 (86.0)	26 (74.3)	34 (87.2)	0.2684‡
Chips	21 (80.8)	32 (80.0)	42 (95.5)	26 (78.8)	32 (82.1)	0.0772‡
Juice	23 (88.5)	28 (70.0)	25 (55.6)	24 (70.6)	22 (55.0)	0.0063‡
Snacks	15 (57.7)	16 (40.0)	17 (37.8)	15 (42.9)	22 (57.9)	0.3925‡
Cakes	14 (53.8)	6 (16.2)	20 (44.4)	17 (48.6)	14 (36.8)	0.0700‡
Ice cream	18 (69.2)	21 (52.5)	20 (44.4)	18 (51.4)	15 (39.5)	0.2036‡
Consume between meals, *N* (%)						
Soda	8 (33.3)	18 (60.0)	38 (95.0)	27 (93.1)	29 (96.7)	< 0.0001*
Juice	10 (43.5)	20 (74.1)	25 (100.0)	19 (100.0)	19 (86.4)	< 0.0001*
Number of times consumed/day (mean ± SD)						
Candy	2 ± 1	1 ± 1	1 ± 1	1 ± 1	2 ± 1	0.0294†
Cakes	1 ± 1	0 ± 0	1 ± 1	0 ± 1	0 ± 0	0.0435†
Oral hygiene habits, *N* (%)						
Use toothbrush	25 (96.2)	39 (97.5)	34 (75.6)	31 (91.2)	36 (94.7)	0.0493‡
Parents help brush	13 (50.0)	3 (7.5)	14 (31.1)	5 (14.7)	11 (28.2)	0.0015‡
Use toothpaste	25 (96.2)	39 (97.5)	35 (77.8)	31 (91.2)	36 (94.7)	0.0788‡
Access to water	24 (92.3)	40 (100.0)	37 (82.2)	23 (67.7)	38 (100.0)	< 0.0001*

*Fisher's exact test.
†ANOVA
‡Generalized estimating equation logistic model.

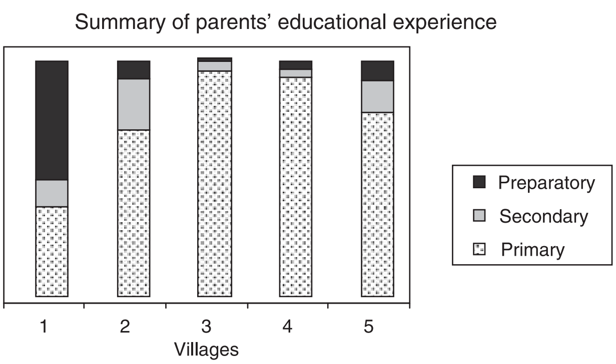

Fig. 1. Percentage of parents' highest education level.

and only 15 children older than 14 years. Since the distribution of children in these ages was sparse and uneven between villages, we further limited our analysis set to children older than 2 and younger than 14 years. This resulted in a reduction of the analysis set to 186 children. One hundred and forty-eight of those children had at least one permanent tooth and 154 had at least one primary tooth.

Prevalence of caries was very high, ranging from 95% to 100% of children in each village having at least one carious lesion in either the primary or permanent teeth (Table 2). The mean number of surfaces per child with lesions having scores ≥ 1 (non-cavitated and cavitated) ranged from 11.2 in village 2 to 18.5 in village 4 (Table 2). The mean DMFS score was significantly smaller for village 3 than for village 4 ($P = 0.0206$). As expected, due to exfoliation of primary teeth and eruption of permanent teeth, the mean dmfs decreased as children aged, while DMFS increased with increasing age.

The mean SES was significantly different between the villages, as expected, because of our study design. Village 3 had significantly lower mean SES than villages 1, 2, and 5. Village 1 also had significantly higher mean SES than villages 4 and 5. In addition, the parent's educational level was significantly different between the five villages. The majority of parents/legal guardians indicated that the highest educational experience of the head of their household as only primary education except in village 1, where 50% indicated a preparatory education. In 99% of the cases, the father was mentioned as the head of household (Fig. 1).

The percentage of children who consumed different types of fermentable carbohydrates is reported in Table 3. In each village, the majority

Table 4. Fluoride concentration and water source.

Village	1	2	3	4	5	*P*-value
No. of children	26	40	45	35	40	
Salt fluoride concentration (p.p.m.) (mean ± SD)	120.9 ± 86.7	114.8 ± 112.2	134.1 ± 98.2	123.7 ± 163.9	92.1 ± 100.9	0.8521*
Range (minimum–maximum)	0.5–247.3	0.5–278.4	0.5–311.0	0.9–466.6	0.7–266.8	
Fluoride concentration of water (p.p.m.) (mean ± SD)	0.08 ± 0.10	0.03 ± 0.02	0.02 ± 0.02	0.06 ± 0.04	0.07 ± 0.13	
Water source, *N* (%)						
Community	0 (0.0)	3 (7.9)	2 (5.0)	4 (12.1)	10 (26.3)	0.0145†
Home	6 (23.1)	15 (39.5)	14 (35.0)	10 (30.3)	14 (36.8)	
Other	20 (76.9)	20 (52.6)	24 (60.0)	19 (57.6)	14 (36.8)	

*ANOVA.
†Chi-squared test.

of children drank juice. Consumption of soda showed similar results. In village 4, which had a 100% prevalence of caries, 100% of children drank soda and of those who did, 93.1% did so between meals. Furthermore, in village 5, which had the lowest caries prevalence, 80% of children drank soda with 96.7% of those doing so between meals.

Oral hygiene habits reported by parents/legal guardians showed that in each village most children brush their teeth at least twice a day, except in village 1, where slightly less than half brushed only once per day. Most children had access to water; however, in each village, except village 5, the majority of parents/legal guardians indicated their water source as something other than a community or home source (i.e. a water truck that visits the village once a week). Mean fluoride concentration in drinking water ranged from 0.02 p.p.m. in village 3 to 0.08 p.p.m. in village 1 (Table 4). Mean fluoride concentration of salt samples ranged from 92.1 p.p.m. in village 5 to 112.2 p.p.m. in village 2. Mean fluoride values for all five villages were below recommended levels of fluoride for salt (250 p.p.m.)[16]; however, there was a large discrepancy between the minimum and maximum levels of fluoride within each village (Table 4).

The univariate models that assessed the association between DMFS and the different risk indicators showed that age, when the child drank soda, and access to water were significantly associated with caries (*P*-values < 0.001, 0.04, and 0.01, respectively). The univariate models that assessed the association between dmfs and the different risk indicators showed that age and drinking juice were significantly associated with caries (*P*-values 0.04 and 0.01, respectively). Drinking juice and drinking soda between meals were associated with increases in mean DMFS or dmfs.

A multivariable model that included village and the variables that were found to be significant was used to examine associations of risk factors with caries. Inclusion of the term for village allowed us to see whether the effects of risk indicators differed between villages. This model showed that, when controlled for other factors, age ($P = 0.0002$) was significantly associated with increased mean DMFS, which was steepest in village 4, while drinking soda between meals ($P = 0.03$) was associated with an increase in DMFS in village 4. The R^2 showed that the model accounted for 49% of the total variation in DMFS.

For dmfs, a multivariable model that included village and the variables that were found to be significant was also used to examine associations of risk factors with caries. This model showed that, when controlled for other factors, gender ($P = 0.04$) was significantly associated with decreased mean dmfs, while drinking juice ($P = 0.01$) was associated with increased dmfs. The R^2 showed that the model accounted for 10% of the total variation in dmfs.

Discussion

Caries prevalence in each of the five villages was very high. Previous studies conducted in urban areas of Mexico have noted caries prevalence between 43% and 91%[10,12]; however, comparisons of prevalence should be made with caution because of the utilization of different indices. This study used the caries index ICDAS-I, which includes incipient lesions. Previous methods of recording caries only at the level of cavitation have been deemed outmoded[17]. In addition, it has been recommended to perform examinations on dry, clean teeth, which this study adapted by having the dental examiner brushed each child's teeth prior to examination. Cotton roll isolation was used along with air drying to achieve optimal exam conditions, which allowed accurate estimation of caries even at the early non-cavitated stages. Data on repeatability for ICDAS-I have shown moderately strong to strong repeatability (weighted kappa 0.7–0.9). The repeatability in this study was very strong. Currently, there are no published reports to make comparisons with the ICDAS-I criteria. Other studies recording non-cavitated lesions have shown a greater number of lesions detected than would be expected by traditional DMF examination[18–21]; therefore, it is not surprising that caries prevalence found in this study was higher than previously reported.

In this study, the filled component of our DMFS and dmfs calculation was very low, ranging from 0% to 3.9%. This is in agreement with previous finding in Mexican rural populations[10]. The very low percentage of restored teeth per subject indicates a lack of access to oral health care among all five villages.

Our results from the multivariable model that included village showed a significant positive association (at the 0.03 level) between mean DMFS and the children drinking soda, when adjusted for other factors. This is in agreement with previous studies that have also shown significant positive associations between soda consumption and caries risk[22–24]. This association is not present, however, for the primary dentition. This is in agreement with other studies that have found that very young children are less likely to consume soda, that patterns of beverage consumption change as the children age, exposing them to beverages with higher sugar content and increasing their risk of caries[2,6,7]. For the primary dentition, our study showed that for each of the five villages, drinking juice was associated with higher severity scores. In this study, natural juice was not separated from juice drinks (less than 10% juice), which have high sucrose content.

A second risk indicator associated to caries in the permanent dentition was access to drinking water. This may have been explained by differences in fluoride level between the different sources of water, which at the time of measurement were negligible in all villages and at those levels did not have any clinical significance; however, for villages with water brought in by truck, fluoride levels may have changed. It is important to point out that fluoride was sampled only once and may not have been representative of children's consumption over the course of a year. A second possible explanation may lie in the fact that the majority of parents/legal guardians in all five villages listed 'other' as their main water source. Parents/legal guardians were not queried on where the 'other' water source came from, nor were they queried on how often they drink water.

Finally, contrary to the findings of other studies that have correlated SES to caries severity, in our study, there was no correlation of the SES of a family to the severity of caries. Several studies have previously reported that the assessment of SES in a developing country, such as Mexico, presents unique challenges since it is difficult to measure differences within a population that, by definition, is extremely homogenous[25].

The current study is an initial attempt at correlating caries severity with specific risk indicators that are relevant in these communities. During the analysis of our results, we obtained information that will be valuable when designing follow-up studies. For example, we learned that multiple beverages are defined as juices, and that the drinking habits of children include coffee beverages since a very young age. There are many limitations inherent to our study design, including the use of a cross-sectional study to evaluate caries risk indicators, and the reliability of food consumption questionnaires. It has been demonstrated that when health personnel conducts interviews, respondents tend to answer according to what their perceived ideal health-related behaviours are[26,27].

What this paper adds

- Our results indicated that caries severity was associated with some caries risk indicators, specifically drinking soda, drinking juice, and access to water.
- Our results indicated that caries prevalence was very high in each of the five isolated rural villages in Mexico.
- Further studies are needed to shed more light on exactly how these risk indicators contribute to dental caries. Such studies might include evaluating potable water for fluoride content over the course of a year and a diet survey that evaluates consumption of fermentable carbohydrates over a 3- to 4-day period.
- Further studies are also needed to investigate the relationship between drinking soda and juice and caries severity.

Why this paper is important to paediatric dentists

- Some of the factors this study found significant may not be routinely considered as risk indicators, such as drinking juice and access to water.
- Questioning parents/legal guardians about their children's exposure to risk indicators associated with caries in this study, such as drinking soda, drinking juice, and access to water, may aid in identifying children who are at greatest risk for dental caries.
- Finally, the high caries prevalence noted in this population indicates the need for comprehensive public dental health programmes. Educational programmes on specific risk factors that have significant effects on caries risk would be beneficial not only for the children, but the parents or legal guardians as well.

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