Food Insecurity and Dental Caries in Rural Mexican Populations

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Research Article

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Abstract

Objectives

Food insecurity (FI) is a priority for government and health organizations. Over 95% of the world's population has a carious lesion or will develop one before death. This study evaluated the association between FI and oral health in two rural communities in Chiapas, Mexico.

Materials and methods

The study was conducted with patients attending an oral health campaign for dental check-ups. Data were collected between April and August of 2017 using the Latin-American and Caribbean Scale of Food Security (ELCSA) and the International Caries Detection and Assessment System (ICDAS). We included 209 participants from the communities of Siltepec and Huehuetan, Mexico; 67% were women.

Results

The results of the ELCSA were mild FI in 43% (n = 91), moderate FI in 22% (n = 45), and severe FI (n = 6) in 3%; 32% had food security. The ICDAS results were initial decay with a mean of 6.22, moderate decay with a mean of 1.81, and extensive decay with a mean of 1.77.

Conclusions

In this study, the FI level was lower than in other rural populations in Mexico. The level of dental caries found was expected for this population.

Clinical Relevance

Food insecurity is associated with dental caries. Food insecure individuals have a higher probability of severe dental caries. Identifying these individuals and addressing the factors related to food insecurity can be useful in rural communities.

Introduction

Food insecurity (FI) is the lack of regular access to sufficient and adequate food for the household [1]. It is a priority for government and health organizations because of its social implications and impact on health [2]. Several scientific reports have found a correlation between FI and chronic illnesses [3, 4, 5].

Dental caries is the most prevalent disease of the oral cavity and an important public health concern. Over 95% of the world's population have a carious lesion or will develop one before death, making it one of the most frequent chronic diseases of modern man worldwide [6]. The interaction between etiopathogenic factors in dental caries and health determinants is complex. Therefore, economic, demographic, and social determinants need to be analyzed. Oral diseases are more frequent in low-income countries, particularly those with high poverty rates [6, 7]. However, a decrease in dental caries in
Latin American and Caribbean children has been found, a change caused by changes in social and public health measures, the effective use of sources of fluoride, and improved living conditions [8].

In Mexico, 28.2% of households had moderate or severe FI. Moderate to severe FI was more frequent in rural (35.4%), indigenous (42.4%), and low socioeconomic households (45.9%) [2]. FI also affects elderly adults (27.9%), and high FI levels are present in individuals with depression and impaired activities of daily living [9]. Moreover, the percentage of elderly adults is estimated to increase from 6.2% in 2010 to 22.6% in 2050 [9, 10].

It is important to identify risk factors for caries because they are closely related to nutrition. These factors include food preparation and the consistency and texture of food, in addition to habits and cultural practices [10]. Therefore, it is paramount to understand the relationship between social determinants and caries, especially FI, because of its relationship with poverty and demographic factors. This study evaluated the association between FI and dental caries in two rural communities in Chiapas, Mexico, that have an elementary diet since they usually consume foods they produce.

Materials And Methods

This descriptive, cross-sectional study of a convenience sample of 209 patients from 85 family groups was conducted in the communities of Siltepec and Huehuetan, Chiapas, Mexico. Participants were recruited during an ambulatory oral health campaign.

Data were collected between April and August of 2017 during the two-week campaigns. The protocol was previously evaluated and approved by the Institutional Bioethics Committee with registration number SPSI-010613 and was granted clearance number 00132.

The inclusion criteria were minors with primary dentition, accompanied by family members, and adults with natural teeth. People who refused to answer the questionnaire were excluded. All participants older than 18 years signed informed consent, and underage participants assented after a responsible adult signed informed consent. We first assessed FI, after which an oral clinical examination was performed by dental professionals, who were trained to assess caries with the ICDAS method. Community assessments were performed during the campaign on different days.

We assessed FI using the Latin-American and Caribbean Scale of Food Security (ELCSA). This scale was selected over other methods because of its sensitivity and specificity, being validated for this region of México [11, 12]. The harmonized Mexican version of the ELCSA was applied because it provides information from the experience of family members. The ELCSA consists of 15 questions. The first eight refer to diverse situations that cause FI in adults in the household, and the remaining seven to conditions that affect members younger than 18 years. According to the protocol, only one questionnaire was applied per family.
The criteria for household FI evaluation are different for households with minors and households with members older than 18 years [12, 13]. The scale for households with minors was household food secure (score 0), mild household food insecurity (score 1 to 5), moderate household food insecurity (score 6 to 10), and severe household food insecurity (score 11 to 15). For households with members over 18, the scale was household food secure (score 0), mild household food insecurity (score 1 to 3), moderate household food insecurity (score 4 to 6), and severe household food insecurity (score 7 to 8) [14].

The International Caries Detection and Assessment System (ICDAS) was used to measure dental caries. ICDAS is a method that has been internationally adopted and applied [15]. Furthermore, this system provides better sensitivity for detecting carious lesions in different states of progress and activity than indexes, such as the DMF-T (Decayed, Missing, and Filled Teeth), which is also widely used. [16] The ICDAS is also used with caries management methods to control them. The system arranges carious lesions into the following groups: initial, moderate, and extensive decay [8, 15, 16].

Different operators in different rooms performed questionnaires and oral examinations to avoid bias. After excluding children under two years of age, 209 people integrated into 85 family units participated. These families were diverse and included small children and elderly adults. Descriptive statistics were reported, and non-parametric correlations were calculated.

**Results**

The 209 participants from Siltepec and Huehuetan had an age range of 2 to 78 years, with a mean of 28.28. However, patients were stratified by age. More than sixty percent were women (67%), and the participants were integrated into 85 family groups, with a mean of 2.12 members per family and a maximum of five. ELCSA was calculated according to the presence of members younger than 18 years. Seventy families qualified with this criterion, and the remaining 15 had only adult members. After calculation, the individual ELCSA measures were 43% mild household FI (n = 91), 22% moderate household FI (n = 45), 3% severe household FI (n = 6), and 32% household food security (Fig. 1).

Dental caries were detected in 98% of the participants with the ICDAS system. The number of carious lesions varied from zero (2%) to 27 (0.5%). The mean number of caries per patient was 9.81 (SD 5.48). Most lesions were classified as initial decay with a mean of 6.22. Moderate decay had a mean of 1.81, and extensive decay had a mean of 1.77 (Fig. 2). The distribution of carious lesions varied according to the age group, with a prevalence of 85% in the 2 to 5 years age range. It decreased to 60% in those 6 to 12 years and increased to 100% in the rest of the age ranges (Table 1).
Table 1
Distribution of caries by age range and International Caries Classification and Management System (ICCMS) category.

<table>
<thead>
<tr>
<th>Age Group, years</th>
<th>Initial cavities</th>
<th>Moderate cavities</th>
<th>Extensive cavities</th>
<th>Total cavities</th>
<th>DMF-T</th>
<th>Prevalence % (DMF-T &lt; 0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–5</td>
<td>3.6</td>
<td>1.6</td>
<td>3.55</td>
<td>8.75</td>
<td>8.9</td>
<td>85</td>
</tr>
<tr>
<td>6–12</td>
<td>5.25</td>
<td>1.1</td>
<td>2.4</td>
<td>8.75</td>
<td>8.85</td>
<td>60</td>
</tr>
<tr>
<td>13–18</td>
<td>10.17</td>
<td>2.41</td>
<td>1.58</td>
<td>14.17</td>
<td>14.47</td>
<td>100</td>
</tr>
<tr>
<td>19–34</td>
<td>9.58</td>
<td>3</td>
<td>1.35</td>
<td>13.94</td>
<td>14.23</td>
<td>100</td>
</tr>
<tr>
<td>35–49</td>
<td>5.47</td>
<td>1.62</td>
<td>1.09</td>
<td>8.19</td>
<td>14.70</td>
<td>100</td>
</tr>
<tr>
<td>50–65</td>
<td>4.15</td>
<td>1.36</td>
<td>1.21</td>
<td>6.73</td>
<td>19.52</td>
<td>100</td>
</tr>
<tr>
<td>65+</td>
<td>4.28</td>
<td>2</td>
<td>0.85</td>
<td>7.14</td>
<td>20.57</td>
<td>100</td>
</tr>
</tbody>
</table>

The total number of caries is the average of the sum of all carious lesions. The Decayed, Missing, and Filled-Teeth index (DMF-T) is the average, including missing and filled teeth. The prevalence of caries was calculated by counting a DMF-T higher than 0.

An association was found between household FI and the level of carious lesions. The distribution of initial and moderate decay remained stable in all FI categories. However, extensive decay increased in households with severe FI (Fig. 3). We also found a correlation between FI and total caries in primary teeth, extensive cavities, and total caries. These results were statistically significant ($P < 0.05$) by the Rho Spearman test (Table 2). We also found a higher percentage of mild to severe FI in Siltepec (75%) compared to Huehuetan (55%) according to the ELCSA scale (Fig. 4).

Table 2
Correlation of carious and Food Insecurity.

<table>
<thead>
<tr>
<th>Non-parametric Correlation with ELCSA</th>
<th>Spearman</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number of cavities in primary dentition</td>
<td>0.178</td>
<td>*0.01</td>
</tr>
<tr>
<td>Extensive cavities</td>
<td>0.269</td>
<td>*0.000</td>
</tr>
<tr>
<td>Total number of cavities</td>
<td>0.200</td>
<td>*0.04</td>
</tr>
</tbody>
</table>

Differences were evaluated with the non-parametric Spearman correlation. The hypothesis of extensive decay is evenly distributed in the categories of FI and is rejected at < 0.05*.

Discussion

FI was present in 67.14% of the individuals in this study. The most frequent FI was mild. This level of FI was lower than in other rural populations in Mexico. Many households in the communities reported some level of food production, either for commercial or personal use. However, this information was anecdotal,
and further inquiry is needed to determine if this was a reason for the levels of FI. Other studies that have analyzed rural populations in Mexico reported FI ranging from 86.5–91% [1, 2, 5]. However, it is important to emphasize that in other studies, some of the questions were modified with regionalisms that might have affected the result.

Carious lesions were more prevalent in our study when considered as a whole than in previous studies in the same population. A previous study conducted on this population in 2015 reported a frequency of carious lesions of 95% [17]. However, the authors used a different system to assess caries that does not consider the initial carious lesion [15]. Reports of caries in rural populations in Mexico vary from 43–100% [7, 18, 19, 20]. Nevertheless, this variability may be due to using other caries assessment systems [16]. Most of the carious lesions were considered initial and were dismissed or underdiagnosed.

Nevertheless, the levels of carious lesions were expected for this group and were statistically significant when grouped by FI classification. In addition, the association between FI and extensive decay lesions might be related to the availability of highly processed food for households or the priority given to acquiring food over medical and preventive dental measures, such as consultations.

A limitation of this study was the sample size because these communities are isolated and of difficult access, making it difficult to include a larger number of inhabitants. An assessment of an urban population would have been useful to compare results. Previous studies have compared FI to dental caries, particularly in children. In the United States, no association was found, whereas, in Brazil, an increase in untreated caries was reported without showing the impact on the severity of the carious lesions [4, 21, 22].

Conclusions

The causes of food and nutrition insecurity are complicated. Most food insecurity and nutrition problems are related to the social determinants of health, such as low income or unemployment, lack of access to nutritious food, affordable housing, and medical care. Food insecurity is associated with dental caries. Addressing the factors that cause food insecurity and providing population and individual interventions can prevent dental caries. Further research is needed to clarify the relationships and generalize this study's associations.

Declarations

Acknowledgments

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Competing interests
The authors declare that they have no competing interests.

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**Author contributions**

CIRS, as the main author, participated in the study design, data collection and analysis, and manuscript writing. KIJ and EMC, as clinical advisors, were involved in the study methods design and reviewed and revised the manuscript. LRS and MNGF were involved in data collection, statistical analysis, and manuscript translation and writing. ANC and RGF were involved in data collection and analysis. MAG, as a methodological advisor, was involved in the design of the study methods, data collection, and review of the manuscript. All authors read and approved the final manuscript.

**Ethics approval**

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The study was approved by the Bioethics Committee of Universidad Autónoma de Nuevo León México (No. SPSI-010613).

**Consent to participate.**

Informed consent was obtained from all individual participants included in the study.

**References**


Figures
Figure 1

Percentage of food insecurity of 85 family groups according to the Latin-American and Caribbean Scale of Food Security (ELCSA).
Figure 2

Dental caries means according to International Caries Detection and Assessment System (ICDAS) categories.
Figure 3

Relationship of dental caries means and food insecurity according to Food Security categories.
**Figure 4**

Comparison of percentages of food insecurity based on the ELCSA scale by community.