DENTAL CARIES EXPERIENCE IN SCHOOL CHILDREN AND THE IMPACT OF NON-CAVITATED LESIONS ON THE CARIES INDEX

Ana M. Acevedo¹, Maglynert Montero¹, Carolina Machado², Ilse Sáez², Fátima Rojas – Sánchez¹, Israel Kleinberg³.

¹ Institute of Dental Research "Raul Vincentelli", School of Dentistry, Central University of Venezuela. Caracas, Venezuela.
² Department of Dentistry, Sucre Municipality, Miranda State, Caracas, Venezuela.
³ Division of Translational Oral Biology, Department of Oral Biology and Pathology, Stony Brook University, New York, USA.

ABSTRACT
The purpose of this study was to evaluate the current status of dental caries in 11 to 13 year-old schoolchildren residing in Sucre Municipality, Miranda State, and the impact of the non-cavitated lesion on the caries index. Twelve elementary schools were included in this study and a sample of 1484 children was examined using artificial light, a #5 mirror and a #23 probe. The criteria followed were those proposed by Radike (1972) as modified by Acevedo et al. (2005) in order to include initial non-cavitated caries lesions. Teeth were cleaned and dried for 5 seconds with a triple syringe. Caries prevalence was 94.07% and the average DMFS index for the total sample was 4.35 ± 4.21. This increased significantly to 6.45 ± 5.01, when the initial caries lesions were included (p < 0.05).

According to gender, DMFS was higher in the female population (4.51 ± 4.45) than in males (4.21 ± 3.97), but the difference was not statistically different (p> 0.05). The same pattern was observed, when the initial caries lesions were added. The new mean DMFS was 6.67 ± 5.15 and 6.26 ± 4.88 for females and males, respectively. Non-cavitated lesions represent 33% of the total caries lesions recorded. Conclusion: These results show that (i) dental caries prevalence in this population remains high and (ii) initial lesions contribute significantly to the DMFS index.

Key words: Dental Caries, prevalence, children.

EXPERIENCIA DE CARIES DENTAL EN NIÑOS ESCOLARIZADOS Y EL IMPACTO DE LAS LESIONES NO CAVITADAS EN EL ÍNDICE DE CARIES

RESUMEN
El objetivo de este estudio fue evaluar la experiencia de caries en escolares de 11 a 13 años de edad del Municipio Sucre, y el impacto de las lesiones no cavidad en el índice de caries. Se seleccionó una muestra a conveniencia de 12 escuelas ubicadas en el Municipio Sucre, Estado Miranda, Venezuela. Previo consentimiento informado, se examinaron 1484 niños utilizando luz artificial, espejo #5 y explorador #23. Los criterios establecidos fueron los trazados por Radike (1972) como los modificados por Acevedo et al. (2005) en el que se incluyen las lesiones iniciales no-cavidad. Los dientes fueron limpiados y secados por 5 segundos con una triple jeringa. La prevalencia de caries fue de 94.07% y la media de DMFS para el total de la muestra fue de 4.35 ± 4.21. Esto aumentó significativamente a 6.45 ± 5.01 cuando se incorporaron las lesiones iniciales (p < 0.05).

De acuerdo al género, DMFS fue mayor en la población femenina (4.51 ± 4.45) en comparación con los varones (4.21 ± 3.97), pero el diferencial no fue estadísticamente significativo (p> 0.05). El mismo patrón se observó cuando se incorporaron las lesiones iniciales, donde el nuevo promedio DMFS fue de 6.67 ± 5.15 para las niñas y de 6.26 ± 4.88 para los varones. Las lesiones no cavidad representan 33% de las lesiones cariosas totales. Conclusion: Estos resultados muestran que (i) la prevalencia de caries dental en esta población permanece alta y (ii) las lesiones iniciales contribuyen significativamente al DMFS.

Palabras Clave: Caries, prevalencia, niños.

INTRODUCTION
Dental caries is a process that involves an imbalance of the dynamic and physiological activities of demineralization and re-mineralization in the dental surface due to intermittent acid attack. If the disease is not controlled over time, net mineral loss can occur, with subsequent cavity formation¹. This mineral loss does not always lead to cavity formation; nevertheless, the signs of the disease should be recognized as a series of continuous changes in severity and not just as a simple cavity on the dental surface. The detection of caries lesions in the non-cavitated stages is extremely important even in epidemiological surveys, because the caries situation of a population can be more accurately described² and in a shorter time.
The results of studies in Venezuela are similar to those in other parts of the world. Dental caries prevalence has decreased over time, presumably in response to the implementation of massive prevention programs. Nevertheless, all of these studies report the caries lesion as a “cavity”, using traditional criteria such as those suggested by the World Health Organization. White, chalky-looking spots or areas, where a probe is retained in the absence of softened tissue are considered healthy. In 1987, using these criteria, caries prevalence was found to be 83% with a DMFT index of 3.67 in 12 year old children in Venezuela, (Fundacredesa 1981 – 1987). Ten years later, Rivera et al. (unpublished data), showed a reduction in the DMFT index (2.12 ± 2.49) for the same age group, and more recently, Morón et al. found a mean DMF of 1.20 for the same group of children, indicating a reduction in the caries index, when compared to the results obtained by Rivera. A cross-sectional study performed by Acevedo et al. in Sucre Municipality, Miranda State, using the DMFS index and detection criteria proposed by Radike showed a dental caries prevalence of 74% for 9 to 13 year-old schoolchildren, with a mean DMFS index of 3.64 ± 0.29 for the 12 year-olds involved. In 2005, the same group of researchers evaluated which teeth were most affected by dental carries in a population between 10½ and 11 years of age, residing in Sucre Municipality. The results showed that the lower first permanent molars were affected more than the upper first molars and the occlusal followed by the buccal surface had the highest percentage of involvement.

It is evident that the use of more specific detection criteria provides more information, when used in epidemiological and clinical studies. The use of methods that evaluate the early stages of the lesion are determinant for establishing the actual situation of dental caries disease and the need for its use should be emphasized in epidemiological studies to be performed in Latin America. In a study by Alvarez et al. on preschool children from Sucre Municipality, where non-cavitated caries lesions were included, the results showed dental caries prevalence of 79%, and there were fewer non-cavitated than cavitated lesions.

The purpose of this study was to evaluate dental caries experience in schoolchildren and the impact of non-cavitated lesions on the caries index in school children residing in Sucre Municipality, Miranda State, using detection criteria that include lesions in both stages of development.

METHODS AND SUBJECTS
Most of the Venezuelan population lives in urban and only 20% in rural areas. Sucre Municipality is one of the most populated marginal urban areas in Miranda State and has a low socio-economic status.

Universe and study sample
A sample of twelve elementary schools (national, state and municipal) located in an area of low socio-economic level of the Sucre Municipality in Venezuela was selected. Twelve schools were selected in random order from a list of schools and numbered from 1 to 12. The study unit was selected in a non-probabilistic manner, and all children were 11 to 13 years of age. The final sample consisted of 1,484 children. The total population registered in elementary schools in Sucre Municipality was 13,637 children; the sample accordingly represented 10.9% of the total population. Prior to clinical examination, the parents and/or the legal representatives of the children were informed of the study objectives and were asked to sign an informed consent form which was endorsed by the research examiner.

Clinical Examination
The oral examination was performed by a previously calibrated examiner (CM, who showed an intra-examiner kappa value of 0.89). This was done in a mobile dental unit, using artificial light, a # 5 flat mirror and a # 23 probe, after completing a thorough cleaning of the dental surface with a small brush installed on a low-speed hand piece. The children evaluated received preventive dental treatment and educational talks that included the use of the toothbrush and fluoridated toothpastes.

The detection of dental caries lesions was performed after a dental prophylaxis using the diagnostic criteria proposed by Radike and modified by Acevedo et al. which included non-cavitated lesions.

Statistical Analysis
The data was analyzed using the SPSS 12.0 program (SPSS Inc., Chicago, USA). The kappa value was used to determine the intra- and inter-examiner
reproducibility. The mean DMFS values and standard deviations were calculated. Student’s t Test was used to establish possible differences between the different variables.

RESULTS
The total sample was distributed according to gender among 782 male subjects (52.7%) and 702 female (47.3%) subjects. The children were distributed according to age as follows: 644 children were 11 years; 598 were 12 years and 242 were 13 years old (Table 1).

The results showed dental caries prevalence of 94.1%; total sound surfaces (94.7%) were considerably higher than affected surfaces (5.3%) (Table 2).

The analysis of DMFS components showed that the carious component was prevalent (4.2%) and lesion distribution within this component was 2.5% cavitated lesions and 1.7% non-cavitated lesions. Filled surfaces represented 0.8%, and missing surfaces 0.3% (Table 2).

The mean DMFS index for the whole sample was 6.45 ± 5.01. When the non-cavitated caries lesions were excluded, the mean index decreased significantly to 4.35 ± 4.21 (p<0.001) (Table 3). The mean dmfs index according to age was 5.23±3.89 in the 11 year-old group; 6.79±5.26 in 12 year-olds; and 8.87±5.95 in 13 year-olds. When the non-cavitated caries lesions were excluded, the index decreased significantly (p<0.001) in each of the age groups 3.42±3.23; 4.63±4.44; and 6.13±5.15 for the 11, 12, and 13 year-olds, respectively. In both cases, the mean caries index increased proportionally to age (Table 3).

According to gender, no statistically significant difference was observed between genders (Table 4), with mean DMFS values of 6.67 ± 5.15 for females (4.51 ± 4.45), when the non-cavitated lesions were excluded and 6.26±4.88 for males (4.21 ± 3.97) when the non-cavitated lesions were excluded.
Finally, the percentage of sound surfaces and/or caries-affected surfaces was determined on each tooth (Table 5). The results showed that 13.6% of the occlusal surfaces were affected, followed by 7.7% of the buccal surfaces, 3.2% of the lingual, 1.1% of the mesial, and 0.9% of the distal surfaces. When all surfaces were considered, it is important to note that the total number of sound surfaces is considerably higher than the number of surfaces affected by caries (>86%). When considering the type of lesion, non-cavitated caries lesion was the most prevalent on occlusal surfaces (5.68%), followed by cavitated caries lesions (5.13%). Comparing the percentage of cavitated and non-cavitated lesions on the buccal, lingual, mesial and distal surfaces, the percentage of cavitated lesions was higher than the percentage of non-cavitated lesions (p<0.001).

Table 6 shows the contribution of non-cavitated caries lesions to the DMFS index. All surfaces except the distal show a significant reduction in the DMFS index when the non-cavitated lesions are excluded (p<0.001). The DMFS index for the occlusal surface was 3.32±2.80, followed by the buccal surface 1.87±1.28. The lingual, mesial, and distal surfaces had lower indexes: 0.78±1.12; 0.26±0.70; and 0.22±0.63, respectively.

**DISCUSSION**

The results in this study show the status of dental caries in children residing in Sucre Municipality, Miranda State, Venezuela. It is important to note that these results cannot be extrapolated to other communities nationwide. Another aspect to consider is that the DMFS index used includes non-cavitated and cavitated caries lesions, which allows the examiner to make a more comprehensive assessment of the caries situation; nevertheless this makes it impossible to compare this study with other national and international studies where the DMFS index has been used, following other detection criteria.

The detection of caries lesions on the occlusal surfaces of the posterior teeth, particularly in pits and fissures and in its earliest stages, is a difficult task10–13, as is making a successful diagnosis.

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Total sound surfaces</th>
<th>Total affected surfaces</th>
<th>Non-cavitated caries lesion</th>
<th>Cavitated caries lesion</th>
<th>FFilled</th>
<th>Missed</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occlusal</td>
<td>86.36%</td>
<td>13.64%</td>
<td>5.68%</td>
<td>5.13%</td>
<td>2.52%</td>
<td>0.32%</td>
<td>100%</td>
</tr>
<tr>
<td>Mesial</td>
<td>98.93%</td>
<td>1.07%</td>
<td>0.12%</td>
<td>0.56%</td>
<td>0.06%</td>
<td>0.32%</td>
<td>100%</td>
</tr>
<tr>
<td>Distal</td>
<td>99.10%</td>
<td>0.90%</td>
<td>0.01%</td>
<td>0.50%</td>
<td>0.06%</td>
<td>0.32%</td>
<td>100%</td>
</tr>
<tr>
<td>Buccal</td>
<td>92.26%</td>
<td>7.74%</td>
<td>1.67%</td>
<td>4.86%</td>
<td>0.89%</td>
<td>0.32%</td>
<td>100%</td>
</tr>
<tr>
<td>Lingual</td>
<td>99.77%</td>
<td>0.23%</td>
<td>1.17%</td>
<td>1.29%</td>
<td>0.42%</td>
<td>0.32%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Diagnostic criteria proposed by Radike modified by Acevedo et al.8

<table>
<thead>
<tr>
<th>Tooth Surfaces</th>
<th>Occlusal</th>
<th>Mesial</th>
<th>Distal</th>
<th>Buccal</th>
<th>Lingual</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMFS excluding non-cavitated lesions</td>
<td>1.94 ± 2.04</td>
<td>0.23 ± 0.67</td>
<td>0.22 ± 0.63</td>
<td>1.46 ± 1.22</td>
<td>0.50 ± 0.91</td>
</tr>
<tr>
<td>Mean DMFS</td>
<td>3.32 ± 2.80*</td>
<td>0.26 ± 0.70*</td>
<td>0.22 ± 0.63</td>
<td>1.87 ± 1.28*</td>
<td>0.78 ± 1.12*</td>
</tr>
</tbody>
</table>

Mean ± Standard Deviation of the DMFS index in a sample of 1,484 school children in Sucre Municipality, Miranda State. *A statistically significant difference was found between DMFS and DMFS excluding non-cavitated caries lesions (p<0.001).
of early lesions, especially those that are non-
cavitated. The WHO reports the inaccuracy of
lesion detection in stages previous to cavitations;
therefore the results would not be reproducible. In
contrast, different studies have shown that inter-and intra-examiner reproducibility of obser-
vations is possible. In this sense, our study showed a high intra-examiner kappa value (0.89),
which indicates good reproduction of the observed data.

While dental caries prevalence has diminished signifi-
cantly since massive preventive and restorative
programs were implemented, it is also true that it has not been completely controlled. Data previ-
ously obtained in this Municipality showed that
in the year 2000, dental caries prevalence in 9 to
13 year-olds was 74%, with a mean DMFS index of
3.64 ± 0.29 at 12 years of age; eight years later, this study has shown a dental caries prevalence of
94% with a mean DMFS index of 4.63 ± 4.44 at
12 years of age (when non-cavitated caries lesions
are not included). A comparison of the two studies shows that the number of subjects affected by
caries increased by 27% and the index is 1.27 times higher. These figures suggest that all the
effort made by the local authorities, such as imple-
mentation of massive educational programs, use
of fluoridated tooth pastes, and the intake of fluo-
ridated salt, which despite its implementation in
1995 does not meet the established standard (unpublished data) has not been enough to con-
trol the disease. It is also true that the social deter-
minants such as low quality of life, inadequate
eating patterns, sanitation services, drinking water,
and deficient sewage, among others to which the
population is exposed have not been taken into
account and keep this population at risk of deve-
lop the disease.

It is worth noting that in spite of the high caries pre-
valence observed in the study population, there was
a low percentage of affected surfaces (5.32%), show-
ing that the disease continues to be prevalent but
only affects a few dental surfaces per individual.
This is consistent with the study published by Lar-
mas, which reported that the real caries experi-
ence of a population must include not only the
prevalence of the disease but also detailed data that
can help further understanding of the disease.
The evaluation of different components of the
DMFS index shows that the decay component was
the most prevalent, and by using more updated
detection criteria it was possible to differentiate
cavitated and non-cavitated lesions, with cavitated
lesions generally being the most prevalent (2.5%).
On the other hand, when the occlusal surfaces were
evaluated alone, a different pattern was observed,
with non-cavitated lesions being significantly more
prevalent (p>0.0001) than cavitated lesions, sug-
gesting a delay of the disease on this surface. These
results suggest that the use of these caries detection
criteria makes it possible to register occlusal caries
lesions at the earliest stages of progression. How-
ever, it is difficult to predict whether these lesions
are at the enamel level or have reached the dentin-
enamel junction or even the dentin. Pits indicate
that the detectable lesion represents a more advan-
ced stage of the lesion, however they can be rever-
ted or their progression controlled with the
bioavailability of calcium, phosphate and fluoride
present in the biofilm, which favor the remineral-
ization process.

The filled component of the DMFS index repre-
tended a very low percentage, indicating the lack of restor-
avative attention by dental health care institutions
in this population.

The results of this study indicated that the occlusal
surface was the most affected tooth caries site.
These results are supported by previous research
conducted in Sucre Municipality and by other
papers published around the world. The second
most affected was the buccal surface, which makes
a major contribution to the DMFS index due to the
presence of the buccal groove, which favors plaque
retention and therefore caries development. The
proximal surfaces (mesial and distal) do not make a
major contribution to the index, not because they
are not susceptible to dental caries, but in epidemi-
ological studies they are under-recorded because of
the limited access for caries detection. Different
authors therefore suggest the use of different tech-
niques to obtain better results, such as elective tem-
porary separation (to observe proximal caries),
drying the dental surface, and the use of x-rays.
The truth is, that in countries where attention and
prevention resources are as limited as ours, the use
of other diagnosis methods such as DIAGNodent,
FOTI (Fiber Optic Transilumination) and QLF
(Quantitative Light-Induced Fluorescence) involves
higher costs, so the excellent sensitivity they provide
must be left aside in favor of the low sensi-
tivity and adequate specificity provided by the visual tactile method. A viable alternative is the use of more specific detection criteria to detect lesions in all progression stages. Currently, ICDAS (International Caries Detection and Assessment System) developed by a consensus Cariology group shows great diagnostic potential when compared to traditional methods. However, although it allows evaluation of the progression of the disease, it is complicated for calculating the caries index used internationally to express the status of caries and makes comparisons with studies performed in the rest of the world. Our study employed a method that allows caries lesions in a non-cavitated stage to be detected, so the results show a real picture of the caries experience in the study population and allows us to evaluate the impact of prevention programs and design strategies that will allow non-cavitated lesions to be stopped or reverted, once they have been detected.

These results show the importance of the detection and inclusion of non-cavitated lesions in the caries index. If this important contribution to the index were ignored, lesions would be under-recorded, and the results would not reflect the real status of the disease in a given population.

ACKNOWLEDGMENTS
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REFERENCES


