Some factors associated with dental caries in the primary dentition of children with Down syndrome

ABSTRACT

Aim: It is well reported in the scientific literature that there is a high level of periodontal disease and lower caries prevalence in Down Syndrome (DS) individuals, when compared with age-matched non DS individuals. This study was conducted to investigate the process of dental caries in DS children.

Materials and methods: In this study the following parameters were considered: oral hygiene habits, levels of Streptococcus mutans (SM) and Lactobacillus spp. (LB), Modified Gingival Index (MGI), and Simplified Oral Hygiene Index (OHI-S). A case group with DS children (n=69) and a control group of non DS children (n=69) were formed to perform this study. Dental caries severity was determined using the DMFT index. Samples of non-stimulated saliva were collected to determine the Lactobacillus spp levels. For SM levels, MSB agar plates were used.

Results: The findings revealed that the case group attended dental check-ups more frequently, brushed their teeth more times per day, flossed less, and also more frequently had SM levels classified as “high count”. The MGI was higher and the OHI-S was lower than the control group (p<0.001).

Conclusion: No significant differences were found between the DMFT indexes of children from the two groups (p=0.345). The logistic regression analysis showed that in the case group, age, MGI, and SM count were positively related to dental caries (p<0.05).

Keywords: Paediatric dentistry; Down Syndrome; Dental caries.

Introduction

Down syndrome is characterised by the presence of an extra copy of chromosome 21 [Cutress, 1971] and its prevalence is approximately 1:800 live births [Rogers et al., 1996]. There is a strong correlation between maternal age and the risk of having a child with DS. At 30 years of age, the risk ratio is 1:1000 and it increases to 9:1000 for women over 40 years old [Johnestone et al., 1999].

Approximately 80% of individuals with DS have an intellectual quotient (IQ) ranging between 25 and 50. Weight and height values at birth are below average and there is a delay in growth as well as early aging [Pinazo et al., 1998]. They are more susceptible to infections of the gastrointestinal, respiratory, and urinary tracts due to immune-system deficiencies (T lymphocytes) [Rogers et al., 1996]. They have a greater risk of developing leukemia (15 to 20 times greater than individuals without this syndrome) and hypothyroidism (approximately 8 times more frequent) [Pinazo et al., 1998]. Approximately 40% to 60% of individuals with DS present with congenital heart diseases, which can be treated during early stages of life, resulting in a good prognosis [Rogers et al., 1996; Desai and Fayetteville, 1997; Fiske and Shafik, 2001].

Several dental anomalies are also observed, such as hypodontia, oligodontia, conoid teeth, microdontia, enamel hypocalcification, fusion and gomination [Allison et al., 2000]. In general, there is a delay in both primary and permanent tooth eruption in individuals with DS, and the primary dentition is not fully completed before 4 or 5 years of age [Pinazo et al., 1998].

Individuals with DS are known to have a greater predisposition to periodontal disease due to alterations in their immune system [Desai and Fayetteville, 1997; Reuland-Bosma et al., 1986]. There have also been reports of low caries incidence in this population, which could be related to a variety of factors including the buffer capacity of their saliva, delayed eruption, generalised diastemas, and a tendency towards bruxism that wears the occlusal surfaces of teeth, making them flat and smooth [Johnestone et al., 1999; Shapira and Stabholz, 1996]. Other factors that could be associated with this low caries prevalence are: colonisation by S. mutans with a less cariogenic profile, difference in the acidogenecity or acidoduricity of strains [Cogulu et al., 2006a] and high levels of salivary IgA [Cogulu et al., 2006b].

The aim of this study was to evaluate the clinical factors, microbiological levels and oral hygiene habits in caries disease in the primary dentition of DS children.

Material and methods

The case group was composed of 69 children with Down syndrome between 13 and 85 months old. They were examined at the Irmandade da Santa Casa de Misericórdia of São Paulo, Darcy Vargas Children’s Hospital, Associação de Pais e Amigos dos Excepcionais (APAE) of the city of Barueri, Brazil. The control group consisted of 69 children without congenital anomalies, selected among students of the Marly Teixeira de Almeida kindergarten, Barueri, São Paulo, who were paired with children of the case group considering gender, age and number of erupted teeth. As the DS children present a delay in the dental eruption process and this factor could influence their caries
prevalence, an age compensation was necessary. In the case group 26 children did not present complete primary dentition. Based on their ages it was possible to identify an average delay of 9 months for girls and 13 months for boys, when compared with the data from tables proposed by Logan and Kronfield (1933) and McCall and Shour (1941). This information was used for pairing the children with complete primary dentition. As this approach was not valid for the younger individuals (for example 13 months old), a secondary criteria based on the number of erupted teeth was adopted for pairing them.

Only children with DS in their primary dentition were included in the study and the exclusion criteria were: children with local oral factors (soft or hard tissue tumors, stomatitis, recurrent canker sores or major oral pathologies) and children who had participated in another clinical study 30 days prior to the development of the present study.

The clinical examination and data collection were performed in the following steps: an interview with the participants’ legal guardians during which all procedures to be carried out were explained and a questionnaire together with a consent form had to be filled out and signed; saliva sample collection for microbiological analysis; determination of GMI and OHI-S, tooth brushing (after the saliva sample collection) and examination to obtain the DTMF index. All exams were performed by a calibrated examiner in a dental office under artificial lighting. The calibration was done through repeated exams during the course of the study (Kappa intra-examiner agreement was 0.89 for DTMF index, 0.83 for OHI-S and 0.88 for GMI). Preparation of culture plates for S. mutans and Lactobacillus spp. and the quantification of colony-forming units of both bacteria were performed at the Oral Microbiology lab of the Biomedical Scientific Institute of the University of São Paulo.

### Medical and dental history

General information regarding the medical and dental history and oral hygiene habits of all children from the case and control groups were obtained from the participants’ legal guardians in a questionnaire. The questions covered: presence of chronic disease, intake of medications, access to dental care, tooth brushing supervision (whether the child brushed its teeth alone, with the father’s or mother’s help, or the help of others), brushing and flossing frequency (not brushing their teeth, brushing 1 time per day, 2 times, three or more times). Information regarding the mother’s age and occupation was also collected.

### Salivary levels of Streptococcus mutans

The salivary levels of Streptococcus mutans were determined using mitis-salivarius bacitracin (MSB) agar plates, prepared as recommended by Gold et al. [1973]. The non-stimulated saliva samples were obtained using a spatula, as described by Köhler and Bratthall [1979]. The plates were placed in plastic bags, in a microaerophilic environment, which was obtained by vacuuming the air, and were incubated at 37°C for 48 hours in a portable kiln. The Köhler and Bratthall’s classification was used to count the bacterial colony-forming units.

### Salivary levels of Lactobacillus spp

Rogosa agar plates were used in this phase of the experiment. Since participants with Down syndrome were not able to cooperate, salivary samples were obtained using an adapted device. A highly powerful vacuum and two tubes were used, with one tube attached to the pump and the other inserted in the child’s oral cavity, and the other end of both of tubes going through the BD Vacutainer® lid. The classification proposed by Klock and Krasse (1977) was used, as follows: <104, 104-105, 105-106, >106.

### Simplified Oral Hygiene Index

The patient’s oral hygiene was evaluated according to the criteria used in the Simplified Oral Hygiene index (OHI-S) proposed by Greene & Vermillion [1964]. With the tip of a cotton bud, a plaque disclosing agent was applied on the buccal surfaces of the primary maxillary right central incisor; the mandibular left central incisor and the maxillary second molars, bilaterally, as well as on the lingual surfaces of the mandibular second molars. These surfaces were examined and given a score from 0 to 3.

### Modified Gingival Index

To evaluate periodontal disease, the index proposed by Löe & Silness [1963] and modified by Lobene et al. [1986] was used, and this technique does not include the application of pressure with a probe to determine the presence or absence of gingival bleeding.

The primary teeth evaluated (gingival margins and papillae) in each oral quadrant were: maxillary right second molar, maxillary right lateral incisor, maxillary left primary molar, mandibular left second molar, mandibular left lateral incisor, and mandibular right primary molar. The MGI consists of visual examination only, using scores from 0 to 4.

### DMFT Index

After brushing the children’s teeth, the dental surfaces were dried with sterile gauze. Intraoral examination was systematically carried out, quadrant by quadrant, using a dental mirror and a dental probe with a blunt tip. The index chosen for carious lesion diagnosis was the DMFT [Grubell, 1944], and the diagnostic criteria were those recommended by the World Health Organization (WHO) in 1987.

### Statistical method

For statistical analysis the Chi-square test, Fisher’s Exact test or t-tests for two independent samples were used. The Chi-square test was used for groups comparison with regard to the qualitative variables. When it was not possible to apply the Chi-square test, the Fisher Exact test was used. The numerical variables (mother’s age and DMFT) were compared by the t-test for independent samples. Statistical difference - that is, the statistical difference level considered significant between the groups - was set at p < 0.05.

A univariate logistic regression analysis was also performed to determine which parameters (child’s age, total number of surfaces, OHI-S, GMI, SM count, Lactobacillus spp. count and cardiopathy) could be
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Results

Oral hygiene habits, age and mother’s occupation

Comparison of the frequency of dental follow-up was statistically significant, indicating that DS children visit the dentist more regularly than non DS ones (Table 1). There was no statistically significant difference between the groups with regard to receiving oral hygiene guidance, as the majority was given professional guidance.

In the case of DS children, tooth brushing was performed by the mother in the majority of cases, and also in the control group tooth brushing was largely performed by the children themselves and by the mother and father, with statistically significant difference between the groups (p<0.001).

In general, the DS children brushed their teeth more times per day than the children without the syndrome, and the comparison was statistically significant. The mean number of times that the children brushed their teeth per day was 2.13 in the case group and 1.88 in the control group (Table 1).

There was no statistically significant difference between the groups as regards the resource used for tooth brushing, as the large majority in both cases used a tooth brush (Table 1). However, DS children tended to use dental floss less frequently than non DS children, and this comparison was statistically significant (Table 1).

The larger part of mothers of DS children did not work outside the home, while in the non DS children’s group, the opposite occurred, and the majority of mothers were employed. In this case, the deceased mothers or those who had disappeared were not taken into account. In Table 1, mothers who were “retired”, “unemployed”, “laid off work” or “housewives” were inserted in the category “do not work outside of the home”.

Frequency of CFUs of Streptococcus mutans and Lactobacillus spp.

Significant difference was identified in the SM count, as the mean count (105 to 106 CFUs of S.Mutans/ml saliva) was more frequent in the control group and the high count (over 106 CFUs of S.Mutans/ml saliva) was more frequent in the DS group. There was no significant difference as regards low SM count (Table 2).

Table 2 shows no statistical difference between the groups as regards the LB count. In all the children with counts considered below 104 CFU/ml, in reality in 9 cases (3 DS and 6 non DS) this count was so low that it was not detected. Moreover, in 7 cases (all DS) it was not possible to collect a saliva sample due to the very low salivary flow and little cooperation from the child.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Case N (%)</th>
<th>Control N (%)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>% having regular dental visits</td>
<td></td>
<td></td>
<td>0.010*</td>
</tr>
<tr>
<td>Yes</td>
<td>38 (55.1)</td>
<td>23 (33.3)</td>
<td></td>
</tr>
<tr>
<td>Oral hygiene orientation</td>
<td></td>
<td></td>
<td>0.729*</td>
</tr>
<tr>
<td>Yes</td>
<td>40 (58.0)</td>
<td>42 (60.9)</td>
<td></td>
</tr>
<tr>
<td>Who brushes the child’s teeth?</td>
<td></td>
<td></td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Does not brush</td>
<td>6 (8.7)</td>
<td>6 (8.7)</td>
<td></td>
</tr>
<tr>
<td>Mother</td>
<td>55 (79.7)</td>
<td>35 (50.7)</td>
<td></td>
</tr>
<tr>
<td>Father</td>
<td>1 (1.5)</td>
<td>1 (1.5)</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>1 (1.5)</td>
<td>3 (4.4)</td>
<td></td>
</tr>
<tr>
<td>By himself/herself</td>
<td>2 (2.9)</td>
<td>9 (13.0)</td>
<td></td>
</tr>
<tr>
<td>Mother and Father</td>
<td>4 (5.8)</td>
<td>15 (21.7)</td>
<td></td>
</tr>
<tr>
<td>Daily frequency of toothbrushing</td>
<td></td>
<td></td>
<td>0.016*</td>
</tr>
<tr>
<td>Does not brush</td>
<td>6 (8.7)</td>
<td>6 (8.7)</td>
<td></td>
</tr>
<tr>
<td>Once</td>
<td>2 (2.9)</td>
<td>14 (20.3)</td>
<td></td>
</tr>
<tr>
<td>Twice</td>
<td>38 (55.1)</td>
<td>31 (44.9)</td>
<td></td>
</tr>
<tr>
<td>3 times</td>
<td>23 (33.3)</td>
<td>18 (26.1)</td>
<td></td>
</tr>
<tr>
<td>Instrument used for brushing</td>
<td></td>
<td></td>
<td>0.813*</td>
</tr>
<tr>
<td>Does not brush</td>
<td>6 (8.7)</td>
<td>6 (8.7)</td>
<td></td>
</tr>
<tr>
<td>Wet cloth</td>
<td>4 (5.8)</td>
<td>3 (4.4)</td>
<td></td>
</tr>
<tr>
<td>Toothbrush</td>
<td>58 (84.1)</td>
<td>59 (85.1)</td>
<td></td>
</tr>
<tr>
<td>Finger brush</td>
<td>1 (1.5)</td>
<td>1 (1.5)</td>
<td></td>
</tr>
<tr>
<td>% children flossing (once a day)</td>
<td></td>
<td></td>
<td>&lt; 0.001*</td>
</tr>
<tr>
<td>Yes</td>
<td>4 (5.8)</td>
<td>21 (30.4)</td>
<td></td>
</tr>
<tr>
<td>% mothers working outside the house</td>
<td></td>
<td></td>
<td>0.001*</td>
</tr>
<tr>
<td>Yes</td>
<td>21 (30.9)</td>
<td>40 (58.0)</td>
<td></td>
</tr>
</tbody>
</table>
MATHIAS MF, SEMIONATO MRL AND GUARÉ RO

**Table 3** shows that there was a statistically significant difference between groups as regards MGI, as children with DS presented a higher MGI than children without the syndrome.

As regards OHI-S, there was also a statistically significant difference between the groups, as children with DS presented a lower OHI-S than children of the non DS group (Table 3).

The difference in the DMFT index between the groups (Table 3) was found to be not statistically significant.

**Logistic Regression**

Study group: Table 4 shows that the child's age and MGI are associated with dental caries. It also shows that children with a high level of SM CFU count (>10⁶) have more propensity to risk of caries than those with a count considered low or medium (10⁵).

The variables: LB count, OHI-S and cardiopathy were not shown to be associated with dental caries (Table 4).

Control group: Table 5 reveals that only the variables child's age and MGI are associated with dental caries.

**Discussion**

The literature has reported the high incidence of periodontal disease in individuals with DS and that the presence of dental biofilm was not related to the severity of periodontal disease, indicating that the main aetiologic factor would be an alteration in their immune mechanism. Other studies, such as that of Shapiro et al. [1969], found a positive correlation between deficient oral hygiene and severity of bone loss in young individuals with the syndrome. The fact that drew attention in the present study was that despite the majority of children with DS presented lower OHI-S values, these children obtained higher MGI values, indicating that the presence of the dental biofilm was not related with the gingivitis found in these individuals.

Although factors such as lack of access to professional care [Allison et al., 2000; López-Perez, 2002], low efficacy of care at home, and limited manual dexterity are mentioned in the literature as being responsible for the severity of the gingivitis observed since the stage of infancy of DS individuals, in the present study it could be observed that the children with the syndrome had regular dental check-ups, statistically more frequently than those in the control group. In São Paulo city and its suburbs, where this study was conducted, there are several public hospitals, such as the Darcy Vargas Hospital, as well as charity institutions such as the APAE, Basic Health Units and dentistry schools in Barueri, which offer dental treatment and periodic preventive and educational follow-ups for children with DS. However, in many underprivileged regions of Brazil, access to dental treatment for patients with special needs is still not a tangible reality.

It is necessary to emphasize that, in most cases, children with DS had their teeth brushed by their mothers. It was also observed that the mothers of the case group children did not work outside their homes, perhaps due to the fact that these children need full time care. Nevertheless, perhaps due to DS children having difficulty with understanding and cooperating, the use of dental floss was more common among children from the control group.

A variety of studies have reported a lower caries

**Table 2** - S. mutans and Lactobacillus spp. count of the case group and control group.

**Table 3** - Mother's age, dental caries index, MGI and OHI-S values of the case group and control group.
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In the DS group a high S. mutans CFU count was also observed, which could be justified by the reduced salivary flow rate frequently found in these children, causing a greater concentration of CFU per milliliter of saliva. However, in the logistic regression, it was verified that children with DS with a high S. mutans CFU count (>10^6) presented a greater risk of developing dental caries than children with a medium or low count.

In the present study it was not possible to identify an association between Lactobacillus spp. count and dental caries, although this variable was almost significant in the DS group. In both groups the majority of children presented a low CFU count for this type of bacteria (<10^4). Of the total sample in this study, consisting of 138 children, only 36 individuals (18 from the case group and 18 from the control group) presented untreated cavitated lesions. This could explain the low Lactobacillus spp. count observed.

The variable child’s age showed to be positively associated with dental caries in both groups. These results are in agreement with those of Walter et al. [1997], who pointed out an increase in caries prevalence with age, with a maximum prevalence between 13 and 24 months of age due to: a greater number of dental surfaces to be colonized, the introduction of sweetened food into the child’s diet and socialization through contact with other people who offer sweets.

The MGI presented an association with dental caries in both groups. In a study Sant’Anna et al. [2001] stated that swelling or bleeding of the papillae was associated with carious lesions in the cervical third, especially proximal lesions. However, Beighton et al. [1996] studied a sample of 328 twelve-year-old British schoolchildren and concluded that dental caries experience was not influenced by the GI.

The aim of the OHI-S is to identify personal oral hygiene habits and both in the case and control groups this index

### Table 4 - Variables related to dental caries in children with DS: univariate logistic regression analysis.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Class</th>
<th>Total N</th>
<th>DMFT ≥1 (%)</th>
<th>OR</th>
<th>P</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (months)</td>
<td>-</td>
<td>69</td>
<td>17 (24.6)</td>
<td>1.04</td>
<td>0.013</td>
<td>1.01 – 1.07</td>
</tr>
<tr>
<td>OHI-S</td>
<td>-</td>
<td>69</td>
<td>17 (24.6)</td>
<td>1.09</td>
<td>0.864</td>
<td>0.42 – 2.82</td>
</tr>
<tr>
<td>MGI</td>
<td>-</td>
<td>69</td>
<td>17 (24.6)</td>
<td>1.40</td>
<td>0.006</td>
<td>1.10 – 1.78</td>
</tr>
<tr>
<td>SM Count</td>
<td>Low + medium</td>
<td>35</td>
<td>5 (14.3)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>34</td>
<td>12 (35.3)</td>
<td>3.27</td>
<td>0.049</td>
<td>1.01 – 10.64</td>
</tr>
<tr>
<td>LB count</td>
<td>&lt; 10^4</td>
<td>55</td>
<td>12 (21.8)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥ 10^4</td>
<td>7</td>
<td>4 (57.1)</td>
<td>4.78</td>
<td>0.060</td>
<td>0.94 – 24.34</td>
</tr>
<tr>
<td>Heart Disease</td>
<td>no</td>
<td>49</td>
<td>12 (25.4)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>yes</td>
<td>20</td>
<td>5 (25.0)</td>
<td>1.03</td>
<td>0.964</td>
<td>0.31 – 3.42</td>
</tr>
</tbody>
</table>
was not associated with dental caries. This is in agreement with Mayer and Lorenzo [2004] whose reports indicated that the relationship between plaque index and caries risk is very weak because there are various types of plaque, with particular metabolic activities and microbiological constitutions and it is impossible to clinically differentiate between cariogenic and non-cariogenic plaque.

Fiske and Shafik [2001] reported that 40% to 60% of children with DS present with congenital heart defects (CHD). In this study, 20 DS individuals with uncorrected CHDs were seen and none of the individuals in the control group had CHDs. Thus, the variable heart disease was only investigated in the experimental group. Results showed that CHDs were not associated with the occurrence of dental caries in these children.

Analysing the results obtained, in which children with DS presented high levels of S. mutans, dental caries and gingivitis, it is necessary to establish a treatment program based on the prevention of oral diseases. The treatment protocol should include a detailed medical and dental history and reduction in dental biofilm formation through mechanical control, the use of chemical agents, and microbiological salivary analysis whenever possible. Moreover, it should be emphasised that education is still the most effective form of prevention. Therefore, as a part of the routine treatment, the children’s parents and carers should be provided with guidance on oral health care, in a multidisciplinary context, providing a holistic view of the child as an individual.

Conclusion

The case group and control group presented a similar caries index, whereas gingivitis was shown to be present from early childhood in children with Down syndrome.

References


