Early Childhood Caries underweight or overweight, that is the question

ABSTRACT

Aim The purpose of this retrospective case study is to describe the body mass index in a group of children, from 3 to 6 years old with ECC and a similar group of caries-free children.

Materials and methods This case-control analysis involves two groups of children: the first was of 244 healthy children, 3 to 6 year-old and caries-free; the second was of 586 otherwise healthy children, same age, with Early Childhood Caries divided into three subgroups according the AAPPD definition. Demographics, dmft, number teeth with pulpal involvement, BMI percentile, weight at birth, weight and height of both parents were measured during the clinical evaluation. Statistical analyses were performed using standard statistical software (SPSS Version 13). BMI distribution of the subjects with caries was graphically compared with the use of confidence intervals to a similar caries-free sample.

Results Results are expressed as mean ± SD and frequencies (percentages), depending on the data type. The distribution of BMI percentiles of the ECC group was: underweight = 10%; normal weight = 55.90%; at risk of overweight = 22.22 %; overweight = 11.11%. Significantly, more children in the case group were underweight than in the control group (10% vs. 4.94%).

Conclusion The ECC population does not have a typical weight distribution, and the underweight finding in a significant number of Severe ECC (S-ECC) children may be due to the chewing alteration related to the dental pain due to caries and to missing teeth after hard tissues breakdown.

Key words: BMI; Early childhood caries; Overweight; Underweight.

Introduction

Early Childhood Caries is a pathologic expression of multifactorial aetiology with a premature onset, characterised by the presence of many deep dental caries in the primary dentition, with rapid progress into the pulpal and periodontal tissues, mostly involving the anterior teeth [Kim Seow, 1998; Wene, 1999]. The definitions of the American Academy of Pediatric Dentistry state the following:

- ECC - presence of 1 or more decayed (non-cavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth in a 71 months of age or younger child;
- S-ECC - any sign of tooth-surface caries is indicative of severe early childhood caries (S-ECC) in children younger than 3 years of age. From ages 3 through 5: 1 or more cavitated, missing (due to caries), or filled tooth surfaces in primary maxillary anterior teeth or a decayed, missing, or filled tooth, with a score of ≥4 (age 3), ≥5 (age 4), or ≥6 (age 5) fall into S-ECC [Lida et al., 2007; Kaste et al., 2005; Vadiakas, 2008; American Academy of Pediatric Dentistry, 2008].

The main cause of this disease is a consistently habitually incorrect diet, especially the intake of sugars at nighttime to aid the child’s sleep. These substances adhere to the dental surface when the salivary clearance is reduced and thus create favorable conditions for the organisation of the plaque responsible of dental caries [Bruerd et al., 1996; Danila et al., 2007].

Other aetiological risk factors may be involved, such as dental structure, immunological efficiency or systemic pathological conditions.

The importance of ECC can be found in its linked sociocultural problems and in its short and long time effects, depending on the medical status of the patient.

Some studies focus how dental caries can affect growth indirectly, by altering the correct trend of auxological parameters in childhood, such as weight and height [Acs et al., 1992; Ayhan et al., 1996]. At the basis of this mechanism there may be an inhibition of release of Growth Hormone (GH), as a consequence of the increased secretion of glucocorticoids, commonly linked to body reaction at stress and pain of pulp or periodontium [Beelke et al., 2003; Jenny et al., 2007; Van et al., 2000]. This hypothetic pathogenesis could start with the rapid progression of dental caries, with complete destruction of coranal hard tissues, which could determine chewing deficit; moreover the continuous waking during the night, due to oral pain, inhibits a relaxing sleep, with consequent major stress and nervousness and further increasing in glucocorticoid secretion and deeper inhibition of GH release [Beelke et al., 2003]. The extension of lesions and pain, which increase with chewing activity but also with the simple introduction of food into the mouth, also determines changes in the diet, that tend to become liquid or semi-liquid, with subsequent reduction of caloric intake [Jenny et al., 2007; Van et al., 2000; Myasthenia gravis Foundation of America, 2008; Clarke et al., 2006]. This latter effect, together with the reduction in GH serum levels, would explain the inhibitory effect on growth parameters.
Materials and methods

This study involved 830 healthy children with complete primary dentition and of age ranging from 3 to 6 years, from the Paediatric Dentistry Department of Rome "Sapienza" University between September 2005 and July 2007. The sample was divided into two groups: 586 children with ECC, and 244 caries-free children (control). The study was approved by the Ethical Committee and informed written consents were obtained by the parents of the young patients.

Demographics, dmft, number of teeth with pulp affected by caries, BMI percentile, weight at birth, weight and height of both parents were measured during the clinical evaluation. In addition, parents informed about food preferences and habits of their children and sleeping alterations, such as disturbed or disrupted sleep.

Clinical examinations and radiographs were used to determine: decayed, missing, or filled teeth (dmft) and the number of teeth with pulp affected by caries. BMI percentile (weight in kilograms/height in meters) was calculated using current Centers for Disease Control and Prevention (CDCP) equation to classify children into 4 categories in an ECC age and sex-matched group.

The study sample included 585 children with caries, mean age 4.6 ± 1 month, 318 males and 267 females and 243 children without caries, mean age 4.7 ± 1 month, 117 males and 126 females (Table 1). The most important characteristics of the study sample are summarised in Table 2, dental caries is correlated with lower socioeconomic status, 80% of children were Caucasian, 44.38% took high sugary drinks such as fruit juice, and 31.40 and 47.10% of children presented sleeping alterations such as disturbed and disrupted sleep, respectively.

Results

The study sample included 585 children with caries, mean age 4.6 ± 1 month, 318 males and 267 females and 243 children without caries, mean age 4.7 ± 1 month, 117 males and 126 females (Table 1).

A comparison was done examining differences in height and weight in presence of the different, above mentioned, factors and lifestyle behaviors [Low et al., 1999]. The present study aims to assess the variability of growth parameters such in caries-free 3 to 6 year-old children and in an ECC age and sex-matched group.

However other studies have found a positive relationship between dental caries and childhood obesity [Kantovitz et al., 2006; Sheller et al., 2009]. Marshall et al. [2007] reported that obese children presented many caries, belonged to a poor family, and also had obese parents. In fact, in the same study the BMI of both parents and children was calculated and showed higher values in the group of children affected by ECC.

The mechanism underlying this possibility are largely unknown, but some facts can be stated. The “2000 Surgeon General’s Report” acknowledged that dental caries represent the most important chronic disease of childhood, affecting 58.6% of children between 5 and 17 years of age. Childhood obesity shows a lower prevalence than caries, as it concerns 10.3% of children aged 2 to 5 years, and 15.8% of children between 6 and 11 years of age. Obese children are at higher risk for dental caries, and clinical controls clearly show that they frequently lose their teeth, and often caries and obesity coexist in children of low socioeconomic status [Gerdin et al., 2008].

Additional studies have also reported no association between dental caries and obesity [Antoniazzi et al., 2000; ACS et al., 1999; Thomas et al., 2002].

The association between dental caries and growth alterations is complicated because of several variables such as biological, genetic, socio-economic, cultural, dietary factors and lifestyle behaviors [Low et al., 1999].

The present study aims to assess the variability of growth parameters such in caries-free 3 to 6 year-old children and in an ECC age and sex-matched group.

Statistical analyses were performed using standard statistical software (SPSS Version 13). Results are expressed as mean ± SD and frequencies (percentages), depending on the data type. Data were compared by taking into consideration children’s age, caries’ degree, weight, height and BMI [Luciano et al., 1997]. Comparisons of mean values were made where appropriate, using the unpaired samples t-test with unequal variances (after this assumption was tested). Values of p < 0.05 were considered statistically significant.

The mechanism underlying this possibility are largely unknown, but some facts can be stated. The “2000 Surgeon General’s Report” acknowledged that dental caries represent the most important chronic disease of childhood, affecting 58.6% of children between 5 and 17 years of age. Childhood obesity shows a lower prevalence than caries, as it concerns 10.3% of children aged 2 to 5 years, and 15.8% of children between 6 and 11 years of age. Obese children are at higher risk for dental caries, and clinical controls clearly show that they frequently lose their teeth, and often caries and obesity coexist in children of low socioeconomic status [Gerdin et al., 2008].

Additional studies have also reported no association between dental caries and obesity [Antoniazzi et al., 2000; ACS et al., 1999; Thomas et al., 2002]. The present study aims to assess the variability of growth parameters such in caries-free 3 to 6 year-old children and in an ECC age and sex-matched group.

Materials and methods

This study involved 830 healthy children with complete primary dentition and of age ranging from 3 to 6 years, from the Paediatric Dentistry Department of Rome "Sapienza" University between September 2005 and July 2007. The sample was divided into two groups: 586 children with ECC, and 244 caries-free children (control). The study was approved by the Ethical Committee and informed written consents were obtained by the parents of the young patients.

Demographics, dmft, number of teeth with pulp affected by caries, BMI percentile, weight at birth, weight and height of both parents were measured during the clinical evaluation. In addition, parents informed about food preferences and habits of their children and sleeping alterations, such as disturbed or disrupted sleep.

Clinical examinations and radiographs were used to determine: decayed, missing, or filled teeth (dmft) and the number of teeth with pulp affected by caries. BMI percentile (weight in kilograms/height in meters) was calculated using current Centers for Disease Control and Prevention (CDCP) equation to classify children into 4 categories in an ECC age and sex-matched group.

The study sample included 585 children with caries, mean age 4.6 ± 1 month, 318 males and 267 females and 243 children without caries, mean age 4.7 ± 1 month, 117 males and 126 females (Table 1).

The most important characteristics of the study sample are summarised in Table 2, dental caries is correlated with lower socioeconomic status, 80% of children were Caucasian, 44.38% took high sugary drinks such as fruit juice, and 31.40 and 47.10% of children presented sleeping alterations such as disturbed and disrupted sleep, respectively.

Mean NCHS weight percentile by age was 66.79 in the control group and 60.25 in the ECC group (Table 3).

A comparison was done examining differences in height and weight in presence of the different, above mentioned, factors and lifestyle behaviors [Low et al., 1999]. The present study aims to assess the variability of growth parameters such in caries-free 3 to 6 year-old children and in an ECC age and sex-matched group.

Statistical analyses were performed using standard statistical software (SPSS Version 13). Results are expressed as mean ± SD and frequencies (percentages), depending on the data type. Data were compared by taking into consideration children’s age, caries’ degree, weight, height and BMI [Luciano et al., 1997]. Comparisons of mean values were made where appropriate, using the unpaired samples t-test with unequal variances (after this assumption was tested). Values of p < 0.05 were considered statistically significant.

The present study aims to assess the variability of growth parameters such in caries-free 3 to 6 year-old children and in an ECC age and sex-matched group.

Results

The study sample included 585 children with caries, mean age 4.6 ± 1 month, 318 males and 267 females and 243 children without caries, mean age 4.7 ± 1 month, 117 males and 126 females (Table 1).

The most important characteristics of the study sample are summarised in Table 2, dental caries is correlated with lower socioeconomic status, 80% of children were Caucasian, 44.38% took high sugary drinks such as fruit juice, and 31.40 and 47.10% of children presented sleeping alterations such as disturbed and disrupted sleep, respectively.

Mean NCHS weight percentile by age was 66.79 in the control group and 60.25 in the ECC group (Table 3).

A comparison was done examining differences in height and weight in presence of the different, above mentioned, factors and lifestyle behaviors [Low et al., 1999]. The present study aims to assess the variability of growth parameters such in caries-free 3 to 6 year-old children and in an ECC age and sex-matched group.

Statistical analyses were performed using standard statistical software (SPSS Version 13). Results are expressed as mean ± SD and frequencies (percentages), depending on the data type. Data were compared by taking into consideration children’s age, caries’ degree, weight, height and BMI [Luciano et al., 1997]. Comparisons of mean values were made where appropriate, using the unpaired samples t-test with unequal variances (after this assumption was tested). Values of p < 0.05 were considered statistically significant.

A comparison was done examining differences in height and weight in presence of the different, above mentioned, factors and lifestyle behaviors [Low et al., 1999]. The present study aims to assess the variability of growth parameters such in caries-free 3 to 6 year-old children and in an ECC age and sex-matched group.

Statistical analyses were performed using standard statistical software (SPSS Version 13). Results are expressed as mean ± SD and frequencies (percentages), depending on the data type. Data were compared by taking into consideration children’s age, caries’ degree, weight, height and BMI [Luciano et al., 1997]. Comparisons of mean values were made where appropriate, using the unpaired samples t-test with unequal variances (after this assumption was tested). Values of p < 0.05 were considered statistically significant.

A comparison was done examining differences in height and weight in presence of the different, above mentioned, factors and lifestyle behaviors [Low et al., 1999]. The present study aims to assess the variability of growth parameters such in caries-free 3 to 6 year-old children and in an ECC age and sex-matched group.

Statistical analyses were performed using standard statistical software (SPSS Version 13). Results are expressed as mean ± SD and frequencies (percentages), depending on the data type. Data were compared by taking into consideration children’s age, caries’ degree, weight, height and BMI [Luciano et al., 1997]. Comparisons of mean values were made where appropriate, using the unpaired samples t-test with unequal variances (after this assumption was tested). Values of p < 0.05 were considered statistically significant.
both ECC and controls subjects with the respective height target showed that children with D3 ECC are the most distant from their parents-based height target. As for males, this is already evident at the age of 4 years, but is more remarkable at the age of 5 and 6 years (more than 50% of children showing the characteristic), with a constant increase (i.e. higher percentages) from 3 to 6 years (Table 6). Females show a similar behaviour (Table 7), though it seems to affect more females with D2 level ECC, and it is better defined by the age of 6 years. Furthermore percentages are not as high and well profiled as they appear to be among males (Table 6, 7).

**Discussion**

The aim of this study was to help recognise whether ECC can affect growth parameters, and in which direction. In particular, the involvement of dental and periodontal tissues can have a negative effect on a child’s chewing abilities and psychophysical wellness, thus determining a change in what and how he/she eats, and in sleeping habits as well, with substantial negative consequences on weight and height [Acs et al., 1992; Thomas et al., 2002; Liang et al., 2008; Filstrup et al., 2003]. The possibility that children with S-ECC have a lower incidence of obesity deserves to be discussed. Looking at this concept from a contrasting point of view, paediatricians and children caretakers should be aware of the fact that a child who is slimmer than normal, and possibly shorter than normal, with an unhealthy diet, might have chewing problems, which could be linked to ECC/S-ECC or other oral conditions [Tuomi, 1989; Chen et al., 1998].

Even though this was not an object of this study, it is well known [Guiton et al., 2003; Bernasconi et al., 2001; Acs, 1999] that a variation of GH levels usually occurs in children about 6 years old, which is a time when there is a first growth spurt, and when the phenomenon of adiposity rebound takes place. Among other influencing factors, GH circulating levels are linked to the sleeping pattern [Beelke et al., 2003; Jenni et al., 2007; Van et al., 2000], which is impaired in children with ECC, and especially with S-ECC. This is another possibility to explain why dental caries in early childhood become a favoring factor of a possible growth impairment, more than a direct aethiological factor. The case group was compared with a control group having a similar socioeconomic status, and considering the mean BMI the control group ranges within

<table>
<thead>
<tr>
<th>Age</th>
<th>Control</th>
<th>ECC</th>
<th>D1 ECC</th>
<th>D2 ECC</th>
<th>Severe</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>63.00</td>
<td>66.19</td>
<td>64.12</td>
<td>73.68</td>
<td>60.88</td>
<td>65.39</td>
</tr>
<tr>
<td>4</td>
<td>64.30</td>
<td>62.12</td>
<td>64.59</td>
<td>59.65</td>
<td>62.36</td>
<td>62.73</td>
</tr>
<tr>
<td>5</td>
<td>66.39</td>
<td>57.55</td>
<td>64.66</td>
<td>64.42</td>
<td>60.21</td>
<td>62.71</td>
</tr>
<tr>
<td>6</td>
<td>71.03</td>
<td>56.65</td>
<td>65.83</td>
<td>59.29</td>
<td>44.45</td>
<td>61.38</td>
</tr>
<tr>
<td>Total</td>
<td>66.79</td>
<td>60.25</td>
<td>64.85</td>
<td>63.90</td>
<td>52.45</td>
<td>62.17</td>
</tr>
</tbody>
</table>

**TABLE 2** - Characteristics of sample with ECC.
the normality. On the contrary, the ECC group, and especially the subgroup with severe ECC, presents a lower BMI; in particular, this reduction is much more evident among 5-6 year-old children (Table 3, 5).

The different BMI values can be essentially explained by the chewing difficulties of these patients, with the progression of caries, since they are caused either by destruction of dental hard tissues or by pain evoked by the contact with food. The collection of data about eating habits and food preferences proves it: a generalised comment of our patients’ mothers was that their children had difficulties in chewing solid food like meat, and preferred soft or liquid foods like processed cheese, meatballs, milk, cookies or potatoes. The ingestion of food that is poorly chewed does not allow a good digestive process, leading to a reduction in the intake and absorption of nutrients. Moreover, the same chewing troubles lead to a change in the children's diet, consistent with the necessity to make the eating process shorter, a way to reduce both level and duration of the pain produced by food ending up in the teeth cavities [Myasthenia Gravis Foundation of America Inc. 2008, American Academy of Pediatric Dentistry 2005]. As a consequence, these children tend to prefer liquid, semi-liquid, or semi-solid refined foods: they are easier to chew and ingest than the solid ones, and, at the same time, give a good, although transient, satiety feeling. This might, in turn, be responsible for a reduced, yet undemonstrated, intake of food [Myasthenia Gravis Foundation of America Inc., 2008].

Another effect of the new eating habit is that the diet becomes richer in carbohydrates and lipids, but poor in proteins, especially in high-value ones. With the major exception of milk and eggs, high-value proteins are, in fact, contained in solid animal food like meat and fish, or in certain combinations of vegetable foods, like cereals and legumes. These types of proteins, complete and well-balanced in their amino-acidic profile, are fundamental for children's growth, but are contained in foods with a greater consistency thus requiring a greater chewing activity, in order to make a correct digestion possible and the subsequent absorption of the nutritional factors needed for muscular and skeletal growth [Luciano et al., 1997].

The changes in diet habits are:
1) intake of easy-to-eat and less consistent food;
2) food with higher lipid and carbohydrate contents;
3) possible reduced intake of food/meals;
4) more frequent snacks or munching due to the missed satiety during regular meals.

All the above can be regarded, under a calorie-protein point of view, as a form of malnutrition, and under the point of view of quality of diet, as a factor towards the possible development of overweight and obesity. The latter can be particularly true even after caries have been treated, since children (and families) tend not to change their past and incorrect eating habits, even after the initial problem has been solved.

Assessment of the genetic growth target confirms that children affected by S-ECC tend to show a lower height percentile than that allowed by their parent-bound target, and statistically quite different from that of their control mates.

Family-based behavioral programmess have been suggested to teach the skills needed to establish and sustain healthier eating patterns and physical activity.

Conclusion

Based on this study's results, the following conclusions can be reached.
• A significant number of children with severe ECC, in particular 5-6 year-olds, are underweight.
• Based on confidence intervals, however, the mean BMI percentile of the ECC group was not significantly different from that of the control children.
• The weight loss associated to severe ECC is very likely

<table>
<thead>
<tr>
<th>Group</th>
<th>obs</th>
<th>mean</th>
<th>Std. Err.</th>
<th>Std. Dev.</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without caries</td>
<td>243</td>
<td>16.26</td>
<td>.17</td>
<td>2.64</td>
<td>15.93 - 16.60</td>
</tr>
<tr>
<td>Caries-free</td>
<td>585</td>
<td>16.20</td>
<td>.15</td>
<td>3.54</td>
<td>15.91 - 16.48</td>
</tr>
<tr>
<td>combined</td>
<td>828</td>
<td>16.22</td>
<td>.11</td>
<td>3.30</td>
<td>15.99 - 16.44</td>
</tr>
<tr>
<td>diff</td>
<td></td>
<td>0.07*</td>
<td>.22</td>
<td>-0.37</td>
<td>0.51</td>
</tr>
</tbody>
</table>

*p=0.7584

TABLE 5 - mean BMI of subjects with ECC and caries-free.
the result of a diet modification induced by the pain connected to chewing and munching.

- Dental caries can be considered an important exogenous factor underlying and helping a condition of wrong dieting able to negatively influence child growth.

References


