

# Obesity in Children: A Challenge that Pediatric Dentistry Should not Ignore – Review of the Literature

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*The link between childhood oral diseases and obesity is demonstrated by their increasing prevalence, potential cause and effect relationship, the significant deleterious effect on the child's present and future oral and systemic health, and the influence of obesity on conscious sedation. The purpose of this manuscript is to review the literature on the relationships between childhood oral diseases and obesity, and between obesity, breathing and conscious sedation. While some reports suggest a connection between caries and obesity others do not, and it is unclear if they correlate or they just coexist since they have common etiologic and/or facilitating factors. Deleterious effects of dental caries and obesity on the systemic condition are clear, may potentiate each other, and facilitate the development and progress of chronic or acute systemic conditions. Obesity may interfere with the possibility to sedate patients because of potential breathing problems, or modify the effect of the sedative agents. Health providers should be aware of the increasing challenge posed by the correlations between dental caries, obesity, oral and systemic diseases. Furthermore, pediatric dentistry should team with other health professions in order to cooperate in the prevention and treatment of these diseases.*

**Keywords:** obesity, caries, children.

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## INTRODUCTION

Pediatric dentists should be aware of the scientific literature that implicates childhood dental caries and obesity, which may have deleterious effects on the child's present and future oral and systemic health. Moreover, it may be possible that these 2 diseases potentiate each other's detrimental impact, which in severe cases may lead to tragic consequences. However, the data provided in the literature is still scarce and sometimes unclear. In addition, obesity may significantly interfere or influence the effect of pediatric dental conscious sedations due to breathing difficulties. The purpose of this manuscript is to review the literature on the relationships between childhood oral diseases and obesity, and between obesity, breathing, and conscious sedation.

## Review of the literature

A literature search for articles in the English language

from 1990 utilizing PubMed (<http://www.ncbi.nlm.nih.gov/sites/entrez>) was done. The used key words were: "oral disease," "dental caries" and "systemic diseases" linked with "obesity," "BMI" and "obstructive sleep apnea." In addition, manuscripts were identified from the reference lists of retrieved papers.

### *Etiology of caries and obesity*

While some of the etiologic factors of dental caries and obesity may interrelate, others may just be common to both diseases: dental caries is a multi factorial infectious disease which can be affected by oral hygiene, diet composition and frequency, socioeconomic status, salivary immune globulins, bacterial load, and fluoride intake;<sup>1,2,3</sup> obesity is a disease in which diet energy intake exceeds the body energy requirements resulting in an excess in body fat.<sup>4</sup>

Environmental changes and life style promoting increased energy intake and decreased energy output have a widespread impact on children, facilitating the recent increases in the prevalence of overweight and obesity among American children, as expressed by a body mass index (BMI) of >85th percentile,<sup>5</sup> (BMI=weight in kg/height in cm<sup>2</sup>). This phenomenon having no age, gender, or ethnic group limitations.<sup>6</sup> Diet has a most significant role in the etiology of dental caries.<sup>3</sup> For example, it has been demonstrated that children who consumed more soft drinks relative to milk and 100 percent fruit juice were at a greater risk of developing dental caries as they grew older.<sup>7,8</sup>

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**Prevalence of caries and obesity**

Dental caries is still the most prevalent chronic disease in children,<sup>9</sup> and obesity rates have increased dramatically in the last years.<sup>10</sup> In fact, dental caries remains an increasing challenge because the possibility of its development at an early age, and the fact that the prevalence of caries in the primary dentition may correlate with caries in the permanent dentition.<sup>11, 12</sup> Childhood overweight has more than doubled in the past 25 years;<sup>13</sup> 14% of children and 12% of adolescents were overweight in the United States by 1994 as defined by a BMI of >85th percentile.<sup>5</sup> The National Health and Nutrition Examination Survey (NHANES) data from a children survey in 1999–2000 revealed that 30.3% of children 6 to 11 years of age had a >85th percentile BMI.<sup>14</sup> Most relevant is the possibility that obese children have a significant possibility to become obese adults.<sup>15</sup>

**The relationship between caries and obesity**

It is unclear if there is a correlation between caries and obesity, or they just coexist since they have common etiologic factors such as diet and socioeconomic status.<sup>16, 17</sup> One could expect that as the result of diet habits, obese children will have a higher prevalence of caries when compared to children who are with a normal or lower than normal weight. On the other hand, it may be possible that children with severe caries have difficulty eating and therefore, be underweight.<sup>17</sup> In fact, the literature does not indicate consistent findings (Table 1).<sup>16, 18–24</sup> For example, Kopycka-Kedziorawski *et al* (2008)<sup>25</sup> reviewed the data of the NHANES 1999–2002 and NHANES III and summarized that overweight children do not have an increased risk for dental caries after controlling for age, race, and poverty/income ratio. Moreover, the data from NHANES III suggested that being overweight may be associated with decreased rates of caries in older children. On the other hand, Alm *et al* (2008)<sup>16</sup> indicated that overweight and obese adolescents had more proximal caries

than normal-weight individuals, and that the frequent consumption of snacking products during early childhood appears to be a risk indicator for caries at 15 years.

**Caries and systemic diseases**

Bacteria from dental abscesses have been reported as the source of cerebral abscesses, orbital complications in children and adults (leading to visual loss in the latter), endocarditis, and Ludwig’s angina,<sup>26–29</sup> which is a rapidly progressive gangrenous cellulitis involving the submandibular space, with possible airway obstruction.<sup>30</sup> With early adequate treatment the patients may recover, however, it may lead to death in if left untreated and in systemically affected individuals.<sup>26</sup> It should also be noted, that it has been suggested that there is a relationship between dental caries and systemic parameters of inflammation, as the concentration of immunoglobulin G against *Streptococcus mutans* and of acute-phase  $\alpha_1$ -acid glycoprotein have been found to significantly correlate with caries prevalence in children.<sup>31</sup>

**Obesity and systemic diseases**

A possible relationship between obesity and systemic diseases in adults has been suggested in the literature. In addition, childhood obesity is associated with significant morbidities, which not only have immediate impact on the health of obese children, but also significantly increase the risk of morbidities in adulthood.<sup>32</sup> Development of insulin resistance and type 2 diabetes,<sup>33, 34</sup> and the association of obesity, insulin resistance, glucose intolerance, hypertension, and a characteristic dyslipidemia, or metabolic syndrome (MS), may predispose individuals to diabetes and cardiovascular disease.<sup>14, 35, 36</sup>

While some authors believe that child obesity and breathing sleep disorders have no straightforward association,<sup>37</sup> others believe that obesity is a classic cause for alveolar hypoventilation and obstructive sleep apnea syndrome

**Table 1.** Research studies on the association between obesity and caries prevalence.

Authors	Country	N*	Age in years	Conclusions
Tuomi (1989) <sup>18</sup>	Finland	516	8-17	Obesity itself was not a good predictor for dental decay, early obesity and caries experience may be used as predicting indicators of the true risk group.
Willerhausen <i>et al</i> (2004) <sup>19</sup>	Germany	842	6-11	There is a relationship between an increase in dental caries and high weight
Pinto <i>et al</i> (2007) <sup>20</sup>	USA	135	8-9	No association between caries prevalence and obesity. Note: population with a low caries rate.
Willerhausen <i>et al</i> (2007a) <sup>21</sup>	Germany	1290	6-10	There is a significant association between caries frequency and weight.
Willerhausen <i>et al</i> (2007b) <sup>22</sup>	Germany	2071	6-10	A significant correlation between BMI and caries persisted even after adjusting for age.
Granville-Garcia <i>et al</i> (2008) <sup>23</sup>	Brazil	2651	1-5	No relationship was found between dental caries and obesity.
Alm <i>et al</i> (2008) <sup>16</sup>	Sweden	402	1-15	Consumption of snacking products at an early age may associate with proximal caries at age 15 years.
Sheller <i>et al</i> (2009) <sup>24</sup>	United States of America	293	2-5	Children with severe early childhood caries do not have a typical weight distribution. A significant number of children with severe early childhood caries are underweight.

\*N = number of subjects

(OSA),<sup>38</sup> which is characterized by episodes of upper airway obstruction during sleep.<sup>39</sup> The most common cause for sleep-related breathing disorders is adenotonsillar hypertrophy.<sup>39</sup> Moreover, obesity and enlarged adenotonsillar tissues have been described as the two major risk factors for obstructive sleep apnea in children.<sup>40</sup> Consequently, adenotonsillectomy has been considered to be safe and the first-line treatment of OSA in obese patients.<sup>41</sup> Obese and non-obese individuals show a dramatic improvement in OSA after adenotonsillectomy, however, since adenotonsillectomy may only improve but not resolve obstructive sleep apnea, persistent sleep apnea is more common in obese children.<sup>42, 43</sup>

Pediatric OSA, particularly when obesity is present, is associated with substantial end-organ morbidities that primarily but not exclusively affect the central nervous and cardiovascular systems; this may be related to gene variants and environmental and lifestyle patterns.<sup>44</sup> Sleep disorder breathing is associated with higher levels of systolic blood pressure in children aged 5-12 years, even after adjusting for age, sex, race, BMI, or waist circumference.<sup>45</sup> These findings are most significant since OSA may increase the risk for systemic hypertension, promote ischemic heart disease and the propensity for stroke, and may lead to chronic systemic inflammation and endothelial dysfunction along with metabolic disturbances.<sup>40</sup> In addition, in children with OSA, morning urinary norepinephrine, epinephrine levels and catecholamines are significantly higher than those without OSA, correlate with the severity of the disease, but do not correlate with obesity.<sup>40</sup>

Poor sleep quality in association with prehypertension in healthy adolescents can not be associated with socioeconomic status, obesity apnea, or known co morbidities, suggesting that inadequate sleep activity is associated with elevated blood pressure.<sup>46</sup> Obese children and adolescents have an increased short (during childhood) and long risk (into adulthood) for cardiovascular risks; for example, obese children who have high blood pressure that may partially related to obstructive sleep apnea, may lead to ventricular hypertrophy. In addition, obese children have been found to have abnormal levels of lipids and insulin.<sup>47</sup>

### Obesity, sedation and apnea in children

Of significant interest to pediatric dentists is that "android obesity" in which fat is distributed primarily intra-abdominally is highly linked to oxygen consumption, cardiovascular risk, and left ventricular dysfunction, and may complicate respiration during dental treatment, specially under sedation.<sup>48</sup> Obesity is a condition in which patients are considered to have chronic compromised systems (restrictive lung disease, cardiovascular, gastrointestinal etc.), which can contribute to major injuries during sedation. Respiratory derangement associated with obesity can compromise the quality of sedation, and put the patients' life at risk since obesity may impede the motion of the diaphragm especially in a supine position.<sup>48</sup> Therefore, the election of sedative agents for an obese patient should have minimal to none

respiratory depression effect. An additional factor is that pharmacokinetics in obese people may influence drug absorption, distribution, metabolism and excretion; for example, sedative agents may require a longer time to affect due to the increased distribution in body fat, but after the appointment the fat-sequestered sedative will slowly return to the systemic circulation, resulting in a longer elimination.<sup>48</sup>

### Obesity and periodontal diseases

While a significant number of studies have reported an association between obesity as reflected by BMI and periodontal diseases in adults,<sup>49-51</sup> only few reports are available on this association in children, probably reflecting the concept that periodontal diseases in children have a relative small prevalence when compared to adults. The current literature supports an association between periodontal disease and overweight in the pediatric population.<sup>52, 53</sup> In view of the looming epidemic of obesity in children due to sedentary life style and unhealthy nutritional habits, it is more than likely that this association will be bolstered by additional epidemiological and interventional studies.

Diabetes in children may be often associated with increased risk for periodontal diseases. A study on the oral status of diabetic children compared to a control group indicated that:<sup>54</sup> a) there were no differences between case and control subjects with respect to dental caries; b) children with diabetes had significantly higher plaque and gingival inflammation levels, and had a higher number of teeth with evidence of attachment loss. These results, were significant even after controlling for age, sex, ethnicity, gingival bleeding, and frequency of dental visits, especially in the 12- to 18-year-old subgroup. In the case group, BMI was significantly correlated with destruction of connective tissue attachment and bone.

### CONCLUSIONS

Health providers should be aware of the increasing challenge posed by the correlations between dental caries, obesity, oral and systemic diseases. Furthermore, pediatric dentistry should team with other health professions in order to team in the prevention and treatment of these diseases.

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