Association between obesity and periodontal disease in children

**ABSTRACT**

**Aim** The objective of this study was to analyse the relationship between obesity and periodontal disease in children. The null hypothesis is that obese and normal weight children show no different degree of periodontal status.

**Methods** The sample for this case control study consisted of 20 males and 24 females with a mean age of 9.43±2.05 years old and mean body mass index standard deviation score (BMI-SDS) of 2.16±0.37 in the test group, and 33 males and 26 females with a mean age of 9.67±1.46 years old and BMI-SDS of 0.22±1.79 in the control group. The periodontal status was assessed using plaque accumulation, bleeding on probing (BOP) index, probing depth (PD) and clinical attachment level (CAL).

**Results** The test group showed higher plaque deposits and BOP and the difference between the two groups was statistically significant (p< 0.05). No significant difference between the two groups was found regarding the loss of clinical attachment, though it was worse in obese children. Categorical variables described as frequency and percentage were compared using the Fisher’s exact test or test $\chi^2$. Continuous variables were analysed using the Mann-Whitney test.

**Conclusion** The study showed an association between obesity and periodontal risk indicators in children that in the long term may lead to oral conditions. The oral health of overweight/obese subjects should be more carefully supervised and checked in order to prevent oral alterations.

**Keywords** Childhood obesity; Periodontal disease; BMI sds.

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**Introduction**

Obesity is one of the most significant health risks for diabetes, cardiovascular disease, and periodontal disease. Moreover, the prevalence of obesity in children and adolescents has more than doubled in the past 25 years [Expert Panel, 1998; Mokdad et al., 2004; Ogden et al., 2006].

Obese adolescents are more likely to become obese adults and obese adults have an increased risk of morbidity and mortality [Costacurta et al., 2011; Giuca et al., 2012; Marchetti et al 2012].

It is possible to distinguish two types of obesity: primary, caused by an imbalance between food intake and energy expenditure, and secondary, linked to endocrine and genetic diseases, such as Cushing’s syndrome, hyperthyroidism, insulinoma, Stein-Leventhal syndrome, endocrine hypothalamic disorders [Ogden et al., 2002]. Genetic factors have a role in the aetiology of obesity; certain monogenic forms of obesity are characterised by defective genes that codify for molecules involved in the hypothalamic regulation of energetic balance [Wardle et al., 2008].

Control over the energetic balance of the body is associated to a great variety of messenger molecules that connect the hypothysis and the entire endocrine system to hepatocytes, adipocytes and muscles. Alterations in this balance can cause fat build-up [Schuller, 2004]. Furthermore, recent studies have suggested that obesity is also associated with oral diseases, particularly with periodontal disease [Dalla Vecchia et al., 2005]. In fact, the adipose tissue secretes several cytokines and hormones during the inflammatory process, suggesting that similar pathways are involved in the pathophysiology of obesity and periodontitis, but the underlying biological mechanisms for this association are not well known.

The aim of the present study was to analyse the relationship between obesity and periodontal disease among adolescents.

**Materials and methods**

Patients reporting to the Department of Paediatric Dentistry of the University of L’Aquila, L’Aquila, Italy, from 2009 to 2011, who were in the permanent or late mixed dentition, whose parents or guardians signed an informed consent form, were eligible for inclusion in the study. Subjects were not included in the study if any of the following exclusion criteria were present: age below 6 years old or above 13 years old, patients who had received periodontal treatment or antibiotics treatment during the previous 3 months, chronic use of antinflammatory drugs and pre-medication within three months prior to study, systemic diseases that might have caused alterations of the periodontal status.
A total of 104 subjects were considered eligible for this study.

The body adiposity status of each subject was evaluated by the same operator, using the International Obesity Task Force classification, to allocate the subjects in the test or control group according to a study of case-control type.

The BMI is used to assess weight status in children and adolescents as well as adults, but whereas in adults the BMI cut points that define obesity and overweight are not linked to age and do not differ for males and females, in growing children BMI varies with age and sex. For this reason the BMI value was matched to a corresponding percentile on the international charts according to the patient's age and gender in order to calculate the BMIsds (standard deviation score of patient's body mass index) which is based on pooled international data that links the accepted adult cut-off points, a BMI of 25 Kg/m² for overweight and 30 Kg/m² for obesity, to body mass index centiles for children while constructing bridging cut-off points related to age for children [Cole et al., 2000].

According to the BMI-SDS, 44 obese subjects were included in the test group and 60 normal weight patients were included in the control group.

The periodontal status of each subject was examined by the same calibrated operator blinded to the BMI-SDS of the subjects, with a mouth mirror and UNC 15 periodontal probe. The clinical findings were rounded up to the nearest millimeter and each examination was performed with a 1-week interval in order to evaluate the intra-examiner error (Kappa statistics: 0.78).

The following periodontal clinical parameters were recorded for each tooth.

- **Plaque accumulation:** was evaluated recording the presence or absence of plaque visible to the naked eye on each tooth surface.
- **Bleeding On Probing (BOP):** was evaluated recording the presence or absence of bleeding up to 15 seconds after gentle probing.
- **Probing Depth (PD):** is the depth to which the periodontal probe penetrates into a periodontal pocket. A calibrated UNC 15 probe was inserted parallel to the long axis of each tooth in order to measure the distance from the gingival margin to base of sulcus or pocket to the nearest millimeter, at four sites of a tooth (mesio-buccal, buccal, disto-buccal, and mid-lingual). The deepest pocket was considered among all PD measurements.
- **Clinical Attachment Level (CAL):** is the distance between the cementoenamel junction and the bottom of the pocket or sulcus. The calibrated UNC 15 probe was inserted parallel to the long axis of each tooth at four sites of a tooth (mesio-buccal, buccal, disto-buccal, and mid-lingual). The deepest pocket was considered among all CAL measurements.

**Statistical analysis**

Descriptive analyses were performed to illustrate the demographic and clinical characteristics of the study sample.

To this end, frequencies and percentages were calculated for discrete and nominal variables. Mean and standard deviation were calculated for continuous variables. Assessment of the normality of data distribution was performed using the Shapiro-Wilk test. Discrete variables described as frequency and percentage were compared using the Fisher’s exact test or test $\chi^2$. Continuous variables were analysed using the Mann-Whitney test. The BMI was calculated as weight (in kilograms) divided by height (in square meters). The degree of obesity was quantified using the Cole’s least mean square method, which normalises the BMI skewed distribution and expresses the BMI as an SDS score. The tests employed are bidirectional and used with a significance level of 5%. The data were processed using the program STATA 12 (Stata Corp, TX, USA).

**Results**

No patients dropped out, so according to the BMI-SDS, 20 males and 24 females with a mean age of 9.43±2.05 years old were included in the test group, and 33 males and 26 females with a mean age of 9.67±1.46 years old were included in the control group. The BMI-SDS was 2.16±0.37 in the test group and 0.22±1.79 in the control group (Table 1).

According to the oral examination, in the test group 7 subjects (46.7%) exhibited no plaque accumulation, 5 subjects (18.3%) showed a moderate plaque accumulation (presence of visible plaque in 6-12 teeth) and 32 subjects (35%) severe plaque deposits (presence of visible plaque in at least 13 teeth).

In the control group, 28 subjects (15.9%) exhibited no plaque accumulation, 11 subjects (11.4%) showed a moderate plaque accumulation (presence of visible plaque in 6-12 teeth), and 21 subjects (72.7%) severe plaque deposits (presence of visible plaque in at least 13 teeth). The test group exhibited higher plaque deposits and the difference between the two groups was statistically significant ($p<0.05$) (Table 2).

BOP was observed in 18 patients of the test group (40.9%) and in 9 patients of the control group (15%). The test group showed a significantly higher BOP in comparison with the controls ($p<0.05$).

The test group showed a higher percentage of sites with a PD $\geq$ 4 (26 subjects, 59.1%) than the control group (3 subjects, 3%), and the difference between the two groups was statistically significant ($p<0.05$) (Table 3).

However, none of the patients included in this study exhibited a CAL $\geq$ 3, thus no significant difference was
obesity and periodontal disease

Discussion

Recently, there has been a high interest in drawing bidirectional connections between periodontal inflammation and other medical conditions such as: diabetes, respiratory disease, osteoporosis, adverse pregnancy outcome, coronary heart disease and stroke.

Furthermore, a relationship between obesity and periodontal disease was addressed by several authors both in adults and in children [Dalla Vecchia et al., 2005; Genco et al., 2005].

In obese patients high plasma levels of TNF-α and its soluble receptors were observed, which may lead to a hyper-inflammatory state increasing the risk for periodontal disease [Genco et al., 2005].

Pro-inflammatory cytokines like interleukins (IL-1, IL-6 and TNF-α), adipokines (leptin, adiponectin, resistin and plasminogen activator inhibitors-1) and other bioactive substances like reactive oxygen species (ROS) are directly linked to the extent of obesity in relation to BMI and may harm the periodontal status promoting a gingival inflammation or periodontal breakdown. The relationship between BMI and the inflammatory mediators in gingival crevicular fluid was investigated from 32 obese subjects aged between 13 and 24 years old and found that BMI positively correlates with TNF-α [Lundin et al., 2004]. Obesity increases hosts susceptibility by modulating the host immune and inflammatory system, leaving the patient with a greater risk for periodontitis, impairs the cell-mediated immune response and decreases lymphocyte immune function and natural killer T-cell activity [Saito and Shimazaki, 2000; Dahiya et al., 2012]. The early-onset form of gingivitis and periodontitis comprises a distinctive and significant morbidity among adolescents and young adults [Grossi et al., 2008]. Obesity represents a potential risk factor for periodontal disease and is associated with increased prevalence of periodontitis especially among young subjects, while underweight is associated with decreased prevalence [Al-Zahrani et al., 2003].

The higher plaque index recorded in the obese subjects included in the present study may be due to the excess in calorie consumption and dietary habit.

Furthermore, a positive correlation between periodontal disease and obesity was found: although obese adolescents showed a higher gingival inflammation and a higher number of periodontal pockets, no attachment loss was recorded.

In a cross-sectional study it was observed that obese adolescents exhibited more gingival inflammation and more pathological periodontal pockets but not incipient alveolar bone loss compared with the normal weight subjects [Modéer et al., 2011]. However, it should...
be considered that chronic gingival inflammation in adolescents may lead to a periodontal breakdown in adulthood.

Dentists should include the evaluation of BMI in routine patient examination and eventually refer obese periodontal adolescents for weight reduction interventions like diet therapy, behavioural therapy, pharmacotherapy, so that they can have better control over periodontal inflammation [Dahiya et al., 2012].

**Conclusion**

A positive association between periodontal disease and obesity in adolescent patients was suggested by the findings of the present study.

Obese adolescents exhibited higher plaque index, gingival inflammation, bleeding on probing (BOP) and probing depth (PD) compared to normal weight subjects of similar age.

The overweight/obese subjects showed a worse attitude towards oral hygiene.

No clinical signs of attachment loss were observed in both groups.

While the relationship between obesity and periodontitis needs further investigations, dentists should be aware of periodontal alterations as a potential hazard associated with obesity.

Furthermore, paediatric dentistry should team with other health professions for prevention and treatment of these conditions.

**References**