

# Childhood overweight-obesity and periodontal diseases: is there a real correlation?

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## Summary

**Objective.** The association between obesity and periodontitis has been extensively investigated in adults but not in young people. The aim of this study was to examine the association between overweight-obesity and periodontal disease in pediatric subjects.

**Methods.** Controlled cross-sectional study involving 100 school children of both gender (50 M and 50 F) between 7 and 12 years of age (mean age  $9.19 \pm 1.57$ ). Two groups were formed based on Body Mass Index value: test group with  $BMI \geq 25$   $Kg/m^2$  and control group with  $BMI \leq 24$   $Kg/m^2$ . Diet intake and oral hygiene habits were recorded by a specific questionnaire and the periodontal clinical parameters were evaluated.

**Results.** The periodontal examination in the control group revealed a full-mouth plaque score (FMPS) value equal to 21.86% against 50.08% in the group of patients overweight/obese; the full-mouth bleeding score (FMBS) in the control group amounted to 12.7% against 26.24% of test group. No patient in either group included in the study presented a probing pocket depth (PPD)  $\geq 3$ , so a significant difference regarding this value was not found. Regarding the frequency and quantity of food consumption, the number of obese patients who did not follow a balanced diet largely exceeded the number of normal-weight patients (70 versus 20%).

**Conclusions.** These results focus the attention on the negative impact of obesity on gingival health in young subjects, probably due to a combination of metabolic and inflammatory profiles and the result of a careless attitude towards prevention diseases of the oral cavity.

**Key words:** periodontal diseases, gingival diseases, pediatric obesity, child nutrition disorders, food habits.

## Introduction

Obesity is defined as an excess of body fat that causes an alteration in the balance of the physical person who is affected. The Body Mass Index (BMI) is the most scientifically accurate system to determine the amount of fat mass in a subject: it is measured dividing the weight of the subject in kilograms and the square of his height in meters ( $Kg/m^2$ ). The World Health Organization (WHO) and the National Heart, Lung and Blood Institute (NHLBI) define overweight people with a BMI between 25 and 29.9 and obese with  $BMI > 30$  (1, 2).

The prevalence of obesity has increased dramatically in a rather short period of time, doubling for adults and tripling in children and adolescents (3-8). Around 31% (about 59 million) of American adults is obese and more than 65% reported a  $BMI > 25$ . In addition, 15.8% of children (6-11 years) and 16.1% of adolescents (12-19 years) are suffering from obesity (1-3). The United States of America reflect the prevalence internationally regarding obesity, except for the African continent (3).

Obesity is not only an aesthetic problem but is considered a chronic disease caused by multifactorial etiology represented by genetic, environmental, socio-economic and behavioral components (9-13).

The association between obesity and inflammatory process has long been known. Adipose tissue is in fact an endocrine organ, metabolically active, producing immuno-regulatory factors involved in the regulation of vascular and metabolic processes associated with alterations like high blood pressure, osteoarthritis, other respiratory disorders, diseases of the gallbladder, the hyperlipidemia, atherosclerosis, pancreatitis, hepatitis and diabetes mellitus (3, 14).

Regarding the association between obesity and periodontal disease, several hypotheses have been formulated with the aim to explain the biological interactions including impaired glucose tolerance, abnormal

lipid profile, deficiency of the immune system, an increased activation of macrophages, alterations of the microcirculation and secretion of pro-inflammatory substances by the adipose tissue such as TNF- $\alpha$ , IL-6 and C-reactive protein (15-19).

Although the topic has been treated and investigated in the literature, few appear to be the studies conducted on groups of patients with a specific age range and still today lack the scientific explanations that may justify the higher incidence of periodontal disease in overweight/obese children.

The purpose of this study was firstly to assess the state of periodontal health in a group of obese and normal children between 7 and 12 years in order to determine if there was a real correlation between periodontal diseases and obesity and, secondly, to find a possible cause of this relationship.

## Material and methods

One hundred patients (50 males; 50 females) aged 7-12 years (mean age  $9.19 \pm 1.57$ ), referred at Department of Oral and Maxillo-Facial Sciences - "Sapienza" University of Rome, Division of Pediatric Dentistry, between September 2013 and September 2014, were included in the study. The selected patients were divided into 2 groups based on Body Mass Index (BMI): the test group included 50 patients overweight/obese with  $BMI \geq 25 \text{ kg/m}^2$ ; the control group was represented by 50 children of normal weight with BMI ranging between  $18.5\text{-}24.9 \text{ kg/m}^2$ .

The ethical committee of "Sapienza" University of Rome approved the study protocol (CE 3732 – 26/10/2015), and for each patient the relative informed consent form was obtained.

The study was designed as an observational case-control to assess the state of periodontal health in children obese/overweight *versus* normal weight children.

The statistical analysis of data was performed by mean  $\pm$  standard deviation of each measured parameter.

### Inclusion criteria:

- Children aged between 7-12 years (males and females);
- Absence of systemic diseases;
- No drugs intake within 7 days before the visit.

### Exclusion criteria:

- Girls had menarche.

To avoid bias related to teeth eruption states, the measures were made only on the first permanent molars and the upper and lower central and lateral incisors. The deciduous teeth were not included in the periodontal evaluation.

For each patient an anamnestic folder containing information about the personal data and medical history was compiled: in addition children were asked to fill out a questionnaire regarding their oral hygiene habits – i.e. how many times the child brushes his teeth, the presence of pain and/or bleeding during the tooth brushing etc., and their lifestyle – i.e. their food habits, possible food intolerances, but also the time spent watching TV and/or playing sports, etc. Moreover, the Authors investigated about the possible presence of sleep disorders (such as noisy breathing, apnea, para-functions, etc.).

The following data were collected for every patient:

- Age
- Weight (Kg)
- Height (cm)
- BMI (Body Mass Index) value, according to the program of the 'US Department of Health & Human Services'.

For each patient both a photographic examination, comprising 5 photos (Fig. 1), and an evaluation of the periodontal health, using mirror and periodontal probe UNC 15 (Fig. 2), were performed by a single operator to evaluate the following clinical parameters:

- full mouth plaque score (FMPS): the full-mouth plaque score is defined as the percentage of sites where plaque is present divided by the number of sites examined;
- full-mouth bleeding score (FMBS): the full-mouth



Figure 1. Photographic examination.



Figure 2. Periodontal evaluation.

bleeding score is defined as the percentage of sites bleeding with respect to the number of sites examined;

- probing pocket depth (PPD): is the distance from the gingival margin to the bottom of the gingival sulcus/pocket. It is measured by means of a graduated periodontal probe with a standardised tip diameter of 0.5 mm. Measurement is taken for each tooth at the mesio-buccal line angle, the mid-buccal, the distobuccal line angle, the distolingual line angle, the mid-lingual and the mesio-lingual line (six sites for each tooth). The physiological value of PPD is considered to be  $\leq 3$  mm. PPD allows an immediate evaluation of diseased sites.

## Results

A total of 100 patients (50 males and 50 females), divided into two groups in accordance with the classification of BMI (Body Mass Index), were included in the study: a test group consisting of 50 children (25 M and 25 F) aged between 7 and 12 years with a BMI

$\geq 25$  and a control group consisting of 50 children of normal weight (25 M and 25 F) of the same age.

The group of overweight/obese had a weight average of  $50.76 \pm 9.24$  kg (mean value  $\pm$  SD) and an height measured in centimeters of  $142.38 \pm 10.64$ . From these data was obtained the mean value of BMI =  $26.38 \pm 1.42$  kg/m<sup>2</sup>, ranging from 25 (36% of the sample) to a maximum value of 30 (only 1 patient, 2% of the test group). The children in test group had a mean age of  $9.26 \pm 1.62$  years old.

The control group included children defined as normal weight based on the classification of the World Health Organization (WHO) with an average weight of  $35.12 \pm 4.97$  kg and a height of  $134.7 \pm 8.53$  cm: the mean value of BMI was  $18.79 \pm 2.52$  kg/m<sup>2</sup>. The average age in this group was  $9.36 \pm 1.78$  years old. The characteristics of two groups are summarized in Figures 3, 4.

The difference in weight between the two groups is statistically significant, with a value of 15,64 kg. Regarding the height of the children, the test group showed to be 7,68 cm higher compared to the control group, but this difference is less significant.

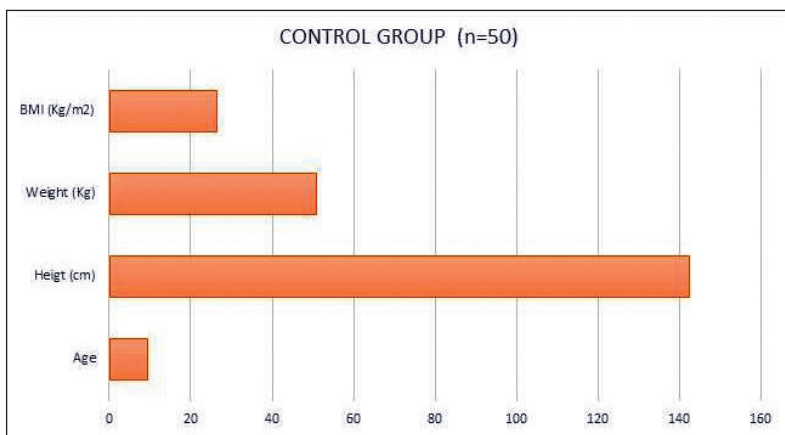


Figure 3. Characteristics of the control group.

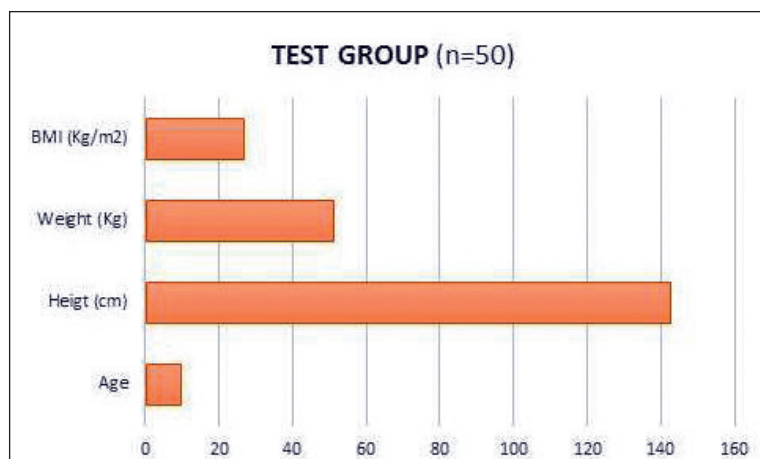


Figure 4. Characteristics of the test group.

**Questionnaire:**

Although the questionnaire had been specially designed to be well understood by children, all questions were posed to the parents too in order to avoid possible bias in the compilation and understanding of the same.

As regards to the oral hygiene, the majority of subjects in both groups reported brushing their teeth at least twice a day (75 and 81%, respectively for the overweight/obese and normal group) with oscillators and rotators movements, especially using the manual toothbrush.

The majority of subjects in both groups reported to have recently gone to the dentist for a check-up visit (51 and 70%, respectively, for test and control group). Despite these results, in both groups were found incorrect procedures in oral hygiene. In fact, the 85% of test group's patients reported to brush their teeth with less than 2 minutes and 75% to change the brush only when it broke.

The overweight/obese children have also shown a worse predisposition in oral hygiene procedures

when compared with those of normal weight, evidence that helps explain the apparent gingival inflammation of patients overweight/obese.

The percentages of the answers regarding the oral hygiene habits of the two groups are summarized in Tables 1, 2.

The food habits and lifestyle questionnaires revealed that the majority of patients in both groups (respectively 90% of obese/overweight children and 85% of normal weight patients) did not have food intolerances. Consumption of fruits and vegetables was high both in the test and in the control groups (respectively 85 and 90%). Regarding the frequency and quantity of food consumption, the number of obese patients who did not follow a balanced diet largely exceeded the number of normal-weight patients (70 versus 20%). In both groups, the majority of patients practiced sports. The study finally reported sleep anomalies in patients overweight/obese: 80% of these children, in fact, were affected by sleep disorders such as noisy breathing, apnea and/or parafunctional habits of the stomatognathic system (clenching,

Table 1. Percentages of the answers regarding the oral hygiene habits of the control group.

CONTROL GROUP			
<i>How many times brushing teeth</i>	1	2	3
	4%	81%	15%
<i>Time spend to brushing</i>	1 min	< 2 min	>2min
	4%	85%	11%
<i>Toothbrush chancing</i>	Every month	Every 2 months	When it broken
	25%	70%	15%
<i>Gingival pain</i>	Yes	No	
	15%	85%	
<i>Gingival bleeding</i>	Yes	No	
	15%	85%	
<i>Topical fluoride use</i>	Yes	No	
	60%	40%	

Table 2. Percentages of the answers regarding the oral hygiene habits of the test group.

	TEST GROUP		
<i>How many times brushing teeth</i>	1	2	3
	15%	75%	10%
<i>Time spend to brushing</i>	1 min	< 2 min	>2min
	10%	85%	5%
<i>Toothbrush chancing</i>	Every month	Every 2 months	When it broken
	5%	20%	75%
<i>Gingival pain</i>	Yes	No	
	80%	20%	
<i>Gingival bleeding</i>	Yes	No	
	80%	20%	
<i>Topical fluoride use</i>	Yes	No	
	80%	20%	

teeth grinding), compared to 20% of the subjects enrolled in the control group.

The specific percentages for each answer regarding these topics are summarized in Tables 3, 4.

*Clinical evaluation:*

The clinical examination of periodontal health in the control group revealed a FMPS value equal to 21.86% against 50.08% in the group of patients overweight/obese; the FMBS in the control group amounted to 12.7% against 26.24% of test group. No patient in either group included in the study presented a PPD $\geq$ 3, so a significant difference regarding this value was not found.

The periodontal measures of both groups are summarized in Table 5.

**Discussion**

While the relationship between periodontal disease

and obesity has been extensively studied in adults, this correlation was not as investigated in children population. In this study, the Authors examined 100 children referred at the Unit of Pediatric Dentistry, Department of Oral and Maxillo-Facial Sciences, "Sapienza" University of Rome, with aiming to test the association between obesity and periodontal disease in children between 7 and 12 years, assessing the FMPS, FMBS and PPD. The choice of this range age was dictated by the need to have subjects that presented the central and lateral permanent incisors, upper and lower, and the first permanent molars. The decision to not evaluate subjects with more than 12 years old has been established to prevent potential bias related to hormonal disorders of menarche.

The results showed that the presence of plaque is the most significant early sign of gingival inflammation. An high value of FMPS (%) is in fact recorded in all studied subjects: our results showed that an increase in fat mass corresponds to an increase of the plaque

Table 3. Percentages for each answer regarding food and life habits of the control group.

	CONTROL GROUP	
<i>Food intolerances</i>	Yes	No
	15%	85%
<i>Consumption of fruits and vegetables</i>	Yes	No
	90%	10%
<i>Balanced diet</i>	Yes	No
	80%	20%
<i>Sport</i>	Yes	No
	95%	5%
<i>Watch tv more than 1 hour/day</i>	Yes	No
	100%	0%
<i>Sleep disorders</i>	Yes	No
	15%	85%



Table 4. Percentages for each answer regarding food and life habits of the test group.

TEST GROUP		
<i>Food intolerances</i>	Yes	No
	10%	90%
<i>Consumption of fruits and vegetables</i>	Yes	No
	85%	15%
<i>Balanced diet</i>	Yes	No
	30%	70%
<i>Sport</i>	Yes	No
	95%	5%
<i>Watch tv more than 1 hour/day</i>	Yes	No
	100%	0%
<i>Sleep disorders</i>	Yes	No
	80%	20%

Table 5. Periodontal results of both groups.

TEST GROUP		CONTROL GROUP	
FMPS%	FMBS%	FMPS%	FMBS%
50.08%	26.24%	21.86%	12.7%

FMPS= Full mouth plaque score; FMBS= Full-mouth bleeding score.

index and gingivitis, as well as demonstrated in other studies (15, 16, 20). Resulting clear the mechanism by which adipose tissue secretes cytokines and activates molecules involved in inflammation, still the scientific opinion is confused and contradictory regarding the relationship between obesity and periodontal disease. Saxlin et al. (21) have shown in a long-term study, which involved 396 obese subjects with a mean follow-up of 4 years, as obesity is associated with periodontal disease but does not constitute a risk factor. In contrast, in another longitudinal study of 3,590 Japanese adults, a dose-dependent correlation between BMI and the development of periodontitis was demonstrated (22). Another study carried out on 4,246 adults of Korean nationality revealed that subjects with a BMI > 25 had a minimal risk compared to individuals of normal weight to develop periodontitis, while subjects with abdominal fat were significantly exposed to the gingival disease (23): this result is to suggest that the metabolic syndrome plays a role in inflammation of the periodontium, like suggested in other studies (24-26).

On the other hand, some Authors have pointed out that the scientific evidence supporting the presence of a biological mechanism underlying the association between obesity and periodontal infection is not fully convincing, assuming a bias related to poor oral health of obese individuals. Reeves et al. (27) analyzed this possible correlation in a group of American teenagers between 13 and 21 years concluding that the onset of periodontitis may be associated with in-

creasing weight and waist circumference. In particular, it was found that in subjects between 17 and 21 years, each increase of 1 kg was associated with a 6% increase in the risk of periodontal disease; similarly, every increase of 1 inch of waist circumference was related to a 5% increase in the risk of periodontitis. In contrast, there was no relationship between these parameters in younger children aged between 13 to 16 years.

Mod er et al. (28) have recently investigated pediatric obesity as an indicator risk for periodontal disease comparing a group of 52 obese children and adolescents between 11 and 17.9 years and a group of 52 subjects of the same age of normal weight. The study reported a worse oral hygiene, an higher incidence of bleeding on probing (BOP%) and the presence of pathological periodontal pockets (>4 mm) in obese subjects compared to the control group.

Our results do not resolve the dilemma on the causes of the correlation between periodontal diseases and excess body fat: what is evident though is that the accumulation of plaque and the consequent gingival inflammation is much more common in children with BMI > 25. Obese children show, in addition, a lifestyle less correct than normal-weight peers. While for adults the correlation between unhealthy lifestyles (smoking, high-calorie diet, physical activity) and onset of periodontitis is well-known, the same cannot be said for children because all the patients declared to devote insufficient time to brushing teeth and to consume high amounts of cariogenic foods.

## Conclusions

In conclusion, the results want to focus the attention on the negative impact of obesity on gingival health in young subjects, probably due to a combination of factors, like metabolic and inflammatory profiles and the result of a careless attitude towards prevention diseases of the oral cavity, including hygiene procedures at home, knowledge of a balance diet and respect for periodic check-up to the dentist (29, 30). In the literature is described the possibility of using protective microorganisms present in dental plaque as *Lactobacillus brevis* to suppress the growth of pathogenic bacteria. *Lactobacillus brevis* has anti-inflammatory activity due to its ability to inhibit, in particular macrophages, the nitrogen oxide synthase activity, indirectly causing a reduction in the levels of inflammatory cytokines (31). These considerations suggest the need to investigate more deeply the relationship between severe obesity and periodontal health, evaluating the possible presence of microbiological alterations at the level of saliva and/or the crevicular fluid in the test group respect the control sample (32, 33).

## Conflict of interest

The Authors disclosure that they have not been any conflict of interest for the study.

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