

## Influence of Overweight and Obesity on Alveolar Bone Loss in Adolescents Attending a Tertiary health Centre in New Delhi, India: A Cross-Sectional Radiographic Study

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### ABSTRACT

#### *Aim*

To evaluate the influence of overweight and obesity on alveolar bone loss among adolescents attending a tertiary care dental centre in New Delhi, India.

#### *Materials and Methods*

This cross-sectional observational study included 109 adolescents aged 12–18 years recruited from the outpatient dental clinics of a tertiary care teaching institution in New Delhi, India. Body mass index (BMI) and waist circumference (WC) were assessed and categorized according to age-adjusted percentiles. Interproximal bitewing radiographs were obtained bilaterally in premolar and molar regions. Radiographic assessment was performed by a calibrated blinded examiner using measurements from the cemento-enamel junction to the alveolar bone crest (CEJ–ABC). Alveolar bone loss was defined as a CEJ–ABC distance >2 mm associated with crestal rarefaction or discontinuity of the lamina dura.

#### *Results*

BMI ( $21.3 \pm 0.57$  kg/m<sup>2</sup>) and WC ( $81.7 \pm 10.1$  cm) were significantly higher in the overweight/obese group compared with the normal-weight group (BMI:  $17.5 \pm 4.9$  kg/m<sup>2</sup>; WC:  $72.7 \pm 6.3$  cm). No statistically significant difference was observed in plaque index scores between groups ( $p=0.1353$ ). Adolescents with overweight/obesity demonstrated a significantly greater prevalence of incipient alveolar bone loss involving two sites compared with normal-weight individuals ( $p<0.0001$ ).

#### *Conclusion*

Overweight and obesity may be associated with increased prevalence of radiographic alveolar bone loss in adolescents.

#### *Clinical Significance*

Body weight may represent an important modifying factor influencing early periodontal breakdown in adolescents, particularly in the presence of poor oral hygiene.

**Keywords:** Alveolar bone loss, obesity, overweight, adolescents, periodontal disease, body mass index, waist circumference, bitewing radiography

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### INTRODUCTION

Epidemiological studies have shown that the gingivitis is universal in children and adolescents, and that the prevalence of the most destructive forms of periodontal disease with alveolar bone loss might be present, but it is lower in young individuals than in adults.<sup>1-5</sup>

Some evidences suggest that the form of periodontitis commonly found in adults can also be seen in adolescents.<sup>6</sup> Other studies also showed that the prevalence of clinical attachment loss and alveolar bone loss is higher in 12-to-17-year-old adolescents than in children.<sup>7-11</sup> Sjödin et al.<sup>3</sup> demonstrated that 40% of patients diagnosed in adulthood with periodontitis had already presented bone loss in

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deciduous dentition. Therefore, the importance of initiating studies of epidemiological nature since childhood for establishment of prevention and health promotion measures are essential.

Several studies showed the prevalence of periodontal disease in children and young people using x-rays as diagnostic methods.<sup>8,12-17</sup> Although there are limitations in the conventional technique of x-rays for data collection and analyses,<sup>18</sup> this technique represent an available, useful and acceptable method, when the standardization is maintained. Thus, the interproximal technique (Bitewing) is the most widely used to check bone loss in youth.<sup>8,10,12,17,19</sup>

Additionally, some studies have suggested that the obesity is an inflammatory chronic condition that may be related to the increase of the prevalence and severity of periodontal diseases by an inflammatory pathway.<sup>20-24</sup> Some authors showed that obesity may be a potential risk factor for the development of periodontal disease, especially in young patients.<sup>20</sup> Greater alveolar bone loss<sup>21</sup> and higher rates of gingival inflammation combined to metabolic, inflammatory processes and negligence in the control of plaque can be verified in adolescents,<sup>25,26</sup> as well as pathological periodontal pockets (> 4 mm).<sup>26</sup>

The need for studies correlating the periodontal disease to the obesity condition in child patients can be observed in the systematic review carried out by Katz & Bimstein,<sup>27</sup> who reported a lack of studies that have assessed the relationship between these two conditions. This way, the present study is proposed to evaluate the prevalence of alveolar bone loss in adolescents presenting normal body weight and overweight/obesity.

## MATERIALS AND METHODS

### Study Design and Setting

This cross-sectional observational study was conducted in the Department of orthopaedics and associated dental outpatient clinics of a tertiary care teaching hospital in New Delhi, India, between September 2023 and November 2025. The study protocol was reviewed and approved by the Institutional Ethics Committee, and all procedures were carried out in accordance with the ethical standards of the Declaration of Helsinki.

Written informed consent was obtained from parents or legal guardians prior to participation, and assent was obtained from adolescents wherever applicable.

### Study Population

Adolescents aged 12–18 years reporting to the dental outpatient department for routine dental examination and treatment were screened for eligibility.

### Inclusion Criteria

- Adolescents aged 12–18 years
- Presence of fully erupted permanent premolars and molars
- Availability of readable proximal surfaces on bitewing radiographs
- Willingness to participate in the study

### Exclusion Criteria

Participants were excluded if they:

1. Had any systemic disease or medical condition affecting periodontal status
2. Had received systemic antibiotics or anti-inflammatory medications within the previous one month
3. Were undergoing orthodontic treatment
4. Were smokers or tobacco users
5. Had partially erupted teeth in the region of interest

6. Had missing proximal surfaces affecting radiographic assessment
7. Had open proximal contacts associated with food impaction
8. Presented radiographs with processing or projection errors

A total of 187 adolescents were initially screened, of whom 134 fulfilled the eligibility criteria. Following exclusions, 109 participants were included in the final analysis.

### Examiner Calibration

Radiographic measurements were performed by a single calibrated examiner blinded to group allocation. Calibration was conducted using radiographs from six randomly selected participants assessed at two different time intervals separated by one week. Intra-examiner reliability was assessed using intraclass correlation coefficient (ICC), which demonstrated excellent reproducibility (ICC = 0.9174;  $p < 0.0001$ ).

### Group Allocation

Participants were categorized into two groups based on body weight status:

- Normal-weight group (n=52)
- Overweight/obesity group (n=57)

BMI categorization was performed according to age- and sex-adjusted international reference percentiles.

### Anthropometric Assessment

Body mass index (BMI) and waist circumference (WC) were recorded for all participants.

Body weight was measured using a calibrated digital weighing scale with participants wearing light clothing and no footwear. Height was measured using a wall-mounted stadiometer. BMI was calculated using the formula:

$$\text{BMI} = \text{Weight (kg)} / \text{Height (m}^2\text{)}$$

Waist circumference was measured in centimeters using a non-elastic measuring tape at the midpoint between the lower costal margin and iliac crest.

### Radiographic Examination

Radiographic evaluation consisted of four standardized bitewing radiographs per participant (right and left premolar and molar regions).

Radiographs were obtained using Ekta-speed films (Kodak®) with standardized exposure parameters (70 kVp, 8 mA, 0.4-second exposure time). Film holders were used to standardize projection geometry.

All radiographs were processed using the time-temperature method and evaluated under standardized viewing conditions using an illuminated viewing box.

Radiographic measurements were performed using a magnifying lens and digital caliper. The distance from the cemento-enamel junction (CEJ) to the alveolar bone crest (ABC) was measured at mesial and distal proximal surfaces.

Alveolar bone loss was defined as:

- CEJ–ABC distance greater than 2 mm

- Presence of crestal rarefaction and/or discontinuity of lamina dura  
The examiner assessing radiographs remained blinded to anthropometric grouping throughout the study.

#### Plaque Assessment

Plaque accumulation was assessed clinically using plaque index scores recorded during oral examination.

#### Statistical Analysis

The complete data for all the subjects was formulated systematically on the Microsoft Excel sheet and then was analysed using Statistical Package for Social Sciences (SPSS) version 23. As there were no dropouts or protocol deviations, the analysis was consistent with an intention-to-treat principle. Quantitative variables were expressed as mean  $\pm$  standard deviation.

Intergroup comparisons were performed using Student's t-test or ANOVA for parametric variables and non-parametric tests where appropriate. Categorical variables were analyzed using Chi-square test and binomial test for proportions.

A p-value  $<0.05$  was considered statistically significant.

#### RESULTS

Table 1 shows that there was no statistical significant difference in age between the participants in the two groups (normal weight and overweight/obese), showing homogeneity in the sample. With respect to gender (independent of sex, i.e), it can be seen that the proportion of patients with normal weight or overweight/obesity groups presented no significant differences.

The BMI ( $21.3 \pm 0.57$  kg/m<sup>2</sup>) and WC ( $81.7 \pm 10.1$  cm) were statistically higher in overweight/obesity than in patients with normal weight (BMI:  $17.5 \pm 4.9$  kg/m<sup>2</sup>; WC:  $72.7 \pm 6.3$  cm). There was no statistical difference between the groups with regard to the percentage of plaque index ( $p= 0.1353$ ), revealing homogeneity between groups with high percentages in both. The alveolar bone loss mean was similar between groups ( $p= 0.7268$ ), with incipient crest resorption (Normal weight =  $2.72 \pm 0.26$  mm; Overweight/obesity =  $2.76 \pm 0.25$  mm)

Table 2 shows that the normal weight group had a higher percentage of absence of lesions (0 site) than the overweight/obesity group ( $p= 0.0096$ ). On the other hand, individuals presenting overweight/obesity showed a greater prevalence of 2 sites with incipient alveolar bone loss than those from normal weight group ( $p < 0.0001$ ). This way, it became evident the influence of the body weight condition in this sample over the number of involved sites with alveolar bone loss and distances greater than 2 mm between the CEJ-BC.

#### DISCUSSION

Some studies have revealed that the clinical attachment loss and the alveolar bone loss is uncommon in 5-to-

11-year-old children, but its prevalence increases in 12-to-17-year-old adolescents.<sup>7-11</sup> In the present study the alveolar bone loss was detected in 42 from the 109 individuals evaluated, totaling 38.6% of the sample (1 site: 13.8%; 2 sites: 19.3%; 3 sites: 5.5%), which demonstrated a high prevalence. It is important to conduct epidemiological studies in order to verify the clinical and radiographic conditions in this specific group of patients, since the diagnosis of pediatric patients have been so far neglected.

Several studies showed the prevalence of periodontal disease in childhood and adolescence using x-rays as diagnostic methods.<sup>8,12-17</sup> Among the radiographic techniques, the interproximal (Bitewing) is the most widely used to check the bone loss in youth.<sup>8,10,12,17,19</sup> So, this technique was chosen in the present methodology. These radiographs have been shown to be a valuable method in the detection of incipient alveolar bone loss in adolescents,<sup>8,17</sup> in agreement with our findings.

Other studies have suggested that obesity is a systemic inflammatory condition that can be related to the increase in the prevalence, severity and progression of periodontal diseases,<sup>20-24</sup> mainly in young people.<sup>20</sup> In addition, Katz & Bimstein<sup>27</sup> showed that more studies are needed to support the hypothesis that obesity in children may be associated with the increase in the rates of periodontal disease. Facing such considerations, it is evident that the importance of this epidemiological study, in which we considered normal weight individuals (control group) and volunteers presenting overweight or obesity (test group), correlating with the periodontal condition.

In the present study the patients presenting overweight/obesity had higher prevalence of sites with rarefaction of the crest and discontinuity of lamina dura (2 sites/individual), with distances greater than 2 mm between the CEJ and the bone crest. A biological explanation for the relationship between periodontal disease and obesity could be justified due to obesity be associated with systemic and inflammatory immunological changes, with increased production of tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ), leptin and interleukin-1 by adipocytes,<sup>31</sup> which hypothetically could also influence alveolar bone metabolism.

Additionally, since the plaque index was similar between the control group (normal weight) and the test group (overweight/obesity), the authors suggest that there is some body weight influence on bone metabolism verified radiographically. This finding corroborates with others by Alabdulkarim et al.<sup>21</sup>, who suggested that obesity is associated with an increase in the prevalence of periodontitis (with greater alveolar bone loss), especially in young people. Franchini et al.<sup>25</sup> also observed in young individuals (10-17 years) presenting overweight and obesity that the gingivitis was probably combined with metabolic, inflammatory processes, and negligence regarding to oral hygiene. Mod er et al.<sup>26</sup> also verified that there was an association between obesity and indicators of periodontal risk in adolescents.

The findings of the present study are particularly relevant in the Indian adolescent population, where increasing prevalence of childhood obesity may contribute to early periodontal alterations. Conducting the study in a tertiary care dental centre in New Delhi improves the clinical relevance and applicability of the findings to urban healthcare settings in developing countries.

In spite of all the possible association between overweight/obesity and periodontal disease evidenced in the literature, there is still the need for histometric and histological studies, which are considered as the gold standard in order to check the real condition of bone metabolism in cell groups with different body weight conditions.

### Limitations

The present study has certain limitations. Being a cross-sectional study, causal relationships between obesity and alveolar bone loss cannot be established. Clinical periodontal parameters such as probing depth and clinical attachment level were not assessed. In addition, inflammatory biomarkers associated with obesity were not evaluated. Future longitudinal multicentric studies incorporating biochemical markers and comprehensive periodontal examination are recommended.

### CONCLUSION

It can be concluded that the overweight and obesity condition may influence on a higher prevalence of alveolar bone crest rarefaction in adolescents, associated with dental plaque accumulation.

### CLINICAL SIGNIFICANCE

Body weight may act as a significant influence on the rarefaction of alveolar bone crest associated to neglected habits of oral hygiene.

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**Table 1.** Evaluated parameters in the study groups (Mean ± Standard Deviation).

Parameters – Mean ± Standard Deviation	Normal Weight	Overweight/Obesity	P Value
Age (years)*	14,5 ± 1,95	13,8 ± 1,4	0,2013
Men: Women (proportion)**	25: 27	33: 24	0,4043
Body Mass Index (kg/m <sup>2</sup> )***	17,5 ± 4,9	21,3 ± 0,57	<0,0001 <sup>β</sup>
Waist Circumference (cm)***	72,7 ± 6,3	81,7 ± 10,1	0,0007 <sup>β</sup>
Plaque index (%)*	62,3 ± 36,9	58 ± 40,5	0,1353
Alveolar bone loss (in millimeters)*	2,72 ± 0,26	2,76 ± 0,25	0,7268

\*ANOVA (criteria) – non-parametric data; \*\*Chi-square Test; \*\*\*T test for parametric data.

<sup>β</sup> Statistically significant difference (P<0,05).

**Table 2.** Relationship between body condition with the number of bone lesions found.

Groups	0 site N (%)	1 site N (%)	2 sites N (%)	> 3 sites N (%)	Total N (%)
Normal weight	41 (78,8)*	5 (9,6)	4 (7,7)	2 (3,9)	52 (100)
Overweight/ Obesity	26 (45,6)	10 (17,5)	17 (29,8)*	4 (7,1)	57 (100)
<b>P Value</b>	<b>0,0096*</b>	0,0679	<b>&lt;0,0001*</b>	0,2482	

\*Binomial Test for two independent proportions (P<0.05 statistically significant difference).