ABSTRACT To assess overall and abdominal obesity and their relation to periodontal disease among young adults, body mass index (BMI) and waist circumference (WC) were measured and clinical attachment loss (CAL), gingival index (GI) and Community Periodontal Index (CPI) were estimated. The sample comprised 380 adults (170 males and 210 females) aged 20–26 years. There was a significant correlation between both BMI and WC and CAL, GI and CPI in females. In males, a significant correlation was only recorded between WC and GI and CPI. Overall and abdominal obesity in young adult females and abdominal obesity in males were significantly associated with periodontal disease.

Rapsort entre obésité générale, obésité abdominale et parodontopathies chez les jeunes adultes

RÉSUMÉ Afin d’évaluer l’obésité générale, l’obésité abdominale et leur rapport avec les parodontopathies chez les jeunes adultes, l’indice de masse corporelle (IMC) a été calculé, le tour de taille a été mesuré et la perte d’attache, l’indice gingival et l’indice communautaire parodontal (CPI) ont été évalués. L’échantillon comprenait 380 adultes (170 hommes et 210 femmes) âgés de 20 à 26 ans. Une étroite corrélation a été établie entre l’IMC, le tour de taille, la perte d’attache, l’indice gingival et le CPI chez les femmes. Chez les hommes, une telle corrélation n’a été constatée qu’entre le tour de taille, l’indice gingival et le CPI. L’obésité générale et abdominale chez les jeunes femmes et l’obésité abdominale chez les hommes étaient associées de manière significative aux parodontopathies.
Introduction

Obesity is one of the most significant health risks of modern society, and is now recognized as a major health concern in both developed and developing countries [1]. The prevalence of obesity is increasing at alarming rates, approaching epidemic proportions, particularly among children and young adults [2]. Environmental and sociobehavioural influences and metabolic abnormalities are likely the most important risk factors for obesity [3]. Obesity itself has been recognized as a major risk factor for a number of systemic diseases [4,5,6]. Therefore, measurement of obesity may provide useful information about the risk of various disease states.

Analysing the effect of nutritional variables on gingival and periodontal health questions the role of obesity and overweight in periodontal disease pathogenesis [7]. The imbalance of the host immune system commonly detected among obese individuals could explain the observed association of obesity with certain diseases including periodontitis [8]. In turn, recent studies have shown that periodontal diseases can exhibit an impact on systemic health such as changing blood chemistry with a rise in inflammatory mediators, affecting blood glucose level and increasing the risk for cardiovascular diseases, suggesting that oral health might affect the health of the entire body [9,10].

Recently, an association between obesity and periodontal disease has been suggested [3]. Furthermore, the results of the Third National Health and Nutrition Examination Survey conducted in the United States of America showed that waist to hip ratio, body mass index (BMI), fat free mass and log sum subcutaneous fat were significantly correlated to periodontitis, signifying that abnormal fat metabolism may be an important factor in the pathogenesis of periodontal diseases [7]. However, studies exploring the relationship between obesity and periodontal disease from developing countries with different eating habits and health behaviours are scarce.

The purpose of the present study was to investigate the relationship between overall and abdominal obesity and periodontal disease among young adults in Egypt.

Methods

A cross-sectional analytical study was designed to determine whether an association exists between obesity and a variety of periodontal disease measurements among the study sample.

The study sample was consecutively collected from young adults, 20–26 years of age, attending the Physical Medicine and Obesity Clinic, Faculty of Medicine, Tanta University, Egypt during the period 1 July 2007–30 September 2007. Smokers, pregnant women, diabetes patients, and those taking medication for endocrine disease were excluded from the study to avoid the confounding effect of known risk factors for periodontal disease [11]. Also, those who were not regular brush users or had had periodontal treatment or antibiotic therapy in the 6 months before the beginning of the study were debarred from participation. The final sample was 380 adults (170 males and 210 females) who were willing to participate in the study out of the 620 who were eligible.

Assessment of obesity

BMI was calculated as an indicator of overall adiposity. Each patient was classified as normal weight (BMI 18.5–24.9 kg/m²), overweight (BMI 25–29.9 kg/m²) or obese (BMI ≥ 30 kg/m²) [12].

Waist circumference (WC) was used to assess abdominal adiposity; this was divided into 2 categories, normal and high, using the cut-off point > 102 cm for males and > 88 cm for females, based on World Health Organization guidelines [13]. All measurements were taken by well-trained nurses in the Physical Medicine and Obesity Clinic under the supervision of a licensed physician.

The periodontal examinations were performed in the clinic of the Periodontology Department, Faculty of Dentistry, Tanta University under normal clinical conditions with a mouth mirror and periodontal probe. All permanent fully-erupted teeth, excluding third molars, were examined for the following periodontal parameters:

- gingival index (GI) of Loe and Silness: the gingiva was assessed for gingivitis and the individual score was expressed as the mean score of the examined teeth [14];
- periodontal clinical attachment loss (CAL): this was assessed at 6 sites per tooth using the indirect measurement method developed by Ramfjord and only the greatest measurement was recorded [15];
- Community Periodontal Index (CPI): index teeth in each sextant were evaluated and the individual CPI score was defined as the highest score among the examined sextants [16].

All periodontal measurements were carried out by one examiner. Intra-examiner consistency was assessed before the study by examining a group of 20 young adults at the dental clinic of the Periodontology Department twice to achieve uniform interpretation and application of criteria (κ = 0.8).

Upon enrolment, approval and informed consent was obtained from each participant after explaining the study procedures.

Data were collected, presented and statistically analysed using SPSS, version 13. Means, standard deviations (SDs), Spearman correlation coefficient and chi-squared tests were used as appropriate. The level of significance used was 5%.
The mean age of the male and female participants was 23.8 (SD 2.2) years and 22.1 (SD 2.9) years respectively. Males and females had a mean weight of 93.6 (SD 9.8) kg and 89.4 (SD 12.4) kg and a mean height of 174.5 (SD 8.7) cm and 166 (SD 7.2) cm respectively. According to BMI, 26%, 42%, 32% of males and 23%, 43% and 34% of females respectively were classed as normal, overweight and obese. According to WC measurement, 35% of males and 19% of females were classed as normal, overweight and obese. According to BMI, 26%, 42%, 32% of males and 23%, 43% and 34% of females respectively were classed as normal, overweight and obese. The mean age of the male and female participants was 23.8 (SD 2.2) years and 22.1 (SD 2.9) years respectively. Males and females had a mean weight of 93.6 (SD 9.8) kg and 89.4 (SD 12.4) kg and a mean height of 174.5 (SD 8.7) cm and 166 (SD 7.2) cm respectively. According to BMI, 26%, 42%, 32% of males and 23%, 43% and 34% of females respectively were classed as normal, overweight and obese. According to WC measurement, 35% of males and 19% of females were classed as normal, overweight and obese. The present findings showed a statistically significant positive correlation between obesity in terms of BMI and WC and periodontal measurements of CAL, GI and CPI in female participants. These results were in accordance with previous findings supporting a positive correlation between obesity and periodontal disease among females [7,20]. The current study also showed a positive correlation between WC and periodontal disease as measured by GI and CPI in males, which agreed with Saiti et al. [19,21]. In Saudi Arabia Al-abdulkarim et al found that obesity was significantly associated with alveolar bone loss among adults, with a stronger association in females [22].

Obesity has been postulated to reduce blood flow to the periodontal tissues, promoting the development of periodontal disease [23]. Furthermore, obesity may enhance immunological or inflammatory disorders, which might be the reason obese subjects tend to exhibit escalating poor periodontal status relative to non-obese individuals [24].

A proposed model linking obesity and periodontal infection suggested that insulin resistance mediates the relationship between them. Dietary free fatty acids contribute not only to obesity but also to insulin resistance by enhancing destruction of β cells of the pancreas [25]. Insulin resistance, in turn, contributes to a generalized hyperinflammatory state, including periodontal tissue, especially when triggered by oral pathogens [3]. Furthermore, adipocytokines, which include tumour necrosis factor α (TNF-α) secreted by adipose tissues, appear to be directly related to periodontal destruction [24].

The differences in the results for males and females in this study may be attributed to the fact that overall obesity in males, as measured by BMI, is

### Table 1 Characteristics of the study sample

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Males (n = 170)</th>
<th>Females (n = 210)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (SD) age (years)</td>
<td>23.8 (2.2)</td>
<td>22.1 (2.9)</td>
</tr>
<tr>
<td>Mean (SD) weight (kg)</td>
<td>93.6 (9.8)</td>
<td>89.4 (12.4)</td>
</tr>
<tr>
<td>Mean (SD) height (cm)</td>
<td>174.5 (8.7)</td>
<td>166 (7.2)</td>
</tr>
<tr>
<td>Overall adiposity [No. (%)]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal&lt;sup&gt;a&lt;/sup&gt;</td>
<td>44 (26)</td>
<td>48 (23)</td>
</tr>
<tr>
<td>Overweight&lt;sup&gt;b&lt;/sup&gt;</td>
<td>71 (42)</td>
<td>90 (43)</td>
</tr>
<tr>
<td>Obese&lt;sup&gt;c&lt;/sup&gt;</td>
<td>55 (32)</td>
<td>72 (34)</td>
</tr>
<tr>
<td>Abdominal adiposity [No. (%)]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal&lt;sup&gt;d&lt;/sup&gt;</td>
<td>59 (35)</td>
<td>40 (19)</td>
</tr>
<tr>
<td>High&lt;sup&gt;e&lt;/sup&gt;</td>
<td>111 (65)</td>
<td>170 (81)</td>
</tr>
</tbody>
</table>

<sup>a</sup>Body mass index (BMI) 18.5–24.9 kg/m²; <sup>b</sup>BMI 25–29.9 kg/m²; <sup>c</sup>BMI ≥ 30 kg/m²; <sup>d</sup>≤ 102 cm for males and ≤ 88 cm for females; <sup>e</sup> > 102 cm for males and > 88 cm for females.

SD = standard deviation.
significantly affected by the amount of muscle and weight of bone [20]. Hence, higher BMI scores in males may not necessarily be indicative of obesity [5]. Brochu Starling and Tchernof observed that, within the same BMI category, males with higher WC had a higher risk of having periodontitis [26]. In females, however, BMI may be a more reliable obesity measure [7]. Additionally, topographic distribution of body fat in females might predispose them to periodontal disease [20]. Abdominal and upper body obesity, commonly found in females, is particularly associated with a decrease in the uptake of insulin by the liver with the consequent disturbance of fat metabolism and systemic dyslipidemia results in enhanced periodontal disease [3]. It has been proposed that the patterns of fat distribution and its relation to periodontal pathogens follow those observed with other obesity-related health problems, such as hypertension and type II diabetes, where visceral fat accumulation plays a key role in increasing susceptibility to these diseases [7].

The results of this study raise the question of whether obesity predisposes individuals to periodontal disease, or periodontal disease affects lipid metabolism, or both? There is some evidence that cytokines such as interleukin-1β (IL-1β) and interferon γ and Gram negative lipopolysaccharides that are produced in high quantities in response to periodontal infection may interfere with lipid metabolism [7]. This may further enhance obesity and obesity-related health problems.

<p>| Table 2 | Relationship between gingival index (GI) and periodontal clinical attachment loss (CAL) and overall and abdominal adiposity in young adults in Tanta, Egypt |</p>
<table>
<thead>
<tr>
<th>Obesity measurement</th>
<th>Mean (SD) GI</th>
<th>Mean (SD) CAL</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Females (n = 210)</td>
<td>Males (n = 170)</td>
</tr>
<tr>
<td>Overall adiposity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>0.3 (0.1)</td>
<td>0.5 (0.1)</td>
</tr>
<tr>
<td>Overweight</td>
<td>1.0 (0.2)</td>
<td>0.6 (0.2)</td>
</tr>
<tr>
<td>Obese</td>
<td>1.8 (0.3)</td>
<td>0.7 (0.1)</td>
</tr>
<tr>
<td>Spearman correlation coefficient</td>
<td>r = 0.9, P &lt; 0.01</td>
<td>r = 0.5, P = 0.06</td>
</tr>
<tr>
<td>Abdominal adiposity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>0.5 (0.3)</td>
<td>0.4 (0.2)</td>
</tr>
<tr>
<td>High</td>
<td>1.5 (0.5)</td>
<td>0.8 (0.3)</td>
</tr>
<tr>
<td>Spearman correlation coefficient</td>
<td>r = 0.7, P = 0.003</td>
<td>r = 0.6, P = 0.01</td>
</tr>
</tbody>
</table>

P < 0.05 was considered statistically significant.

<p>| Table 3 | Community periodontal index in relation to different obesity indicators in young adults in Tanta, Egypt |</p>
<table>
<thead>
<tr>
<th>Obesity indicator</th>
<th>Community periodontal index</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males (n = 170)</td>
</tr>
<tr>
<td></td>
<td>0–2</td>
</tr>
<tr>
<td>Overall adiposity</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>24</td>
</tr>
<tr>
<td>Overweight</td>
<td>33</td>
</tr>
<tr>
<td>Obese</td>
<td>24</td>
</tr>
<tr>
<td>Significance</td>
<td>χ² 12.2, P = 0.06</td>
</tr>
<tr>
<td>Abdominal adiposity</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>37</td>
</tr>
<tr>
<td>High</td>
<td>44</td>
</tr>
<tr>
<td>Significance</td>
<td>χ² 8.2, P &lt; 0.01</td>
</tr>
</tbody>
</table>

P < 0.05 was considered statistically significant.

| a | Body mass index (BMI) 18.5–24.9 kg/m²; | b | BMI 25–29.9 kg/m²; | c | BMI ≥ 30 kg/m²; | d | waist circumference ≤ 102 cm for males and ≤ 88 cm for females; | e | waist circumference > 102 cm for males and > 88 cm for females | SD = standard deviation.
Although in this study a significant correlation was found between obesity and periodontal disease, it is not possible to prove causality. Further prospective studies are needed to address the question of causality and to determine if obesity is a true risk factor for periodontal disease, especially among the younger population. If this proves to be the case, periodontal disease prevention could be included in planned intervention campaigns designed to prevent obesity-related diseases. Conversely, prevention and management of obesity may be an adjunctive approach to improving periodontal health.

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References