Clinical condition of the oral cavity in overweight and obese patients

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Abstract

Background. The increasing prevalence of both obesity and periodontal disease in adults has raised interest among researchers in a correlation between these conditions. Obesity is caused by a poorly balanced diet, rich in sugars, that leads to the accumulation of excessive amounts of plaque, which results in the development of gingivitis, periodontitis and caries. It is known that there is a correlation between these 2 disease entities, but the mechanisms of the interaction have not been explored to date. Thus, attempts to address this research question seem justified.

Objectives. The aim of the study was to compare selected parameters of dental and periodontal health as well as the oral hygiene status between overweight/obese adults and a control group. Additionally, eating habits and other factors affecting obesity in adults were examined in comparison with the control group on the basis of a self-developed questionnaire.

Material and methods. The study included 120 adult patients (men and women), aged 19–55 years, divided into a study group of 60 overweight/obese individuals and a control group of 60 individuals with a normal weight based on the body mass index (BMI). The study involved anthropometric measurements (BMI, waist circumference – WC and hip circumference – HC) and dental examination, including dental caries examination (the decayed, missing and filled teeth index – DMF), oral hygiene assessment (the approximal plaque index – API) and periodontal tissue examination (pocket depth – PD, clinical attachment level – CAL, bleeding on probing – BOP, and the community periodontal index – CPI). Sociomedical examination was performed taking into account dietary and hygienic habits.

Results. The group with BMI ≥ 25 kg/m² was found to have worse parameters of periodontal health and unsatisfactory oral hygiene status as compared to the control group. This group also presented lower regularity of eating meals and a higher rate of sweets consumption.

Conclusions. Lower regularity of eating meals and higher sweets consumption, combined with poor hygiene habits, are reflected in increased rates of gum inflammation and plaque accumulation as well as worsened periodontal tissue status. A positive correlation between periodontal disease and BMI points to the need to arrange for periodontal disease prevention and treatment among overweight and obese patients.

Keywords: diet, overweight, periodontal disease, oral hygiene

Cite as

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Introduction

Periodontal disease is a chronic inflammatory condition with increasing prevalence in Poland, which makes it not only a health problem, but also a social issue. It affects about half of the adult population of the United States over the age of 30,¹ and is one of the leading causes of tooth loss.^{2,3} The growing prevalence of overweight and obesity in adults worldwide has contributed to raised interest among researchers in using obesity-related indices to assess the risks of many chronic health conditions, including periodontal disease. Gingivitis observed in overweight and obese patients may be a result of metabolic disorders, inflammatory factors or improper oral hygiene habits. The latter are associated with the frequent consumption of sweetened, pulpy and highly processed food products, snacks, and sweetened carbonated beverages, which is a risk factor for becoming overweight, particularly in children and adolescents. The consumption of free sugars is a risk factor for both dental caries and obesity. Given that the excessive intake of sugars and social deprivation are risk factors for dental caries and obesity, it has been hypothesized that these 2 outcomes may be more likely to co-exist within the same individuals or populations. Aside from free sugars and socio-economic deprivation, obesity in children and young people is affected by many complex behavioral and societal factors, including the overall calorie intake, the level of physical activity, genetic factors, and the media. Dental caries is also affected by exposure to fluoride, the overall dietary composition, oral bacteria, the salivary composition and flow rates, and the tooth enamel structure. Obesity caused by a poorly balanced diet, rich in sugars, can lead to the accumulation of excessive amounts of dental plaque, causing the growth of *Streptococcus mutans* (*S. mutans*) bacteria and *Lactobacillus spp.* bacteria, which can result in the development of gingival inflammation, periodontitis and caries. It is believed that obese patients are more likely to lose their teeth over-early due to untreated caries and periodontitis, which results in the premature extraction of teeth. Moreover, overweight and obesity can affect salivary secretion and the properties of saliva, including changes in its microbiological composition. The relationship between obesity and the occurrence of chronic, moderate inflammation of the salivary glands has received attention. The inflammatory mediators secreted by the adipose tissue of obese people, such as resistin, pro-inflammatory cytokines, interleukins IL-1, IL-6, IL-8, and IL-10, and tumor necrosis factor alpha (TNF- α), may influence the development of periodontitis.⁴ Tumor necrosis factor alpha is a major mediator of periodontal tissue destruction by bacterial endotoxins. The concentration of TNF- α in periodontal tissue is higher in people with periodontitis as compared to those without periodontitis, and decreases when inflammation is successfully treated. It has also been shown that the concentration of TNF- α in gingival fluid is directly related to the body mass index (BMI). Thus, obesity may exacerbate the course of periodontitis. It is now known that there is a correlation between these 2 disease

entities; however, the mechanisms of the interaction between them have not been fully explored to date. Therefore, further research addressing this question is justified.

In light of the relationship between obesity and periodontal disease, often discussed in the literature, the objective of this paper was to compare selected parameters of dental and periodontal health as well as the oral hygiene status between overweight and obese adults and a control group.

Material and methods

The study included 120 adult patients (men and women), aged 19–55 years, who reported to the Department of Periodontology and Oral Diseases at the Faculty of Dentistry of the Medical University of Warsaw and a private dental practice in Warsaw, Poland, between June 2013 and May 2015. The methodology adopted for taking patient history and physical examination was approved by the Bioethics Committee of the Medical University of Warsaw (KB/194/2013).

The inclusion criteria for overweight/obese patients were as follows: BMI ≥ 25 kg/m²; and for women – waist circumference (WC) >88 cm and the waist-to-hip ratio (WHR) >0.8 , or for men – WC >102 cm and WHR >1.0 .

The exclusion criteria were more than a single missing tooth or a chronic disease.

All patients were generally healthy; they underwent anthropometric assessment, including the BMI, WC and hip circumference (HC) measurements as well as the clinical examination of the teeth and periodontal tissues, and oral hygiene status assessment. The results were recorded in individual patient dental examination charts.

The study group was made up of 60 overweight/obese individuals, including 38 women and 22 men, with a mean age of 39 years. All had BMI ≥ 25 kg/m²: 41.7% had BMI in the range of 25–30 kg/m² and 58.3% had BMI >30 kg/m². The control group was made up of 60 individuals, including 34 women and 26 men, aged 19–43 years, with a mean age of 34 years, and BMI in the range of 18–24.9 kg/m².

Following dental examination, dental health was assessed using the decayed, missing and filled teeth count (DMF), while the oral hygiene status was evaluated according to the approximal plaque index (API), without intraoral dyeing.

The clinical condition of the periodontium was examined based on the measurements of pocket depth (PD) and bleeding on probing (BOP). Moreover, periodontal probing was used to measure PD and clinical attachment level (CAL) at 4 sites of the tooth, which gives a total of 112 evaluated sites.

The community periodontal index for treatment needs (CPITN) procedure according to Ainamo et al.⁵ was applied to assess prevention and the treatment needs (TN) of the participants. All 6 sextants were evaluated: 17–14; 13–23; 24–27; 34–37; 33–43; and 44–47.

Sociomedical examination was also performed, taking into account diet, and dietary and hygiene habits.

Statistical analysis

The χ^2 test was used for the primary comparative analysis of the 2 groups. If the expected count in at least 1 field of the four-field table was <5 , the two-tailed Fisher's exact test was then used. The adopted level of statistical significance was $p < 0.05$ for all tests.

Results

Detailed data on the general characteristics of the study population, divided according to gender, average age, education, smoking, and BMI distribution, are presented in Table 1.

Table 2 presents the comparison of the oral hygiene and periodontal tissue status between the groups with BMI ≥ 25 kg/m² and BMI < 25 kg/m². Statistically significant differences were found for the following variables: API ($p = 0.031$); BOP ($p < 0.001$); PD ($p = 0.015$); and CPITN ($p < 0.001$). The summary is presented below:

- API: in the BMI ≥ 25 kg/m² group, 48.3% of patients had API in the range of 40–69% and 38.3% had API ≥ 70 %; in the BMI < 25 kg/m² group, 23.3% had API ≥ 70 % and 8.3% had a normal API (<25 %);
- BOP: in the study group with BMI ≥ 25 kg/m², the mean BOP was 55%, while in the control group, the mean BOP was 27.5%;
- PD: in the patient group with BMI ≥ 25 kg/m², the mean PD was 3.0 mm, compared to 2.7 mm in the group with BMI < 25 kg/m²;

Table 1. General characteristics of the population

Characteristics	Group BMI ≥ 25 kg/m ² <i>n</i> = 60	Group BMI < 25 kg/m ² <i>n</i> = 60
Gender <i>n</i> (%)		
female	38 (63.3)	34 (56.7)
male	22 (36.7)	26 (43.3)
Age [years]	28–55	19–43
BMI [kg/m ²] <i>n</i> (%)		
<18.5	0 (0.0)	4 (6.6)
18.5–24.9	0 (0.0)	56 (93.3)
25.0–30.0	25 (41.7)	0 (0.0)
>30.0	35 (58.3)	0 (0.0)
Education <i>n</i> (%)		
primary	6 (10.0)	6 (10.0)
vocational	3 (5.0)	7 (11.7)
secondary	28 (46.7)	29 (48.3)
higher	23 (38.3)	18 (30.0)
Smoking <i>n</i> (%)		
non-smoker	36 (60.0)	26 (43.3)
smoking for 2–4 years	3 (5.0)	4 (6.7)
smoking for >4 years	13 (21.7)	18 (30.0)
smoking for >20 years	8 (13.3)	12 (20.0)

BMI – body mass index.

Table 2. Oral hygiene and periodontal tissue status in the study group and the control adult population

Parameter	Group BMI ≥ 25 kg/m ² <i>n</i> = 60	Group BMI < 25 kg/m ² <i>n</i> = 60	<i>p</i> -value
DMF <i>M</i> (min–max)	13 (11–16)	12 (11–15)	0.132
API [%] <i>n</i> (%)			0.031*
<25	0 (0.0)	5 (8.3)	
25–39	8 (13.3)	14 (23.3)	
40–69	29 (48.3)	27 (45.0)	
≥ 70	23 (38.3)	14 (23.3)	
BOP [%] <i>M</i> (min–max)	55.0 (42.0–64.5)	27.5 (13.0–45.0)	<0.001 *
PD [mm] <i>M</i> (min–max)	3.0 (2.5–3.5)	2.7 (2.0–3.0)	0.015*
CAL [mm] <i>M</i> (min–max)	2.7 (2.0–3.2)	2.0 (1.0–3.0)	0.075
1–2 mm <i>n</i> (%)	23 (38.3)	33 (55.0)	
3–4 mm <i>n</i> (%)	35 (58.3)	26 (43.3)	
>4 mm <i>n</i> (%)	2 (3.3)	1 (1.7)	
CPI TN			
0 0	2 (3.3)	7 (11.7)	<0.001 *
1 1	0 (0.0)	11 (18.3)	<0.001 *
2 2	14 (23.3)	29 (48.3)	<0.001 *
3 2	28 (46.7)	13 (21.7)	<0.001 *
4 3	16 (26.7)	0 (0.0)	<0.001 *

DMT – decayed, missing and filled teeth index; API – approximal plaque index; BOP – bleeding on probing; PD – pocket depth; CAL – clinical attachment level; CPI – community periodontal index; TN – treatment needs; *M* – mean; min – minimum; max – maximum; * statistically significant.

- CPI: in the study group, the highest percentage of patients (46.6%) was CPI-3, while in the control group, CPI-2 prevailed at 48.4%.

According to TN based on CPI, 96.7% of patients with BMI ≥ 25 kg/m², compared to 70% in the control group, required professional cleaning of the tooth surface from plaque and tartar as well as oral hygiene instruction.

Table 3 presents a statistically significant difference ($p = 0.037$) in the severity of periodontal disease according to the classification of the American Academy of Periodontology (AAP).

Table 3. Periodontal tissue status in the study and control groups – American Academy of Periodontology (AAP) classification

Periodontal tissue status	Group BMI ≥ 25 kg/m ² <i>n</i> = 60	Group BMI < 25 kg/m ² <i>n</i> = 60	<i>p</i> -value
Severity of periodontal disease			
healthy	0 (0.0)	8 (13.3)	0.037*
gingivitis	8 (13.3)	4 (6.7)	
slight chronic periodontitis	8 (13.3)	10 (16.7)	
moderate chronic periodontitis	22 (36.7)	17 (28.3)	
severe chronic periodontitis	22 (36.7)	21 (35.0)	
Extent of periodontal disease			
healthy	11 (18.3)	13 (21.7)	0.625
localized	20 (33.3)	21 (35.0)	
generalized	29 (48.3)	26 (43.3)	

* statistically significant.

Data presented as number (percentage) (*n* (%)).

Table 4. Comparative analysis of the study group and the control adult population regarding dietary habits, based on a survey

Dietary habits	Group BMI ≥ 25 kg/m ² <i>n</i> = 60	Group BMI < 25 kg/m ² <i>n</i> = 60	<i>p</i> -value
Knowledge about nutrition <i>n</i> (%)			
bad	4 (6.7)	3 (5.0)	0.705
sufficient	15 (25.0)	18 (30.0)	
good	35 (58.3)	30 (50.0)	
very good	6 (10.0)	9 (15.0)	
Meal regularity <i>n</i> (%)	24 (40.0)	39 (65)	0.006*
Number of meals <i>M</i> (min–max)	3 (3–4)	3 (3–5)	0.712
Diabetic diet <i>n</i> (%)	4 (6.7)	0 (0.0)	0.118
Meat and fat consumption frequency <i>n</i> (%)			
none	0 (0.0)	0 (0.0)	<0.001*
< once a week	0 (0.0)	0 (0.0)	
once a week	5 (8.3)	22 (36.7)	
> once a week	55 (91.7)	38 (63.3)	
every day	0 (0.0)	0 (0.0)	
Dairy consumption frequency <i>n</i> (%)			
none	0 (0.0)	0 (0.0)	0.032*
< once a week	5 (8.3)	11 (18.3)	
once a week	14 (2.3)	22 (36.7)	
> once a week	41 (68.3)	27 (45.0)	
every day	0 (0.0)	0 (0.0)	
Fish consumption frequency <i>n</i> (%)			
none	4 (6.7)	4 (6.7)	0.088**
< once a week	13 (21.7)	5 (8.3)	
once a week	27 (45.0)	24 (40.0)	
> once a week	16 (26.7)	27 (45.0)	
every day	0 (0.0)	0 (0.0)	
Fruit and vegetables consumption frequency <i>n</i> (%)			
none	0 (0.0)	0 (0.0)	0.104
< once a week	6 (10.0)	4 (6.7)	
once a week	10 (16.7)	20 (33.3)	
> once a week	44 (73.3)	36 (60.0)	
every day	0 (0.0)	0 (0.0)	
Sweets consumption frequency <i>n</i> (%)			
none	1 (1.7)	5 (8.3)	0.002*
< once a week	5 (8.3)	19 (31.7)	
once a week	21 (35.0)	17 (28.3)	
> once a week	33 (55.0)	19 (31.7)	
every day	0 (0.0)	0 (0.0)	
Fast food consumption frequency <i>n</i> (%)			
none	9 (15.0)	5 (8.3)	0.467
< once a week	16 (26.7)	12 (20.0)	
once a week	24 (40.0)	29 (48.3)	
> once a week	11 (18.3)	14 (23.3)	
every day	0 (0.0)	0 (0.0)	
Amount of liquids received daily [L] <i>n</i> (%)			
<0.5	10 (16.7)	9 (15.0)	0.927
0.5–1.5	26 (43.3)	25 (41.7)	
>1.5	24 (40.0)	26 (43.3)	

* statistically significant; ** trend-level significance.

In the patient group with BMI ≥ 25 kg/m², a higher percentage of patients was found to have severe or moderate chronic periodontitis at 36.7% each. In the group with BMI < 25 kg/m², the distribution was more even, with severe chronic periodontitis in 35% of patients and more patients showing evidence of less severe chronic periodontitis. Healthy patients accounted for 13.3% of subjects in the control group, compared to 0% in the patient group with BMI ≥ 25 kg/m² (Table 3).

The patients also differed in terms of periodontal disease progression, according to the new classification from 2017. In the patient group with BMI ≥ 25 kg/m², 48.3% of patients were classified as stage II of periodontitis, compared to 43.3% in the group with BMI < 25 kg/m² (Table 3).

In the analysis of the survey responses, a significant difference was observed concerning the regularity of food consumption ($p = 0.006$); 40% of respondents in the group with BMI ≥ 25 kg/m² had meals regularly, while this percentage was 65% in the control group (Table 4).

Analyzing the frequency of eating individual foods, a statistically significant difference was found between the groups in the frequency of eating meat and fat ($p < 0.001$), dairy products ($p = 0.032$) and sweets ($p = 0.002$) as well as a trend-level significance in the frequency of eating fish ($p = 0.088$) (Table 4).

The results showed that 91.7% of patients in the study group with BMI ≥ 25 kg/m² consumed meat and fat more often than once a week vs 63.3% in the control group with BMI < 25 kg/m². Similarly, dairy products were consumed more frequently than once a week in the BMI ≥ 25 kg/m² group at 68.3% vs 45% in the control group. In the group with BMI ≥ 25 kg/m², the consumption of sweets occurred more often than once a week in 55% of patients, while in the group with BMI < 25 kg/m², the distribution was more balanced, with 31.7% reporting the consumption of sweets less frequently than once a week and 8.3% reporting no consumption at all. In addition, 45% of people in the group with BMI < 25 kg/m² consumed fish more often than once a week, whereas in the BMI ≥ 25 kg/m² group, 45% of people reported consuming fish once a week and 21.7% even less often (Table 4).

Statistically significant differences were also found in the responses to questions about the frequency of follow-up visits to the dentist ($p = 0.018$) and hygienic habits, including the movement performed while brushing the teeth ($p = 0.022$), the type of brush used ($p = 0.025$), the use of dental floss ($p < 0.001$), the use of mouthwash ($p = 0.005$), and the occurrence of bleeding gums when brushing the teeth ($p = 0.003$) (Table 5).

Table 5. Comparative analysis of the study group and the control adult population regarding oral hygiene habits, based on a survey

Oral hygiene habits	Group BMI ≥ 25 kg/m ² <i>n</i> = 60	Group BMI < 25 kg/m ² <i>n</i> = 60	<i>p</i> -value
Frequency of follow-up visits			
< once every 12 months	29 (48.3)	18 (30.0)	0.018*
once every 12 months	19 (31.7)	16 (26.7)	
> once every 6 months	12 (20.0)	26 (43.3)	
Frequency of daily tooth brushing			
once a day	15 (25.0)	9 (15.0)	0.548
twice a day	26 (43.3)	32 (53.3)	
3 times a day	15 (25.0)	15 (25.0)	
>3 times a day	4 (6.7)	4 (6.7)	
Bleeding gums	31 (51.7)	15 (25.0)	0.003*
Using an electric toothbrush	11 (18.3)	22 (36.7)	0.025*
Movement during tooth brushing			
circular	19 (31.7)	14 (23.3)	0.022*
transverse	18 (30.0)	10 (16.7)	
sweeping	10 (16.7)	25 (41.7)	
combined	13 (21.7)	1 (1.7)	
Toothpaste with fluoride	58 (96.7)	60 (100.0)	0.496
Use of dental floss	11 (18.3)	33 (55.0)	<0.001*
Use of mouthwash	15 (25.0)	30 (50.0)	0.005*
Frequency of gum chewing after meals			
never	18 (30.0)	11 (18.3)	0.124
rarely	25 (41.7)	25 (41.7)	
often	15 (25.0)	24 (40.0)	
always	2 (3.3)	0 (0.0)	
Tooth loss	14 (23.3)	8 (13.3)	0.160
Diagnosed periodontitis	9 (15.0)	5 (8.3)	0.255
Awareness of periodontal disease	18 (30.0)	12 (20.0)	0.206

* statistically significant.

Data presented as number (percentage) (*n* (%)).

In the BMI ≥ 25 kg/m² group, 48.3% of patients had follow-up visits less frequently than once every 12 months, while in the control group, 43.3% visited the dentist more often than once every 6 months (Table 5).

In the group with BMI ≥ 25 kg/m², 31.7% of patients brushed their teeth in a circular motion and 30% used a transverse motion, while in the group with BMI < 25 kg/m², patients brushing their teeth with a sweeping motion dominated at 41.7%. In the group with BMI ≥ 25 kg/m², the percentage of patients using an electric toothbrush and dental floss was 18.3% each, while in the group with BMI < 25 kg/m², the percentages of patients using an electric toothbrush and dental floss were 36.7% and 55%, respectively. Similarly, in the group with BMI ≥ 25 kg/m², only 25% of patients used mouthwash, while in the group with BMI < 25 kg/m², the percentage was 50% (Table 5).

Discussion

The increasing prevalence of overweight/obesity as well as periodontal disease in adults has met with growing interest among researchers due to the possibility of using obesity-related indices to assess the risk of developing periodontal disease.⁶

The first studies on the relationship between obesity and periodontal disease in people were undertaken in Japan, where 241 patients aged between 20 and 59 years were examined.⁷ It was demonstrated that a high BMI value was positively associated with periodontal disease prevalence. The analysis, including adjustments for age, gender, hygiene habits, and tobacco smoking, proved that periodontal disease was 8.6 times more common in subjects with BMI ≥ 30 kg/m² as compared to the control group with BMI < 20 kg/m².⁷ A later study by Saito et al. with 643 patients aged 19–79 years demonstrated a statistically significant positive correlation between elevated BMI and periodontal disease prevalence ($p < 0.002$), which was confirmed by finding the relationship between high BMI and WHR and high PD values ($p < 0.001$). Interestingly, high WHR was linked to the risk of periodontal disease, particularly in the higher categories of BMI.⁸

Over the last 10 years, a significant body of literature and meta-analyses has been devoted to the association between overweight/obesity and periodontal disease, revealing a significant positive correlation.^{6–14} Some authors found a directly proportional relationship between BMI and the severity of periodontal disease.^{6,7} Dalla Vecchia et al. investigated the association of obesity with periodontitis, demonstrating a significant correlation between the occurrence of these 2 conditions, particularly in adult non-smoking women.¹⁵ Khader et al. studied the relationship between periodontal disease and obesity among the adult inhabitants of Jordan, concluding that high BMI as well as high WC were significantly associated with an increased risk of periodontal inflammation.¹⁶

The findings from the present study confirm earlier reports on a positive correlation between the overall obesity (based on BMI) and the occurrence of periodontal disease. Increased PD values were noted in the study group with BMI ≥ 25 kg/m². It was also demonstrated that patients with BMI ≥ 25 kg/m² tended to have increased plaque accumulation and symptoms of periodontitis based on BOP. Kongstad et al. investigated the relationship between obesity based on BMI and the loss of gum attachment by means of the CAL and BOP measurements, but only inconsiderable correlations were found between these parameters.¹⁷

The authors therefore suggest that the distribution of body fat may be a better prognostic factor for the development of periodontal disease than general body fat. Even though overweight and obesity in adults are commonly defined with reference to BMI, this index fails to describe body fat distribution. Hence, additional studies should focus on this relationship. In the literature, there have been reports on the considerably more frequent occurrence of periodontal disease in association with symptoms of abdominal adiposity, diagnosed by measuring WC, HC and WHR.^{15–17} However, this is not the only important aspect of the development of periodontal disease. Obese individuals have been found to have increased levels of plaque accumulation as compared to those with a normal weight, which may suggest a two-way interaction of risk factors in the occurrence and progression of periodontal disease.

A study by Górka et al. focusing on patients aged 35–44 years from large Polish cities showed that adults in Poland had some of the worst periodontal health in Europe, and among those studied, as much as 16% required comprehensive periodontological treatment (CPI-4).¹⁸ Furthermore, 23% of the studied population needed to improve their oral hygiene and undergo supragingival scaling (CPI-2), while more than 40% required oral hygiene training and subgingival scaling (CPI-3).¹⁸ A study by Konopka et al. aimed to explore the relationship between BMI and periodontal tissue parameters in a randomly chosen group of 200 inhabitants of Wrocław aged 35–44 years.¹⁹ The results revealed statistically significant dependencies between BMI and API and BOP. The study confirmed that particularly obese women failed to properly clean interdental spaces, and therefore required more extensive prophylactic action.¹⁹

The present study showed that only 3.3% of patients in the BMI ≥ 25 kg/m² study group had healthy periodontium, while 46.7% of overweight and obese patients needed oral hygiene instruction and subgingival scaling (CPI-3), and 26.7% required comprehensive periodontological treatment (CPI-4). In the healthy control group, calculus was found in 48.3% of individuals; they needed to improve their oral hygiene habits and to undergo treatment.

In conclusion, the data from this study may be of significance in terms of public health and can be used in the development of prevention programs aimed at controlling overweight/obesity and periodontal disease in Poland. As BMI is not the most accurate measure of obesity, the criteria for measuring obesity should also take into account WC. Irrespective of the above findings, patients should be advised by their general practitioners, medical specialists and dentists to modify their health behaviors, both general and oral, in order to improve their quality of life and reduce the possible negative consequences resulting from the interplay of oral and systemic diseases.

Our study showed a statistically significant difference in the number of meals consumed during the day between the study and control groups. This difference was evaluated in relation to the CAL value, which showed that patients eating more often and consuming 4–5 meals a day had lower BMI and lower CAL, which indicates a less severe degree of periodontal tissue changes. Studies show that people eating 1–2 meals a day tend to gain weight, have higher blood cholesterol levels and more impaired carbohydrate tolerance than people who eat 5 meals a day or more.²⁰

Our own research showed that the group with BMI ≥ 25 kg/m² had higher consumption of sweets as compared to the control group, statistically significant differences were found in the frequency of eating meat and fat and dairy products, and a trend in the frequency of eating fish was noted. In relation to the clinical parameters of periodontitis, these patients were characterized by worse oral hygiene and more advanced inflammatory changes in periodontal tissues.

A study by Yudkin confirmed that diet affects oral health.²¹ First of all, an excessive carbohydrate intake, combined with improper oral hygiene, can lead to the development of caries and periodontal disease. The researcher hypothesized that these disease entities are early warning signals of the development of diabetes, obesity and coronary heart disease.²¹

By analyzing the frequency of check-ups at the dentist and hygiene habits, such as the movement performed while brushing the teeth, the type of toothbrush used, the use of dental floss and mouthwash, and the occurrence of bleeding gums when brushing the teeth, our study showed greater care for oral hygiene in the group of patients with a normal weight, including the more frequent use of an electric toothbrush and cleaning the teeth with a sweeping motion.

Patients with normal BMI used dental floss and mouthwash more often, and they also had more regular dental check-ups every 6 months. It was shown that the less patients cared about oral hygiene, the higher the values of API and BOP were observed in patients with BMI ≥ 25 kg/m². These results coincide with a study of 292 patients by Prpić et al., who showed that obese people aged 31–75 had worse oral health, used dental floss/interdental brushes less often and had more missing teeth as compared to the group of patients with a normal weight.²²

A study by Hujoel et al. showed that the lack of daily usage of dental floss is strongly positively associated with obesity in patients suffering from periodontal disease.²³ These authors pointed out, however, that the habit of daily flossing of interdental spaces could also be nothing more than a sign of a generally accepted healthy lifestyle in people with a normal weight, which emphasizes how complicated and multifactorial the epidemiology of oral diseases can be.²³

Patients should be educated about what foods are part of a healthy diet, and we should make them aware of the impact of the diet not only on their overall health, but also on their oral health. Patients suffering from periodontal disease should include in their diet foods containing anti-inflammatory nutrients, such as fatty fish, rich in omega-3 fatty acids, and vitamin D as well as fruit and vegetables.

Conclusions

The analysis of these findings led the authors to certain conclusions. The group of obese and overweight adults presented lower regularity of eating meals and higher sweets consumption, combined with poor hygiene habits, which was reflected in increased rates of inflammation of the gums, increased plaque accumulation as well as worsened periodontal tissue status. Moreover, the positive correlation found between the occurrence of periodontal disease and the overall obesity (BMI) points to the need to arrange for periodontal disease prevention and treatment among overweight and obese patients.

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