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The effects of overweight and obesity on oral health status in children and adolescents

Wpływ nadwagi i otyłości na stan zdrowia jamy ustnej dzieci i młodzieży

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Keywords

obesity, children, oral hygiene

Summary

Introduction. Improper eating habits among children and adolescents often lead to overweight and obesity. Research indicates that these are risk factors for many diseases, including diseases in the oral cavity.

Aim. To analyse the correlations of selected parameters of dental and periodontal health as well as oral hygiene status in overweight and obese children and adolescents versus control group.

Material and methods. The study included 120 patients aged 11-18 years, who were classified into a study group with 60 overweight/obese individuals and a control group of 60 individuals with normal body weight based on BMI (Body Mass Index).

Each patient underwent anthropometric measurements, such as height (cm), body weight (kg), which were used to calculate BMI. Additional measurements were taken of waist circumference (WC) and hip circumference (HC), to obtain the waist-hip ratio (WHR). Clinical examination of the oral cavity included an assessment of dentition (DMF), oral hygiene API (Approximal Plaque Index) and periodontal tissue (PD – Pocket Depth, CAL – Clinical Attachment Level, %BOP – % Bleeding On Probing) and CPITN (The Community Periodontal Index for Treatment Needs).

Results. Statistically significant differences were found between patient groups with BMI ≥ 25 and BMI < 25 in the values of the following parameters: DMF $p = 0.005$, API $p < 0.001$, %BOP $p < 0.001$, PD $p < 0.001$, CPI $p < 0.001$.

Conclusions. Overweight and obese children were found to have worse parameters of dental and periodontal health as well as oral hygiene status compared to the group with normal weight. Our observations indicate that overweight and obesity may be potential risk factors for periodontal diseases in the study group.

Słowa kluczowe

otyłość, dzieci, higiena jamy ustnej

Streszczenie

Wstęp. Nieprawidłowe nawyki żywieniowe wśród dzieci i młodzieży często prowadzą do nadwagi i otyłości. Badania wskazują, że są to czynniki ryzyka wielu chorób, w tym chorób występujących w jamie ustnej.

Cel pracy. Analiza korelacji wybranych parametrów stanu uzębienia, tkanek przyzębia i higieny jamy ustnej u dzieci i młodzieży z nadwagą i otyłością oraz w grupie kontrolnej.
Materiał i metody. Badaniem objęto 120 pacjentów w wieku 11-18 lat, których podzielono na grupę badaną 60 osób z nadwagą i otyłością oraz grupę kontrolną 60 osób z prawidłową masą ciała stwierdzoną na podstawie wskaźnika BMI (ang. *body mass index*).
U każdego pacjenta dokonano pomiarów antropometrycznych, takich jak wzrost (cm) i masa ciała (kg), na ich podstawie wyliczano wskaźnik BMI. Mierzono obwód talii (WC) oraz obwód bioder (HC) celem wyliczenia wskaźnika talia-biodro (WHR). Badanie kliniczne jamy ustnej obejmowało ocenę stanu uzębienia (liczba PUW – Próchnica Ubytek Wypełnienie), higieny jamy ustnej (wskaźnik API – Approximal Plaque Index) i tkanek przyzębia (PD – Pocket Depth, CAL – Clinical Attachment Level, %BOP – Bleeding On Probing) oraz wskaźnik CPITN (The Community Periodontal Index for Treatment Needs).
Wyniki. W grupie pacjentów z BMI ≥ 25 i BMI < 25 stwierdzono różnicę istotną statystycznie w wartościach wskaźników: liczby PUW $p = 0{,}005$, API $p < 0{,}001$, %BOP $p < 0{,}001$, PD $p < 0{,}001$, CPI $p < 0{,}001$.
Wnioski. U dzieci z nadwagą i otyłością stwierdzono gorsze parametry stanu uzębienia, tkanek przyzębia i higieny jamy ustnej w porównaniu z grupą kontrolną. Obserwacje własne wskazują, że nadwaga oraz otyłość mogą być czynnikami ryzyka rozwoju chorób przyzębia w badanej grupie.

Introduction

Obesity, long regarded as a by-product of life in affluent industrial societies, has also become a threat for the inhabitants of developing countries. Nutrition specialists are warning against a global epidemic of obesity-related diseases, such as type 2 diabetes, hypertension, cancer or cardiovascular diseases. One of the most recent studies led by the WHO and Imperial College London published data on the prevalence of obesity and overweight among children and adolescents (aged between 5 and 19 years). Looking at changes, including those in BMI, which took place between 1975 and 2016, the study revealed that the number of obese people between 5 and 19 years of age has risen tenfold over the past four decades. In 1975, the obesity rate among children and adolescents was under 1% (11 million), whereas in 2016 it had risen up to 6 and 8% (124 million) among girls and boys, respectively (1).

Like obesity, periodontal disease affects an increasing percentage of the human population. Epidemiological studies have shown that more than 2/3 of the global population suffer from periodontal diseases. Albandar et al. found in their study assessing the prevalence of early-onset periodontitis in a group of young people from the USA, that 0.6% of 13-15 year olds, and 2.75% of 16-17 year olds were affected by chronic periodontitis (2).

Lately, there has also been a growing number of scientific reports linking obesity with periodontal disease (3). Up until recently, the adipose tissue was perceived merely as the body's energy storage. Today, it is known to be metabolically active, secreting numerous pro-inflammatory hormones and cytokines (adipocytokines), including TNF-alpha (tumour necrosis factor alpha) and IL-6 (interleukin 6) (4). The majority of cytokines produced by the adipose tissue are also involved in the development of periodontal disease, suggesting that similar mechanisms are at play in the pathophysiology of periodontitis and obesity. These observations suggest that both these conditions share a similar pathogenesis and remain closely linked to each other (5). Even though obesity and oral health are some of the most important health challenges in children and adolescents worldwide, there is very little research into the associations between obesity and periodontal status or the prevalence of dental caries in children. Therefore, it seems relevant to try and explore the relationship between the anthropometric factors of overweight and obesity and the factors of oral health, notably dental caries and periodontal disease. If demonstrated, such a relationship may have significant implications for our current views on public health.

Aim

The aim of this paper was to analyse the correlations of selected parameters of dental and periodontal health as well as oral hygiene status with anthropometric measures in overweight/obese children and adolescents and in the control group.

Material and methods

The study included 120 patients (boys and girls) at developmental age between 11 and 18 years, participating in holiday fitness and weight loss camps for children, as well as patients treated at a private dental practice in Warsaw between June 2013 and May 2015.

Overweight or obesity, confirmed by BMI score ≥ 25 kg/m^2, was the inclusion criterion. The patients were classified into 2 groups. Group I (study group) included 60 overweight and obese patients aged between 11 and 18 years, with mean age of 14 years, including 37 girls and 23 boys with BMI ≥ 25 kg/m^2. Group II (control group) included 60 children, including 38 girls and 22 boys aged between 11 and 18 years, with mean age of 15 years, with BMI scores in the range of 18-24.9 kg/m^2.

All patients from groups I and II underwent a clinical assessment of dentition, oral hygiene status and periodontal tissue. Dental health was assessed using DMF oral hygiene status was evaluated using the Approximal Plaque Index (API) according to Lange et al.; the clinical condition of gums and periodontium was assessed based on the Offenbacher scale, with reference to the measurements of pocket depth PD (PD) and bleeding on probing %BOP; periodontal probing was also employed to measure pocket depth PD and clinical attachment level CAL in the evaluation of periodontal status. The Community Periodontal Index for Treatment Needs (CPITN) procedure according to Ainamo was applied to assess prevention and treatment needs of the participants.

Each patient underwent selected anthropometric measurements, such as height (cm), body weight (kg), which were then used to calculate the BMI (Body Mass Index) score.

Additional anthropometric measures of overweight and obesity included waist circumference WC and hip circumference HC, which were then used to calculate the waist-hip ratio (WHR).

The relationships between the individual parameters describing periodontal and oral hygiene status and anthropometric measurements were presented using Spearman's rank correlation coefficient (or Spearman's rho) in tables and graphically. Multiple regression analysis was also used to calculate partial correlations, which consider the influence of age and sex simultaneously. A level of statistical significance was assumed at $p < 0.05$ for all tests. Calculations were performed using the STATISTICA 12.0 PL package (StatSoft, Inc. 2015, Tulsa, USA). Supporting calculations, tables and charts were made in the form of MS Excel spreadsheet (Microsoft Corporation 2010, Redmond, USA).

Moreover, additional dichotomisation was employed in statistical analysis, based on the median value of selected parameters describing periodontal and oral hygiene status (median-split). The adopted watershed in the children's group was (i) the median value of BOP and (ii) the median value of API (the CAL values in children ≤ 2 mm did not demonstrate sufficient differentiation to allow for reliable dichotomisation).

Results

Statistically significant p values were marked dark grey in tables, whereas values approaching statistical significance (the so-called tendencies) were signed as moderate (<0,5).

Comparative analysis of correlations between anthropometric measures of overweight and obesity and oral hygiene and periodontal health parameters in the study group vs. control group in the population of children and adolescents

Among children with BM I ≥ 25, the correlation analysis revealed a strong correlation between DMF and body weight (rho 0.56), a moderate correlation with age (rho 0.41), height (rho 0.44), WC (rho 0.37), HC (rho 0.38), and a positive correlation with BMI (rho 0.28).

In the analysis of subsequent parameters, a strong correlation was found between API and BMI (rho 0.52), and a moderately strong one with body weight (rho 0.43), waist circumference WC (rho 0.38) and hip circumference HC (rho 0.37).

The variable %BOP was moderately correlated with body weight (rho 0.41), BMI (rho 0.40), WC (rho 0.49), and HC (rho 0.30).

In turn, pocket depth PD showed a moderate correlation with WHR (rho 0.33) and a positive correlation with WC (rho 0.28).

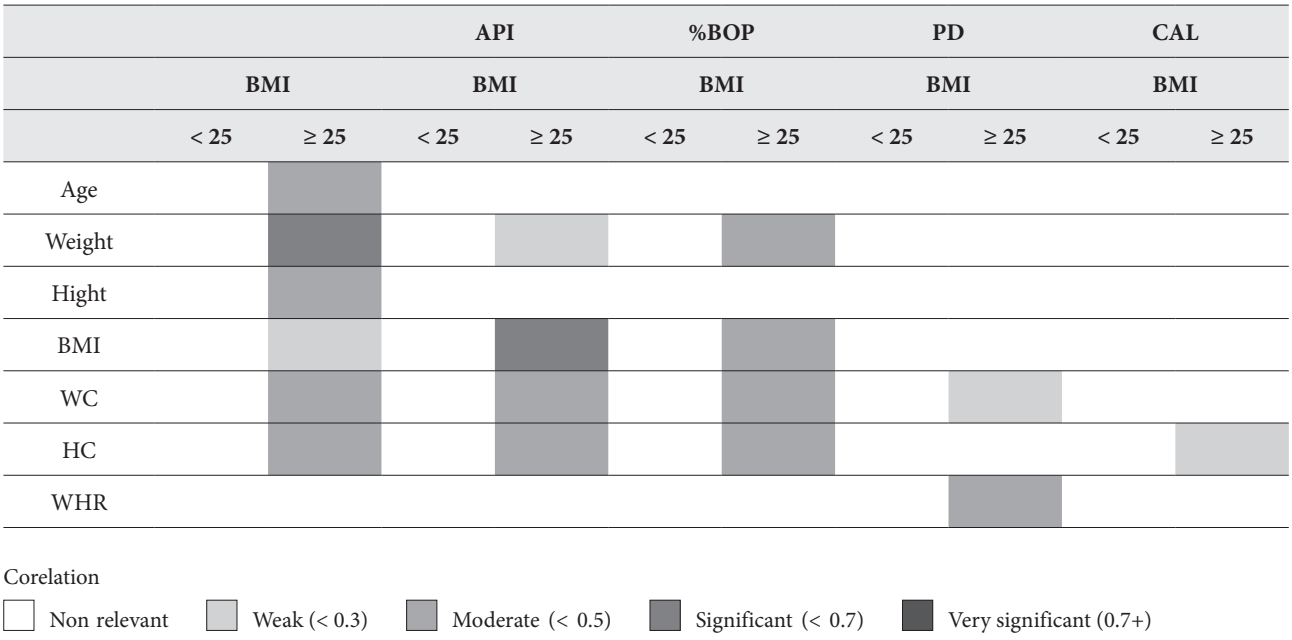
For CAL, a strong correlation was observed with age (rho 0.53) and a weak one with hip circumference HC (rho 0.27) (tab. 1, 2).

Tab. 1. Spearman's rank correlation analysis of relationships between age, weight, height, BMI, WC, HC, WHR vs. DMF, API, %BOP, PD, CAL in the population of children and adolescents with BMI ≥ 25

Children with BMI ≥ 25, Spearman's correlation	DMF		API		%BOP		PD		CAL	
	rho	P	rho	P	rho	P	rho	P	rho	P
Age	0.41*	0.001**	0.06	0.653	0.23	0.082	0.01	0.928	0.53*	< 0.001**
Weight	0.56*	< 0.001**	0.43*	0.001**	0.41*	0.001**	0.11	0.394	0.17	0.187
Hight	0.44*	< 0.001**	0.14	0.277	0.18	0.165	0.08	0.550	0.23	0.078
BMI	0.28*	0.030**	0.52*	< 0.001**	0.40*	0.002**	0.12	0.372	-0.04	0.757
WC	0.37*	0.004**	0.38*	0.003**	0.49*	0.000**	0.28*	0.031**	0.14	0.281
HC	0.38*	0.002**	0.37*	0.004**	0.30*	0.021**	-0.06	0.626	0.27*	0.035**
WHR	-0.02	0.874	0.06	0.654	0.20	0.128	0.33*	0.010**	-0.11	0.405

BMI – Body Mass Index; WC – Waist Circumference; HC – Hip Circumference; API – Approximal Plaque Index; %BOP – Bleeding On Probing; PD – Pocket Depth; CAL – Clinical Attachment Level; WHR – Waist-Hip Ratio; DMF – Determination of Caries Intensity Index; p** – statistically significant, rho* – significant strenght of correlation, rho – not significant

Tab. 2. A graphic representation of Spearman's rank correlation for the study group and the control group in the population of children and adolescents



In the group of children with BMI < 25, Spearman's rank correlation analysis did not reveal statistically significant dependencies between anthropometric factors of overweight and obesity and oral hygiene and periodontal health parameters (tab. 2, 3).

Comparative multiple regression analysis of correlations between anthropometric measures of overweight and obesity and oral hygiene and periodontal health parameters in the population of children and adolescents including sex and age

In the group of children with BMI ≥ 25, partial correlations in multiple regression analysis including sex and age demonstrated statistically significant dependencies. DMF was positively correlated with body weight (rho 0.28), and moderately correlated with BMI (rho 0.32) and HC (rho 0.30). API was found to have a strong correlation with body weight (rho 0.53), a moderate correlation with BMI (rho 0.48), WC (rho 0.40), HC (rho 0.44), and a weak correlation with height (rho 0.27). In turn, %BOP was moderately correlated with BMI (rho 0.44), WC (rho 0.40), weight (rho 0.31) and HC (rho 0.31). Lastly, PD was moderately correlated with WHR (rho 0.32) (tab. 4, 5).

In the group of children with BMI < 25, partial correlations in multiple regression analysis including sex and age revealed no statistically significant dependencies between anthropometric measures of overweight and obesity and oral hygiene and periodontal health parameters (tab. 4, 6).

Comparative analysis of the study group and the control group including a median-split of %BOP in the population of children and adolescents

In the group of children with BMI ≥ 25 and %BOP scores above the median, API values were found to be significantly elevated (0.76 vs. 0.62) p = 0.009 (tab. 7).

The groups differed statistically significantly in terms of findings according to the Offenbacher scale p < 0.001 (tab. 8). In the group with BMI < 25 and %BOP above the median the prevailing finding was BGI-G 96.7%.

In the group with BMI ≥ 25, patients with API above the median were observed to have a tendency to have elevated levels of %BOP (60 vs. 54%) p = 0.064. In the group with BMI < 25, patients with API above the median were also found to have an increased DMF index (7 vs. 5), p = 0.003, and significantly higher pocket depth PD (1 vs. 0.7), p < 0.001 (tab. 9).

No statistically significant differences were found between the subgroups in terms of the Offenbacher scale (tab. 10).

Patients with API scores above the median were found to have higher BMI scores (31.2 vs. 29.4 kg/m^2) p < 0.001 and higher hip circumference HC (107 vs. 103 cm) p = 0.017 (tab. 9, 11).

Discussion

Our study conducted among children and adolescents clearly shows that there is a positive association between body weight, BMI, waist circumference WC and symptoms of gum disease, i.e. %BOP, and plaque accumulation, i.e. API.

Tab. 3. Spearman's rank correlation analysis of relationships between age, weight, height, BMI, WC, HC, WHR vs. DMF, API, %BOP, PD, CAL in the population of children and adolescents with BMI < 25

Children with BMI < 25, Spearman's correlation	DMF		API		%BOP		PD		CAL	
	rho	P	rho	P	rho	P	rho	P	rho	P
Age	0.11	0.416	0.21	0.109	0.13	0.309	0.15	0.249	-0.04	0.751
Weight	0.01	0.961	0.14	0.292	0.04	0.733	0.09	0.472	-0.14	0.276
Hight	-0.01	0.951	0.04	0.759	0.06	0.646	0.01	0.931	-0.03	0.819
BMI	-0.04	0.739	0.14	0.280	0.03	0.834	0.12	0.350	-0.19	0.142
WC	0.11	0.388	0.01	0.951	0.14	0.295	0.04	0.774	-0.21	0.100
HC	-0.09	0.485	-0.07	0.606	-0.13	0.330	-0.10	0.454	-0.05	0.732
WHR	0.14	0.292	0.06	0.654	0.16	0.216	0.10	0.470	-0.20	0.119

BMI – Body Mass Index; WC – Waist Circumference; HC – Hip Circumference; API – Approximal Plaque Index; %BOP – Bleeding On Probing; PD – Pocket Depth; CAL – Clinical Attachment Level; WHR – Waist-Hip Ratio; DMF – Determination of Caries Intensity Index; rho – not significant strength correlation, p – statistically not significant

Tab. 4. A graphic representation of multiple regression analysis for both the study and control group in the population of children and adolescents, including sex and age

	DMF		API		%BOP		PD		CAL	
	BMI		BMI		BMI		BMI		BMI	
	< 25	≥ 25	< 25	≥ 25	< 25	≥ 25	< 25	≥ 25	< 25	≥ 25
Age										
Weight										
Hight										
BMI										
WC										
HC										
WHR										

Corelation

Non relevant | Weak (< 0.3) | Moderate (< 0.5) | Significant (< 0.7) | Very significant (0.7+)

Markovic et al. also showed in their study in 422 children and adolescents aged between 6 and 18 years that there is a positive correlation between BMI, body weight, tooth brushing frequency and the plaque index (PI) and the gingival index (GI) (6).

Considering the prevalence of dental caries, Markovic et al. additionally found that younger children, aged between 6 and 11 years, had a lower DMF index, which then increased with participants' age, i.e. it was higher in the age group 12-18 years and was associated with poor eating habits. Nevertheless, the study failed to provide strong evidence of an increased risk of dental caries among children and adolescents with BMI > 25.

Our study also revealed a relationship between DMF and age, as well as showed that the study group with BMI ≥ 25 did not differ significantly in terms of DMF from the control group, which may confirm the findings of Markovic et al.

In their study in 803 students aged 11-17 years, Foroogh et al. found a significant correlation (P = 0.006) between DMF and BMI, observing that a 10-point increase in BMI causes the DMF index to go up by 0.57 (7).

Tab. 5. Multiple regression analysis of relationships between weight, height, BMI, WC, HC, WHR vs. DMF, API, %BOP, PD, CAL in the population of children and adolescents with BMI ≥ 25, including sex and age

Chidren with BMI ≥ 25	DMF		API		%BOP		PD		CAL	
	rho	P	rho	P	rho	P	rho	P	Rho	P
Weight	0.28*	0.032**	0.53*	< 0.001**	0.35*	0.007**	0.07	0.590	-0.04	0.748
Hight	0.06	0.662	0.27*	0.038**	0.01	0.927	0.00	0.971	-0.11	0.427
BMI	0.32*	0.015**	0.48*	< 0.001**	0.44*	0.001**	0.11	0.407	0.07	0.600
WC	0.14	0.281	0.40*	0.002**	0.40*	0.002**	0.24	0.066	0.11	0.422
HC	0.30*	0.020**	0.44*	0.001**	0.31*	0.018**	0.06	0.668	0.05	0.729
WHR	-0.13	0.314	0.00	0.978	0.13	0.328	0.32*	0.015**	0.07	0.603

BMI – Body Mass Index; WC – Waist Circumference; HC – Hip Circumference; API – Approximal Plaque Index; %BOP – Bleeding On Probing; PD – Pocket Depth; CAL – Clinical Attachment Level; WHR – Waist-Hip Ratio; DMF – Determination of Caries Intensity Index; p** – statistically significant, rho* – significant strenght of correlation, rho – not significant

Tab. 6. Multiple regression analysis of relationships between weight, height, BMI, WC, HC, WHR vs. DMF, API, %BOP, PD, CAL in the population of children and adolescents with BMI < 25, including sex and age

Children with BMI < 25	DMF		API		%BOP		PD		CAL	
	rho	P	rho	P	rho	P	rho	P	rho	P
Weight	-0.15	0.263	0.05	0.730	-0.04	0.786	0.02	0.872	-0.08	0.575
Hight	-0.16	0.217	-0.12	0.356	-0.04	0.740	-0.08	0.568	0.06	0.671
BMI	-0.07	0.584	0.18	0.187	0.01	0.916	0.10	0.457	-0.17	0.195
WC	0.09	0.502	0.03	0.802	0.06	0.646	0.14	0.282	-0.25	0.061
HC	-0.18	0.183	-0.13	0.313	-0.18	0.167	-0.17	0.210	-0.04	0.775
WHR	0.15	0.262	0.08	0.551	0.14	0.303	0.21	0.122	-0.15	0.252

BMI – Body Mass Index; WC – Waist Circumference; HC – Hip Circumference; API – Approximal Plaque Index; %BOP – Bleeding On Probing; PD – Pocket Depth; CAL – Clinical Attachment Level; WHR – Waist-Hip Ratio; DMF – Determination of Caries Intensity Index; rho – not significant strength correlation; p – statistically not significant

Tab. 7. Comparative analysis of the study group and the control group including a median-split of BOP scores and parameters of DMF, API (%), %BOP, PD, CAL in the population of children and adolescents

	BMI > 25			BMI < 25		
	BOP ≤ 59.0% (n = 35)	BOP 59.0% (n = 25)	P	BOP ≤ 13.5% (n = 30)	BOP > 13.5% (n = 30)	P
DMF	7 (5-8)	7 (5-9)	0.982	5 (5-7)	6 (5-8)	0.216
API						
< 0.25	1 (2.9)	0 (0.0)	0.036	10 (33.3)	4 (13.3)	0.321
0.25-0.39	3 (8.6)	0 (0.0)		9 (30.0)	11 (36.7)	
0.40-0.69	22 (62.9)	10 (40.0)		9 (30.0)	13 (43.3)	
0.70+	9 (25.7)	15 (60.0)		2 (6.7)	2 (6.7)	
BOP (%)	49 (38-56)	69 (65-76)	< 0.001*	0.0 (0.0-0.0)	33.5 (25-44)	< 0.001*
PD						
CAL	0 (0-0)	0 (0-0)	0.101	0 (0-0)	0 (0-0)	0.334

BMI – Body Mass Index; API – Approximal Plaque Index; %BOP – Bleeding On Probing; PD – Pocket Depth; CAL – Clinical Attachment Level; DMF – Determination of Caries Intensity Index; * – statistically significant

Tab. 8. Comparative analysis of the study group and the control group, including a median-split of BOP scores and Offenbacher classification in the population of children and adolescents

	BMI ≥ 25 (n = 60)			BMI < 25 (n = 60)		
	BOP ≤ 59.0% (n = 35)	BOP > 59.0% (n = 25)	P	BOP ≤ 13.5% (n = 30)	BOP > 13.5% (n = 30)	P
BGI-H				30 (100)		< 0.001
BGI-G	35 (100)	25 (100)	1.000*		29 (96.7)	
P1						
P2					1 (3.3)	
P3						

BMI – Body Mass Index; BOP – Bleeding On Probing; BGI-H – Biofilm Gingival Interface-Healthy; BGI-G – Biofilm Gingival Interface-Gingivitis; * – statistically significant

Tab. 9. Comparative analysis of the study group and the control group including a median-split of API scores and parameters of DMF, API (%), %BOP, PD, CAL in the population of children and adolescents

	BMI ≥ 25 (n = 60)			BMI < 25 (n = 60)		
	API ≤ 0.65 (n = 31)	API > 0.65 (n = 29)	P	API ≤ 0.49 (n = 30)	API > 0.49 (n = 30)	P
DMF	7 (4-8)	7 (6-9)	0.275	5 (4-6)	7 (5-8)	0.003
API	0.54 (0.46-0.61)	0.77 (0.71-0.81)	< 0.001	0.28 (0.18-0.34)	0.53 (0.46-0.62)	< 0.001
BOP (%)	54.0 (39.0-65.0)	60.0 (51.0-70.0)	0.064	4.0 (0.0-38.0)	17.0 (0.0-31.0)	0.683
PD (mm)	1.65 (1.20-2.00)	1.66 (1.43-2.01)	0.947	0.69 (0.50-0.87)	1.00 (0.90-1.30)	< 0.001
CAL	0 (0-0)	0 (0-0)	0.596	0 (0-0)	0 (0-0)	0.334
CPITN	1 (1-2)	1 (1-2)	0.663	0.5 (0-1)	1 (0-1)	0.499

BMI – Body Mass Index; API – Approximal Plaque Index; %BOP – Bleeding On Probing; PD – Pocket Depth; CPITN – The Community Periodontal Index for Treatment Need; DMF – Determination of Caries Intensity Index; CAL – Clinical Attachment Level

Tab. 10. Comparative analysis of the study group and the control group including a median-split of API scores and Offenbacher classification in the population of children and adolescents

	BMI ≥ 25 (n = 60)			BMI < 25 (n = 60)		
	API ≤ 0.65 (n = 31)	API > 0.65 (n = 29)	P	API ≤ 0.49 (n = 30)	API > 0.49 (n = 30)	P
Periodontitis progression						
BGI-H				16 (53.3)	11 (36.7)	0.297
BGI-G	31 (100)	29 (100)	1.000*	14 (46.7)	18 (60.0)	
P1				0 (0.0)	1 (3.3)	
P2				0 (0.0)	0 (0.0)	
P3				0 (0.0)	0 (0.0)	

BMI – Body Mass Index; API – Approximal Plaque Index; BGI-H – Biofilm Gingival Interface-Healthy; BGI-G – Biofilm Gingival Interface-Gingivitis

Tab. 11. Comparative analysis of the study group and the control group including a median-split of API scores and overweight/obesity parameters WC (cm), HC (cm), WHR in the population of children and adolescents

	BMI ≥ 25 (n = 60)			**BMI < 25 (n = 60)**		
	API ≤ 0.65 (n = 31)	**API > 0.65 (n = 29)**	**P**	**API ≤ 0.49 (n = 30)**	**API > 0.49 (n = 30)**	**P**
WC	93 (87-101)	102 (88-109)	0.065	77.5 (69-86)	75.5 (70-85)	0.79
HC	103 (93-108)	107 (99-112)	0.017	92 (89-98)	92.5 (88-97)	0.678
BMI	29.4 (27.9-30.1)	31.2 (30.1-33.2)	< 0.01	21.8 (20.0-22.7)	21.2 (20.3-22.5)	0.745

BMI – Body Mass Index; WC – Waist Circumference; HC – Hip Circumference; API – Approximal Plaque Index

Our own observations correspond to those presented by Willershausen et al. and suggest that there is a relationship between caries frequency and body weight (8).

On the other hand, the study by Paisi et al. based on a sample of 347 children aged 4-6 years demonstrated no statistically significant correlation between overweight (BMI) and the number of decayed teeth (9). There have also been other reports indicating that children with an increased risk of overweight are at the same time at a higher risk of dental caries, compared to normal weight population (10, 11). In the scientific literature, there are also research findings where authors failed to identify any statistically significant differences in the prevalence of caries depending on the BMI category (12, 13). An inverse correlation between body weight and dental caries has also been observed, for instance by Sohn (14).

Peng et al. found in their study including 668 12-year-olds a statistically significant positive correlation between DMF and anthropometric measures of overweight and obesity WC and WHR (p = 0.027) (15). The present study confirmed the statistically significant correlation between DMF and WC in Spearman's correlation analysis. A significant positive correlation between DMF and BMI and weight was also demonstrated.

Scorzetti et al. examined 44 people aged 10-11 years with BMI > 25 and 59 people with BMI < 25 and found a statistically significant difference between the study groups with regard to API and %BOP (p < 0.05). Other parameters analysed in the study included pocket depth PD and clinical attachment level CAL in both groups, but no statistically significant differences were demonstrated, even though it was observed that these parameters were impaired in overweight and obese children (16). Our study showed no statistically significant correlations between periodontal health indicators and anthropometric measures of overweight and obesity in the BMI < 25 group. However, a relatively strong correlation was found between age and CAL (p < 0.001) in the study group, indicating that longer harmful exposure in obese individuals leads with time to an increased risk of periodontitis. This is supported by the fact that a statistically significant association was identified between API and BMI in this patient group.

In their study in 100 children aged 7-12 years, Sfasciotti et al. demonstrated a significant difference between controls and overweight/obese children in the analysis of the full-mouth plaque score (FMPS), which was 21.86% in the group with normal weight and 50.08% in the group with BMI > 25, as well as the full-mouth bleeding score (FMBS), which was 12.7 and 26.24%, respectively. PD > 3 was not observed upon examination in either group (17).

Zhao et al. looked at the Sulcus Bleeding Index (SBI), plaque index (PI), %BOP and PD, and examined the relationships between obesity and periodontal disease among Chinese school-age children. Additionally, they investigated the levels of TNF-alpha in gingival crevicular fluid. The authors concluded that TNF-alpha may be a potential prognostic factor in the prediction and prevention of periodontitis in children, as it occurs in the gingival crevicular fluid before any clinical symptoms of obesity-related periodontitis are visible (18). The present study used CPITN to assess prevention and treatment needs in the participants. The group of overweight/obese children included children who required no intervention, whether for the purposes of prevention or treatment, while bleeding and periodontitis were found in 71,6% (CPI-1). Calculus was found in 28% of the participants (CPI-2). These findings may be compared with those obtained by Irigoyen-Camacho et al., who evaluated the relationship between BMI and the bleeding factor %BOP plus CPI in 257 15-year-old school children. In their study, healthy periodontium was found in only 59.7% of the participants (CPI-0), calculus was detected in 23.8% of the participants (CPI-2), and 3.1% were found to have gingival pockets (CPI-3) (19).

Similar observations were published by Partata et al., based on a study in 88 children aged 5-10 years, which demonstrated that among the obese participants code CPI-1 was found in 44%, and CPI-3 in 7.4% of patients. Also, %BOP was statistically higher among obese children than those with normal weight (20). Similarly, we observed a significant correlation between overweight/obesity and periodontitis in children and adolescents.

Our observations suggest that overweight and obesity may be risk factors of periodontal diseases; therefore, it seems that the promotion of a healthy lifestyle and physical activity among children and adolescents has implications not only for their general health and well-being, but is also necessary in the prevention of oral diseases. Nevertheless, excess weight is undoubtedly related to other dental diseases and it would be wise to include weight and height measurements in the current and future programmes aimed at preventing oral diseases.

In summary, the present study in children and adolescents shows a significant positive correlation between the parameters of API and %BOP and obesity, and, at the same time, a positive correlation between caries prevalence and BMI.

Conclusions

Overweight and obesity may be potential risk factors of periodontal diseases in children and adolescents; therefore the promotion of a healthy lifestyle and physical activity is necessary not only to maintain general health, but also for the prevention of oral diseases.

Hence, a stronger cooperation between paediatricians, dieticians and dentists is needed to achieve more effective patient care.

Conflict of interest
Konflikt interesów

None
Brak konfliktu interesów

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