Pathologic features in the oral cavity in adolescence with disturbances in the nutritional status

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The aim of the study is to investigate the carious process and gingival inflammation in adolescents with disturbances in nutritional status. The study was conducted in 2023-2024 and involved 162 children (86 boys and 76 girls) between 11-17 years old with a median age of 14. The nutritional status of the studied children was analyzed using an anthropometric indicator BMI-Z Percentile. The adolescents were divided into three groups: normal body weight, risk of obesity, and overweight. DMFT, SiC index, and PUFA index were used to evaluate the carious process. Gingival inflammation was evaluated using the Papillary Bleeding Index (PBI). Of all children studied, 68 (42%, 95% CI:34.3-50) were with normal body weight, 75 (46.3%, 95% CI:38.4-54.3) were at risk of obesity and 19 (11.7%, 95% CI:7.2-17.7) were overweight. In the three groups, there was no significant difference in DMFT, but median SiC index was increased in the second group - 9 (8-10.5) and in the third - 10 (8-12) (p>0.05). PUFA index was increased in the third group–

31.6%, in the second – 32% (p<0.05). PBI grew in the second group - 66%, while in the first and third -50%. (p<0.05). Post hoc analysis showed a statistically significant difference between the first and second groups' PBI. A moderate positive correlation was observed between PUFA and PBI in the first (ρ (rho) = 0.47, p<0.001) and the second group (ρ (rho) = 0.61, p< 0.001). Nutrition has a significant role in developing and complicating the carious process and gingival inflammation in adolescence.

Keywords: adolescent, carious process, gingival inflammation, nutritional status

INTRODUCTION

Obesity among adolescents is a worldwide public health problem. According to the World Obesity Federation, it is estimated that there will be 206 million obese children/adolescents in 2025 and 254 million in 2030 [1]. Failure to solve it leads to a predisposition to obesity in adulthood [2]. According to the American Academy of Pediatrics, Committee on Nutrition, overweight and obesity are now the most common medical conditions of childhood [3].

There is a similarity between caries and its complications, gingival inflammation, and obesity. All of them are of global importance, multifactorial, and related to lifestyle, which leads to interconnection between them. Important for their development are the way of eating, oral hygiene habits, active lifestyle, psychosocial behavior, socio-economic status, and parental support [4-6].

In our fast-paced everyday life, with fast food consumption, on-the-go eating and not enough time to prepare home-cooked meals, the results are there. Fast foods lack essential micro and macro elements such as vitamins, minerals, fiber, and amino acids, their nutritional value is extremely low. In contrast, they are rich in white flour, refined sugar, salt, polysaturated fats, trans fats, colorings and additives [7]. Diet and eating habits affect adolescents' growth, general and oral health [8, 9]. Adequate nutrition childhood during and adolescence is essential for children's growth and development [10]. Frequent consumption of carbohydrates in foods and drinks increases the risk of excess body weight, the development and progression of the carious process, and gingival inflammation [11]. In addition, according to the global disease burden from 2017, the most common condition is untreated and complicated caries of permanent teeth [12].

EXPERIMENTAL

The study was conducted in the period 2023-2024 at the Medical University "Prof. Dr. Paraskev Stoyanov"- Varna, University Medical and Dental Center at the Faculty of Dental Medicine and clinical halls at the Department of Pediatric Dentistry of the Faculty of Dental Medicine - Varna. A clinical examination was conducted to record the carious status by DMFT and SiC index, complication of the carious process by PUFA index, gingival

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inflammation by PBI.

In the study, we used one of the general health indicators, the overweight and obesity, BMI-Z score. It is used to diagnose the risk of obesity and overweight in children and adolescents. Children fall into the column "at risk of obesity" when the BMI Zscore is between the 85th and 95th percentile, "overweight" when they are above the 95th percentile and "severely obese" above the 99th percentile [13]. This index shows only total adipose tissue, and additional index systems are used to estimate its distribution [14].

The most universal index for reporting the prevalence of dental caries - DMFT - was used. D shows teeth with a carious lesion, and M shows Missing teeth in the dentition due to a complication of a carious process. F-teeth that have been restored after caries treatment. According to the WHO, the diagnosis of caries registered by DMFT-index is based only on visual diagnostics [15]. The DMFT index is a quick and convenient method, a widely used method for assessing the risk of caries [16]. In addition to the DMFT index, we used the Significant Caries Index (SiC Index). It draws attention to patients with the highest caries rates in each study population. It represents the average DMFT index of one-third of the studied adolescents in the population with the highest score [17].

However, these two indices, DMFT and SiC index, do not consider the severity and complications of the carious process. We therefore used a PUFA index created by Monse et al. [18], which was used to estimate the prevalence and severity of oral conditions associated with untreated caries. Reflects the presence of visible pulp (P/p), traumatic ulceration of the oral mucosa due to injury from residual sharp pieces of a tooth, root fragments (U/u), fistula in a suppurating fistulous course associated with a tooth or involvement of the pulp (F/f) or abscess (A/a) when soft tissue swelling with purulent content is associated with pulp necrosis. The score of the examined patient is calculated in a cumulative way (P+U+F+A) and can vary from 0 to 32 for permanent dentition.

The Papillary Bleeding Index (PBI) is used to measure the level of gingival inflammation. It is beneficial for evaluating gingival inflammation in the area of the interdental papillae. The examination is carried out with the help of an atraumatic periodontal probe, which is inserted into the base of the papilla from the medial side and moved coronally to the tip of the papilla. The same movement is repeated distal to the tooth. After 20-30 seconds, the intensity of bleeding is assessed when the quadrant is fully examined. All available papillae in quadrants are examined. I and III quadrant are examined orally, and II and IV quadrant vestibularly. The index is a sensitive indicator of the severity of gingival inflammation [19].

The intensity of the bleeding that occurred was measured by scoring on a scale of 0-4 [20]. The evaluation criteria are:

0: no bleeding; 1: a single discrete point of bleeding occurs; 2: bleeding points or a single bleeding line appear; 3: the interdental area is filled with blood after probing; 4: profuse bleeding on probing and blood flow to the marginal sulcus.

The amount of bleeding is calculated using a formula to find the PBI value. PBI is calculated by summing the results and dividing their sum by the number of papillae examined. Mean PBI was categorized according to the ranges [21]: 0—no inflammation, 0- 1.3—mild inflammation, 1.4 – 2.7—moderate inflammation, and 2.8 – 4 severe inflammation.

The collected data were coded, and a statistical analysis was carried out using Microsoft Excel 2010 and Jamovi Version 2.4. Analysis of the data was carried out by frequency distributions and descriptive statistics (chi-square test, Fisher's exact test, Mann–Whitney U test, Welch's test. For the strength and direction of the Correlation Relationship, the Spearman test was used. Level of significance - p<0.05.

RESULTS

Of all adolescents, 86 were boys and 76 were girls aged 11-17 with a median age of 14.

Of the 162 children examined, 68 (42%, 95% CI:34.3-50) were of normal body weight, 75 (46.3%, 95% CI:38.4-54.3) were at risk of obesity and 19 (11.7%, 95% CI:7.2-17.7) were overweight (Fig. 1).

In children with normal body weight, the median of the DMFT index is 4 (2-6.3), at risk of obesity - 5 (3-8), and with overweight - 3 (2-8) (p>0.05) (Table 1). An increase in the median SiC index was observed in children at risk of obesity 9 (8-10.5) and in those with overweight 10 (8-12), while in children of normal body weight its median was 8 (6.5-11).

Post hoc analysis showed a statistically significant difference between the PBI of normal weight children and those at risk of obesity.

The most affected by complications of the carious process, measured by the PUFA index, are adolescents with overweight -31.6 % and at risk of obesity -32 %.

PBI increased significantly in the at-risk group–66%, while in normal and overweight adolescents it was 50% (p<0.05).

Kr. Mineva et al.: Pathologic features in the oral cavity in adolescence with disturbances in the nutritional status **Table 1.** Prevalence of DMFT, SiC, PUFA and PBI in the three studied groups

Index	Group*	Ν	Mean (SD)	Me (Q1-Q3)	p**
DMFT	1	68	4.5 (3.5)	4 (2-6.3)	0.24
	2	75	5.5 (3.6)	5 (3;8)	
	3	19	5.1 (4.3)	3 (2;8)	
SIC	1	23	8.5 (2.7)	8 (6.5;11)	0.23
	2	24	9.7 (2.5)	9 (8;10.5)	
	3	6	10.5 (3)	10 (8;12)	
PBI	1	68	0.6 (0.4)	0.5 (0.2;0.8)	<0.001
	2	75	1.0 (0.9)	0.66 (0.3;1.5)	
	3	19	0.5 (0.3)	0.5 (0.3;0.7)	
PUFA	1	68	0.2 (0.5)	0 (0;0)	0.018
	2	75	0.4 (0.9)	0 (0;1)	
	3	19	0.4 (0.8)	0 (0;1)	

*1-group-adolescents with normal body weight; 2-group-adolescents at risk of obesity; 3-group-overweight adolescents; DMFT=Decay-missing-filled index; SiC=Significant Caries Index; PUFA=An index of clinical consequences of untreated dental caries; PBI=Papillary Bleeding Index; Q1-25th percentile; Q3-75th percentile; **Welch's test



*BMI-Z Percentile=BMI-for-age; 1-group-adolescents with normal body weight; 2-group-adolescents at risk of obesity; 3-group-overweight adolescents

Fig. 1. Distribution of examined children according to BMI-Z Percentile*



**PUFA-0- without caries complications; PUFA-1- with one complication of caries; PUFA-2-with two complications of caries; PUFA-3+- with three or more caries complications

Fig. 2. Distribution of caries complications in the studied adolescent groups**

No complications of the carious process (PUFA-0) were observed in 85.3% of children with normal body weight, in 68% of children at risk of obesity and in 68.4% of children with overweight (Fig. 2). 26.3% of overweight adolescents had one tooth complicated by caries (PUFA-1), 16% of children at risk of obesity and 10.3% of normal-weight adolescents had PUFA-1. 10.7% of adolescents from the second studied group, 4.4% from the first group and 0% from the third group have two teeth complicated by caries. 5.3% of children at risk of obesity and overweight and 0% of children with normal body weight have three or more teeth complicated by caries (p=0.05).

A moderate positive correlation was also observed between PUFA and PBI in adolescents with normal weight (ρ (rho) = 0.47, p < 0.001) and at risk of obesity (ρ (rho) = 0.61, p < 0.001).

DISCUSSION

The prevalence of the carious process is more significant in children with disturbances in the nutritional status compared to children with normal body weight [22]. Willerhausen also reached this conclusion in 2004. In his study, 36% of children of normal weight were caries-free, while 28% at risk of obesity and 30% of overweight children had healthy teeth [23]. In their studies, Willerhausen and colleagues considered excess body weight responsible for the increased level of the carious process, but emphasized that weight is not the only etiological factor [24].

According to another study conducted by Marro *et al*, the median DMFT and prevalence of dental caries in overweight adolescents was significantly higher than in those of normal weight (p < 0.001) [25].

In a 2021 study of Panagiotou *et al.*, the increased level of caries, plaque accumulation, and inflammation of the gingiva in adolescents with overweight and obesity is proven [26].

Regarding periodontal status, the study by Marro *et al.*, showed significantly higher gingivitis scores (p < 0.001) in overweight adolescents [25]. A negative effect on the health of the gingival tissue in adolescents due to being overweight was also observed according to the study by Franchini *et al.* [27]. The results of our study confirm the theses of other studies finding a positive relationship between parameters of periodontal inflammation (bleeding on probing) and excess body weight [28]. Modeer *et al.* found in their studies that children with disturbances in the nutritional status had increased gingival inflammation [29, 30].

Poor nutritional status among adolescents can be a major reason for their inability to maintain oral health [31].

Therefore, screening for general health, oral health and assessment of nutritional status should be included as an essential part of health services. Our study showed higher values of DMFT, PUFA-2 and PUFA-3, PBI in children at risk of obesity compared to overweight children. Parents do not pay enough attention when their children fall into the "at risk of obesity" column to undertake corrections in their child's BMI and dental treatment accordingly. Studies by Kamran, Shahbong and Dixit found high PUFA index values among adolescents with disturbances in the nutritional status [32-34]. A survey by Chauhan et al. concluded that as the BMI index increases, the prevalence of the carious process and its severity among adolescents increases [35].

CONCLUSION

Nutrition plays a significant role in the development and complications of the carious process and gingival inflammation in adolescence. Continuous monitoring of this population is mandatory to improve the general and oral health of adolescents in the future.

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