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10.2478/AMB-2023-0002

ORIGINAL ARTICLE

DIETARY INTAKE OF VITAMIN D AND DENTAL CARIES INCIDENCE IN PEOPLE WITH OVERWEIGHT AND OBESITY

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Abstract. Aims: *The aims of the present study are to investigate the relationship between the anthropometric indicators and peculiarities of the nutritional intake in people with overweight and obesity and the risk factors for the development of dental caries in adults.* ***Materials and Methods:*** *The study involved 264 individuals aged between 18 and 60 years. The following risk factors for the development of dental caries were traced: diet (carbohydrate intake), oral hygiene habits and social status in overweight and obese people. The dental caries incidence was determined through the DMFT index, by assessing the total number of teeth which are decayed (D), missing (M) due to caries, or filled (treated, F).* ***Results:*** *The age-related distribution was as follows: from 18 to 25 years – 14.4%; from 25 to 35 years – 16.7%; from 35 to 50 years – 42.4%; and over 50 years – 26.5%. The established average BMI was 25.60 ± 4.359, with the lowest and highest measured values – 18.5 and 37.55, respectively. The value of DMFT was 12.55 ± 5.545. A direct correlation between the elevated incidence of dental caries in patients with overweight and obesity was revealed. No significant relationship was found between the decreased nutritional intake of vitamin D and the incidence of dental caries in individuals with Class I and Class II obesity.* ***Conclusion:*** *Dental caries and obesity have a similar etiology – improper dietary habits, excessive consumption of foods containing low molecular weight carbohydrates and carbonated beverages. The reported higher levels of dental caries in these groups could be explained by an improper diet and more frequent snacking.*

Key words: *overweight, obesity, dental caries incidence, vitamin D*

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Received: *22 December 2022;* ***Revised:*** *27 December 2022;* ***Accepted:*** *31 December 2022;* ***Last Revised:*** *6 January 2023*

INTRODUCTION

The World Health Organization (WHO) has defined obesity as a chronic recurrent disease which is included in the international classification of diseases [1, 2]. The disease is polyetiological, having physiological, biochemical, metabolic, anatomical, psychological, social, genetic, and hereditary factors. It is believed that the disturbed equilibrium between the bacterial species in the intestinal microflora, especially Bacteroidetes and Firmicutes, is often associated with overweight and obesity [3]. In the intestinal microbiome of obese people, a predominance of the Firmicutes bacterial species was found, and vice versa, in healthy individuals, there were more Bacteroides and greater species diversity [4]. Many authors consider that obesity results from an energy imbalance related to increased caloric intake and decreased caloric expenditure [5]. The basic risk factors include a sedentary lifestyle and consumption of foods rich in fats and refined sugars [6, 7, 8]. The higher incidence of obesity is closely connected to: (1) significant dietary changes; (2) consumption of carbonated beverages; (3) excessive intake of low molecular weight carbohydrates, and (4) changed lifestyle.

Obesity and dental caries share a multi-factor etiology. Their incidence results from the dietary and oral hygiene habits, as well as the type of food consumed. Dental caries is a consequence of the usage of fermentable carbohydrates, including sucrose, glucose, fructose, lactose, maltose, and starch [9]. These fermentable carbohydrates have a local effect on dental caries development [10,11]. The interactions between the dental structure, a biofilm formed over the tooth's surface, sugars, the salivary, and genetic factors are the main prerequisites for development of dental caries. The damage begins with the demineralization of the hard dental tissues as a result of the exposure of the tooth enamel to fermentable carbohydrates. Streptococcus mutans and Streptococcus sorbrinus synthesize organic acids (lactic, acetic, and formic acids) from the adopted sugars and create insoluble extracellular dextran, which contributes to bacterial colonization around the tooth surface [12]. When the acidity in the dental plaque decreases during the process of bacterial fermentation below the level of pH 5.5-5.7, the demineralization of the tooth enamel begins. This appears after consuming too much added sugar found in sweets, carbonated beverages, fruit juices, or sugar added to coffee or tea [13]. The consequences of dental caries, especially if left untreated, can lead to tooth loss, reduced chewing ability, low self-esteem, impaired quality of life, and a generally negative effect on nutrition and general health. The severity of this problem has been supported by a recent systematic review by Chan et al., where more than 50% of adults had a minimum of one untreated dental caries [14]. On the other hand, the amount and composition (lysozyme, lactoferrin, peroxidase enzymes, histatin, proline-rich proteins, mucins, glycoproteins, fibronectin, beta-macroglobulin, lysozyme, secretory immunoglobulin) of saliva act as natural protective mechanisms against this process [12].

The data on the relationship between overweight and the elevated dental caries incidence among adults is controversial. Idrees et al. [2], as well as Sharma et al. [15], do not establish a statistically significant correlation between the increased body mass index (BMI) and the increased frequency of dental caries, but in many other studies, a positive correlation between these indicators has been reported [13, 16, 17]. The main factors related to the increased caries incidence in overweight patients are those resulting from nutritional habits as: frequent meals, excessive consumption of fermentable carbohydrates in the food, including carbonated beverages, eating of unhealthy and high-calorie and cariogenic foods [18]. On the other hand, the concentration in the saliva of some micronutrients, such as vitamin D, has a suppressive effect on bacterial metabolism and dental plaque maturation [19]. Thus, they could have a protective effect on the dental surface demineralization [20]. In some studies, an elevated dental caries incidence in patients with low serum vitamin D concentrations has been revealed [21]. Currently, there is no direct evidence of an inversely proportional relationship between the low serum levels of the vitamin D and the increased dental caries incidence in adults [7].

Aims of the study: To investigate the relationship between anthropometric indicators and the peculiarities of the nutritional intake in overweight and obese individuals and the risk factors for developing dental caries in adults aged between 18 and 60 years.

MATERIALS AND METHODS

This is a cross-sectional observational study. It was approved by the responsible authorities at the Medical University of Sofia and complied with the ethical standards and the Declaration of Helsinki. Informed consent from each participant prior to his/her participation in any procedure was obtained. The following inclusion criteria for selecting the participants in the study were applied: (1) age from 18 to 60 years (the age limit was chosen in order to avoid the influence over the body mass of age-related sarcopenia); (2) BMI ≥ 18.5 kg/m²; (3) the minimal level of oral hy-

giene – twice a day. The exclusion criteria were as follows: (1) body weight over 150 kg; (2) obesity resulting from the administration of glucocorticoids or psychotropic medications; (3) hypercorticism; (4) hypothalamic or hereditary syndromes; (5) decompensated hypothyroidism and hyperthyroidism; (6) other secondary causes – heart inefficiency, respiratory inefficiency, chronic renal failure, cirrhosis of the liver, pancreatitis, and musculoskeletal disorders.

The following risk factors for dental caries development were traced: diet (carbohydrate intake), oral hygiene habits, social status, routine dental visiting, and development of new caries over the last 36 months. During the clinical examination the number of affected teeth was recorded as follows: (1) dental caries; (2) extracted teeth due to dental caries; and (3) filled teeth, applying the recommendations of the World Health Organization published in 1997 and 2013. In cases where the diagnosis of dental caries was difficult for clinicians, sectoral (periapical) radiographs were used. The number of Decayed (D), Missed (M), and Filled (F) teeth (DMFT) was calculated. The height and weight of the patients were measured. The body mass index (BMI) was calculated according to the following formula: BMI = Weight (kg) / Height^2 (m^2). BMI was categorized according to the standard criteria: underweight (BMI < 18.5); normal weight (BMI 18.5-24.9); overweight (BMI 25-29.9), and obesity (BMI > 30 kg/m^2). In addition, information about nutritional habits – consumption of carbonated beverages and foods containing refined sugar; physical activity data; smoking, and oral hygiene habits were recorded.

STATISTICAL ANALYSIS

The data were processed using IBM SPSS Statistics 25 (Armonk, NY, 10504-1722, USA). For the level of significance at which the null hypothesis (H0) was rejected, it was accepted $p < 0.05$. Methods of descriptive statistics, correlational analysis, as well as methods for testing of hypotheses were applied. The following working hypothesis was defined: overweight and unhealthy dietary habits affected the incidence of dental caries in adults. To monitor the existence (or absence) of a correlation between the frequency of dental caries and the impact of overweight, we used a non-parametric Spearman's test.

RESULTS

A total of 264 patients (128 men and 136 women), aged between 18 and 60 years, were examined. According to the age groups, the distribution is as follows: from 18 to 25 years – 14.4%; from 25 to 35 years – 16.7%; from 35 to 50 years – 42.4%; and over 50 years – 26.5%. We found a high incidence of dental caries. It was revealed that the DMFT index values were ranging between 1 and 21. The average value of DMFT index was 12.55 (SD = 5.54). We used the Kruskal-Wallis test to check if the DMFT index was distributed evenly between all age groups. The data showed a statistically significant difference in the distribution of DMFT values in the among age groups (h 89.353; df 3; P = 0.001, n 264). An increase in the incidence of dental caries was also established as age increased (Figure 1).

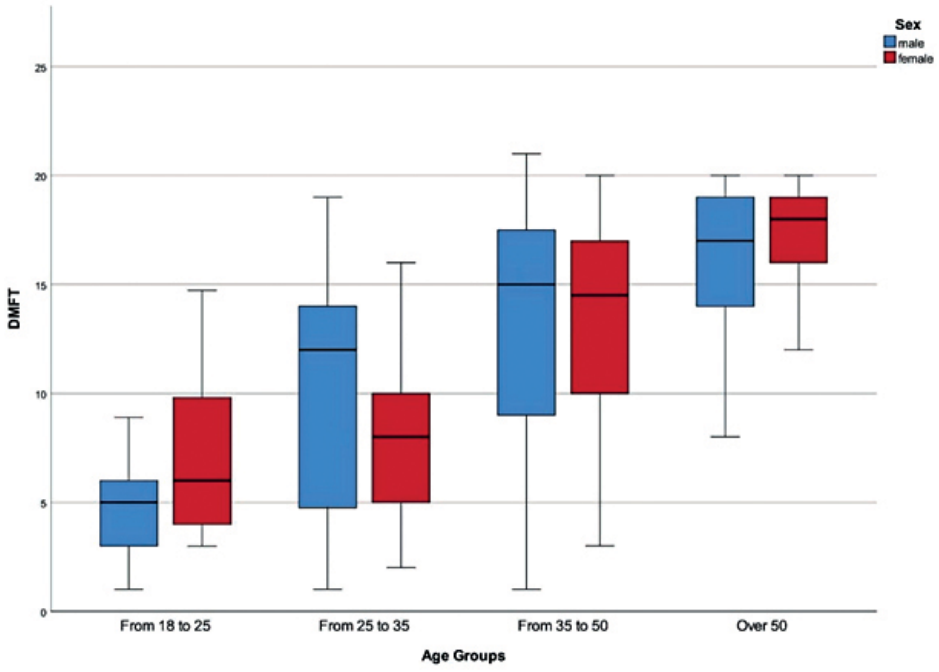


Fig. 1. Distribution of DMFT* is defined by age groups and sex. An increase in the incidence and the number of teeth affected by dental caries is observed as age increases. In patients under 25 years, the average DMFT values are approximately the same in men and women, in the group with participants aged 25-35 years it is higher in men, whereas in the next two groups, they are distributed almost similarly. As age increases, the trend related to increasing the number of teeth affected by caries is stable

* DMFT – Decayed, Missing, and Filled Teeth

The mean value of BMI in the cases was 25.60 (n 264), St. Dev = 4.359. The lowest BMI was 18.5, whereas the highest BMI – 37.55. The distribution of the indicator tracked, according to the age groups and sex, is presented in Table 1.

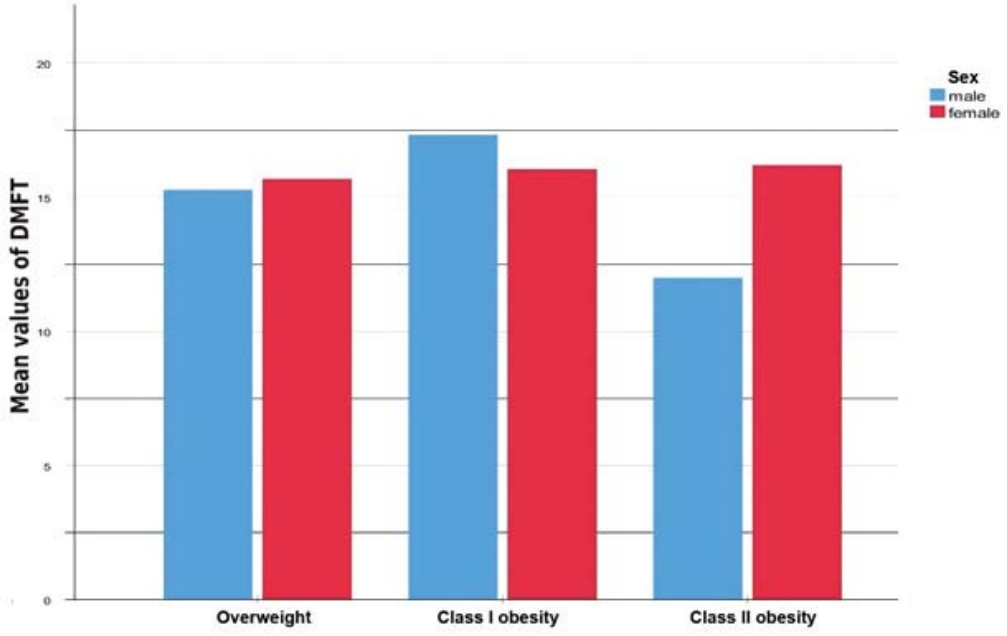
The results showed that overweight and obesity have a statistically significant correlation with the elevated incidence of dental caries in the studied cases (Rho = 0.592; p = 0.001, n 264). We did not find statistically significant differences related to the increased DMFT values in the overweight and obese patients according to their sex (Mann-Whitney U = 8628.000; Z = -0.123; p = 0.902, n 264) (Figure 2).

The data in Figure 2 show that the mean values of DMFT levels in the selected sample of overweight cases (BMI 25-29.9) demonstrate close values to the Class I obesity (BMI from 30 to 34.9) and Class II obesity. DMTF is similarly distributed between men and women.

The average daily intake of vitamin D in all groups of studied participants was lower than the recommended dietary intake of 15 μg/day (the average daily intake of vitamin D for the entire group was 6.6 μg/day). In the groups with a BMI higher than 30, the nutritional intake of Vitamin D was the lowest – 6.0 μg/day, affecting mostly women with Class II (BMI >

Table 1. Distribution of BMI according to the age groups and sex

BMI Groups			Sex		
			Male	Female	Total
Normal weight	Age Groups	From 18 to 25	16	16	32
		From 25 to 35	13	15	28
		From 35 to 50	12	30	42
		Over 50	4	6	10
	Normal weight group total:		45	67	112
Overweight	Age Groups	From 18 to 25	4	0	4
		From 25 to 35	7	6	13
		From 35 to 50	27	23	50
		Over 50	23	13	36
	Overweight group total:		61	42	103
Obese	Age Groups	From 18 to 25	0	2	2
		From 25 to 35	0	3	3
		From 35 to 50	9	11	20
		Over 50	13	11	24
	Obese group total:		22	27	49
Total for all groups:			128	136	264



* DMFT – Decayed, Missing, and Filled Teeth

Fig. 2. Distribution of DMFT* between the overweight and obesity groups (n = 152)

35) and Class III obesity (BMI > 40) [39]. We tried to find evidence regarding the existence or absence of a relationship between the higher DMFT values and the low nutritional intake of Vitamin D among these groups. No statistically significant difference in DMFT distribution and reduced intake of vitamin D was found in these groups.

DISCUSSION

The results of our study give us grounds to accept the null hypothesis (H0). We found a direct correlation between increasement in the dental caries incidence and the cases of overweight and obesity. The dental caries incidence in men and women from the studied groups is similarly distributed. The mentioned data fully complies with the findings of Abbass M. et al. [16], Pereira A. et al. [18], Iwasaki T. et al. [22], and Hamasha AA. et al. [23]. The foregoing studies have been conducted among adults in Japan, Saudi Arabia, Egypt, and Brazil. Such a relationship has not been found in the study conducted in the Republic of Korea by Song IS. et al. [24]. The authors did not establish a connection between the increased BMI values and the elevated incidence of dental caries. This difference indicates the polyethiology of the dental caries, which is mainly dominated by dietary habits and the food composition used in various geographical regions.

Other studies by Słotwińska S. et al. [20] and Alswat K. et al. [25] have found that overweight patients have a greater incidence of dental caries than the patients from other groups. Increased incidence of dental caries (DMFT > 6.5) is associated with more frequent food intake and is not related to the sex of the participants in the studied group. The study of Modéer T. et al. [21] has shown that overweight and obese patients are more affected by dental caries than those with normal weight, which may be explained by the frequent snacking in these groups and consumption of foods containing low molecular weight carbohydrates.

Our data show that the elevated dental caries incidence in patients with overweight and obesity affects equally both sexes, being in accordance with the foregoing studies. Furthermore, like Abbass M. et al. [16], we have found a significant increase in the incidence of the DTMF index as age increases.

The influence of serum vitamin D concentrations as a protective factor in the etiology of dental caries in adults has not been fully clarified so far. However, we have found very close average values in the incidence of dental caries related to overweight and obesity groups. These results are in full compliance with the studies of Hujoel P. et al. [9] and Hu Z. et al. [19]. Although, the intake of vitamins (including vitamin D) is often recommended as a protective measure against oral diseases and dental caries, there is currently no persuasive evidence of their protective function in terms of dental caries in adults.

In our study, we found higher values of dental caries distribution, and, the coefficient of DMFT (12.55 ± 5.545) compared to the data obtained from other geographical regions. Higher values of DMFT index for our country have been reported by Bonev B. et al.: 17.8 ± 7.98 [26]. These differences are probably related not only to the size of the sample used but also to the place of living of the studied groups. Unlike our study, in their sample, 47% of the cases were residents of small towns and villages, where the access to health care differs from that in the big cities.

CONCLUSION

This study has shown a direct relationship between the increased dental caries incidence and BMI in patients with overweight and obesity. Men and women are equally affected by this condition. Both diseases have similar etiology – improper dietary habits, excessive consumption of foods containing low molecular weight carbohydrates and carbonated beverages. Overweight and obese patients are at greater risk of dental caries development. The more frequent snacking can explain the higher DMFT values in this group.

Acknowledgments

This article is supported by Council on Medical Science at Medical University of Sofia, Bulgaria – grant number 7149/10.11.2021 and under Contract number D-127/16.06.2022.

Disclosure Summary: *The authors have nothing to disclose.*

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