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Eating habits and certain anthropometric characteristics among individuals with type 2 diabetes mellitus in Banja Luka (Bosnia and Herzegovina)

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ABSTRACT

Introduction: The analysis of healthy eating parameters in comparison with the anthropometric characteristics of individuals with type 2 diabetes mellitus can serve as a useful tool to prove that changes in glucose metabolism are related to dietary habits. This study investigates the dietary habits and anthropometric characteristics of individuals with type 2 diabetes mellitus (T2DM) in Banja Luka, Bosnia, and Herzegovina. The primary aim was to assess the correlation between dietary habits and anthropometric measurements, including body mass index (BMI), waist circumference (WC), and waist-to-stature ratio (WSR), using the UK Diabetes and Diet Questionnaire (UKDDQ).

Methods: A cross-sectional survey was conducted at the University Clinical Centre of the Republic of Srpska. The study involved 160 participants, aged 40-80 years, with a diagnosis of T2DM. Dietary habits were assessed using the UKDDQ, while anthropometric measurements (BMI, WC, and WSR) were calculated following standard procedures. Statistical analysis was performed using SPSS version 25, applying descriptive statistics, one-way ANOVA test, and the Mann–Whitney U test to assess associations.

Results: The results showed that only 27.5% of participants adhered to healthy dietary habits, while the majority (72.5%) exhibited partially unhealthy or unhealthy eating patterns. Significant correlations were found between unhealthy dietary habits and higher BMI, WC, and WSR values. In addition, sociodemographic data indicated a predominance of older individuals and a higher percentage of women among the participants, with a significant portion residing in urban areas with low socioeconomic status.

Conclusion: This study demonstrates a link between poor dietary habits and higher anthropometric indices in individuals with T2DM. Targeted nutritional interventions, particularly increasing fruit, vegetable, and omega-3 intake, are essential for better diabetes management, especially in urban populations with low socioeconomic status.

Keywords: Anthropometric indices; dietary habits; nutritional interventions; type 2 diabetes mellitus

INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disorder in humans and a disease of modern times with pandemic proportions, and type 2 DM (T2DM) occurs in 90% of cases compared to type 1 diabetes (1). T2DM is characterized by an increase in blood glucose levels resulting from a combination of genetic predisposition, unhealthy diet, physical inactivity, and an increase in body weight with central distribution, leading to complex pathophysiological processes (2). Studies have shown that most individuals with T2DM are older and have excess body weight, highlighting the importance of long-term weight control as it is a risk factor for this disease (3). In the treatment, primary and secondary prevention of DM, the application of healthy eating principles is crucial. It is an integral and essential aspect of successfully managing individuals with diabetes and an important part of all educational and therapeutic processes. The principles of healthy eating are individually and permanently adapted to people with diabetes (1). In overweight and obese individuals with T2DM, even modest amounts of weight loss (approximately 5% of body weight) have been shown to improve glycemic control. Longitudinal cohort studies indicate that changes in BMI among patients with T2DM are significant predictors of changes in HbA1c, and patients who lose weight are

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more likely to achieve target HbA1c values than those with stable weight or weight gain (4).

The increasingly popular Mediterranean diet represents an effective strategy in managing T2DM by providing nutrients that are key to glycemic control and maintaining a healthy lipid profile (5). The abundance of vegetables, fruits, whole grains, olive oil, nuts, and fish forms the basis of this diet, whose nutritional value has proven vital in preventing diabetes-related complications. Integrating the Mediterranean diet as a part of diabetes therapy not only helps regulate metabolic parameters but also promotes overall health (6).

In a study conducted by Abboud et al. among individuals with type 2 diabetes, the majority (75%) exhibited less healthy eating habits, while only 25% had a healthy diet. The same study shows that the average index of healthy eating habits was 43.81 out of 115 (7). The authors of the study emphasize in their conclusion the need to strengthen education about the importance of healthy eating among people with type 2 diabetes to enable them to acquire the knowledge and skills necessary to make proper food choices. In their study, Adam et al. demonstrated that more than two-fifths of people with type 2 diabetes do not adhere to the recommended diet (8). According to a study conducted in Portugal, Correia Rodriguez et al. showed that only 36.2% of respondents achieved a score considered indicative of healthy eating habits (9).

The analysis of healthy eating parameters in comparison with the anthropometric characteristics of individuals with T2DM can serve as a useful tool to prove that changes in glucose metabolism are related to dietary habits (10). Anthropometric parameters are very useful and simple tools for defining indicators that assess the risk of T2DM. Their consistency and uniformity are absolutely maintained across studies involving both sexes, all age categories, and different forms of the disease (11). In addition, anthropometric parameters are extremely useful in medical studies when determining the effectiveness of a drug or supplement for T2DM (12). The most commonly used anthropometric parameters for assessing nutritional status and central obesity, both in people at risk of metabolic disorders and in those with diabetes, are body mass index (BMI), waist circumference (WC), and waist-to-stature ratio (WSR) (13).

The primary goal of this study was to determine the eating habits of individuals with T2DM using a survey and determining the correlation with certain anthropometric characteristics of the participants.

METHODS

This cross-sectional study was carried out at the University Clinical Centre of the Republic of Srpska, Banja Luka, from March 2023 to September 2023. The sample size consisted of 160 participants with T2DM (aged 40-80 years). Participants were selected as they attended endocrinology consultations at the hospital. The research criterion included that individuals were adults and diagnosed with type 2 diabetes, while the exclusion criteria included pregnancy, lactation, and recent surgery. Sociodemographic data (gender, age, area of residence, education, socioeconomic status, and occupation) were collected using a self-report questionnaire. All participants were residents of Banja Luka. Urban areas were defined as the city center, whereas rural areas included suburban neighborhoods and village settlements administratively classified as part of the city.

All anthropometric measurements were performed by the same person in the morning, with the participants lightly dressed and without shoes. Weight, height (stature), and WC were measured using standard procedures (14). After measuring body height and weight, the BMI was calculated using the formula BMI = Body weight (kg)/(body height (m)^2, and the WSR was calculated as WC (cm)/height (m).

For dietary assessment, the UK Diabetes and Diet Questionnaire (UKDDQ) was used. The questionnaire is designed to reflect dietary habits important for the prevention and management of diabetes**.** It has been shown to be a reliable and valid measure of dietary intake when compared with 4-day food diaries. In addition, the questionnaire is culturally adaptable, ensuring its relevance across different populations. For the purposes of this study, it was translated into Bosnian/Croatian/Serbian language with the assistance of language experts and reviewed by endocrinologists to ensure contextual appropriateness.

It contains 25 questions, of which 20 contribute to the total score. Each question had a set of 6 responses: A and B for healthy dietary choices, C and D for partially unhealthy dietary choices, and E and F for unhealthy dietary choices. Each response was assigned a number for data analysis: A - 0, B - 1, C - 2, D - 3, E - 4, and F - 5. Finally, the mean UKDDQ score was calculated for each person on a scale from 0 to 5 (15).

Written informed consent was obtained from all participants. The study was approved by the Ethical Review Committee of the University Clinical Centre of the Republic of Srpska (No. 01-19-420-2/22).

For statistical analysis, SPSS v.25 software was used. Descriptive statistics were applied to summarize the data, including the mean (M), standard deviation (SD), 95% confidence intervals (CI) for continuous variables, and frequency (%) for categorical variables. The one-way ANOVA and Mann–Whitney U tests were used for comparisons of continuous variables, depending on the number of groups. A $p < 0.05$ was considered statistically significant.

The data used in this study are part of an ongoing PhD dissertation and are not yet deposited in a public repository. Full data access will be made available upon the completion and publication of the dissertation. Until then, the data can be requested from the corresponding author for review purposes, if necessary.

RESULTS

General data on participants with T2DM are presented numerically and as percentages in Table 1. This study included 160 participants with T2DM: 68 males (42.5%) and 92 females (57.5%). The mean age of the sample was 65.3 ± 8.32 years, with a minimum age of 40 and a maximum of 80 years. The majority of participants had completed high school (66.9%), and most of them resided in urban areas (75.0%). Half of the participants (51.3%) belonged to a low socioeconomic status, and 63.8% were retired.

TABLE 1. General data of study participants (N=160)

General data	N	%
Gender		
Male	68	42.5
Female	92	57.5
Age		
40-49	10	6.3
50-59	23	14.4
60-69	78	48.8
70+	49	30.6
Area of residence		
Urban	120	75
Rural	40	25
Level of education		
Primary Education	32	20
High School	107	66.9
Higher Education	11	6.9
University/College	8	5
Other	2	1.3
Socioeconomic status (SES)		
Low SES	82	51.3
Middle SES	39	24.4
High SES	8	5
Other	31	19.4
Occupation		
Employed	32	20
Unemployed	11	6.9
Retired	102	63.8
Other	15	9.4

The frequency of dietary habit classifications was determined to assess the participants' eating habits and is presented in Figure 1. Of the 160 participants, only 27.5% achieved a UKDDQ score indicative of healthy dietary habits, 54.4% exhibited partially unhealthy dietary habits, and 18.1% had unhealthy dietary habits (Figure 1).

The next aspect of the analysis focused on the frequency of UKDDQ score related to dietary habits, specifically the types of food consumed by person. Table 2 presents the mean and SD for each food item, along with the 95% CIs for the mean values. The table also displays the frequency of each food item consumption categorized by the UKDDQ dietary habit scores: healthy (UKDDQ 0-1), partially unhealthy (UKDDQ 2-3), and unhealthy (UKDDQ 4-5). In the category of healthy eating habits (UKDDQ 0-1), high percentages were observed for alcohol consumption (98.8%), puddings/dessert (97.5%), fast food (95.0%), salted snacks (88.8%), and sweet drinks (81.3%). For vegetable consumption, 25.0% of respondents met the criteria for healthy habits, while for fruit consumption, 47.6% reported consuming fruit almost daily. More than 60% of respondents adhere to healthy eating choices regarding the infrequent consumption of cakes and chocolate, as well as avoiding high-calorie snacks between meals. The lowest results were recorded for the consumption of full-fat spreads, with only 25% achieving healthy choices. Regular meals throughout the day and breakfast within 2 h of waking are practiced by 17.5% and 18.1% of respondents, respectively. In addition, only 11.9% of respondents consume high-fiber bread. Consumption of oily fish was also low, with 25.0% of respondents reporting "healthy intakes."

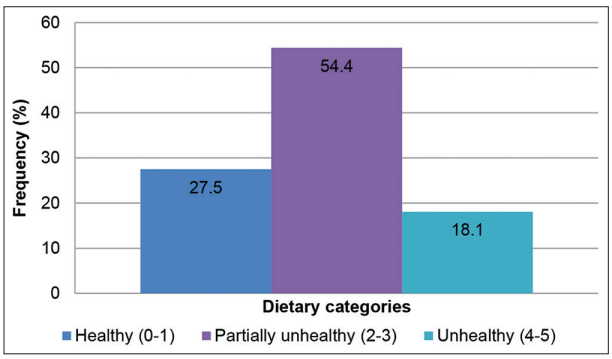

FIGURE 1. Classification of dietary habits into three categories.

To analyze differences in unhealthy dietary habits among individuals with type 2 diabetes, a statistical analysis was conducted to determine the significance of differences in alcohol consumption and processed meat intake in relation to the UKDDQ score, considering the participants' gender.

The results of the analysis are presented in Table 3. The Mann–Whitney U test was used for the analysis and identified statistically significant differences in alcohol consumption and processed meat intake between men and women. Specifically, alcohol consumption showed a significant difference ($p < 0.001$), with men exhibiting a higher mean rank compared to women. Similarly, processed meat consumption also demonstrated a significant difference ($p = 0.020$), with men having a higher mean rank than women. In contrast, differences in the UKDDQ score were not statistically significant ($p = 0.852$).

Comparison of anthropometric parameters (BMI, WC, and WSR) across dietary categories is presented in Table 4. The results indicate a correlation between the mean values of BMI, WC, and WSR depending on dietary categories (healthy, partially unhealthy, and unhealthy diets). The results show a linear increase in mean values of BMI, WC, and WSR across dietary categories (healthy, partially unhealthy, and unhealthy diets).

The ANOVA test results presented, used to compare different dietary categories, indicate statistically significant differences between groups ($p < 0.05$) for all three variables: BMI, WC, and WSR.

DISCUSSION

In this study, the participants were all individuals who visited the endocrinologist at the University Clinical Center of The Republic of Srpska for examination, with no exclusions, making the sample of 160 participants fully representative of anthropological research. The higher percentage of female individuals (57.5%) compared to males (42.5%) indicates that women are more frequently affected by T2DM compared to men. These findings are consistent with data from the Institute for Public Health of the Republic of Srpska, which shows that among reported cases, 55% are female and 45% are male (16). The prevalence of type 2 diabetes among women, particularly in older age groups, can be partially explained by hormonal changes associated with menopause, which represents a significant risk factor for the development of T2DM (17).

TABLE 2. Frequency and dietary patterns of UKDDQ score by food items

Questionnaire food item	Mean (standard deviation)	95% Confidence interval	Frequency (%)		
			Healthy (UKDDQ 0-1)	Partially unhealthy (UKDDQ 2-3)	Unhealthy (UKDDQ 4-5)
Vegetables	2.20 (0.99)	2.04-2.36	40 (25.0)	104 (65.5)	16 (10.0)
Fruit	1.70 (1.01)	1.54-1.86	76 (47.6)	74 (46.3)	10 (6.1)
Cake and biscuits	1.32 (0.79)	1.20-1.44	101 (63.2)	57 (35.7)	2 (1.3)
Chocolate and sweets	1.33 (0.81)	1.20-1.46	99 (61.9)	60 (37.5)	1 (0.6)
Sweet drinks	0.83 (0.83)	0.70-0.96	130 (81.3)	29 (18.1)	1 (0.6)
Full-fat spread	3.16 (1.03)	3.00-3.32	41 (25.7)	110 (68.7)	9 (5,6)
Oily fish	2.86 (1.38)	2.64-3.07	40 (25.0)	88 (55.0)	32 (20.0)
Alcohol	0.18 (0.42)	0.12-0.25	158 (98.8)	2 (1.3)	0 (0)
High-fat chees	2.26 (1.05)	2.11-2.41	30 (18.8)	110 (68.8)	20 (12.5)
Processed meat	2.60 (1.05)	2.44-2.76	25 (15.6)	105 (65.6)	30 (18.8)
Salted snack	0.59 (0.70)	0.48-0.70	142 (88.8)	18 (11.2)	0 (0)
Savoury pastries and pie	2.09 (0.77)	1.97-2.21	32 (20,0)	126 (78.8)	2 (1.3)
Fast food	0.60 (0.61)	0.51-0.69	152 (95.0)	8 (5.0)	0 (0)
Pudding or dessert	0.13 (0.57)	0.34-0.51	156 (97.5)	4 (2.5)	0 (0)
Regular meal (3-4 meal/day)	2.50 (1.15)	3.32-2.68	28 (17.5)	91 (56.9)	41 (25.6)
Breakfast	2.51 (1.15)	2.33-2.69	29 (18.1)	100 (62.5)	31 (19.4)
High-fat sugar snack	1.37 (1.14)	1.19-1.55	99 (61.9)	55 (34.4)	6 (3.7)
High-fiber bread	3.20 (1.51)	2.96-3.44	19 (11.9)	94 (58.8)	47 (29.4)
High-fiber cereal	2.67 (1.97)	2.36-2.98	92 (57.5)	4 (2.5)	64 (40.0)
Type of milk	2.36 (2.48)	1.97-2.74	85 (53.1)	1 (0.6)	74 (46.3)
UKDDQ score	1.96 (0.51)	1.88-2.04			

UKDDQ: UK Diabetes and Diet Questionnaire

TABLE 3. Mann–Whitney U test for the comparison UKDDQ score and some questionnaire food item by gender

Parameter	N	Mean Rank	Summ Rank	U	Z	p
UKDDQ score						
Male	68	81.29	5528		−0.186	0.852
Female	92	79.91	7352	3074		
Questionnaire item alcohol						
Male	68	97.6	6637		−6.181	<0.001*
Female	92	67.68	6237	1965		
Questionnaire item processed meat						
Male	68	90	6120		−2.335	0.020*
Female	92	73.48	6760	2482		

N -number, U - Mann–Whitney test, Z – score, statistical significance $p<0.05$*. UKDDQ: UK Diabetes and Diet Questionnaire

In addition, analysis of age-related data shows that in our study, the individuals were of older age, with a mean age of 65.3 ± 8.32 years. These results are consistent with data from other researchers, who report a mean age of 67.5 ± 9.41 years (18). The number of individuals with T2DM increases with age, with the highest number of cases found in the age group of 60-69 years (48.8%). These results indicate that the risk of developing T2DM significantly increases in older age groups, which is consistent with known trends in the literature (16).

In terms of area of residence, the majority of participants (75%) were from urban areas, while the remaining 25% were from rural regions. These findings are consistent with the literature, which indicates a higher risk of developing diabetes in urban areas, associated with the unhealthier lifestyle typical of urban environments (19).

Studies have shown that low education and income are associated with a higher risk of T2DM (20). The results of our study indicate that the majority of participants have a low socioeconomic status (51.3%) and only a high school education (66.9%), which may limit access to key information about the disease and healthy eating. This further underscores the need for prioritizing educational and economic factors in research and health policy development to improve diabetes prevention and management in populations with similar characteristics (21).

The results show that the dietary habits of individuals with T2DM in Banja Luka are at a very low level. Only 27.5% of them have a UKDDQ score indicative of healthy dietary habits, while the majority, 54.4%, have partially unhealthy dietary habits. It is particularly concerning that nearly one-fifth of the participants, specifically 18.1%, have unhealthy dietary habits. These findings are comparable to a study from Lebanon (7), where 25.0% of individuals had healthy dietary habits based on their total UKDDQ score, while the same parameter was 14.5% in a study conducted in Erbil City, Iraq (22) and 36.27% in a study conducted in Portugal (9). The best results were recorded in a study from Western India, where 46.9% of the participants had healthy dietary habits based on the composite UKDDQ score (23). These findings suggest that individuals with T2DM living in urban environments tend to have poorer dietary habits, often relying on fast and processed foods, while rural environments offer more opportunities for a healthier diet.

In our study, the vast majority of individuals adhered to dietary recommendations regarding food items such as alcohol, desserts, fast food, and snacks. Specifically, 98.8% of individuals rarely consumed alcohol, 97.5% rarely consumed puddings/desserts, 95.0% rarely consumed fast

TABLE 4. Values of anthropometric parameters (BMI, WC, and WSR) by dietary categories

Parameter	Dietary categories (mean±SD)				df	F	p-value
	Healthy	Partially unhealthy	Unhealthy	Average			
BMI (kg/m²)	26.30±2.41	31.50±3.23	35.43±4.11	30.78±4.47	2	75.46	<0.001*
WC (cm)	92.42±8.08	104.45±8.99	113.34±9.49	102.75±11.35	2	52.42	<0.001*
WSR	0.55±0.05	0.62±0.06	0.84±0.92	0.64±0.40	2	41.10	<0.001*

Statistical significance p-value <0.05*. BMI: Body mass index, WC: Waist circumference, WSR: Waist-to-stature ratio, df: degrees of freedom between groups, F: values from one-way ANOVA

food, 88.8% rarely consumed salted snacks, and 81.3% rarely consumed sweet drinks. These findings highlight their commitment to maintaining healthier dietary practices. In the literature, these food items are commonly identified as unhealthy dietary choices for individuals with T2DM. In addition, it is emphasized that the timing of food intake is crucial, with the period from 10:00 AM to 5:00 PM being particularly significant (2, 24).

In our study, only 17.5% of individuals with T2DM consumed regular meals throughout the day, while only 18.1% had breakfast within 2 h of waking, which is a very low percentage and a critical factor for managing this disease. Recommendations for fruit and vegetable consumption in individuals with diabetes emphasize the importance of daily intake of these foods as they are rich in fiber, vitamins, and minerals that help regulate blood sugar levels (25, 26). The results showed that 47.6% of individuals regularly consumed fruit, similar to a study in Lebanon where 44.4% did the same (7). In contrast, only 25.0% of individuals in our study consumed vegetables daily, compared to 49.3% in a study conducted in Portugal (9).

The separate analysis in our study of alcohol and processed meat consumption shows that men consume these items more than women. Conversely, the same analysis indicates no statistically significant difference between genders for the overall average UKDDQ scores. This finding suggests that men's poorer lifestyle may contribute less to the incidence of type 2 diabetes compared to women. Updated guidelines recommend that there is no safe level of alcohol consumption. Adults with diabetes who choose to drink alcohol should do so moderately (no more than one drink per day for adult women and no more than two drinks per day for adult men). Alcohol consumption can increase the risk of hypoglycemia in people with diabetes, particularly if they are using insulin or insulin secretagogues (27).

Good results were achieved regarding the infrequent consumption of fast food, which can be explained by the fact that this is an older population with less habit of consuming fast food. Similar results were obtained in a study from Western India (23). It has been demonstrated that the consumption of sweetened beverages is associated with adverse health outcomes in the diabetic population. In our study, results showed that 81.3% of participants rarely consumed sugary drinks, whereas this percentage was significantly lower in the Erbil city study at 12.5% (22) in the Western India study at 46.0% (23) and in the Portugal study at 71.1% (9). Insufficient knowledge about omega-3 is a reason behind the unhealthy nature of omega-3 intake (28). Only 25% of participants in our study consume fish once a week, which is considered poor. In contrast, in the Lebanon study, almost 40% of individuals never consumed fish (7).

As the pace of modern life accelerates, an increasing number of people are neglecting breakfast, which is considered an important meal of the day. In our study, only 18.1% of individuals achieved a healthy score for having breakfast within 2 h of waking up, compared to 30.5% in the Lebanon study (7), and 36% in the Erbil city study (22). Regular meal consumption had a healthy score of 17.5% in our study, with better results reported in the Erbil city study at 38.4% (22), Lebanon at 33.6% (7), and the best results in Western India at 52.2% (23).

The anthropological analysis of the association between the mean values of BMI, WC, and WSR concerning the healthy, partially unhealthy, and unhealthy dietary categories of the respondents shows that our participants with T2DM had high values for these parameters. The linear increase in BMI, WC, and WSR values with a higher degree of unhealthy dietary habits in individuals with T2DM was statistically significant. This suggests a strong correlation between the nutritional habits of the respondents and these anthropometric variables, while the significance further confirms the unhealthy dietary habits of these individuals, leading to their increased body weight and making the disease more difficult to treat. Our study results showed no statistically significant difference between dietary habits and nutritional status between genders, which is consistent with a study conducted in Erbil City (22), while a study conducted in Portugal showed that women have better dietary habits than men (9).

Studies have consistently shown that men traditionally consume more meat than women and have higher alcohol intake compared to women. These gender differences in dietary habits are well-documented in the literature (29, 30). Although the study participants were diagnosed with diabetes, the results revealed the same gender differences in dietary habits. Anthropometric measurement of WC and anthropometrically derived indices BMI and WSR are correlated with each other (31). The anthropometric indicator - BMI is most often used to assess the nutritional and health status. BMI is directly related to eating habits (32). The results in our study showed that individuals categorized as having healthy dietary habits have an average BMI of 26.30 ± 2.41 kg/m², while participants with partially unhealthy dietary habits have an average BMI of 31.50 ± 3.23 kg/m². The highest average BMI was recorded among individuals with unhealthy dietary habits, amounting to 35.43 ± 4.11 kg/m². The overall average BMI for all categories is 30.78 ± 4.47 kg/m², with a statistically significant p-value of.000, indicating a strong association between the type of dietary habits

and BMI. Without a doubt, anthropometric parameters have shown significance in identifying dietary issues in individuals with T2DM. Literature data warn that the main problem among individuals with this disease is their poor dietary habits, followed by a lack of physical activity, smoking, and alcohol consumption (33).

CONCLUSION

This study highlights significant associations between dietary habits and anthropometric measures in individuals with T2DM in Banja Luka, particularly in urban areas and among those with low socioeconomic status. Poor dietary habits were linked to higher BMI and central obesity, emphasizing the need for targeted nutritional interventions. While some participants demonstrated healthier dietary choices, improving the intake of fruits, vegetables, and omega-3 fatty acids remains essential for effective diabetes management. Public health efforts should focus on education and socioeconomic factors to enhance diabetes prevention and care.

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DECLARATION OF INTERESTS

Authors declare no conflict of interest.

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