

Provision of Nutrition Counseling and Taichi Exercise on Blood Sugar Levels of Type II Diabetes Mellitus Patients

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ABSTRACT

The main goal of nutritional therapy in patients with diabetes mellitus is to achieve normal blood sugar levels to prevent further disease development. Setting diet, physical exercise is one of the important things, apart from drug therapy. The purpose of this study was to assess whether providing nutrition counseling and taichi exercise for 4 weeks can improve blood sugar levels in type 2 DM patients to normal. The research method was Quasi-Experimental with a control group on 12 type 2 DM patients with age 45–65 years, and have blood sugar levels >200 mg/dl. The interventions provided were nutritional counseling and Taichi exercises for 4 weeks. Data analysis used Paired Sample T-test and Independent Sample T-test. Results: The second intervention given, namely nutrition counseling and taichi exercise as well as nutrition counseling intervention alone could reduce blood sugar levels (p -value <0.05) or the mean decrease in blood sugar levels in the intervention group was 93.76 mg/dl and the control group 45.7 mg/dl. Conclusion: Nutrition counseling interventions and taichi exercises or nutrition counseling alone can reduce blood sugar levels. However, the decrease in blood sugar levels was two times higher in the combined intervention of nutrition counseling and taichi exercise compared to nutrition counseling alone. Suggestion: Healthy lifestyle interventions are effective for controlling blood sugar levels in type 2 DM patients.

Keywords

Type II Diabetes Mellitus, Nutrition counseling, Energy, Taichi Exercise.

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Received: Januari 10, 2023; **Accepted:** March 16, 2003; **Published:** March 22, 2023

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Citation: Aurasyifa Salsabila Nixon, Iskari Ngadiarti, Pritasari. Provision of Nutrition Counseling and Taichi Exercise on Blood Sugar Levels of Type II Diabetes Mellitus Patients. *Int J Diabetes Metabolic Synd.* 2023;3(1):1-7.

Introduction

Diabetes Mellitus (DM) is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action or both [1]. At present, almost all of the world's population suffers from this disease, and almost half of the sufferers are not diagnosed or even treated [2].

Indonesian data through the 2018 Basic Health Research (RISKESDAS) report, the prevalence of DM based on a doctor's diagnosis in the population aged ≥ 15 years is 2%, and has increased by 0.5% over a period of 5 years [3]. Because in 2013 the prevalence was only 1.5%. Type 2 diabetes mellitus is also a significant cause of death and disease related to heart, kidney,

blindness, and neurological diseases [4].

Environmental factors including eating behavior and lack of physical activity that interact with genetic susceptibility are the causes of type 2 DM [5]. The main key in controlling diabetes is to control the sufferer's blood sugar levels to normal. Based on PERKENI 2019, type 2 DM can be declared under control if blood glucose levels, lipid levels and HbA1c are in accordance with expected levels, and nutritional status and blood pressure reach the specified targets [1].

Diet control and increasing physical activity, stopping smoking are the main keys to non-drug control that must be done. Nutrition

therapy holds. an integral part in the overall management of type 2 DM [6]. This is because the food consumed daily can affect blood sugar levels. Diet recommendations for people with type 2 DM are currently the same as those for healthy people, namely eating a variety and balanced nutrition and managing the right diet according to the 3J principle (amount, type, schedule) namely the location of the number of calories and nutrients, the right type of food, namely choosing foodstuffs that do not quickly increase blood sugar levels. A high glycemic index in food can increase blood sugar levels. Finally, on schedule, DM sufferers need to pay attention to the schedule/time to eat. The recommended meal times for DM sufferers, namely eating more often with small portions, can help improve blood sugar levels [1].

Regular physical exercise cannot be ignored, because it is known to improve the quality of blood vessels and improve all metabolic aspects, including increasing insulin sensitivity and improving glucose tolerance. The effect of physical activity is directly related to increasing the speed of muscle glucose recovery (how much muscle takes up glucose from the bloodstream). During physical activity, the muscles use the glucose stored in the muscles and if glucose is reduced, the muscles fill the void by taking glucose from the blood. Thus causing a decrease in blood glucose thereby increasing blood glucose control [7].

The 2018 Riskesdas data reported that the proportion of physical activity in the population aged > 10 years in Indonesia who lacked physical activity was 33.5%. Based on research conducted by Setiawan (2018) 32% of respondents had light physical activity [8]. Generally, respondents no longer work after being diagnosed with diabetes mellitus by a doctor, so these respondents do more sedentary activities (sitting and watching television) when compared to physical activities such as sports. Especially during the COVID-19 pandemic, which required people to do physical activity at home. Starting from school, college, and work done at home, causing a sedentary lifestyle.

The American Diabetes Association (ADA) recommends physical activity for diabetics to do aerobic exercise with moderate intensity for at least 150 minutes per week. Aerobic exercise involves repeated and continuous movements of large muscle groups. Physical activities that can be done are walking, cycling, jogging and swimming [9]. One of the sports that DM sufferers can do is gymnastics, which can be trusted to reduce blood sugar levels including taichi exercises and diabetes gymnastics.

This taichi exercise is a traditional exercise originating from China, this exercise combines breathing exercises, relaxation, and slow and gentle movement structures. Slow exercise and assisted by improvements in the respiratory system help the vascular system in the elderly in transporting blood glucose to all cells in the body gradually but regularly. The relaxation that is elicited when doing tai chi exercises will help reduce blood pressure in DM sufferers because it can suppress the release of various hormones that can increase blood sugar levels [10]. Based on research conducted by

Srywahyuni (2019), giving taichi exercise interventions 3 times a week with a duration of 60 minutes can reduce blood sugar levels from 219.44 mg/dl to 208 mg/dl. Even though Taichi has many health benefits, many people still don't know about it.

One effort that can increase nutritional knowledge and improve nutritional problems that are being faced is by conducting nutritional counseling. Nutrition counseling is a process of providing assistance to others in making a decision or solving a problem through understanding the facts, expectations, needs and feelings of the client. The purpose of counseling is to assist clients in efforts to change behavior related to nutrition to improve the quality of nutrition and health of clients, including changes in knowledge, changes in attitudes, and actions. Based on research conducted by Hasibuan (2018) that there was a decrease in blood sugar levels of 66.136 ml/dl after being given a nutritional consultation and setting a 3J pattern for 1 week [11].

In view of these various backgrounds, researchers wanted to find out how energy intake, carbohydrates, fats and blood sugar levels of type 2 diabetes mellitus patients were after being given nutritional counseling interventions and taichi exercises.

Methods

This study uses a quasi-experimental design with an experimental design. The Pretest-Posttest with control group. The number of samples was 12 taken from type 2 DM patients who were on outpatient treatment at the Setiabudi District Health Center. Nutrition counseling is provided 4 times a month with counseling duration of 30-60 minutes. The content of counseling is a discussion about eating arrangements, physical activity and medication behavior. Nutrition counseling is carried out by D4 nutrition students who have passed a nutrition counseling course. The selection of 12 samples was taken by purposive sampling according to the inclusion and exclusion criteria determined by the researcher. The inclusion criteria selected were having an Android mobile phone and having the Whatsapp application, having received a medical examination by a doctor, aged 45-65 years, blood sugar levels >200 mg/dl, and had never received nutritional counseling. While the exclusion criteria were those who needed help from other people to take care of themselves, type 2 DM patients with complications such as diabetic ulcers, diabetic foot, and had comorbidities such as CHD, asthma and had participated in taichi gymnastics.

Data on energy, carbohydrate and fat intake were obtained through a 2x24 hour food recall, carried out 5 times, namely at the beginning before the intervention, 4 weeks during the intervention. Recall data were collected by researchers assisted by D4 nutrition students who had previously been briefed for common perceptions. The value of blood sugar levels was carried out using the glucose oxidase biosensor method which was taken once every 1 week using a glucometer which was carried out directly by the researcher. Data analysis was used to test the effect of nutritional counseling on energy intake, carbohydrates, fats, and blood sugar

levels using a paired sample t-test, while to find out the difference in decreasing blood sugar levels between the intervention group and the control group using an independent sample t-test.

Result

Table 1: Frequency Distribution of Respondent Characteristics.

No	Characteristics	Intervention Group (n=6)		Kontrol Group (n=6)		Total	
		n	%	n	%	n	%
1.	Sex:						
	a. Male	2	33,3	2	33,3	4	33,3
	b. Female	4	66,7	4	66,7	8	66,7
2	Usia:						
	a. Middle Aged : 45 – 54 years old	1	16,7	4	66,7	5	41,7
	b. Elderly : 55 – 65 years old	5	83,3	2	33,3	7	58,3
3.	the length of time they were diagnosed:						
	a. <1 year	0	0	0	0	0	0
	b. 1 – 5 years	5	83,3	6	100	11	91,7
	c. > 5 years	1	16,7	0	0	1	8,3
4.	Job:						
	a. Working	1	16,7	5	83,3	6	50
	b. Not Working	5	83,3	1	16,7	6	50

*The characteristics between the intervention group and the control group were not significantly different ($P > 0.05$).

Based on table 1 the highest proportion of respondents based on gender was female, 8 people (66.7%) compared to the proportion of male respondents, 4 people (33.3%). Likewise, the number of female respondents in each group (50%) was higher than the male respondents.

The proportion of respondent's age was 5 people who were in the middle aged category, namely 45-54 years (41.7%) and 7 people who were in the elderly category, namely 55-65 years (58.3%). The proportion of respondents who were in the middle elderly age category, namely 45-54 years, was mostly in the control group, with 4 people (66.7%), while the respondents who were in the elderly category, namely 55-65 years, were mostly in the intervention group, with 5 people (83.3%). This is in line with the prevalence of diabetes mellitus according to Riskesdas in 2018, most are aged 55-64 years (6.3%). The proportion of respondents based on the length of time they were diagnosed with DM was the most, namely 1-5 years, as many as 11 people (91.7%). The proportion of respondents who have been diagnosed with DM for 1-5 years is mostly in the control group of 6 people (100%). The proportion of respondents based on work is 6 respondents working (50%) and 6 people not working (50%). The proportion of respondents who worked was the most in the control group, namely 5 people (83.3%) and the proportion of respondents who did not work was the most in the intervention group, namely 5 people (83.3%).

Table 2: Differences in Total Energy, Carbohydrate and Fat Intake Before and After the Intervention.

Variabel		Sebelum Intervensi	Sesudah Intervensi	p-value
		Mean ± SD	Mean ± SD	
Energy (kcal)	Intervention group	1486.7 ± 393.8	1442.2 ± 238.5	0.541* ¹
	Control Group	1522.9 ± 289.3	1426.9 ± 474.6	0.375* ¹
p-value		0.860* ²	0.945* ²	
Carbohydrate (g)	Intervention group	197.4 ± 82.9	197.4 ± 82.9	0.708* ¹
	Control Group	203.3 ± 68.4	196.4 ± 34.1	0.709* ¹
p-value		0.896* ²	0.474* ²	
Fat (g)	Intervention group	46.77 ± 9.272	45.0 ± 15.8	0.237* ¹
	Control Group	47.3 ± 19.8	43.1 ± 4.8	0.548* ¹
p-value		0.957* ²	0.819* ²	

*¹no significant difference based on the Paired Sample T-test ($P > 0.05$).

*²no significant difference based on the Independent Sample T-test ($P > 0.05$).

The results of the research presented in the table 2 show the average change in fat intake that occurred during counseling. There was a decrease in carbohydrate intake after being given the intervention for 4 weeks. The highest proportion of carbohydrate intake was in the control group, both before 203 ± 68.4 g (52.4%) and after intervention 196.4 ± 34.1 g (51.8%).

Likewise, with fat intake, there was a decrease during the 4 weeks given the intervention. The highest proportion of fat intake was found in the control group with an average intake of 47.3 ± 19.8 g (23.1%). Meanwhile, after the intervention, the average fat intake was highest in the intervention group of 45.0 ± 15.8 g (23.7%). Based on the results of the paired sample t-test in the intervention group and the control group, each p value was obtained, namely $p = 0.709 > 0.05$ and $p = 0.708 > 0.05$ so it can be concluded that there was no significant difference in fat intake after being given nutritional counseling for 4 weeks.

Table 3: Differences in Blood Sugar Levels before and After the Intervention.

Blood Sugar Levels	Before Interventions		After Interventions		p-value
	Min-max	Mean ± SD	Min-max	Mean ± SD	
Intervention Group	220-321	279.50 ± 42.11	167-206	185.83 ± 14.12	0.047* ¹
Control Group	232-350	277.50 ± 39.67	198-275	231.83 ± 30,76	0.021* ¹
p-value		0.934		0.008	

*¹significant based on the Paired Sample T-test ($p < 0.05$)

*²no significant difference based on the Independent Sample T-test ($P > 0.05$).

Based on table 3, the results of the study in the intervention group showed that the average blood sugar level before the intervention was 279.50 mg/dl and after the intervention was 185.83 mg/dl.

Whereas in the control group the average blood sugar before the intervention was 277.50 mg/dl and after the intervention was 231.83 mg/dl. This shows that the average difference in the intervention group is greater than the control group.

Based on table 3, statistical tests have been tested with the Independent T-test above showing that the average value of blood sugar levels after the intervention in the intervention group was 185.83 mg/dl and the control group was 231.83 mg/dl so that a p-value ≤ 0.05 . Interpretation of the results is that there is a significant difference in the decrease in blood sugar levels between the control group and the intervention group.

Discussion

Characteristics of Respondents

Characteristics based on gender in this study were more women, namely 66.7%. This is because women have a greater body fat composition when compared to men, so that women are more prone to obesity, which will increase the risk of obesity and DM. In addition, there is a connection with estrogen and endogenous hormones, which are protective in women. This research is in line with the results of the 2018 DKI Jakarta Province Riskesdas that the prevalence of Diabetes Mellitus Based on a Doctor's Diagnosis in women is higher (2.82%) when compared to the prevalence of men (2.33%). Research conducted by Komariah K (2020) shows that the percentage of women with diabetes is greater than that of men. It can be concluded that the characteristics of respondents based on gender are in accordance with the description of diabetes mellitus Riskesdas DKI Jakarta 2018 [12].

When compared with the 2018 Indonesian Riskesdas data, there is a similarity in the proportion of type 2 DM sufferers in this study, namely in the age range of 55-64 years.

The proportion of respondents based on the length of time they were diagnosed with DM was the most, namely 1-5 years, as many as 11 people (91.7%). The longer a person suffers from DM, the greater the risk of experiencing complications, one of which is diabetic neuropathy. The duration of having DM for more than 10 years has a 19 times higher risk of experiencing diabetic neuropathy [13].

Respondents who do not work tend to live a sedentary lifestyle, namely just sitting, cleaning the house, watching TV. This research is in line with the results of the 2018 DKI Jakarta Riskesdas, the prevalence of type 2 DM sufferers who are not working is the highest (5.91%). It can be concluded that the characteristics in this study are similar to the characteristics of type 2 DM patients according to Riskesdas, namely there are more DM patients who do not work.

Effect of Nutrition Counseling on Energy, Carbohydrate and Fat Intake

Type 2 DM disease is widely known as a disease that is closely related to food intake. Excessive food intake such as energy,

carbohydrates, fats can be a risk factor for the onset of DM. The more excessive food intake, the greater the possibility of causing DM [14]. If there is an imbalance between food intake that is high in energy and energy expenditure used for activities in the long term, it can lead to obesity, insulin resistance and type 2 DM disease.

The decrease in intake occurred because respondents had started to reduce their consumption of foods that were high in carbohydrates and high in fat, although not completely. Reducing the intake of sugar and fat will decrease the intake of glucose into the body, so that energy use in the body will take stored energy reserves. If the glucose used is converted into energy, it will lower the blood sugar level of the respondent.

There was a decrease in carbohydrate intake after being given the intervention for 4 weeks. The highest proportion of carbohydrate intake was in the control group, both before 203 ± 68.4 g (52.4%) and after intervention 196.4 ± 34.1 g (51.8%).

Likewise, with fat intake, there was a decrease during the 4 weeks given the intervention. The highest proportion of fat intake was found in the control group with an average intake of 47.3 ± 19.8 g (23.1%). Meanwhile, after the intervention, the average fat intake was highest in the intervention group of 45.0 ± 15.8 g (23.7%).

Effect of Nutrition Counseling on Blood Sugar Levels

Based on the results of the paired sample t-test statistic, a p-value of 0.002 was obtained which indicated that there was a relationship between nutrition counseling and blood sugar levels. After measuring the blood sugar levels of the respondents who were given nutritional counseling once a week, most of the respondents still had uncontrolled blood sugar levels. It is known to reduce blood sugar levels from 277.50 mg/dl to 231.83 mg/dl. This is most likely to occur due to non-compliance with implementing the 3J dietary principles that have been given during nutritional counseling and the lack of knowledge of type 2 DM sufferers regarding the 3J principles so that the amount of respondent's intake does not match their nutritional needs, the eating schedule is not fully regular and they still consume this type of food. which are recommended to be avoided, such as foods that are high in carbohydrates, fat.

The results of the interview using the 2x24 hour recall method showed that almost all of the respondents with uncontrolled blood sugar levels had never adopted a diet according to the 3J principles or not in accordance with the DM diet. In addition, it appears that the respondents did not know about the types of foods that contain complex carbohydrates and simple carbohydrates, this causes an increase in blood sugar levels due to the food consumed containing more simple carbohydrates which basically need to be avoided by people with type 2 DM.

Biological Research (2020) explains that consuming excess carbohydrates can cause an increase in blood sugar levels. Carbohydrates that enter the body will be broken down into a

simpler form, namely glucose which will then be absorbed in the intestines and enter the blood circulation [15]. This increase in blood sugar levels will cause the body to produce the hormone insulin. The main function of the insulin hormone is to lower blood sugar levels and carry fat throughout the body. Another thing that can be a factor in applying the 3J principle is age. As we get older, there will be a decrease in the function of organs, one of which is the brain, which can be related to one's memory. With the increasing age of DM sufferers, the ability to carry out daily planning, especially in accordance with the 3J principles, will decrease. The food that will be consumed will increase blood sugar levels, one to two hours after eating blood sugar levels reach their highest point. By setting a diet according to the 3J principle (Amount, Type, Schedule) it is hoped that the respondent's blood sugar level can be maintained. Therefore, it is necessary to provide nutritional counseling with more attention to several important aspects such as how many times to provide education about diet so that what is conveyed can be well received.

According to research conducted by Notarianti, et al. (2018) there is a significant difference in blood glucose levels after being given nutritional counseling [16]. This research is also in line with research conducted by Jasmani, et al. (2016) that there is a relationship between the provision of education carried out by nurses and blood sugar levels in DM patients in the Jati Datar Health Center, Lampung Regency [17]. However, this is in contrast to research conducted by Selfi, et al. (2018), namely that there was no effect of providing dietary education on the respondent's blood sugar levels [18].

Provision of education and appropriate information can increase compliance with type 2 DM sufferers in carrying out a comprehensive treatment program, so that control of blood sugar levels can be achieved. Providing education and counseling is very important because DM is a disease related to a person's lifestyle. According to Adi Sucipto (2014) with the provision of education and counseling it is hoped that respondents will have sufficient knowledge about diabetes which in turn is expected to be able to control blood sugar levels and improve quality of life.

Relationship of Nutrition Counseling and Taichi Exercise to Blood Sugar Levels

The results of the paired sample t-test statistic obtained a p-value of 0.001 ($p < 0.05$) which indicated that there was a relationship between nutrition counseling and taichi exercise with blood sugar levels. Based on the results of measuring the blood sugar levels of the respondents in the intervention group who had received nutritional counseling once a week plus the provision of taichi exercise it was found to be able to reduce blood sugar levels from 279.50 mg/dl to 185.83 mg/dl. When compared to the control group, which was only given nutritional counseling, there was a decrease in blood sugar levels 2x greater if given nutritional counseling and taichi exercises. This research is in line with Selfi, et al. (2018) that there are differences in blood sugar levels after education on diet and exercise [18].

According to PERKENI (2019) that in optimizing the management of Type 2 DM a combination of nutrition education, meal planning, exercise and medication is needed if needed. Providing nutritional counseling can increase knowledge about a healthy lifestyle and control blood sugar levels in type 2 DM sufferers [1]. Knowledge is a predisposing factor for behavior, such as one's knowledge of what to do, beliefs, beliefs, values and so on [17]. According to Notoadmodjo (2010) knowledge is the result of knowing, and occurs after someone senses a particular object. Sensing occurs through the five senses, namely the senses of sight, hearing, smell, taste and touch. Most of human sensing is obtained through the eyes and ears. Therefore, this study provides nutritional counseling and is assisted with leaflets to optimize the use of the five senses, namely sight and hearing [19].

At the beginning of suffering from this type of DM disease, insulin production is generally not disturbed. The main problem that occurs in type 2 DM is the lack of receptor response to insulin or what is commonly called insulin resistance. Because of this disturbance, insulin cannot help transport glucose into cells. When exercising, the muscles will experience contractions that have insulin-like effects.

Doing good and regular exercise can increase blood flow to the muscles by opening capillaries (small openings of blood into the muscles), and this will lower blood pressure in the muscles and then increase the supply in the muscle tissue itself. Thus eating will reduce disturbances of carbohydrate metabolism in patients with type 2 DM, so that it can reduce blood glucose levels [20]. Physical activity in type 2 DM sufferers has an important role in regulating blood glucose levels. In a study conducted by Nugraha, et al. (2016) it was explained that in patients with type 2 DM, physical exercise is one of the pillars in the 4 pillars of DM management which is very important because it can prevent diabetic complications, by doing sports, glucose is widely used by muscles to move effectively. active and glycogen in the liver will be used to meet the needs of glucose in the body, so that blood sugar levels remain stable or can decrease [20].

The effect of physical activity is directly related to increasing the speed of muscle glucose recovery (how much muscle takes up glucose from the bloodstream). During physical activity, the muscles use the glucose stored in the muscles and if glucose is reduced, the muscles fill the void by taking glucose from the blood. Thus causing a decrease in blood glucose thereby increasing blood glucose control.

This is in line with the meta-analysis conducted by Chao (2018) that taichi effectively has an impact on controlling blood glucose and HbA1c in patients with type 2 DM [21]. Based on research conducted by Srywahyuni (2019), providing taichi exercise interventions 3 times a week with a duration of 60 minutes can reduce blood sugar levels from 219.44 mg/dl to 208 mg/dl when compared to diabetes exercise [10]. Membrane permeability to glucose will increase in contracting muscles. So there is a decrease in insulin resistance, conversely there is an increase in

insulin sensitivity. Taichi exercises focus on building strength, flexibility and balance which aims to prevent the elderly from easily falling and the various injuries they cause [22]. Taichi gymnastic movements can be a physical exercise to increase lower body strength. The position of the stance that is slightly bent when doing taichi produces a large load on the muscles and bones of the legs so that it can be an exercise for lower extremity strength. Taichi exercises can also encourage mental relaxation and reduce stress, which is stress related to the release of various hormones, such as cortisol and hormones to mobilize energy. The hormone cortisol is a steroid hormone secreted by the adrenal glands. This hormone suppresses insulin secretion by pancreatic beta cells thereby increasing glucose production by hepatic gluconeogenesis by preventing peripheral glucose use [23].

Conclusion

Nutrition counseling interventions and taichi exercises or nutrition counseling alone can reduce blood sugar levels. However, the decrease in blood sugar levels was two times higher in the combined intervention of nutrition counseling and taichi exercise compared to nutrition counseling alone. Healthy lifestyle interventions are effective for controlling blood sugar levels in type 2 DM patients.

Limitation

- The limiting factor that was very influential was the presence of the COVID-19 pandemic when the research was taking place. As a result, everyone's mobility was limited and required everyone to stay at home, including diabetes mellitus sufferers in the Setiabudi District Health Center work area, so the research was conducted online.
- Another factor is the difficulty of carrying out research in the midst of the COVID-19 pandemic so that the intervention time is only carried out for 4 weeks, namely in March 2022, screening in January 2022 and post-testing in March - April 2022.
- The Tai Chi exercise intervention was given online and was carried out independently by the respondents so that the data collection during the study was not optimal because there was no monitoring whether the Tai Chi exercise was carried out by the respondents according to the recommended duration and frequency.

Acknowledgement

Thank you to the South Jakarta Health Office and the Head of the Setiabudi Health Center for giving permission to carry out the research. Thank you to the respondents who have agreed to participate in the research from start to finish. In addition, the researchers would like to thank the enumerators who have helped carry out the research.

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