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The relationship of nutritional status and dietary pattern with the incident of prediabetes at productive age in the Mangkubumi, Tasikmalaya city, Indonesia

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ABSTRACT

Introduction: Prediabetes is the condition of a person whose blood sugar levels are more than normal but is not yet said to be suffering from diabetes mellitus. Prediabetes is a transitional stage that can be reversible leading to a normal condition if handled well or irreversible to diabetes if not handled properly. This research aims to determine the relationship between nutritional status and eating patterns (carbohydrates, fats, and so on) with the incidence of prediabetes in productive age.

Method: This research uses a quantitative approach with an observational analytical study design, namely cross-sectional. The respondents of this research are of productive age in the Mangkubumi Community Health Center Work Area. The total number of samples studied was 125 people taken using the purposive sampling technique. Distribution of the number of samples in each sub-district with a high incidence of obesity in the Mangkubumi Health Center Working Area, namely Mangkubumi Sub-district with 58 people, Karikil Sub-district with 32 people, Cipari Sub-district with 35 people using proportionate random sampling. The IBM Statistical Package for Social Sciences (SPSS) program processed and analyzed quantitative data. Data was considered statistically significant with a p-value of <0.001.

Results: Analysis was carried out on 125 research subjects with most were female (63.2%), employment status not working (49.6%), aged 19-59 years (88.8%), high school education (30.4%), over nutritional status (48.8%), eating patterns with sufficient carbohydrate intake (63.2%), enough fat intake (60%), insufficient fiber intake (56.5%), and those with normal blood sugar levels (60%). There is a relationship between nutritional status and diet (carbohydrates, fat, and fiber) with the incidence of prediabetes in productive age in the Mangkubumi Community Health Center working area with a p-value of 0.000 for each.

Conclusion: Based on the research results, it would be better to improve pre-diabetes screening and educate about healthy dietary patterns in the productive age group at Posbindu to prevent the occurrence of type 2 diabetes mellitus.

KEYWORDS

Prediabetes, nutritional condition, dietary pattern, productive age.

INTRODUCTION

Prediabetes is the condition of a person whose blood sugar levels are more than normal but is not yet said to be suffering from diabetes mellitus (DM)[1–3]. Prediabetes was first introduced in 2002 by the Department of Health and Human Services (DHHS) and the American Diabetes Association (ADA)[4]. The prediabetes threshold is 140-199 mg/dl for instant blood sugar, 100-125 mg/dL for fasting blood sugar, 140-199 mm/dL for blood sugar 2 hours after OGTT, and 5.7-6.4 mm/dL for HbA1c[1,2]. Prediabetes is a transitional stage that can be reversible leading to a normal condition if handled well or irreversible to diabetes if not handled well[3,5]. Prediabetes is a problem that must be considered because it has a greater prevalence than diabetes mellitus itself[4].

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According to the World Health Organization (WHO), around half of diabetes mellitus cases are estimated to come from Southeast Asia and the West Pacific. According to the International Diabetes Federation (IDF), 6.7 million people, or around 1 person every 5 seconds die from diabetes mellitus at the age of 20-79 years[6]. In 2021, around 9.1% of adults aged 20-79 years in the world will experience impaired glucose tolerance. A person with impaired glucose tolerance is at high risk of developing diabetes mellitus for approximately 5 years[7]. The prevalence of diabetes mellitus in the world in the age range 20-79 years increased from 8.5% (2011) to 9.8% (2021)[8]. According to the IDF, around 44% of adults have not been diagnosed with diabetes mellitus[6].

According to the IDF, 4 out of 5 diabetes mellitus sufferers live in middle and low-income countries, 81%[6,9]. Indonesia is one of the middle-income countries and ranks fifth in the world for the highest prevalence of diabetes mellitus, which is 10.6% in 2021[9]. Basic Health Research Data (Riskesdas) in 2018 stated that the prevalence of diabetes mellitus in Indonesia based on a doctor's diagnosis at the age of 2-15 years increased from 2013 by 1.5% to 2%. The prevalence of diabetes mellitus at all ages is 1.5%. The largest age category for diabetes mellitus is in the 55-64 year age range at 6.3% and 65-74 years at 6%. Diabetes mellitus sufferers in Indonesia are more likely to be women at 1.8% compared to men at 1.2%4.

West Java is in 10th place out of 34 provinces with a prevalence of diabetes mellitus of 1.7%[10]. The prevalence of diabetes mellitus in West Java has increased from 1.5% in 2013 to 1.74% in 2018[11]. The prevalence of diabetes mellitus is greater in urban areas, namely 1.9%, compared to 1.0% in rural areas[6,11]. One of the urban areas in West Java with a high incidence of diabetes mellitus is Tasikmalaya City[11]. The number of diabetes mellitus cases in Tasikmalaya City has increased from 4,928 people (4.98%) in 2021 to 9,822 people (1.87%) in 2023. In Tasikmalaya City, the highest number is in the Mangkubumi Health Center working area, namely 755 people (7.68%)[12].

Efforts to prevent diabetes mellitus by paying attention to risk factors for prediabetes. Risk factors for prediabetes are lack of physical activity, consumption of unhealthy/balanced foods, genetic factors that influence insulin secretion and insulin work, increasing age, pregnant women with a history of diabetes and giving birth to babies weighing more than four kilograms, having a history of ovarian cysts. eggs accompanied by infertility (polycystic ovary syndrome), people who are exposed to cigarette smoke, babies born with LBW, have hypertension, dyslipidemia, and obesity[13,14].

Nutritional status is the result of a balance between intake and the need for nutrients needed for body metabolism and is categorized into less, normal and more nutritional status[15,16]. One of the risk factors for prediabetes is obesity. The accumulation of excess body fat can cause the beta cell response to blood glucose to be reduced[16,17]. Insulin receptors on cells become resistant and their number decreases so that insulin in the blood cannot work properly[18]. A person who is over-nourished will increase leptin levels in the body. This increased leptin will inhibit the phosphorylation of insulin receptor substrate 1, causing an increase in blood sugar levels, thus inhibiting the action of glucose[16,17].

A person who is obese has seven times the risk of developing diabetes mellitus[19]. Obesity is more at risk of causing death than suffering from malnutrition. Obesity can also cause an increase in various comorbid conditions[18]. This is because obesity increases the possibility of various chronic diseases that cause death, such as type 2 diabetes mellitus, cardiovascular disease, chronic kidney failure, and other degenerative diseases[20].

Obesity is closely related to poor eating patterns, such as not consuming enough vegetables and fruit, and consuming high amounts of sugar, salt, and fat. Poor diet is the first factor that triggers prediabetes. This is because it is difficult to prevent false hunger, namely when the blood glucose level is >200mg/dL but the body does not have enough insulin, so the body feels that it is still hungry[21]. Dietary patterns that affect blood sugar levels include carbohydrate, fiber, and fat intake[22]. Dietary regulation is one of the pillars of preventing diabetes mellitus[23]. A study shows that interventions carried out by changing lifestyle (changes in diet and increasing physical activity) reduce the incidence of diabetes by 25-58%[24].

The Mangkubumi Health Center Technical Implementation Unit (UPTD) with a fairly large area and large population has the highest number of diabetes mellitus cases compared to other health centers in Tasikmalaya City. Based on the results of initial observations carried out on 15 respondents of productive age in the Mangkubumi Community Health Center working area, it was found that 9 people (60%) were sufferers of type 2 diabetes mellitus and 5 people (55.6%) were included in the over-nutrition status category with history of a diet that often consumes sweet foods high in sugar, foods high in fat, and low in fiber. Based on the description of the data, researchers are interested in researching the relationship between nutritional status and eating patterns and the incidence of prediabetes in productive age in the working area of the Mangkubumi Health Center, Tasikmalaya City in 2024.

METHODS

Study Design

This research uses a quantitative approach with an observational analytical study design, namely cross-sectional. Observational analytical design is a research design to determine the relationship between variables and the re-

searcher only observes without intervening on the research subject. Cross-sectional is part of an analytical design which means that measurements of the variables studied are carried out at one particular time[25]. The design selection aims to determine the relationship between nutritional status and eating patterns and the incidence of prediabetes in productive age in the Mangkubumi Community Health Center working area in 2024.

Data Collection

Based on population data in this study, there are all productive age groups aged 15-64 years in the Mangkubumi, Karikil, and Cipari sub-districts, totaling 25,449. Sample calculations using the Lameshow formula resulted in 113 people. The sample is increased by 10% to anticipate if there are samples that drop out. The total number of samples studied was 125 people. The distribution of the number of samples in each subdistrict was 58 people in the Mangkubumi Subdistrict, 32 people in the Karikil Subdistrict, and 35 people in Cipari Subdistrict.

Sampling Technique

The sampling technique uses purposive sampling and proportionate random sampling. Purposive sampling was used in selecting the research location, namely selecting three subdistricts with the highest prevalence of obesity in the working area of the Mangkubumi Health Center, namely Mangkubumi Village, Karikil Village, and Cipari Village based on the 2023 annual report of the Mangkubumi Health Center UPTD[26]. Proportionate random sampling was used to take samples from subjects of productive age (15-64 years) in Mangkubumi Village, Karikil Village, and Cipari Village. Subject members of each group have the same chance of being selected which is adjusted by taking into account comparisons so that the sample distribution for each group is balanced.

Sampling was carried out by selecting samples from each sub-district (Mangkubumi, Karikil, and Cipari) randomly, namely randomizing the names of the productive age groups in the sub-district until the number of samples was met and in accordance with the predetermined sample distribution. Then, coordinate with the cadres of each sub-district to collect data on the names selected at the Posbindu.

The inclusion criteria in this study were research subjects who were willing to be respondents, aged 15-64 years (productive age), and included as Posbindu participants in Mangkubumi, Karikil, and Cipari sub-districts and able to communicate well. The exclusion criteria were that respondents had a family history of diabetes mellitus, had a history of cardiovascular disease (heart disease, hypertension, stroke), and had physical disabilities (no legs or other body parts that affected their physical activity).

Quantitative Data

1. Anthropometric data

Antropometric data sheet to record body weight and height measurements as follows:

a) Digital step scale with an accuracy of 0.1 kg to measure the respondent's body weight. The following is the procedure for measuring body weight by an enumerator[27,28]:

   1) Ensure scales are complete and clean and install batteries.
   2) Place the scale in a flat, hard, well-lit place.
   3) Turn on the scale and ensure the scale is at 00.0.
   4) Prepare for weighing by telling respondents to remove sandals/shoes/jackets/coats or wear as little clothing as possible, as well as remove items that affect the weighing results.
   5) Invite the respondent to stand straight in the middle of the scale, facing forward until the number on the scale appears and does not change.
   6) Record the results of weighing.
   7) The measurements were repeated three times and if there was a difference of 0.5 kg then the measurement was repeated once. The data used is the average of three repetitions.

b) Stadiometer with an accuracy of 0.1 cm to measure the respondent's height. The following is the procedure for measuring height by the enumerator[29]:

   1) Install the stadiometer and place it on a flat, hard floor and wall.
   2) Ensure the stadiometer measuring arm is working properly before the measurement begins.
   3) Prepare for the measurement by asking respondents to remove shoes/footwear, socks, hair accessories, and head coverings that may affect the measurement.
   4) Invite the respondent to stand upright on the stadiometer platform and under the measuring arm. The respondent's gaze is straight ahead with both knees and heels together.
   5) Ensure that there are five parts of the respondent's body attached to the wall, namely the back of the head, back, buttocks, calves and heels. In obese respondents, at least two parts of the body were attached to the wall, namely the back and buttocks.

6) Pull the stadiometer measuring arm to adjust to the respondent's height.

7) View the height measurement results shown on the vertical pole of the stadiometer by looking at the arrow pointing to the measurement results under the measuring arm.

8) Record the results of measuring the respondent's height.

9) The measurements were repeated three times and if there was a difference of 0.5 cm then the measurements were repeated once. The data used is the average of three repetitions.

2. The dietary pattern

Dietary Patterns questionnaire (carbohydrate, fiber, and fat intake) uses a 1x24-hour food recall form and a food photo book to determine the respondent's consumption level. The following is the procedure for collecting dietary pattern data, namely:

a. Interviewing respondents regarding the food consumed within 1 x 24 hours.

b. Record the type and amount of food consumed in the form of Household Measures (URT).

c. Convert the portion size consumed by respondents into weight (grams).

d. Process the data using the Nutrisurvey software application to calculate the respondent's carbohydrate, fiber, and fat intake.

e. Determine the respondent's level of carbohydrate, fiber and fat intake.

3. Prediabetic

Glucometer examination to see the fasting blood sugar (GDP) levels of respondents so that they can see the incidence of prediabetes. The procedure for checking Fasting Blood Glucose (GDP) using a glucometer, namely:

a. The examiner has carried out infection prevention such as washing hands 7 steps and using a handscoon.

b. Insert the test strip into the glucometer.

c. Ensure hands are clean.

d. Prick the tip of the respondent's finger using a piercing tool to get blood.

e. Touch and hold the tip of the test strip on the respondent's blood and wait for the results.

f. Record the respondent's blood glucose levels that appear on the glucometer screen.

Statistical Analysis

The initial stage of this research used univariate analysis to determine the frequency distribution of respondent characteristics, independent variables (nutritional status and eating patterns), and dependent variables (incidence of prediabetes). The next stage uses bivariate analysis, namely the data analysis technique used to determine the level of closeness of the relationship between variables is the Chi-Square Test. The Chi-Square test is a non-parametric statistical test which is used to compare two/more groups on categorized data[30]. Data analysis was carried out using SPSS (Statistical for Social Science) 25 for Windows software.

Ethical Approval

This research has received ethical approval from the Health Ethics Committee of the Health Polytechnic of the Ministry of Health, Semarang. No. 0368/EA/KEPK/2024

RESULT

Univariate Analysis

The respondents in this study were 125 people of productive age in the working area of the Mangkubumi Health Center, Tasikmalaya City in 2024. The characteristics of the research respondents can be seen in the table below.

Based on Table 1, it can be seen that the majority are female (63.2%), employment status is not working (49.6%), aged 19-59 years (88.8%), and have a high school education (30.4%), nutritional status is more (48.8%), diet has sufficient carbohydrate intake (63.2%), sufficient fat intake (60%), and less fiber intake (56.5%), and respondents have normal blood sugar levels (48%).

Bivariate Analysis

The relationship between nutritional status and diet and the incidence of prediabetes can be seen in the table below.

Based on table 2, shows that excess nutritional status can lead to diabetes by 100%, shows the relationship between sufficient carbohydrate intake and normal sugar levels of 95.1%, shows the relationship between sufficient fat intake and normal sugar levels of 75.4%, and explains the relationship Insufficient fiber intake can be classified as diabetes by 96% with each variable having a p-value of <0.001.

DISCUSSION

Characteristics of Respondents

The results of the analysis of respondent characteristics are in Table 1. with the majority being female at 79%, unemployed employment status at 49.6%, adult age group (19-59 years) at 88.8%, high school education at 30, 4%, almost half of the nu-

Table 1. Frequency Distribution of Respondent Characteristics

Variable		Frequency	Percentage (%)
Gender	Man	46	36.8
	Woman	79	63.2
Employment Status	Work	59	47.2
	Doesn't work	62	49.6
	Not yet working/student	4	3,2
Age	Teenagers (15-18 years)	2	1.6
	Adults (19-59 years)	111	88.8
	Elderly (60-64 years)	12	9.6
Last education	elementary school	32	25.6
	JUNIOR HIGH SCHOOL	23	18.4
	SENIOR HIGH SCHOOL	38	30.4
	vocational school	14	11.2
	D1	2	1.6
	D3	6	4.8
	S1	10	8.0
Nutritional status	Malnutrition	6	4.8
	Normal	58	46.4
	More nutrition	61	48.8
Carbohydrat e Intake	Not enough	1	0.8
	Enough	79	63.2
	More	45	36
Fat Intake	Not enough	11	9.2
	Enough	72	60
	More	37	30.8
Fiber Intake	Not enough	70	56.5
	Enough	52	41.9
	More	2	1.6
Prediabetes Occurrence	Normal	60	48.0
	Prediabetes	39	31.2
	Diabetes	26	20.8

tritional status is 48.8%, adequate carbohydrate intake is 63.2%, fat intake is 30.8%, fiber intake is deficient at 56.5% and the incidence of prediabetes is 31% and diabetes is 31%. 20.8%.

The majority are characterized by the adult age group (19-59 years). This is related to the theory according to Sherwood (2004), that biological changes in the form of the aging process (aging) usually occur in middle adulthood, the production of enzymes such as protein kinase, glycogen kinase, glucokinase which can bind insulin begins to be disturbed, so that as a result the glucose in liver and muscles circulate back into the blood. Changes in cell permeability and the response of the cell nucleus to the hormone insulin, which results in glucose not being able to enter the cells, is one of the impacts of the aging process resulting in hyperglycemia[30].

Globally, the adult age group is vulnerable to prediabetes[30]. It was also found by research in Pima India that the proportion of impaired glucose tolerance in adults was 22.2%[33]. As we age, the function of the body's organs, including the pancreas, decreases, causing an increase in blood sugar levels. According to research by Ani Astuti (2019), prediabetes most often occurs at the age of 20-44 years[23]. Another research conducted by Soewondo and Pramono (2011) found that the proportion of prediabetes in middle adulthood was 43.8%[27].

The relationship between nutritional status and eating patterns with the incidence of prediabetes

The results of the correlation statistical test between the nutritional status variable and the prediabetes incidence variable are in Table 2. Using the Chi-Square Test, a p-value of 0.000 or <0.05 is obtained, so it can be concluded that there is a relationship between nutritional status and eating patterns and the incidence of prediabetes at age. productive in the Mangkubumi Community Health Center work area in 2024.

Based on Table 2, the frequency distribution of bivariate analysis shows that there is a relationship between overnutrition status and the incidence of diabetes of 100% with a p-value of 0.000. This research is in line with research by Nur Rizky and Nurhayati (2018) which states that general obesity and abdominal obesity together contribute the most to increasing the prevalence of prediabetes[14]. Other research conducted by Ani Astuti (2019) shows that there is a relationship between obesity and prediabetes[34]. This research is also supported by Irma,

Table 2. Results of analysis of the relationship between nutritional status and eating patterns and the incidence of prediabetic

Variable		Prediabetes Occurrence						P-value
		Normal		Prediabetes		Diabetes		
		N	%	n	%	n	%	
Nutritional status	Malnutrition	5	8.2	1	2.6	0	0	<0.001
	Normal	46	75.4	12	30.8	0	0	
	More nutrition	10	16.4	26	66.6	25	100	
Carbohydrate Intake	Not enough	1	1.6	0	0	0	0	<0.001
	Enough	58	95.1	18	46.2	3	12	
	More	2	3.3	21	53.8	22	88	
Fat Intake	Not enough	9	14.8	3	7.7	0	0	<0.001
	Enough	46	75.4	17	43.6	9	24	
	More	6	9.8	19	48.7	16	64	
Fiber Intake	Not enough	22	36	25	64.1	24	96	<0.001
	Enough	39	64	13	33.3	0	0	
	More	0	0	1	2.6	1	4	

Syahrizal, and Septyana (2023). It is known that the results are statistically significant for obesity and the incidence of prediabetes. Research conducted by Soewondo explains that by preventing obesity, the incidence of prediabetes can be reduced by up to 23%[27].

A person experiencing overnutrition/obesity causes excessive fat storage, thereby blocking insulin sensitivity to glucose and causing hyperglycemia. Excess fat in the body is closely related to insulin resistance, causing an increase in a person's risk of developing prediabetes. The presence of free fat deposits in the body causes binding to fat oxidation which inhibits the use of glucose in muscles, causing impaired insulin sensitivity[24].

Based on Table 2, the frequency distribution of bivariate analysis shows that there is a relationship between sufficient carbohydrate intake and normal sugar levels of 95.1% with a p-value of 0.000. This is in line with research by Dwi (2017) which shows that there is a significant relationship between carbohydrate eating patterns and the incidence of diabetes mellitus[18]. This research is also supported by Farida et al (2023) who state that carbohydrate intake is significantly related to blood glucose levels[23]. This is not in line with research by Ucik, Setyaningrum, and Siti (2009) which states that there is no relationship between carbohydrate intake and fasting blood glucose levels. This agrees with Suparni (2005) who stated that there is no relationship between carbohydrate intake and controlling blood glucose levels in people with type 2 diabetes mellitus[19]. One of the latest studies by Petrus et al (2023) contradicts the results of this study, which states that less carbohydrate intake is more likely to have high blood glucose levels[30].

Carbohydrate intake is related to the incidence of prediabetes. The effect of carbohydrate intake on blood sugar levels occurs due to the conversion of carbohydrates into glucose which encourages insulin secretion[41]. During the digestive process, carbohydrates will be broken down into simple sugars/glucose which will then be absorbed by the small intestine and enter the bloodstream. The higher the amount of carbohydrate intake, the higher the sugar level in the blood[22].

A low carbohydrate diet can prevent prediabetes by consuming salads, broccoli, cauliflower, cucumbers, cabbage, fats from animal foods, oils, butter, and avocados as well as protein in the form of meat, fish, shellfish, eggs, cheese, nuts, seeds, fruit (for example, berries), and consume more vegetables, avoiding starchy and sweet foods such as pasta, rice, potatoes, bread, and sweets. Low carbohydrate diet with a reduction of up to 26–45% of total calories[23,24].

Based on Table 2, the frequency distribution of bivariate analysis shows that there is a relationship between adequate fat intake and normal sugar levels of 95.1% with a p-value of 0.000. This research is in line with Dwi (2017) which shows that there is a significant relationship between fat eating patterns and the incidence of diabetes mellitus[18]. This research is also supported by Elida and Dia (2019) who stated that there is a relationship between fiber intake and glycemic load on blood glucose levels in type 2 diabetes mellitus patients at Jasmine 2 Clinic Surakarta[45]. Another study by Nur Hikmah, Mahpolah, and Niken (2023) showed a significant relationship between fat consumption patterns and the incidence of type 2 diabetes mellitus in the working area of the Landasan Ulin Community Health Center in 2022[16].

Fat intake is related to the incidence of prediabetes. Fat contributes to the regulation of blood sugar levels. Eating foods high in fat can slow digestion and inhibit insulin performance. As fat stores increase and adipocyte cell size increases, the receptor cells become less responsive to insulin thereby inhibiting glucose transport[47]. Excessive fat intake can increase blood sugar levels[24].

Recommendations for a low-fat diet to prevent prediabetes include emphasizing vegetables, fruit, starch (eg bread/crackers, pasta, whole grains, starchy vegetables), low-fat protein sources (including nuts), and low-fat dairy products. Total fat intake ≤30% of total calories and saturated fat intake ≤10%[24].

Based on Table 2, the frequency distribution of bivariate analysis shows that there is a relationship between insufficient fiber intake and the incidence of diabetes of 96%, p-value of 0.000. This research is in line with Farida et al (2023) who stated that fiber intake is significantly related to blood glucose levels[23]. Another study by Nur Hikmah, Mahpolah, and Niken (2023) showed a significant relationship between fiber consumption patterns and the incidence of type 2 diabetes mellitus in the working area of the Landasan Ulin Health Center in 2022[26].

This research is not in line with Putri, *et al* (2024) who stated that there is no relationship between energy, carbohydrate, protein, fat, and fiber intakewere not significantly correlated with glycemic indicators orplasma insulin. Macronutrient intakewas not significantly correlated with glycemic profile[29].

Fiber (non-glycemic carbohydrate) is a type of carbohydrate that cannot be hydrolyzed by enzymes; but is fermented in the large intestine. Fiber absorption is slower and has a low glycemic index value (GI ≤ 55 compared to the glucose scale)[26]. Fiber plays a role in controlling blood sugar levels because it slows down the release of glucose by absorbing, binding, and breaking down several particles in simple carbohydrates and removing them from the body with the help of water-soluble fiber[30].

Recommended sources of fiber to prevent prediabetes are vegetables, not consuming flour-based foods, avocados, fruit and berries, and legumes such as beans, peas and lentils.

The limitation of this research is information bias due to using a 24-hour food recall method which is based on respondents' memory, so the food consumption conveyed is less accurate.

CONCLUSIONS

There is a relationship between nutritional status and diet (carbohydrates, fats, and so on) with the incidence of prediabetes in productive age in the working area of the Mangkubumi Health Center, Tasikmalaya City in 2024 with a p-value of 0.000 for each. Based on the research results, it would be better to improve pre-diabetes screening and educate about healthy eating patterns in the productive age group at Posbindu as a preventive measure for type 2 diabetes mellitus.

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