Indonesian Journal of Advanced Research (IJAR)
Vol. 4, No. 3, 2025: 315-326

Effect of Enteral Formula on Blood Glucose Levels and Body Weight of Type 2 Diabetes Mellitus Patients

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A R T I C L E I N F O

Keywords: Enteral Food, Hospital Formula, Commercial Formula, Blood Glucose Level

Received : 4, February
Revised : 23, February
Accepted: 26, March

A B S T R A C T

Patients with type 2 diabetes mellitus with complications such as stroke usually have difficulty eating so they are given enteral formula (FRS) or commercial formula (FK) to control blood glucose levels and avoid excessive weight loss. To determine the effect of enteral foods FRS and FK on blood glucose levels and body weight of type 2 DM patients at Tarakan Hospital. This research was a quasi-experimental study with a pre post test control group design using a sample of 40 patients who were divided into 2 groups. The control group was given FRS enteral food and the treatment group was given FK enteral food. The pretest data were obtained when the patient was admitted to the hospital and the posttest data were obtained after the patient had consumed enteral food for seven days. The results of the Wilcoxon and Dependent T-test found significant differences in blood glucose levels before and after consuming FRS enteral foods (p = 0.0001) and FK (p = 0.0001), the Mann-Whitney test results showed no. differences in blood glucose levels after ingestion of FRS and FK enteral foods (p = 0.117). Whereas for body weight before and after consuming enteral food FRS and FK, there was no significant difference (p = 0.401) (p = 0.773). Independent T-test results showed no difference in body weight after consumption of FRS and FK enteral foods (p = 0.871). FRS and FK enteral foods can affect the increase of blood glucose levels to normal blood glucose levels. However, after receiving FRS or FK enteral food there was no change in body weight.

DOI: https://doi.org/10.55927/ijar.v4i3.14086
ISSN-E: 2986-0768
https://journal.formosapublisher.org/index.php/ijar

INTRODUCTION

Diabetes mellitus (DM) is a type of non-communicable disease that has increased every year in countries around the world. According to (WHO, 2017) the number of people with diabetes has increased from 108 million in 1980 to 422 million in 2017. The global prevalence of diabetes among adults over 18 years has increased from 4.7% in 1980 to 8.5% in 2017. Diabetes prevalence is increasing more rapidly in middle and low-income countries. For the highest prevalence of diabetes sufferers in the world, Indonesia ranks 6th after China, India, the United States, Brazil, and Mexico, with an estimated number of diabetes sufferers of 10 million. Diabetes with complications is the third leading cause of death in Indonesia. (Ariane, 2014)

Enteral feeding in the hospital is given if the gastrointestinal tract can still be used optimally but there is a disturbance in oral function. Support for enteral feeding in the hospital is usually associated with metabolic stress accompanied by complications, increased infection, multi-organ dysfunction, incidence of malnutrition, and increased mortality. (Khalid, et al., 2010)

The enteral feeding route is given in the form of liquid food or a formula orally, given when oral feeding is inadequate. Enteral feeding is given through the gastrointestinal tract by a tube or catheter. The standard enteral formula averages approximately 1.0 to 1.2 kcal / ml and 14% to 16% calories and protein. Enteral feeding specifically for DM such as diabetes milk has several advantages, namely they contain a low glycemic index of about 5.1% compared to rice, are high in fiber so they can reduce the risk of heart disease, is easy to digest, is equipped with chromium to help increase insulin effectiveness and contain energy and protein enough. (Bankhead et al., 2009)

Control of blood glucose levels in DM patients is related to dietary factors or meal planning. Patients with type 2 diabetes usually find it difficult to control blood glucose levels which are exacerbated by complications such as stroke, type 2 DM patients also have difficulty chewing and swallowing food so proper dietary modifications are needed such as enteral feeding that can be done to control blood glucose levels. Diabetes-specific formulas contain compositions designed to enable good glucose level control (Qurratuaeni, 2009). This is in line with research conducted (Riastuti, 2109) which states that changes in fasting blood glucose levels in the diet and enteral feeding groups are better than in the diet group.

The existence of complications in DM patients can lead to decreased appetite so weight loss is at risk of malnutrition. About 30-50% are elderly patients who are malnourished. Nutritional support aims to maintain or improve nutritional status. Providing proper nutrition to DM patients will improve quality of life, prevent or overcome malnutrition, and reduce morbidity and mortality. So a special enteral formula for diabetes is needed for nutritional support for DM patients. The research conducted (Wang et al., 2018) stated that giving early enteral feeding to DM patients gave a good response to nutritional status to overcome malnutrition and infection.

The use of enteral feeding can improve the nutritional status of patients, this is in line with research conducted by (Kim, Hyunjung, 2011) in DM patients

who are treated in intensive care units (ICU) who receive adequate enteral feeding in the form of energy for seven days, nutritional status these patients increased as marked by an increase in mean body weight of 0.13 ± 0.10 kg.

RSUD Tarakan is a regional tertiary referral hospital for the areas of Central Jakarta, West Jakarta, and North Jakarta based on Governor Regulation number 189 of 2015 concerning Regionalization of the Health Service Referral System and Guidelines for Zoning Referral System in DKI Jakarta Province. So that many patients were treated at Tarakan Hospital, one of which was type 2 DM patients, as evidenced by data from the medical records of Tarakan Hospital Jakarta in 2018 there were 1,358 patients diagnosed with DM and 228 patients suffering from type 2 DM who were hospitalized while for type 2 DM patients with complications such as stroke, there were 123 patients with an average of eleven days of hospitalization.

Therefore, this study aims to identify and analyze the effect of commercial enteral feeding on blood glucose levels and body weight of type 2 DM patients at Tarakan Hospital.

LITERATURE REVIEW

Enteral Food

Enteral food or enteral food is food or nutritional formula that is given directly into the digestive tract through the mouth or a tube (feeding tube). Enteral food is used to meet the nutritional needs of patients who have difficulty eating normally but still have fairly good digestive function.

Blood Glucose

Blood Glucose Level or blood glucose level is the amount of glucose (sugar) contained in the blood at a certain time. Glucose is the main source of energy for the body, especially for the brain and other cells.

METHODOLOGY

This study uses a quasi-experimental research type. This method is used on the basis of the consideration that the nature of the research carried out is a process that is tried in the form of looking for the effect of certain treatments (Sugiono, 2010), namely the effect of enteral feeding on blood glucose levels and body weight in type 2 diabetes mellitus patients at Tarakan Hospital. Jakarta. The research design used was the pre-treatment and post-treatment design using a control group. The control group was type 2 DM patients who received hospital formula enteral feeding (HF) and the treatment group was type 2 DM patients who received commercial formula enteral feeding (CF)

The research was conducted at Tarakan Hospital, Central Jakarta. Taking place from July 2019 to June 2020. The sample in this study amounted to 40 respondents divided by 20 respondents respectively from the control group and 20 respondents in the treatment group. Inclusion criteria for diagnosing type 2 diabetes mellitus and patients receiving continuous CF enteral feeding or HF continuous feeding. Exclusion criteria were patients who received enteral feeding for less than seven days. The dependent variables in this study were

blood glucose levels and body weight, while the independent variables were enteral feeding.

The type of data in this study is secondary data. The data collection technique for respondents was obtained from medical records of type 2 DM patients who received CF or HF enteral feeding in the form of respondent identity including gender, age, education level, occupation, and disease complications. Blood glucose level and body weight data. Pre-blood glucose level data, obtained when the patient first enters the hospital and is measured using a glucometer carried out by trained health personnel, namely nurses who are recorded in the patient's medical record data, and post blood glucose level data, obtained when the patient receives enteral feeding for seven days and measured using a glucometer carried out by trained health personnel, namely nurses who are recorded in the patient's medical record data. Pre-body weight data is obtained from the results of a nutritional assessment conducted by a nutritionist when the patient first enters the hospital and post weight data is obtained from the results of monitoring and evaluation carried out by nutritionists when the patient receives enteral food for six days at the hospital.

The data analysis used was univariate analysis and bivariate analysis. The bivariate analysis used is the dependent and independent T-test if the data is normally distributed and the alternative test if the data is not normally distributed is to use the Wilcoxon test and the Mann-Whitney test.

RESEARCH RESULTS

Characteristics of Respondents

Table. Characteristics of Respondents

Characteristics of Respondents	Treatment group (n=20)	Percentage (%)	Control group (n=20)	Percentage (%)
Gender				
Men	9	45	8	40
Women	11	55	12	60
Age				
<50 years	6	30	4	20
50-60 years	7	35	6	30
>60 years	7	35	10	50
Job				
Not Working	8	40	6	30
Entrepreneur	5	25	8	40
Civil Servants	4	20	2	10
Others	3	15	4	20
Education				
Not School	1	5	2	10
Elementary School	1	5	3	15
JHS	4	20	4	20
SHS	12	60	8	40
Academic	2	10	3	15
Complications of the Disease				

Characteristics of Respondents	Treatment group (n=20)	Percentage (%)	Control group (n=20)	Percentage (%)
Pulmonary Tuberculosis	7	35	9	45
Hemorrhagic Stroke	4	20	3	15
Ischemic Stoke	4	20	3	15
Acute Renal Failure	1	5	2	10
Chronic Renal Failure	2	10	1	5
Coronary Heart	2	10	2	10

Based on Table 1 shows the characteristics of respondents in the form of gender, age, occupation, education and disease complications. The characteristics of the respondents based on gender can be seen that the respondents in the most treatment group are female sex (55%) while in the control group as much as (60%) female sex. As for the age characteristics of the respondents, most of the respondents in the treatment group as well as in the control group aged> 60 years (35% and 50%). Respondents based their work on the treatment group of many who did not work (40%). While the majority of respondents control the private sector (40%) and those who work as civil servants only 2 people (10%). In addition to the characteristics of the respondents based on the level of education most are high school educated in both treatment groups and control groups (60% and 40%). And for the disease complications of the respondents in the treatment group as well as the control group have the most complications of the disease is Lung TB (35% and 45%). While the least in the treatment group were GGA (5%) and GGK (5%) in the control group.

Blood Glucose Levels

Table 2. Average Blood Glucose Levels

Blood Glucose Level Value	Treatment Group		Control Group	
	Median±SD	Min-Max	Mean±SD	Min-Max
Pre-Treatment	336.75±117.76	30-523	358.00±119.01	206-678
Post-Treatment	143.65±43.90	79-250	172.50±43.87	105-236

From Table 2 it can be seen that the average blood glucose level in the treatment group during pre-treatment is 336.75 ± 117.76 with the lowest blood glucose level is 30 and the highest is 523. While at post-treatment the average blood glucose level is 143.65 ± 43.90 with The lowest blood glucose is 79 and the highest is 250.

In the control group the median value of blood glucose level during pre-treatment is 358.00 ± 119.01 with the lowest blood glucose level is 206 and the highest is 678. While at post-treatment the median value of blood glucose level is 172.50 ± 43.87 with the lowest glucose level is 105 and highest 236.

Body Weight

Table 3. Average Body Weight

Body Weight Value	Treatment Group		Control Group	
	Mean±SD	**Min-Max**	**Mean±SD**	**Min-Max**
Pre-Treatment	61.67±14.08	38.90-98.60	62.49±14.23	40.90-88
Post-Treatment	61.70±13.84	39.70-98	62.41±13.91	41.50-87.30

From Table 3 it can be seen that the average weight gain in the treatment group during pre-treatment is 61.67 ± 14.08 with the lowest weight is 38.90 and the highest is 98.60. Meanwhile, at the time of post-treatment, the average weight gain was 61.70 ± 13.84 with the lowest weight being 39.70 and the highest 98.

In the control group it can be seen that the average weight gain from Table 4.3 when pre-treatment is 62.49 ± 14.23 with the lowest weight is 40.90 and the highest is 88. While at post-treatment the average weight gain is 62.41 ± 13.91 with the lowest weight is 41.50 and the highest 87.

Effect of CEF Enteral Feeding on Pre and Post Blood Glucose Levels in DM Type 2 Patients

Table 4. Effect of Commercial Enteral Formula on Blood Glucose Levels in Type 2 DM Patients

	N	**Mean±SD**	***P Value***
Pre-Treatment	20	336.75±117.76	0.0001
Post-Treatment	20	143.65±43.90	

*there is a significant difference ($p < 0.05$)

Table 5. Effect of Hospital-based Enteral Formula on Pre and Post Blood Glucose Levels in Type 2 DM Patients

	N	**Median±SD**	***P Value***
Pre-Treatment	20	358.00±119.01	0.0001
Post-Treatment	20	172.50±43.87	

*there is a significant difference ($p < 0.05$)

Effect of CF and HF Enteral Feeding on Post Blood Glucose Levels in DM Type 2 Patients

Table 6. Effect of Enteral Formula on Post-Blood Glucose Levels in Type 2 DM Patients

Group	**N**	**Median±SD**	***P Value***
Treatment Group (CEF)	20	136.50±43.90	0.117

Control Group (HEF)	20	172.50±43.87

*there is a significant difference (p < 0.05)

Based on the results of the Nonparametric Test - 2 independent samples (Mann-Whitney test) with a degree of confidence of 95%, from the table above can be known the value of p>0.05 then it can be said that CF and HF enteral feeding have no significant effect on post blood glucose levels treatment in DM type 2 patients.

Effect of CF Enteral Feeding on Pre and Post-Body Weight in DM Type 2 Patients

Table 7. Effect of CF Enteral Feeding on Pre and Post Body Weight in DM Type 2 Patients

	N	Mean±SD	*P Value*
Pre-Trearment	20	61.67±14.08	0.773
Post-Treatment	20	61.70±13.84	

*there is a significant difference (p < 0.05)

Based on the results of the Paired sample t-test (Dependent T-test) with a degree of confidence of 95%, from the table above can be known the value of p> 0.05, it can be said that CF enteral feeding does not give a significant effect on body weight.

Effect of HF Enteral Feeding on Pre and Post-Body Weight in DM Type 2 Patients

Table 8. Effect of HF Enteral Feeding on Pre and Post-Body Weight in DM Type 2 Patients

	N	Mean±SD	*P Value*
Pre-Trearment	20	62.49±14.23	0.401
Post-Treatment	20	62.41±13.91	

*there is a significant difference (p < 0.05)

Based on the results of the Paired sample t-test (Dependent T-test) with a degree of confidence of 95%, from the table above can be known the value of p> 0.05 then it can be said that HF enteral feeding does not give a significant effect on body weight.

Effect of CF and HF Enteral Feeding on Post Body Weight in DM Type 2 Patients

Table 8. Effect of Enteral Formula on Post Body Weight in Type 2 DM Patients

Group	N	Mean±SD	*P Value*

Treatment Group (CF)	20	61.70±13.84	0.871
Control Group (HF)	20	62.41±13.91	

* there is a significant difference (p < 0.05)

Based on the results of the Independent-samples T Test with a degree of confidence of 95%, from the table above can be known the value of p> 0.05, it can be said that CF and HF enteral feeding have no significant effect on post weight in DM type 2 patients.

DISCUSSION

Effect of Enteral Feeding on Blood Patient Blood Glucose Level DM Type 2

Monitoring of blood glucose levels is a form of DM type 2 treatment, preferably done by the patient himself so that the patient has a responsibility in the management of diabetes, because blood glucose control is the main goal of diabetes management. (Qurratuaeni, 2009). Enteral feeding through continuous feeding, will help DM type 2 patients get intake according to their schedule thus minimizing the risk of hypoglycemia. (Riastuti, 2109). RSUD Tarakan, in providing enteral feeding by continuous feeding is given 4 times, namely, at 06.00-12.00, 12.00-18.00, 18.00-24.00 and 24.00-06.00. The average volume of CF enteral feeding for one day is 1,525 ml where each giving is 381 ml and for HF is 1,560 ml, each giving is 390 ml. Patients who get enteral feeding by CF or HF on average can consume the enteral food given. If there is residual enteral feeding then in the next serving the volume will be reduced. For example, on the first day you get 1500 ml of enteral feeding but there is leftovers so on the second day the volume of enteral feeding is reduced to 1400 ml.

Based on the results of the study in table 4 in the treatment group based on t-test dependent test (Table 4) there is a significant difference (p = 0.000) between pre and post glucose levels after obtaining CF enteral feeding. The average pre and post glucose levels after obtaining CF enteral feeding were 336.75 mg / dl and 143.65 mg / dl. The CF brand given to DM type 2 patients is vanilla-flavored diabetasol. Diabetasol was chosen because it has been hospitalized and the taste given is vanilla so it is not too strange for the patient. In the manufacture of CF diabetasol then need 4 tablespoons of diabetasol takar into 200 ml of warm boiled water.

Diabetasol was chosen because it has several benefits such as, low glycemic index content of 31 so that the increase in blood glucose levels after consuming diabetsol occurs slowly, in addition diabetasol contains inulin dietary fiber which works to slow the absorption of glucose, provide satiety and lower blood fat to health The heart can be awake. (Eliana, Fatimah., 2018). Diabetasol is also easily digested, and comes with chromium to help increase the effectiveness of insulin as well as contain enough energy and protein. (Bankhead et al., 2009). DM type 2 patients who get enteral feeding countinous feeding, their nutrient intake becomes controlled so that controlling blood glucose levels is easier. (Mahendra, 2009).This is in line with research conducted (Retnapeni, 2015) that there is a difference in blood glucose levels after the consumption of DM formula

milk and hospital food in inpatients of the Sultan Agung Semarang Islamic Hospital.

Meanwhile, in the control group there was a significant difference (p = 0.000) pre and post blood glucose levels after obtaining HF enteral feeding. The average pre and post blood glucose levels of HF enteral feeding were 368.70 mg / dl and 165.45 mg / dl. The HF enteral feeding provided is a basic milk-free snack such as eggs, rice flour, chicken, oil and salt to taste and blended. Oil containing unsaturated fat (MUFA) can control blood glucose levels and reduce insulin resistance, so that blood glucose levels can be controlled. (Tjahjono, 2013). In addition, enteral feeding given by countinous feeding so as not to cause blood glucose levels increase suddenly. One of the advantages of HF enteral feeding is the low risk of diarrhea so that patients with diarrhea are given HF enteral feeding.

Based on the results of the Mann-Whitney test (Table 4.6) to analyze the differences in post blood glucose levels in the treatment group and control group showed, there was no significant difference (p = .117) between changes in blood glucose levels after CF enteral feeding and after HF enteral feeding. This is because the type of enteral feeding given either CF or HF is the same given by countinous feeding, has ingredients that have a low glycemic index and the average supply of enteral feeding volume for one day tends to be the same

Effect of Enteral Feeding on Body Weight of Patients DM Type 2

Being overweight is one of the risk factors for type 2 DM disease so that type 2 DM patients should have an ideal weight. (Fathmi, 2012). In addition, patients with type 2 DM who are old and have some complications of the disease tend to experience rapid weight loss and cause malnutrition (Price, 2012). Therefore, DM type 2 patients whose oral intake is <60% due to swallowing or chewing disorders are given enteral burial as their nutritional intake.(Mahan LK, Stupm SE, 2012). Researchers obtained pre-weight data when the first patient entered the hospital and for post-weight data were obtained after double monitoring evaluation (anthropometry) that is on the sixth day the patient was treated and performed by a hospital nutritionist.

In this study for the treatment group can be seen in table 4.7 based on the results of t-test dependent test showed that there was no significant difference (p = 0.773) on body weight. And the control group (table) using t-test dependent test get results (p = 0.401) where> 0.005 so it can be said that there is no significant difference in pre and post weight gain HF enteral feeding. The average pre and post weight gain for CF enteral food, pre and post gain for HF enteral feeding in sequence is 61.67 kg / m2, 61.70 kg / m2, 62.49 kg / m2 and 62.41 kg / m2.

There was no difference in weight due to the fact that most DM type 2 patients had pulmonary TB complications, in the treatment group of 7 people and in the control group of 9 people. In DM patients with pulmonary tuberculosis need special attention, especially in the nutritional fulfillment of patients, because in DM patients with pulmonary tuberculosis need to maintain blood sugar levels so that the effectiveness of the drug can work and nutrient intake for pulmonary tuberculosis should not be ruled out. (Price, 2012). Malnutrition

conditions increase the risk of pulmonary tuberculosis infection by up to 3 times.(WHO, 2011). So that the provision of diet for lung TB patients is a TETP (high energy high protein) diet while giving a type 2 DM diet is a low calorie diet that means mutually supportive so that DM type 2 patients who are overweight or obese in the treatment group or control group its intake is not reduced and given according to its needs. (Cahyadi, 2011). Where should type 2 DM patients who are overweight or obese should reduce their food intake slowly. So in this study there is no difference in weight before and after the treatment group or control group.

Based on the results of independent t-test test (Table 9) to analyze post weight difference in treatment group and control group showed no significant difference (p = .871) between weight change after CF enteral feeding and after HF enteral feeding . This is because this study only measures weight after getting enteral feeding for six days. While weight loss in one week is only 0.5 - 1 kg. (Faizah & Muniroh, 2018). In a study conducted by (Kim, Hyunjung, 2011) on DM patients treated in intensive care unit (ICU) who received adequate enteral feeding in the form of energy for seven days, the nutritional status of the patient increased marked by an increase in average weight of 0.13 ± 0.10 kg. So in this study there is no difference in weight after consuming CF enteral feeding or after consuming HF enteral feeding.

CONCLUSIONS AND RECOMMENDATIONS

The conclusion of this study is the availability of CF enteral feeding on blood glucose levels in DM type 2 patients at Tarakan Hospital. There was no CF enteral feeding response to weight gain in DM type 2 patients at Tarakan Hospital.

ADVANCED RESEARCH

This further study aims to understand more deeply how CF enteral feeding can be optimized in the management of type 2 DM. With a multidisciplinary approach that includes nutrition, gut microbiota, and the risk of long-term complications, the results of this study can be the basis for the development of more effective CF formulas and more targeted clinical recommendations for type 2 DM patients.

ACKNOWLEDGEMENT

Praise the author to the presence of Allah SWT for the overflow of His grace. The author would like to express his sincere gratitude to Tarakan Hospital for allowing the study of secondary data collection of patients. Guiding lecturers Anugrah Novianti, S.Gz., M.Gizi and Harna, S, gz., M.Si for the guidance given and all parties who have supported the compilation of this manuscript.

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