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Catfish (Clarias sp.) as an animal protein source to improve serum albumin levels of hemodialysis patients

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ABSTRACT

Background: Hemodialysis patients often experience hypoalbuminemia complications, which occur mainly due to decreased synthesis due to inflammation, lack of protein intake, the fluid status of patients, and losses from the dialysate. Another problem in hemodialysis is malnutrition, with a prevalence between 23–73% globally. Gastrointestinal disorders such as nausea, vomiting, and decreased appetite also often occur in hemodialysis. Therefore, hemodialysis patients need to get nutritional support, which can be given in the form of catfish abon, one of the local Indonesian food.
Objective: To determine the effectiveness of the use of catfish as a source of animal protein to improve the albumin levels of hemodialysis patients.
Materials and Methods: This was a quasi-experimental study with a pre-post test design. This study involved 34 hemodialysis patients as subjects, with inclusion criteria, were routinely two times a week, aged >18 years, willing to be the subject and follow the research procedures, have albumin levels ≥3.0 g/dL, and no catfish allergies. Patients with anasarca edema, experiencing complications of diabetes mellitus and malignancy were excluded. The dependent variable was albumin content, while the independent variable was catfish as an animal protein source. Data were analyzed univariate and bivariate by Fisher's Exact test.
Results: Fisher's Exact test results on the effectiveness of using catfish as an animal protein source to improve albumin levels of hemodialysis patients showed p-value=0.048.
Conclusion: The use of catfish as an effective animal protein source significantly affected on improving albumin levels in hemodialysis patients.

Keywords: Nutritional support; Catfish (Clarias sp.); Albumin levels; Hemodialysis patients.

BACKGROUND

Chronic kidney disease is a global widespread epidemic disease, which a prevalence rate is 5-15%. The incidence rate of end-stage renal disease patients requiring dialysis is also increasing (1). Basic Health Research in Indonesia shows that the prevalence of chronic kidney disease nationally increased from 0.2% in 2013 to 0.38% in 2018. Province Special Region of Yogyakarta, where the Panembahan Senopati Hospital is located, ranked 12th nationally for the prevalence of chronic kidney disease (2).

Panembahan Senopati Bantul Hospital is a large type B hospital, which obtained a hospital-level plenary accreditation certificate. Panembahan Senopati Bantul Hospital is one of the hospitals that has a Hemodialysis Unit in Bantul Regency. Based on data from the 2013 Panembahan Senopati Bantul General Hospital annual report, the number of chronic kidney disease patients undergoing hemodialysis is increasing every year. In 2011, the number of routine hemodialysis patients was 111 people, in 2012, it increased to 125 people, in 2013, it became 142 people, and in 2014 it increased again to 144 people. The hemodialysis patient is accommodated in a room (Hemodialysis Unit) with a capacity of 22 beds.

Hemodialysis patients often experience hypoalbuminemia complications, which occur mainly due to decreased synthesis due to inflammation, lack of protein intake, the fluid status of patients, and losses from dialysate (3,4). Another problem that often arises in hemodialysis is malnutrition, with a prevalence between 23–73%

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globally (5). Gastrointestinal disorders such as nausea, vomiting, and decreased appetite also often occur in hemodialysis patients (6).

Protein-energy malnutrition is a major risk factor for mortality and inflammation; the presence of co-morbid conditions like cardiovascular disease increases this risk further (7). Both low protein intake and a high state of inflammation are associated with low serum albumin in maintenance hemodialysis patients (8). Therefore, hemodialysis patients need to get nutritional support, one of them with catfish.

Catfish have many advantages in terms of nutritional content but are still often underestimated by the community because of conventional processing. Catfish can be processed into various types of food products, one of which is catfish *abon*, so it is expected to increase the acceptability and intake of hemodialysis patients. *Abon* is one of the local food in Indonesia. This study was conducted to determine the effectiveness of the use of catfish as a source of animal protein to improve the albumin levels of hemodialysis patients.

MATERIALS AND METHODS

This research was conducted at the Hemodialysis Unit of Panembahan Senopati Bantul Hospital in January–December 2017. This research type was a quasi-experimental design with a pre-post design. This study involved 34 subjects with inclusion criteria for routine hemodialysis patients twice a week, aged >18 years, willing to be the subject of research and follow the research procedures, have albumin levels ≥3.0 g/dL, and there was no catfish allergy. Whereas patients with anasarca edema, complications of diabetes mellitus, and malignancy were excluded from the study.

An experiment in the form of providing nutritional support for catfish *abon* for 21 days, based on the half-life of albumin. The nutritional content of catfish *abon* which is given as nutritional support is shown in Table 1. With a protein requirement of 1.2 g/kg body weight per day, nutritional support for hemodialysis patients can be given protein additions of ±0.2 g/kg body weight per day. The protein content of catfish *abon* based on proximate test results is 54.89 grams per 100 grams of catfish *abon*. With the nutritional support needs of hemodialysis patients of 0.2 g/kg ideal body weight/day, the need for *abon* is 0.36 g/kg ideal bodyweight/day.

Table 1. Nutrient content of catfish *abon* in the study

Nutrient	Unit	Nutrient content
Energy	kcal	421.294
Protein	g	54.894
Fat	g	25.159
Carbohydrate	g	326.091
Crude fiber	g	0.127
Sodium	ppm	1619.25
Potassium	ppm	421.294

Before being given an intervention (pre-intervention), subjects first measured levels of albumin. Then the subjects were given the intervention to provide nutritional support in the form of catfish *abon* for 21 days and were asked to record all the food and drinks they consume every day in the food record questionnaire. To ensure subjects consume catfish *abon* according to the nutritional support needs of protein and record food and drink intake every day, the researchers did the monitoring by sending a reminder in the form of a Short Message Service reminder. Messages sent to the subject only contained a reminder to consume *abon* given in the study but did not contain material related to dietary therapy on hemodialysis. Nutrition monitoring using SMS is proven to improve dietary adherence of hemodialysis patients (9). If the patient adheres to the given diet, the nutritional status of the patient will increase and can indirectly increase the albumin levels (10,11). This is related to changes in behavior which is the most influential factor on adherence to the diet of hemodialysis patients (12).

The contents of the SMS were sent to subjects only to remind and ensure subjects to eat catfish *abon* and record their food and drink intake from sources other than *abon* regularly every day. The SMS does not contain material related to the hemodialysis diet so as not to cause bias related to nutritional counseling provided by the hospital nutritionist. After 21 days post-intervention, the subject's albumin level was measured again.

The dependent variable of this study was albumin levels, while the independent variable was the use of catfish as an animal protein source. Albumin level was on a nominal scale with two categories, i.e. hypoalbuminemia when the albumin levels were <3.50 g/dL and normal when the albumin levels were ≥3.50 g/dL. In this study, there are external variables that are thought to affect albumin levels, namely patient intake. Patient's intake was defined as the overall energy, protein, fat, and carbohydrate intake of hemodialysis patients obtained by the food record method, then processed using the Nutrisurvey program, compared to the patient's needs calculated individually, and presented. The calculation of its needs using the formula according to Pernefri, namely energy needs of 35 kcal/kg BW/day, protein requirements of 1.2 g/kg BB/day, fat 20% of total energy needs, and carbohydrates are the remaining total energy requirements.

The data obtained were then analyzed univariately to determine the frequency distribution of each variable and bivariate analysis using the Fisher's Exact test. This research has obtained Ethical Clearance from the Health Research Ethics Commission, Faculty of Health Science, Universitas Respati Yogyakarta No: 330.4/FIKES/PL/II/2017 dated 15 February 2017.

RESULTS

Hemodialysis patients routinely come 2 times a week with a fixed schedule, namely Monday–Thursday, Tuesday–Friday, and Wednesday–Saturday. The hemodialysis patient schedule is divided into 3 shifts, namely the morning shift (07.00–11.00 WIB), afternoon (11.00–15.00 WIB), and evening (16.00–20.00 WIB).

Subjects in this study were patients with a diagnosis of chronic kidney disease (CKD) with hemodialysis routinely 2 times a week. The number of subjects there were 34 people taken by purposive sampling technique from 3 shifts (morning, afternoon, evening) on Monday–Thursday, Tuesday–Friday, Wednesday–Saturday. Subject characteristics in this study include age, gender, education, and complication of the disease, which are shown in Table 2.

Table 2. Frequency distribution of subject characteristics

Subject characteristics	Category	Frequency (n)	Percentage (%)
Age	17 – 25 years	1	2,9
	26 – 35 years	4	11,7
	36 – 45 years	11	32,3
	46 – 55 years	9	26,4
	56 – 65 years	7	20,5
	≥ 65 years	2	5,8
Total		34	100
Gender	Man	15	44,1
	Woman	19	55,8
Total		34	100
Education	Primary school	13	38,2
	Junior high school	5	14,7
	Senior high school	14	41,1
	University	2	5,8
Total		34	100
Complication of disease	With complications	19	55,8
	No complications	15	44,1
Total		34	100

Based on Table 2, the majority of subjects belonging to the adult age category (11 people or 32.3%). Based on gender, there were more female subjects (19 people; 55.8%) than male subjects (15 people; 44.1%). Based on the level of education, the majority of subjects had a high school / vocational education (14 people or 41.1%) and at least were university graduates, namely 2 people or 5.8%. Based on complications, there were more subjects with disease complications (19 people; 55.8%) than subjects without disease complications (15 people; 44.1%). Complications of the subject's diseases include hypertension, gastrointestinal disorders (gastritis), gout, and lupus.

In this study, subjects were given nutritional support for catfish *abon* for 21 days, under the need of subjects that was 0.36 g/kg BB/day. The body weight used to calculate the needs of catfish *abon* is

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the post hemodialysis body weight of each subject. Subjects consume all catfish *abon* given and controlled by sending a Short Message Service to the subject to remind the subject to consume the catfish *abon*. Even based on the results of the interview with the subjects, they liked the catfish *abon* and wanted to be given the catfish *abon* for a longer time after the study was completed. It means that the catfish *abon* product has good acceptance. Variable utilization of catfish as an animal protein source can be divided into pre-intervention and post-intervention.

Table 3 shows that in the pre-intervention condition, subjects with normal albumin levels were higher (73.53%) than subjects who experienced hypoalbumin (26.47%). Similarly, in the post-intervention condition, subjects with normal albumin levels were more (88.24%) than subjects who experienced hypoalbumin (11.76%). Table 3 shows that the number of subjects with normal albumin levels increased in the post-intervention condition compared to the pre-intervention.

Table 3. Frequency distribution of subject based on albumin levels

Data retrieval time	Category	Frequency (n)	Percentage (%)
Pre-intervention	Hypoalbumin	9	26.47
	Normal	25	73.53
Total		34	100
Post-intervention	Hypoalbumin	4	11.76
	Normal	30	88.24
Total		34	100

Total nutrient intake and non-catfish *abon* nutrient intake during the intervention in hemodialysis patients

The results of this study consider external variables that are thought to affect the results of the study, namely the patient's nutritional intake. The patient's nutritional intake is divided into the total nutrient intake during the intervention and the patient's nutritional intake from sources other than catfish *abon*.

The total nutrient intake during the intervention in this study included intake from catfish *abon* plus intake from non-catfish *abon*. Nutrient intake was obtained from the average intake of subjects for 21 days obtained by the Food Record method, processed using the Nutrisurvey program, then compared with the patient's needs calculated per individual. The intake is categorized to be low if the intake <80% needs, good if the intake 80–110% needs, and high if >110% needs.

Table 4. Frequency distribution of subject based on total nutrient intake during the intervention

Variable	Category	Frequency (n)	Percentage (%)
	Low	13	38.2
Energy intake	Good	18	52.9
	High	3	8.8
Total		34	100
	Low	18	52.9
Protein intake	Good	14	41.1
	High	2	5.8
Total		34	100
	Low	21	61.7
Fat intake	Good	11	32.3
	High	2	5.8
Total		34	100
	Low	12	35.2
Carbohydrate intake	Good	18	52.9
	High	4	17.6
Total		34	100

Table 4 shows that the majority of subjects consumed energy in the good category, as many as 18 people (52.9%). Most subjects consume protein in the less category, as many as 18 people (52.9%). Most of the subjects consume fat with fewer categories, namely as many as 21 people (61.7%). Most subjects consume carbohydrates in the good category, namely as many as 18 people (52.9%).

The intake of non-*abon* nutrients during the intervention was the intake of subjects sourced from food and beverages other than *abon* catfish. The intake of non-*abon* nutrients was obtained from the average intake of non-*abon* subjects for 21 days obtained by the Food Record method, processed using the Nutrisurvey program, then compared with the patient's needs calculated per individual. The intake of non-*abon* nutrients is categorized to be less if the intake <80% needs, both if the intake 80–110% needs, and more if >110% needs.

Table 5. Frequency distribution of subject based on nutrition intake from non-catfish *abon* source during the intervention

Variable	Category	Frequency (n)	Percentage (%)
Energy intake	Low	17	50
	Good	15	44.1
	High	2	5.8
Total		34	100
Protein intake	Low	28	82.3
	Good	5	14.7
	High	1	2.9
Total		34	100
Fat intake	Low	25	73.5
	Good	7	20.5
	High	2	5.8
Total		34	100
Carbohydrate intake	Low	12	35.2
	Good	18	52.9
	High	4	11.7
Total		34	100

Table 5 based on the intake of energy nutrients shows that the majority of subjects consume energy from non-catfish *abon* sources with fewer categories, as many as 17 people (50%). Based on the intake of protein nutrients from non-catfish *abon* sources the majority of subjects consumed protein in the less category, as many as 28 people (82.3%). Based on the intake of non-catfish *abon* fat nutrients, the majority of subjects consumed less fat, namely 25 people (73.5%). Based on the intake of non-*abon* carbohydrate nutrients, the majority of subjects who consumed carbohydrates in the good category, namely as many as 18 people (52.9%).

Effectiveness of catfish *abon* as nutritional support to albumin levels of hemodialysis patients

Fisher's Exact test results in Table 6 show that the use of catfish as an effective animal protein source has a significant effect on improving albumin levels of hemodialysis patients with p-value=0.048 (p-value<0.05).

Table 6. Bivariate analysis result of the effectiveness of catfish *abon* as nutritional support to albumin levels of hemodialysis patients using Fisher's Exact test

Category of albumin levels		Post-intervention		Total	*p-value*
		Hypoalbumin	Normal		
Pre-intervention	Hypoalbumin	3 (33.30%)	6 (66.70%)	9 (100.00%)	0.048
	Normal	1 (4.00%)	24 (96.00%)	25 (100.00%)	
Total		4 (11.80%)	30 (88.20%)	34 (100.00%)	

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DISCUSSIONS

This study was dominated by adult subjects. This study was consistent with the general description of CKD patients undergoing hemodialysis in Indonesia, as reported by the Indonesian Renal Registry, which in 2011 found 89% of CKD patients undergoing hemodialysis aged 35–70 years with the most age groups of 45–54 years which are 27%.

Age is one of the factors that can affect an individual's health status. At the age of 40–70 years, glomerular filtration rate will progressively decrease to 50% from normal, i a decrease in the ability of the kidney tubules to reabsorb and concentrate urine, decrease the ability to empty the bladder thereby increasing the risk of infection and obstruction, and decreasing fluid intake which is a risk factor for kidney damage (13). Gender and age affect the incidence of glomerulonephritis which is one of the risk factors for chronic kidney failure (14).

The results of this study, more female subjects than male subjects. These results are similar to previous studies that the sex of patients with chronic kidney failure who performed hemodialysis were more women, as many as 33 people (52.4%), compared to 30 men (47.6%) (15).

Most of the subjects in this study had high school/vocational education and at least a university education graduate. In patients who have higher education will have broader knowledge also allows patients to be able to control themselves in overcoming the problems faced, have high self-confidence, experienced, and have precise estimates of how to handle events and easily understand what is happening recommended by health workers, will be able to reduce anxiety so that it can help the individual in making decisions (16). Knowledge of cognitive is a very important domain for the formation of action, behavior based on knowledge will be more lasting than those not based on knowledge (17).

Based on complications, the number of subjects with complications is higher than subjects without complications. Complications of the subject's diseases include hypertension, gastrointestinal disorders (gastritis), gout, and lupus.

Albumin levels of Hemodialysis Patients

In this study, there was an increase in the number of normal albumin subjects who experienced an increase in the condition of post-intervention compared to pre-intervention. Albumin is a very important serum in the body which is the main determinant of blood plasma osmotic pressure. The effect caused by decreased albumin will cause a shift in fluid from the intravascular space (18).

Hypoalbumin in patients with chronic kidney failure who have undergone hemodialysis can be caused by severe malnutrition caused by the inflammatory process in patients with chronic kidney failure. The presence of inflammation is associated with anorexia in dialysis patients. Chronic inflammation can also result in a rapid decrease in skeletal muscle protein and other tissues, reducing muscle and fat resulting in hypoalbumin (19). In addition to the inflammatory process of hemodialysis which removes protein and vitamins along with the dialysate which during hemodialysis runs it will lose 10–12 grams of amino acids, glucose will also be released via dialysate (20).

Albumin deficiency occurs when production is reduced and loss of albumin. More protein is lost than is made by a healthy liver (21). Decreased albumin levels in patients undergoing hemodialysis are influenced by malnutrition due to the inflammatory process that still occurs due to lack of hemodialysis time (22).

Total nutrient intake and non-catfish *abon* nutrient intake during the intervention in hemodialysis patients

Nutrient intake includes energy, protein, fat, and carbohydrates. The total nutrient intake during the intervention in this study included intake from catfish *abon* plus intake from non-catfish *abon*. The intake of non-catfish *abon* nutrients during the intervention was the intake of subjects sourced from food and beverages other than catfish *abon*.

Patients with chronic kidney failure with hemodialysis are recommended high protein intake to maintain nitrogen balance and replace amino acids lost during the hemodialysis process, ie 1–1.2 g/kg BW/day with 50% protein should be of high biological value because protein intake is very necessary remembering its function in the body. The effect of protein intake plays an important role in the prevention of nutrition of patients with chronic kidney failure because the symptoms of the uremic syndrome are caused by the accumulation of body protein catabolism. Therefore, the better the protein intake, the better it is in maintaining its nutritional status (23).

Cultivated fat intake 30% of calorie intake. On the one hand, fat intake is sufficient to meet calorie needs, while on the other hand fat also worsens kidney function and increases morbidity due to atherosclerosis. Consumption of complex carbohydrates such as rice, bread, sweet potatoes, and cassava can spur the removal of excess uric acid in the blood (24).

Food intake of hemodialysis patients refers to the level of deterioration in kidney function. Food intake that must be limited in consumption is, protein intake is limited to 1–1.2 g/kg/day, potassium intake is limited to 40–70 meq/day, given the decreased function of potassium excretion and excretion of urea nitrogen by the kidneys. Meanwhile, the number of calories given is 30–35 kcal/kg BB/day (25).

Effectiveness of catfish *abon* as nutritional support to albumin levels of hemodialysis patients

In this study after being tested using Fisher's Exact, it was shown that providing nutritional support for catfish *abon* was effective in influencing the albumin levels of hemodialysis patients. Catfish *abon* has never been given as a form of dietary therapy in hemodialysis patients that is needed to replace the protein lost during hemodialysis and prevent catabolism of protein so that it can maintain serum creatinine levels within normal limits, overcome hypoalbuminemia, and enhance immunity.

Nutrient-based dietary guidelines emphasize animal-based protein foods for preventing and managing protein-energy wasting in hemodialysis patients (26). Fish is an animal food that contains proteins of good quality due to the complete content of essential amino acids. Fish can be extracted to obtain plasma protein (sarcoplasmic) containing albumin and another nutrient that has the potency to improve hypoalbuminemia condition (27).

There is a similar study with the basic ingredients of processed fish which are nutritional support in hemodialysis patients, the fish used is cork fish filtrate. Giving an extra intradialytic diet can maintain and increase serum albumin levels, as a result of protein intake during the hemodialysis process so that it can replace the amino acids lost especially during hemodialysis (25). The high intensity of use of cork fish (snakehead fish) to produce various products of fish albumin has put the natural stock of this fish species under great pressure. Therefore, it is necessary to find alternative sources of fish albumin other than the cork fish (28). Catfish is one of the sources of animal protein that has a high biological value, has a high protein content, and can be accessed by the public at a low price. The protein from catfish contains albumin, which can improve the albumin levels of hemodialysis patients if consumed with an adequate amount.

CONCLUSIONS

The use of catfish as an effective animal protein source has a significant effect on improving albumin levels in hemodialysis patients. Based on these conclusions, it is recommended to the hospital conduct continuous monitoring of the intake of hemodialysis patients, especially animal protein sources, to maintain the nutritional status of hemodialysis patients. Further research needs to be done on nutritional support for hemodialysis patients, with the use of local food in Indonesia.

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