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THE RELATIONSHIP BETWEEN ENERGY AND MACRONUTRIENT INTAKE AND NUTRITIONAL STATUS IN CHRONIC RENAL FAILURE PATIENTS WITH HAEMODIALYSIS

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ABSTRACT
Patients with end-stage renal disease, especially those receiving HD treatment, often show characteristics in the body's protein and energy storage, called protein energy wasting (PEW). HD is the mainstay of treatment for end-stage renal disease and the number of patients undergoing HD is increasing every year. Appropriate nutritional therapy is needed to improve nutritional status and improve the patient's quality of life. Malnutrition is a common condition in patients undergoing haemodialysis (HD) and is associated with increased morbidity and mortality. The main aim of this study was to evaluate the relationship between energy and macronutrient intake and nutritional status in HD patients at at Haemodialysis Unit Dr. H. Abdul Moeloek General Hospital Bandar Lampung. This research is an observational analytical study with a cross sectional design with 30 respondent with chronic kidney failure who underwent HD at at Haemodialysis Unit Dr. H. Abdul Moeloek General Hospital Bandar Lampung from April to May 2024, sampling technique using consecutive sampling technique. Information regarding eating patterns was collected using the 1 x 24 hour food recall method, mini mental status examination (MMSE) used to evaluate dementia in elderly respondents and the nutritional status index was based on an assessment using the mid-upper arm circumference percentile, the patient's height was obtained by measuring the patient's knee height which was then calculated using the Chumlea equation to obtain ideal body weight. The nutritional status index uses mid-upper arm circumference to categorize patients with good and poor nutritional status. Data were analyzed using Fisher's test. The results showed that the majority of respondents had inadequate energy intake as many as 20 patients (66.7%), inadequate protein intake as many as 24 patients (80%), inadequate fat intake as many as 26 patients (86.7%) and inadequate carbohydrate intake as many as 23 patients (76.7%). So it can be concluded that there is no relationship between energy intake (p = 0.633), protein (p = 0.656), fat (p = 0.557) and carbohydrates (p = 0.567) with nutritional status in HD patients at at Haemodialysis Unit Dr. H. Abdul Moeloek General Hospital Bandar Lampung. Further research needs to be carried out to determine the intake of other nutrients such as fluids, sodium and potassium as well as the duration of HD which is a common problem in HD patients.

Keywords: chronic renal failure; hemodialysis; macronutrients; nutritional status

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INTRODUCTION

Chronic Kidney Disease (CKD) is a kidney disorder that lasts more than three months, indicated by abnormalities in kidney structure or function with or without a decrease in glomerular filtration rate function (eGFR < 60 mL/minute/ 1.73m2) based on the presence of

pathological abnormalities or signs. kidney damage, including abnormalities in blood or urine composition or abnormalities in laboratory tests (Ministry of Health of the Republic of Indonesia, 2023). The biggest risk factors that increase the prevalence of CKD are caused by obesity and diabetes mellitus, so it is estimated that the number of CKD sufferers worldwide is 843.6 million people worldwide in 2017 (Kovesdy, 2022).

According to 2017 Global Burden of Disease data, CKD is in the 12th highest cause of death in people throughout the world. The prevalence of CKD in Indonesia is 0.64% with the highest prevalence of CKD being in North Kalimantan (0.64%) and the lowest prevalence of CKD in West Sulawesi (0.18%) (Hidayaningsih et al., 2023). Risk factors that can increase the risk of developing CKD are hypertension, diabetes mellitus, dyslipidemia, hyperuricemia, low physical activity and smoking behavior (Wang L et al., 2023). Assessment of nutritional status using % mid upper arm circumferences is used for patients who receive aggressive resuscitation therapy and are in critical condition (Prystina et al., 2022). HD sufferers with malnutrition are susceptible to muscle catabolism and are at risk of losing 4 - 9 grams of amino acids and 7 - 8 grams of protein when undergoing HD, resulting in malnutrition, increasing the risk of morbidity, mortality and metabolic imbalance as well as reducing quality of life (Adrianto et al., 2021) .

CKD patients undergoing hemodialysis (HD) are at risk of protein energy malnutrition and are associated with an increased risk of morbidity and mortality caused by inadequate food intake due to anorexia, emotional distress, changes in the sense of taste and dialysis procedures which result in wasted nutrition and protein catabolism so that patients HD requires adequate nutrition to prevent energy and protein malnutrition (Janardhan, 2011). Based on preliminary studies obtained at Dr. H Abdul Moeloek General Hospital, Lampung Province, it is known that the number of HD patients in 2023 will reach 19,390 people and in February 2024 the number of HD patients will reach 3,309 people (Medical Records Department Abdul Moeloek Hospital, 2024). In January 2024 the total number of HD patients reached 3,309 people, the total number of HD patients in March 2024 reached 3,467 people, the total number of HD patients in April reached 3,498 people (Medical Records Department Abdul Moeloek Hospital, 2024). This study aims to analyze the relationship between energy and macronutrient intake and nutritional status in HD patients at Dr. H. Abdul Moeloek General Hospital Lampung Province.

METHOD

This research uses an observational analytical method with a cross sectional approach. Research data collection was carried out from April to May 2024 located at at Haemodialysis Unit Dr. H. Abdul Moeloek General Hospital Bandar Lampung. Observations or data collection carried out in the research include primary data in the form of mid upper arm circumferences measurement data, knee height, energy and macronutrient intake as well as MMSE data and secondary data in the form of the number of HD patients in 2023 and in January, February and March in 2024 , respondent type of payment of HD patients, HD schedule and type of diagnosis of HD patients. The instruments used were a 24-hour food recall questionnaire for macronutrient intake, a high knee caliper tool to measure the respondent's knee height, a food photo book and a mid upper arm circumferences tape used to measure the nutritional status of the respondent based on the mid upper arm circumferences percentile, a mini mental status examination (MMSE) questionnaire for evaluation of the cognitive function of elderly respondents with a reliability of 0.827 and a validity of 0.776 and it was concluded that the MMSE questionnaire was reliable and valid for use (Komala DW et al., 2021).

Knee height measurements are used to estimate the respondent's height using the Chumlea formula which is needed to calculate ideal body weight so that each respondent's energy, protein, fat and carbohydrate needs can be determined. The respondents' food consumption data that has been collected is calculated by calculating their actual nutrient intake using the Indonesian Food Composition Table (TKPI) and then calculating the Recommended Dietary Allowance (% RDA). Mid upper arm circumferences percentile data is used to determine the nutritional status of respondents. There are 3 categorizations of nutritional status based on the mid upper arm circumferences percentile, as follow good nutrition (> 85%), malnutrition (70.1% - 84.9%) and poor nutrition (<70%). The % RDA categorization is based on the 1990 Ministry of Health guidelines, as follow ≥100 (good), 80 – 90% (medium), 70 – 79% (poor) and < 70% (deficit) (Ministry of Health, 2018).

Energy intake is adequate if it is in the range of 80 – 120% of needs (30 – 35 kcal/ kg ideal body weight /day for age≥60 years old and 35 kcal/ ideal body weight /day for ages < 60 years, adequate protein intake if it reaches 80 – 120% of the requirement of 1.2 gram/ kg ideal body weight /day, adequate fat intake if it reaches 80 – 120% of the fat requirement of 15 – 30% of energy requirements per day and adequate carbohydrate intake if carbohydrate intake is 80 - 120% of the requirement, 55 - 70% of energy requirement per day. The population of CKD with HD is 80 patients per day. The samples in this study were CKD patients who underwent HD at Dr. H. Abdul Moeloek General Hospital and the total sample is 30 respondents with a research duration of 4 weeks. The sampling method used consecutive sampling. Inclusion criteria are that the respondent's age ranges from 19 to 75 years, undergoing routine HD at least 2 times a week, outpatient HD patient, in stable condition and does not have tuberculosis, hepatitis B, C and HIV infections, does not have dementia, is not in pregnant and willing to become a respondent by signing informed consent. The data obtained were analyzed statistically using Fisher's test with significance limits ($p < 0.05$) and a 95% confidence interval. This study has obtained a research permit from the Academic Department of Medical Faculty Lampung University and Education and Training Programs Dr. H. Abdul Moeloek Hospital with research permit number 420/0972A/VII.01/10.26/III/2024.

RESULTS

An overview of respondents' characteristics, energy, protein, carbohydrate and fat intake and nutritional status is shown in table 1.

Table 1.
Characteristics of Respondents

Variable	f	%
Gender		
Woman	18	60
Man	12	40
Age		
Adult (19 – 59 years)	16	53.3
Elderly (≥ 60 years old)	14	46.7
Duration of Hemodialysis		
< 2 years	23	76.7
≥ 2 years	7	23.3
Mid upper arm circumferences's Percentile Nutritional Status		
Good Nutrition (> 85%)	6	20
Malnutrition (<70 % - 84.9%)	24	80

Table 1, it can be seen that more of the CKD respondents who underwent HD were female. CKD respondents with HD are dominated by those aged 19 – 59 years compared to the elderly. Duration of HD under 2 years is more dominant compared to duration of HD more

than 2 years. Only 20% of respondents had good nutrition, this shows that more CKD respondents experienced malnutrition.

Table 2.
Nutritional needs, intake and average %RDA of respondents

Gender	Variables	Energy (g)	Protein (g)	Fat (g)	Carbohydrates (g)
Man	Need	1823	69.9	30.7	253.7
	Intake	1550	54.1	57	168
	%RDA	84.5%	78.2%	184.8%	65.8%
Woman	Need	1727	61.9	28.7	237
	Intake	1432	43.9	49.2	173
	%RDA	85.8%	72%	175%	73.3%

Tabel 2, it can be seen that the average need for energy, protein, fat and carbohydrates for men is greater than for women. %RDA in male respondents for fat was 184.8 (good), energy 84.5 (moderate), protein 78.2 (poor) and carbohydrates 65.8 (deficit). %RDA in female respondents for fat was 175 (good), energy 85.8 (moderate), protein (72) and carbohydrates 73.3 (poor).

Table 3.
Distribution of Respondents Based on Dietary Desirable Pattern (DDP)

No	Rice - grain	Tubers	animal	Oil and fat	Oily fruit and seeds	Nuts	Sugar	Fruit and vegetables	Etc	DDP Score
1	1.61	0	24	3.03	0	0	0	0	0	28.6
2	1.86	0	24	5	0	5	10	1.71	13.86	56.4
3	14.95	2.5	24	5	0	10	0.36	4.95	0	61.7
4	7	0	24	5	0	10	1.89	30	0	77.9
5	23.68	0	24	5	0	0	1.56	30	0	84.2
6	10.11	0	24	2.2	0	0	1.69	0	0	38
7	7.34	2.5	24	5	0	0	0.38	0	0	39.2
8	8.74	2.5	24	5	0	0	0	17.2	0	57.4
9	3.56	2.5	24	5	0	10	0.29	0	0	45.3
10	17.7	0	24	5	0	0	0	29.24	0	75.93
11	15.89	0	24	5	0	10	2.5	7.42	0	64
12	10.15	0	24	5	0	0	0	23.6	0	62.7
13	15	2.5	24	2.2	0	5,6	2.5	4.8	0	56.6
14	25	0	0	5	1	10	1.04	23.61	0	65.6
15	25	0	24	3.3	0	10	0	5.78	0	68
16	15.68	0	15.27	5	0	9.66	0	11.53	0	57.14
17	16.78	0	7.66	4.55	0	10	2.32	7.45	0	48.75
18	19.8	2.5	13.35	5	0	0	0	30	0	70.6
19	24.93	2.5	24	3.16	0	0	0	13.2	0	67.7
20	15.21	2.5	5.13	2.57	0	0	0	30	0	55.41
21	19.23	0	24	0	1	0	0	29.4	0	73
22	16.27	2.5	24	2.78	0	0	2.5	0	0	73.6
23	25	2.5	12.68	5	0	10	1.69	9.12	0	65.9
24	10	2.5	24	4.18	0	8.4	2.5	5.76	0	58.3
25	8.32	0	10.94	2.78	0	4.2	0	10.73	0	36.9
26	23.35	0	21.85	2.78	0	0	0.56	9.03	0	57.78
27	21.98	2.5	24	5	1	4.2	0	6.49	0	65.1
28	13.73	2.5	17.02	5	0	0	0	18.96	0	57.2
29	16.48	2.5	24	5	0	8.4	0	30	0	86.3
30	8.24	2.5	24	2.78	1	0	1.46	20	0	59.9
	Average									60.5

Table 3 showed that the average DDP score is 60.5. The highest average DDP score was 86.3 and the lowest DDP score was 28.6. Sources of carbohydrates consumed by respondents include rice and bread. Sources of animal protein consumed are fried chicken, fresh water fish, fried shrimp, chicken eggs, sardines and sea fish. The vegetable protein consumed is tempeh and tofu. Vegetables consumed include long beans, stir-fried bean sprouts, vegetable soup and sour vegetables. To increase the respondents' nutritional content, there were several respondents who consumed milk specially formulated for CKD patients. The fluid intake consumed by respondents ranged from ½ glass to 1 glass of star fruit a day.

Table 4.
Distribution of the Relationship between Energy Intake and Nutritional Status of HD Patients

Energy Intake	Nutritional status						
	Good		Not enough		Total		p
	f	%	f	%	f	%	
Adequate	1	3.3	9	30	10	33.3	0.633
Inadequate	5	16.6	15	50	20	66.7	

Table 4 showed that, 5 patients with CKD whose energy intake was inadequate (25%) had good nutritional status and 15 patients (75%) had poor nutritional status. Meanwhile, 1 patient (10%) had good nutritional status and 9 patients (90%) had poor nutritional status. The statistical results obtained a p value of 0.633 which means that there is no relationship between energy intake and the nutritional status of CKD patients with HD at Dr. H. Abdul Moeloek General Hospital.

Table 5.
Distribution of the Relationship between Protein Intake and Nutritional Status of HD Patients

Protein Intake	Nutritional status						
	Good		Not enough		Total		P
	f	%	f	%	f	%	
Adequate	1	3.3	5	16.6	6	20	0.656
Inadequate	5	16.6	19	63.3	24	80	

Table 5, it is known that there is no relationship between protein intake and the nutritional status of HD patients at Dr. H. Abdul Moeloek General Hospital. Based on the results of statistical analysis, as many as 5 patients (83.3%) with adequate protein intake had poor nutritional status and 1 patient (16.7%) had good nutritional status, while those with inadequate protein intake, as many as 19 patients (79.2%) had nutritional status. Among 5 patients (20.8%) had good nutritional status There is no relationship between the two variables as seen from the results of the Fisher's Exact statistical test, with a p value = 0.656. Because p>0.05, the hypothesis (Ha) is rejected, so it can be concluded that there is no relationship between protein intake and the nutritional status of kidney failure patients. chronicle with HD at Dr. H. Abdul Moeloek General Hospital.

Table 6.
Distribution of Fat Intake by Nutritional Status of HD Patients

Fat Intake	Nutritional status						
	Good		Not enough		Total		P
	f	%	f	%	f	%	
Adequate	0	0	4	13.3	4	13.3	0.557
Inadequate	6	20	20	66.6	26	86.6	

Table 6, it shows that 4 patients (100%) had inadequate fat intake, while 20 patients (76.9%) had inadequate fat intake and 6 patients (23.1%) had good nutritional status. Good. This result is based on the Fisher's Exact test, the p value = 0.557, so the hypothesis (Ha) is rejected. The

p value is> 0.05, so it can be concluded that there is no relationship between fat intake and the nutritional status of patients with chronic kidney failure at Dr. H. Abdul Moeloek General Hospital.

Table 7.
Distribution of the Relationship between Carbohydrate Intake and Nutritional Status of HD Patients

Carbohydrate intake	Nutritional status						
	Good		Not enough		Total		P
	f	%	f	%	f	%	
Adequate	1	3.3	6	20	7	23.3	0.567
Inadequate	5	16.6	18	60	23	76.6	

Table 7, 6 patients with adequate carbohydrate intake (85.7%) had poor nutritional status and 1 patient (14.3%) had good nutritional status, while 5 patients (21.7%) had inadequate carbohydrate intake with good nutritional status) and 18 patients (78.3%) experienced poor nutritional status. Based on the Fisher's Exact test, the value of p = 0.567 is obtained, so the hypothesis (Ha) is rejected. The p value is> 0.05 so there is no relationship between carbohydrate intake and the nutritional status of chronic kidney failure patients at Dr. H. Abdul Moeloek General Hospital.

DISCUSSION

The average %RDA score for male respondents for fat was 184.8 (good) while energy was 84.5 (moderate), protein 78.2 (poor) and carbohydrates 65.8 (deficit). The %RDA in female respondents for fat was 175 (good), energy 85.8 (moderate), protein (72) and carbohydrates (73.3) in the poor category. The average DDP score in HD patients is 60.5 and is in the low category, this is because HD patients are advised to limit potassium intake in the range of 51 – 77 mEq/day (2 – 3 grams/day) and grade 5 CKD patients are advised to have fruit and low potassium vegetables and consult a nutritionist to prevent hyperkalemia (Gilbert et al., 2014). Decreased food consumption can be caused by reduced appetite and nausea, which can increase the risk of malnutrition (Sultan S et al., 2021).The average DDP score of respondents is 60.5 and is included in the bronze triangle category because the food quality score is ≤ 78. This is because the energy intake from animal foods, vegetables, fruit and nuts is still low below the DDP norm, but for energy from rice, tubers, oil and sugar relatively meet DDP norms (Nugraheni M, 2016). High and low DDP is influenced by family size, education level and household income level (Argandi, S et al., 2019).

Kidney clinicians and dietitians recommend that HD patients to consume vegetables and fruit and other foods that has low in potassium but high in fiber and other micronutrients. Food composition tables with nutritional content can help the food selection. Boiling vegetables can reduce potassium levels and reduce the taste of food due to the boiling process and the decrease in taste sensation in HD patients leads to decrease in appetite, therefore that aromatic herbs can be used to improve the taste of food (KDOQI, 2020). HD respondents in this study had HD schedules twice a week, this is in line with research by Harun et al (2023) showed in some low and middle income countries (India, Nepal, Thailand, Vietnam, Philippines, Indonesia, Bangladesh, Pakistan etc) use twice-weekly HD regimens for non-adherent dialysis patients due to financial constraints or scarcity of resources, lack of affordable treatment, poor access to nephrology care, and inadequate dialysis facilities (Harun et al., 2023). Analysis of the relationship between energy, protein, carbohydrate and fat intake is based on 24 hour food recall and nutritional status based on percentile for mid upper arm circumferences assessment.

The results of this study showed that there was no significant relationship between energy, protein, fat and carbohydrate intake and nutritional status in chronic kidney failure sufferers undergoing HD at Dr.H Abdul Moeloek General Hospital Lampung Province. This is in line with research by Kusumastuti et al (2015) also showed there is no significant relationship between nutritional status and energy intake (p=0.163), protein (p=1.000), fat (p=0.390) and carbohydrates (p= 0.585) in Dr. Moewardi General Hospital. And in line with research by Zulfikar et al (2023) which states that there is no significant relationship between fat and carbohydrate intake and nutritional status in HD patients at dr. Dradjat Prawiranegara General Hospital ($p > 0.05$). According to the 2011 Pernefri Consensus, the recommended energy intake for CKD patients undergoing HD is 30 – 35 kcal/ kg ideal body weight /day. The prevalence of protein energy wasting in hemodialysis patients is quite high and is estimated to be 23 - 76% and this condition of protein energy wasting can be a predictor of morbidity and mortality (Maurya et al, 2019). Negative energy balance occurs due to changes in cellular energy metabolism due to increased catabolism processes and loss of amino acids from the dialyzer. If this is not balanced with inadequate energy intake, malnutrition can occur (Yogyantini et al., 2023).

According to the Pernerfri CKD Nutrition Consensus (2011), CKD patients with HD have other risk factor of protein energy malnutrition. HD will increase protein catabolism by 4 - 9 grams of amino acids and 2 - 3 grams of peptide amino acids are wasted in one HD session. Repeated use of dialyzers results in a high risk of loss of amino acids and albumin (Pernefri, 2011). So hemodialysis patients need to comply with adequate protein intake to prevent malnutrition (Sherly, S et al., 2021). The Kidney Disease Outcomes Quality Initiative recommends that CKD patients undergoing HD need to meet a protein intake of 1.0 – 1.2 grams/ kg ideal body weight /day to maintain stable nutritional status (KDOQI, 2020). Sources of protein consumed by HD patients include chicken eggs, chicken meat, fish, milk specifically for HD patients, tempeh and tofu.

According to KDOQI (2020) for HD patients, total fat consumption should not exceed 30% of total calories (Duong, T. et al., 2018). Low fat intake is caused overall by low energy and protein intake as well as gastrointestinal disorders accompanied by decreased appetite, nausea and vomiting(Zulfikar et al., 2023). According to KDOQI (2020), the recommended carbohydrate intake is 45 – 65% of total energy (Duong, T. et al., 2018). Meanwhile, according to PERSAGI (2018) the recommendation for carbohydrate intake is 50 – 70% of total energy. Strict dietary restrictions in HD patients make them vulnerable to an inadequate diet and are at risk of experiencing protein energy wasting (Gityamwi et al., 2021). A prospective cohort study of adult respondents in the US from The National Health and Nutrition Examination Survey (NHANES) in 1999 – 2010 showed that a long-term low-carbohydrate diet increased the risk of mortality from all causes (Ren, Q et al., 2023). Sources of carbohydrates commonly consumed by HD patients include rice, bread and granulated sugar to add a sweet taste to tea drinks. The limitation of this study were researchers use food recall 1 x 24 hours so that it is less representative of the eating habits of respondents so further research is needed using the 2 x 24 hour food recall method or combined with the Food Frequency Questionnaire (FFQ) method.

CONCLUSION

Based on the research results, it can be concluded that there is no significant relationship between energy, protein, carbohydrate and fat intake and nutritional status among CKD patients undergoing HD at Dr. H. Abdul Moeloek General Hospital Lampung Province in 2024.

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