Energy, protein, and potassium intake with nutritional status among chronic renal failure patients undergoing hemodialysis in hospital Dr. M.Yunus, Bengkulu, Indonesia

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Energy, protein, and potassium intake with nutritional status among chronic renal failure patients undergoing hemodialysis in hospital Dr. M.Yunus, Bengkulu, Indonesia

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Abstract:

Renal failure was the standard end line of various urinary and renal tractus. Malnutrition among hemodialysis patients can be estimated using Subjective Global Assessment (SGA)–Dialysis Malnutrition Score (DMS) which is simple and reliable. The purpose of this research was to know the relationship between energy intake, protein, and potassium with nutritional status SGA in renal failure patients who were treated by hemodialysis in hospital Dr. M. Yunus Bengkulu. The design of this research was analytical observational by using prospective cohort approach. The number of respondents was 57 patient. Recall method was used to measure intake of energy, protein, and potassium with 2 × 24 h recall a week, as well as the measurement of SGA–DMS. Bivariate statistical tests using correlation are testing the significance of the relationship or difference with a 95 % confidence level and with $\alpha = 5$ %. There was a relationship between the protein intake ($p = 0.035$) with SGA, there was no relationship between the energy intake ($p = 0.242$) with SGA, and there was no link between intake of potassium with SGA ($p = 0.603$) in chronic renal failure patients undergoing hemodialysis. This study showed which is no significant relationship between energy intake with SGA, there was a relationship of protein intake with SGA and there was no relationship between intake of potassium with SGA.

Keywords: Energy, hemodialysis**,** malnutrition, potassium, protein

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Introduction

Kidney Failure is a disease in which the kidneys are unable to carry the metabolic waste from the body or carry out its regular functions. A material that usually eliminated in urine that accumulates in body fluids due to impaired renal excretion and causes disruption of endocrine and metabolic functions, fluids, electrolytes, and acid–base. It is the common final pathway of various urinary tract diseases and kidneys. Then, kidney failure is a systemic disease. As stated by the United State Renal Data System (USRDS), the prevalence of chronic kidney failure is around 10 % to 13 % in 2009. The prevalence of chronic kidney failure is quite high in Indonesia, which are around 30.7×10^6 people. People with end–stage kidney failure have around 14.3×10^6 people currently undergoing treatment according to PT Askes data (1). Furthermore, the prevalence of chronic kidney disease (permil) based on the doctor's diagnosis in residents aged ≥ 15 yr from 2013 until 2018 has increased. The prevalence of more men with chronic kidney disease is 4.17 % compared to women, which is 3.52 %. Chronic kidney failure is more affected in urban areas, which is 3.85 %, while in rural areas, it is 3.84 %. 65 yr to 74 yr of age are more susceptible to chronic kidney disease, which is 8.23 % (2).

The National Kidney Foundation Kidney Disease Core Quality Outcome (NKFKDOQI) recommends for dialysis patients to have high protein intake. Patients with chronic kidney disease are usually low food intake due to decreased appetite, the onset of nausea, and accompanied by vomiting so that it will affect weight loss, which can cause malnutrition (3). Moreover, subjective global assessments can be used reliably to assess malnutrition in chronic kidney disease patients and are therefore useful in disease prognostication (4). Subjective Global

Assessment (SGA) for dialysis patient, namely Dialysis Malnutrition Score (DMS) is a tool that uses five components of medical history (changes in body weight, dietary intake, gastrointestinal symptoms, functional ability, comorbidity and their relationship to nutritional needs) and two components of physical examination (simptoms of fat and muscle, replacement nutrients in fluids). It has the advantage of being inexpensive, fast, and can use effectively [5]. Based on the explanation above, the study was intended to investigate the correlation between energy intake, protein, and potassium with nutritional status (SGA) in renal failure patients undergoing hemodialysis in hospital Dr. M. Yunus Bengkulu Indonesia in 2019.

Materials and Methods

This study was observational research with a prospective cohort design. The research was carried out in the room of the hemodialysis hospital Dr. M. Yunus Bengkulu, beginning in January until April 2019. The subject of this study was 57 people. In this study, the researcher used a non–probability sampling method with a purposive sampling technique based on specific considerations made by the researcher himself, based on characteristics of the population. The specific criteria of the subject recorded as patients with chronic kidney disease who got hemodialysis in hospital Dr. M. Yunus Bengkulu in 2019, this type of person is willing to be a sample, routine hemodialysis twice in a week, adult patients (> 18 yr). The population of samples was 159 subjects. Moreover, free variables are energy intake, protein, potassium, and bound variables are nutritional status based on SGA for dialysis patient namely Dialysis Malnutrition Score (DMS). The research tool used in this study was a 2 × 24 h recall form to assess the intake of energy, protein, and calcium, which is processed by computer. In addition to using photo media food ingredients for food, injection scales to measure the weight and subject matter, and microtoise to reach the height of the subject and subject matter. The height and weight of the body used to calculate the needs of food a day. In order to count the DMS, the researcher used the DMS questionnaire, skin fold, and meter indicator. Energy, protein, and calcium intake obtained through food recall for 2 d, which is 1 d before hemodialysis and 1 d after hemodialysis. To reduce the bias in the recall, this is given a photo of the material media food to help reduce the object remembering the food consumed. The researcher asked directly to the patients in order to know their quality of life, and it helped by the enumerator during the hemodialysis. Measure the DMS for an assessment of the status of the patients based on medical history, examination, and physical measurement. DMS is carried out by completing the DMS questionnaire answer regarding changes in weight, changes in diet, gastrointestinal symptoms, functional capacity, physical and physical examinations covering the reduction in the risk of fat and insomnia, the results of which are a minimum score of 7 and a maximum score of 35. Furthermore, DMS assessment carried out twice on the subject of the study, at the beginning and the end of the measurement. Nutritional status interpretation are if the score is 7: Proper nutrition, value 8 to 20: Mild, grade 21 to 34: Moderate, value ≥ 35: Severe malnutrition. The intake of energy categorized as strong if energy is sufficient, which is 35 kcal kg^{-1} IBW. Intake of protein can adequate if the high protein is 1 g kg^{-1} BW d^{-1} to 1.2 gr kg^{-1} BW d^{-1}. Potassium intake and categorized as strong should be as low as 40 mEq d^{-1} to 70 mEq day^{-1} (8 mg kg^{-1} BW d^{-1} to 17 mg kg^{-1} BW d^{-1}). Afterward, bivariate statistical tests using correlation are testing the significance of the relationship or difference with a 95 % confidence level and with $\alpha = 5$ %.

Result

Subject characteristics:

Table 1 shows the age of the research subjects as young as 22 yr and the shortest at 74 yr. The comorbidities of the most substantial study subjects did not know, and most of them were diabetes mellitus. The comorbidities with diabetes mellitus amounted to 13 people. Also, the complications of four people.

Table 1. Frequency distribution of characteristics of patients

Characteristics	n	(%)
Age		
18 yr to 40 yr	13	22.8
> 40 yr	44	77.2
Gender		
Male	32	56.1
Female	25	43.9
Education Level		
Under high school	38	66.7
University/Academy	19	33.3

(continued on next page)

Table 1. Continued

Characteristics	n	(%)
Hemodialysis Duration		
1 yr to 4 yr	49	85.9
> 4 yr	8	14.1
Hemodialysis causes		
Unknown	20	35.1
Comorbidities	33	57.8
Complication	4	7
Nutritional Status		
7 yr to 20 yr	55	96.4
> 20 yr	2	3.6

Table 2. Frequency distribution of the intake of energy, protein, and potassium

Nutrients	Intakes			Needs
	Min	Max	Mean	Average
Energy	722.20	2 588.45	1 414	2 052
Protein	25.90	138.55	55.70	63.37
Potassium	1 401.95	4 159	2 303	990.38

The general of energy and protein intake from the subject is in–adequate except potassium

Table 3. The relation of the intake of energy, protein, and potassium toward the nutritional status

Variable	Nutritional Status				p-value
	Light		Medium		
	n	%	n	%	
Intake					0.242
Adequate	6	10.52	1	1.75	
Inadequate	49	85.96	1	1.75	
The intake of protein					0.035
Adequate	14	24.56	1	1.75	
Inadequate	41	71.92	1	1.75	
The intake of potassium					0.603
Adequate	55	96.49	2	3.50	
Inadequate	0	0	0	0	

Intake of protein is the most related with nutrition status

Discussion

The intake of energy:

Adequate daily energy consumption ensures nitrogen balance and prevents protein catabolism and tissue damage, which can optimize nutritional status and hemodialysis results. However, daily macro–nutrient and micro–nutrient intake is largely inadequate in hemodialysis patients. More than half of hemodialysis patients have problems following healthy dietary guidelines (related to energy and nutritional intake) related to behavior, technical difficulties, physical condition, time and food preparation. Inadequate food intake is also a result of significant lifestyle changes when receiving dialysis treatment [(6)]. Furthermore, this research was in line with Sharif's research [(7)] which states that there is no correlation between energy intake and nutritional status in patients with chronic renal failure with hemodialysis in Wahidin Sudirohusodo Hospital, Makassar, Indonesia. In–adequate energy intake caused by in–adequate intake, metabolic disorders, and hemodialysis processes. Afterward, besides the food intake, nutritional status was also influenced by stress factors, inflammation, drugs that cause dyspepsia, and extended illness [(8)].

Nutrition consumption aims to prevent and treat nutritional deficiencies. However, when nutrition is excessive, the body faces problems controlling nutrient absorption and storage. Excessive nutrition, especially energy absorption and storage, can not only affect health but also cause many diseases such as diabetes, cardiovascular disease, obesity, hypertension, and hyperlipidemia. energy is used for a variety of life activities, especially oxidative phosphorylation for energy supply [9]. Nutritional status assessment based on subjective global assessment (SGA) is highly suggested by the National Kidney Foundation (NKF) Kidney Disease/Dialysis Kidney Results (Q/KDOQI) and Quality for use in nutritional status supported by nutrition, because SGA can help with quality of life HD CRF patients [10]. SGA assessment in patients with CRF HD can be an indicator of nutritional status that is valuable for predicting mortality, besides this assessment presentsna comprehensive report of CRF HD patients from clinical aspects and nutritional problems [11]. The study involving 2 058 HD patients with HD and peritoneal dialysis in Korea stated that the continuity of nutritional assessment at least every six months based on SGA is essential. SGA can provide an assessment of changes in nutritional status of patients related to the incidence of death in patients with end–stage renal failure because SGA has a medical history assessment and physical examination [12].

Food intake, nutritional status assessment, laboratory data are essential determinant factors in determining the nutritional status [13]. In patients with CRF HD who have undergone hemodialysis therapy, the problem of malnutrition can reach 80 %, which has implications for increasing inflammation and ultimately improving the quality of life. These three things are related to each other, which will increase the risk of morbidity and mortality in CRF HD patients [11]. In patients with CRF HD often experience decreased appetite and anorexia nervosa. Anorexia nervosa is most common in HD CRF patients, especially patients who are just starting dialysis therapy because physiological or psychological changes occur in their lives. Good food intake in most CRF HD patients with is difficult to fulfill, the cause is multi–factor, one of which is uremia syndrome in which patients will feel nauseous, vomiting, loss of taste, gastrointestinal disorders. It will cause protein–energy malnutrition that will facilitate the occurrence of chronic and co morbid inflammation [14]. While the better food intake has to do with the better the patient in maintaining nutritional status for HD CRF patients [15]. In this study, energy intake not related to nutritional status based on SGA. This study is in line with research in hospitals in Bengkulu. It is probably due to the low energy intake of the subject [16]. It is in accordance with the theory that in patients with CRF HD almost all patients have experienced in–adequate energy intake, because of anorexia, anorexia almost occurs in 1/3 of patients with HD CRF. It can even reach 2/3 of patients with CRF HD in the first 1 mo to 2 mo of hemodialysis. Enough energy of 30 kcal kg^{-1} BW d^{-1} to 35 kcal kg^{-1} BW d^{-1} is reported to make the use of protein more effective and prevent the use of energy reserves in the body. In patients with CRF HD energy metabolism is damaged and formed from negative energy balance due to cellular energy metabolic disorder. With the availability of energy as needed, there can be a positive nitrogen balance and prevent tissue damage and protein catabolism [17]. Recent studies discuss energy balance in maintenance dialysis patients through 7 d weighed Food record and portable arm ban devices for energy expenditure.

The results revealed that maintenance dialysis patients has a negative energy balance and the risk of malnutrition, thus questioning the risk of previous malnutrition in maintenance dialysis patients. Patients who achieved a dietary energy intake of about 35 kcal kg^{-1} d^{-1} were able to maintain cell mass. On the other hand, the low dietary energy intake group (25 kcal kg^{-1} d^{-1}) had a lower cell mass than the dietary protein intake according to the recommended level which is 1.2 g kg^{-1} d^{-1}. This study discusses the importance of proper dietary energy intake for changes in body composition [18]. Energy intake represents the type and amount of food consumed daily and announced in energy that categorized as less or sufficient after being compared with the needs according to the patient's diet [7]. The number of new chronic kidney disease patients undergoing maintenance dialysis is increasing worldwide. However, the life expectancy of this patient is still much lower than others with unclear causes of death [19]. Malnutrition is a common problem in CKD patients due to metabolic and endocrine disorders that cause poor appetite and weight loss. Recommended for subjective global assessment (SGA) of CKD patients at initial visit and again every three months to determine patient nutritional status. The SGA evaluation shows whether there are changes in nutritional status that occur during the course of the disease so it is important to identify patients who experience nutritional disorders in each stage of CKD or malnutrition [20].

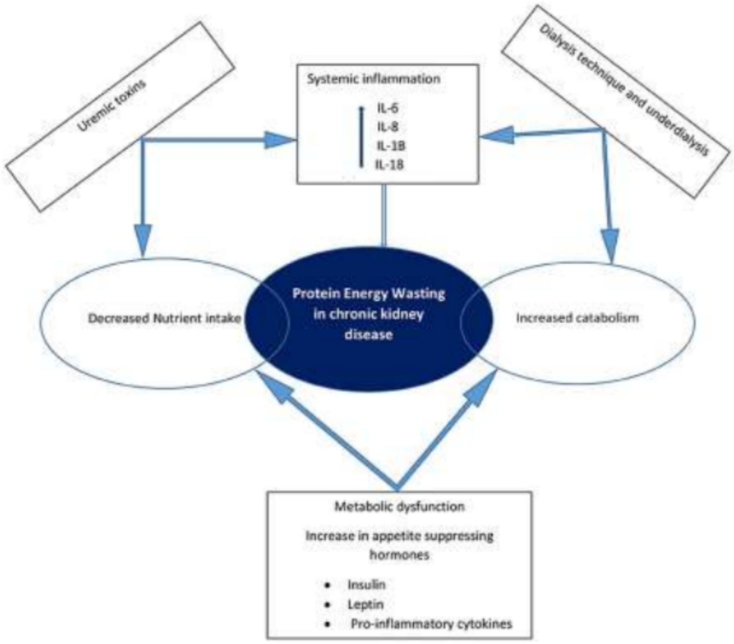

Figure 1. Schematic representation of the reason of protein energy deficiency and pathophysiologic interactions in chronic kidney disease
Source : [21]

Furthermore, the pathogenesis of waste protein energy was complex and multifactorial. Decreased protein and energy intake due to anorexia, increased catabolic protein, decreased anabolism, financial inflammation, metabolic acidosis, and hormonal imbalances that have been supported by wasting protein–energy as an etiological factor. Anorexia was common in patients with CRF and may result from changes in orexigenic (appetite welcoming) hormones and appetite in–hibiting hormones, collecting metabolic products in the body during pregnancy, abnormal taste and using drugs on the tongue. The accumulative impact of yield factors in nutritional intake decreases. The result of chronic inflammatory expenditure in CRF is an increase in resting energy expenditure, which is released by protein catabolism and a decrease in anabolism. Research has shown an increased in energy expenditure between 12 % and 20 % during dialysis, indicating an increased in protein requirements and energy intake in dialysis patients. Catabolic proteins, besides increasing protein loss (mostly amino acids) through dialysis (both hemodialysis and peritoneal dialysis) and decreased albumin synthesis due to negative nitrogen balance and muscle wasting (14.23). In children on peritoneal dialysis, loss of peritoneal protein can be significant and contribute to the development of protein malnutrition and growth disorders. Younger children also support the inverse correlation between body surface area and peritoneal protein loss in children on peritoneal dialysis regarding more considerable lack of protein. This loss was very high during episodes of peritonitis. While adequate protein intake is essential for children with CRF to avoid negative nitrogen balance and help preserve muscle mass, this in itself may be inadequate in avoiding wasting protein energy. In this case, licensing requirements were also needed. Kidney National Foundation for quality kidney disease (KDOQI) must maintain food protein intake (DPI) in 100 % up to 140 % of reference food intake (DRI) for ideal body weight in children with 3 CRF and at 100 up to 120 % DRI in children with CRF mount 4 to 5. In children with CRF mount 5D, it shows to maintain DPI at 100 % of DRI for ideal body weight plus allowances for dialytic proteins and amino acids. The KDOQ in table 3. Energy requirements for children with CRF level 2 to 5 and those approved for 100 % of the estimated energy needed for chronological age [21].

Protein intake:

Patients with chronic kidney disease with hemodialysis are advised to consume high protein to maintain nitrogen balance and replace amino acids lost during the hemodialysis process, which is 1 g kg^{-1} BW d^{-1} to

1.2 g kg^{-1} BW d^{-1} with 50 % protein should be of high biological value because protein intake is essential considering its function in the body [(20)]. The effect of protein intake plays a vital role in overcoming nutrition in patients with chronic renal failure because the accumulation of body protein catabolism causes the symptoms of the uremic syndrome, therefore the better the intake of protein the better in maintaining nutritional status [(20)]. According to Bellizi *et al*. [(22)], based on a clinical study that showed HD patients who used energy and protein below the threshold value, namely protein intake below 0.8 g kg^{-1} BW d^{-1} and energy intake below 25 kcal kg^{-1} BW d^{-1} cannot maintain neutral nitrogen balance. Pranawa [(18)] also states that protein intake < 0.8 g kg^{-1} BW d^{-1} can increase the risk of morbidity and mortality. Patients in chronic hemodialysis are at risk for malnutrition. Risk factors for the incidence of malnutrition in these patients, including protein and energy intake, the same as inflammation. Because malnutrition and low protein intake are related with an elevated risk of morbidity and mortality, so monitoring protein intake and nutritional status in chronic hemodialysis patients are essential [(23)]. Then, protein disorders at the time of dialysis generally caused by a combination of protein and energy deficiency known as uremic malnutrition. Approximately 20 % to 50 % of dialysis patients canceled by loss of somatic protein characterized by muscle mass and serum creatinine, and visceral protein concentrations characterized by serum albumin and prealbumin concentrations [(24)]. The loss of protein through urine and loss of amino acids during a dialysis session also play a role. Metabolic acidosis is an essential factor that plays a significant role in negative nitrogen balance and total body protein in chronic renal failure [(25)]. The results of this study are in accordance with the results of Sari research [(26)], which concluded that there was a significant relationship between protein intake and nutritional status (SGA). Then that protein intake was related to nutritional status based on SGA because, in SGA it assessed the loss of body weight. One of the many wasted nutrients. When hemodialysis is protein. When amino acid hemodialysis wasted by 1 g d^{-1} to 2 g d^{-1} of dialysis or it estimated that 10 g to 12 g of protein would be lost every hemodialysis, so the need for 1 g kg^{-1} to 1.2 g kg^{-1} of BW d^{-1} is expected to replace the lost protein and get better from animal protein because the amino acids obtained are complete. The protein intake that adequate of 1.2 g kg^{-1} BW d^{-1} was expected to maintain nitrogen balance and loss during the dialysis process. In the process of amino acid hemodialysis will be wasted by 1 g d^{-1} to 2 g d^{-1} of dialysis, so patients with CRF HD must meet the protein requirements of high protein food intake. Protein intake can be influenced by low protein consumption in the diet, lack of food intake, effects of the weak immune system, dialysis process. The effect of protein intake plays a vital role in overcoming nutrition in patients with chronic renal failure because of the symptoms of the uremic syndrome caused by a build–up of protein catabolism in the body. Therefore, the better protein intake, the better in maintaining nutritional status [(27)].

Potassium intake:

Excess potassium in hemodialysis patients would make the result in hyperkalemia and hypokalemia in patients with renal failure before hemodialysis due to disturbances in electrolyte balance caused by fluid depletion. It was in accordance with the theory which explains that if there was a severe decrease in glomerular filtration rate, there would be complications in the form of metabolic acidosis and electrolyte balance disorders in the form of hyperkalemia and hypokalemia. Kidney failure that is at a more severe stage, the tubule can no longer exchange K^{+} / H^{+} for Na^{+} causing severe hyperkalemia which can later trigger cardiac arrest. Kidney failure that is at a more severe stage, the tubule can no longer exchange K^{+} / H^{+} for Na^{+} causing severe hyperkalemia which can later trigger cardiac arrest [(28)]. The results of this study were not in line with the research of Sari [(26)], whose statistical results showed that there was an association between potassium intake and nutritional status based on SGA. In patients with CRF HD, the condition of the body often changes, the condition of nausea, vomiting, diarrhea, and the use of diuretics can cause hypokalemia. So, CRF HD patients should indeed monitor their food intake once a month in malnourished patients, or at least 3 mo in stable patients [(10)]. In a 3 yr cohort study, involving hemodialysis patients and CAPD, the CAPD group was 3.3 times lower serum potassium level < 4.0 mEq L^{-1} and the risk of death was 51 %, and 52 % in those who had serum potassium levels < 3.5 mEq L^{-1} or 5.5 mEq L^{-1}, so that the levels of hypokalemia and hyperkalemia are equally dangerous in dialysis patients. An adequate range of potassium intake is 4.6 mEq L^{-1} to 5.5 mEq L^{-1}, if < 3.5 mEq L^{-1} or > 5.5 mEq L^{-1} is associated with increased mortality [(29)]. Patients with kidney failure limitation of potassium were essential to prevent the occurrence of potassium excretion since there was a disruption in kidney function that cannot excrete potassium through urine resulting in hyperkalemia. Potassium intake gave from 1 560 mg d^{-1} to 2 730 mg d^{-1}. High potassium food ingredients in fruit tubers, avocados, Ambon bananas, mangoes, tomatoes, bamboo shoots, cassava leaves, papaya leaves, spinach, peanuts, green beans and soybeans [(20)]. Normal blood potassium levels were 3.5 mEq L^{-1} to 5.0 mEq L^{-1} and low levels < 2.5 mEq L^{-1} while blood potassium levels are high > 7.0 mEq L^{-1}. Then, if the blood potassium concentration was too low, it caused by a kidney that was not functioning normally or too much potassium was lost through the digestive tract (due to diarrhea, vomiting). When kidney function decreases, the ability to maintain serum potassium in a normal range is physiologically threatened. One of the many roles for dialysis treatment is to regulate serum and potassium levels in the body. Indeed in long-term HD patients, hyperkalemia has been associated with higher mortality. Therefore, people with CKD are advised to consume less than 1 500 mg (< 76 mmoL) of potassium d^{-1} [19]. Normal blood potassium levels were 3.5 mEq L^{-1} to 5.0 mEq L^{-1} and low levels < 2.5 mEq L^{-1} while blood potassium levels are high > 7.0 mEq L^{-1}. Then, if the blood potassium concentration was too low, it caused by a kidney that was not functioning normally or too much potassium was lost through the digestive tract (due to diarrhea, vomiting).

Mechanism of potassium for hemodialysis:

Potassium plays a variety of roles in the maintenance of the body from potential resting membranes and neuromuscular functions, intracellular acid–base balance, water balance, maintenance of cell volume, cell growth, DNA and protein synthesis, and enzymatic functions. Daily potassium intake was estimated to range from 50 mmoL to 100 mmoL, of which 90 % of potassium intake excreted by the kidneys and the remainder by the large intestine. Then it was entirely excreted by the kidneys in 6 h to 12 h. Therefore the short–term maintenance of potassium concentrations depends on the extra–kidney mechanism that can respond in minutes. May majority in the body located in the intracellular compartment. Many factors influence the intake of potassium in the body. Factors that stimulated the potassium were the shifting from extracellular fluid to intracellular fluid compartments, including insulin release, catecholamine's, metabolic alkalosis, and anabolic. The reverse process occurs in mineral acidosis, hyperosmolarity, non–selective beta–blockade used, and Alpha–1 Stimulation. Potassium filtered in the glomerulus, and proximal tubules reabsorb about 65 % of the filtered load. Potassium secreted into the urine. Factors affecting kidney potassium excretion include; distal sodium delivery colonies, activation of the renin–angiotensin–aldosterone system, vasopressin status, food potassium intake, acid–base status, distal urine urinary flow, and serum potassium concentration. Then, the secretion of potassium into the distal lumen of the colonies was passive and passive movement of this depending on the gradient in the luminal membrane, negative lumen electrical gradient (mainly produced by sodium reabsorption) in favor of secretion, and luminal membrane permeability to potassium. Aldosterone plays an essential role in the regulation of potassium homeostasis. Aldosterone binds to mineralocorticoid receptors in the distal tubule and cells in the cortical collecting duct. There is a cellular level. Aldosterone opens a channel increasing potassium and ATPase activity in the basolateral membrane, which increases potassium secretion. The primary stimulation for aldosterone secretion is angiotensin II and elevation in serum potassium. Aldosterone also affects extra–kidney, and potassium secreted through the increased colon and salivary secretions [13].

Conclusions

This research concluded that there was a significant relationship between protein intake and nutritional status based on SGA, and there is no significant relationship between energy intake and potassium with SGA.

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