Relationship Between 7-Point Subjective Global Assessment With Phase Angle And Quality Of Life In Chronic Kidney Disease Patients With Regular Hemodialysis

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Background: Malnutrition in regular hemodialysis patients is a frequent clinical manifestation and as an independent factor in worsening quality of life and mortality. *7-point Subjective Global Assessment* (SGA) is a simple nutritional status assessment method, cheap and effective in patients with hemodialysis. BIA phase angle examination is an examination of modern body composition and is widely used as a predictor of nutritional status and mortality of chronic kidney disease (CKD) with regular hemodialysis.

Target: To determine the 7-point SGA relationship with quality of life and phase angle value (PhA) at BIA in patients with chronic kidney disease with regular hemodialysis.

Method: Cross sectional study was analytic with 52 subjects of CKD patients with regular hemodialysis 2 times per week. Nutritional status was assessed with a 7-point SGA score, quality of life with Short Form-36 (SF-36), and BIA examination after hemodialysis process.

Result: From the results of the examination, 34 people (65.4%) suffered from malnutrition. There is a significant relationship between 7-point SGA and PhA (r=0,717; p<0,001). Severe malnutrition has *cut-off* PhA ≤ 4,43^0 with 100% sensitivity and specificity 78,3% (AUC=0,946; p<0,001), whereas malnutrition has *cut-off* ≤ 5,54^0 with sensitivity 85,3% and specificity 77,8% (AUC=0,886; p<0,001). There is a strong relationship between 7-point SGA and SF-36 physical health (r=0,480; p<0,001), but the SF-36 mental health is not strong even though it remains significant (r=0,331; p=<0,05).

Conclusion: 7-point SGA score is a significant predictor of PhA and the quality of life of CKD patients with regular hemodialysis. Seeing the impact of malnutrition can reduce the value of PhA and quality of life, using regular 7-point SGA is expected to help reduce morbidity and mortality.

Keywords: Malnutrition, 7-point SGA, phase angle, quality of life..

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INTRODUCTION

1.1. Background

The final morbidity and mortality rate of patients with chronic kidney disease (CKD) undergoing hemodialysis is still high, about 15-20 percent per year, although improvements have been made in the management of cardiovascular disease, infections and dialysis therapy (USRDS, 2010). Several independent factors have been known as predictors of this fact, among which the most important are malnutrition and decreased muscle mass (Lowrie and Lew, 1990).

Malnutrition is a clinical manifestation that often occurs in hemodialysis patients. Several studies have found that 20-80% of hemodialysis patients are malnourished (Anees, 2004; Herselman et al., 2000). The cause of this nutritional status disorder is multifactorial, including due to lack of intake, the process of uremia that occurs, maldigesti and malabsorption and the hemodialysis procedure itself. Malnutrition is characterized by changes in the integrity of cell membranes and disruption of fluid balance, so that measurement of body composition is the most important part in assessing the nutritional status of hemodialysis patients. Knowing and overcoming these nutritional problems in a timely manner can improve the patient's prognosis, for example by helping patients gain normal weight, improve therapeutic response and reduce therapeutic complications. By knowing and overcoming malnutrition at the beginning of undergoing hemodialysis therapy is very important to achieve good results so that the quality of life of patients becomes good too (Oliviera et al., 2010).

But this is still a challenge for clinicians because the nutritional status of CKD patients with regular hemodialysis is influenced by the etiology of kidney disease itself and the hemodialysis process so that it is difficult to determine standards in measuring nutritional status. Methods for assessing nutritional status, including with Subjective Global Assessment (SGA),Malnutrition Universal Screening Tool, Mini Nutritional Assessment, Nutritional Risk Screening (NRS) 2002, anthropometric measurements and laboratory parameters such as transferrin and albumin and modern measurements with Dual X-ray Absorbtiometry (DEXA), Magnetic Resonance Imaging (MRI) and bioelectrical impedance analysis (BIA) (Oliviera et al., 2010; Abad et al., 2011).

SGA is a clinical assessment of nutritional status that is fast, easy to use and inexpensive, widely used especially

in surgical patients, cancer patients and CKD (Makhija, 2008). The SGA assessment itself has several modifications, including the original SGA, 7-point SGA and Patient-Generated SGA (PG-SGA), the Malnutrition Inflammation Score (MIS), Dialysis Maintenance Score (DMS), but currently the 7-point SGA recommended by KDOQI in 2000 until recently.

Quality of Life Short Form-36 (SF-36) has been widely used to evaluate the quality of life in chronic diseases including end-stage kidney disease. SF-36 is an assessment of quality of life with a score system that includes 36 questions with 8 scales, namely (1) physical function, (2) limitations due to physical problems, (3) pain / pain, (4) general health, (5) vitality , (6) social function, (7) limitations due to emotional problems, and (8) mental health. Then each scale was concluded into two dimensions, namely the dimensions of physical health and mental health dimensions. SF-36 is given a score of 0 to 100, where a higher score indicates a better quality of life (Mingardi et al., 1999; Zadeh et al., 2001).

Recently a tool has been introduced to assess various body composition and nutritional status, namely bioelectrical impedance analysis (BIA), which can detect early changes in cell membrane and fluid imbalances that can precede various measurement methods. BIA is a tool that is easy to use, non-invasive, can be done repeatedly and does not depend on operators with a low error rate so that results can be trusted to measure nutritional status in patients undergoing regular dialysis (Saxena et al., 2008) .

One of the parameters that can be assessed from this BIA examination is the phase angle (PhA). Phase angle describes the distribution of fluid (resistance) and the integrity of the cell membrane (capacitance) of the human body. As an indicator of fluid distribution between intracellular and extracellular, phase angle is a sensitive indicator of malnutrition (Bernard et al., 2007). Malnutrition can reduce the mass and integrity of cell membranes and encourage the transfer of fluid balance, so that the phase angle value will be low. Phase angle is also used as a prognostic sign in some situations where cell integrity and fluid balance are impaired, such as HIV infection, cancer, liver cirrhosis, pregnant women, sepsis and hemodialysis (Oliviera et al., 2012; Saxena et al., 2008).

In Indonesia there has been no research that looks for the relationship between phase angle values in BIA and quality of life using SF-36 with 7-point Subjective Global Assessment (SGA) which is one method of measuring nutritional status, so researchers try to prove that relationship can ultimately improve prognosis and improve the quality of life of hemodialysis patients.

LITERATURE REVIEW

2.1 Chronic Kidney Disease
2.1.1 Definition of Chronic Kidney Disease (Suwitra, 2009)
Chronic kidney disease is a pathophysiology process with a variety of etiologies, resulting in progressive decline in kidney function, which generally ends with kidney failure. While kidney failure is a clinical condition characterized by irreversible decline in kidney function, which will require permanent kidney replacement therapy in the form of dialysis or kidney transplantation. PGK criteria can be seen in table 1.

Table 2.1 Criteria for Chronic Kidney Disease

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1. Kidney damage that occurs> 3 months, in the form of structural or functional abnormalities, with or without a decrease in glomerular filtration rate (LFG), with manifestations:
    a. pathological abnormalities
    b. there are signs of kidney abnormalities, including abnormalities in the composition of blood or urine, or abnormalities in imaging tests
2. LFG <60 ml / minute / 1.73m² for 3 months, with or without kidney damage.

2.1.2 Classification of Chronic Kidney Disease (Suwitra, 2009)

CKD is classified on two things, based on the degree of disease and on the basis of a diagnosis of etiology. Classification based on the degree of disease, is made on the basis of LFG, which is calculated using the Kockcroft-Gault formula as follows:

$$LFG (ml/mnt/1,73m^2) = \frac{(140 \text{ age}) \times \text{body weight }*)}{72 \times \text{plasma creatinine (mg/dl)}}$$

*) in women multiplied 0,85

The classification is shown in table 2.

Table 2.2 Classification of Chronic Kidney Disease on Basic Degree of Disease

Degrees (ml/mnt/1,73m²)	Explanation	LFG
1	Kidney damage with normal LFG or ↑	≥90
2	Kidney damage with LFG ↓ light	60-89
3	Kidney damage with LFG ↓ medium	30-59
4	Kidney damage with LFG ↓ weight	15-29
5	Kidney failure	<15 or dialy-sis

2.1.3 Management of Chronic Kidney Disease (Suwitra, 2009)

CKD management includes:

a. Specific therapy for the underlying disease

b. Prevention and therapy of comorbid conditions

c. Slow the deterioration of kidney function

d. Prevention and therapy for cardiovascular disease

e. Prevention and therapy for complications

f. Renal Replacement Therapy

Renal Replacement Therapy is needed in patients with CKD at the terminal stage, when LFG <15 ml/mnt/1,73m², where the kidneys cannot compensate for the body's need to remove metabolic waste products released through urinary discharge, regulate acid-base balance and fluid balance and maintain inner environmental stability (Suharjono and Susalit, 2009).

The goal of renal replacement therapy is to maintain life, improve quality of life so that patients can engage in activities as usual and prepare kidney transplants whenever possible. ' There are currently 2 options for renal replacement therapy: dialysis and kidney transplant. There are 2 dialysis methods namely hemodialysis and peritoneal dialysis (Suwitra, 2009).

2.2 Hemodialysis

Hemodialysis is one of the renal replacement therapy is the most preferred by the terminal stage CKD patients. In a hemodialysis process, the patient's blood is pumped by the machine into the blood compartment on the dialyzer. Dialyzer contains thousands of synthetic fibers with small holes in the middle. Blood flows in the fiber hole while the dialysate flows outside the fiber, while the fiber wall acts as a semipermeable membrane where the ultrafiltration process occurs. Ultrafiltration occurs by increasing the hydrostatic pressure across the dialyzer membrane by applying negative pressure into the dialysate compartment which causes water and dissolved substances to move from the blood into the dialysate liquid for further disposal (Suharjono and Susalit, 2009).
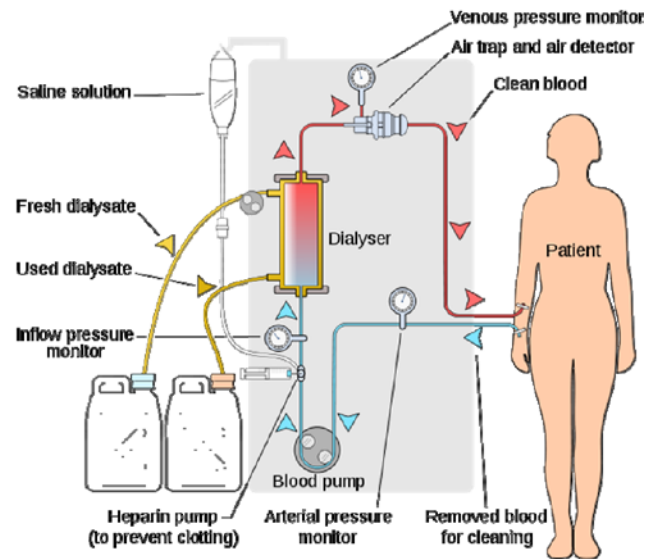
Figure 2.1 Hemodialysis process

2.2.1 Hemodialysis indication (Suharjono and Susalit, 2009)

In general, indications of doing HD in patients with terminal stage CKD are if LFG <5 mL/minute. Patient condition with LFG <5mL/minute is not always the same, so that dialysis is considered new needs to be started when it has happened:

volume overload

a. Bad general condition and real clinical symptoms
b. Serum potassium >6 mEq/L
c. Blood urea > 200 mg/dL
d. Blood pH < 7,1
e. Anuria is prolonged (>5 days)

2.2.2 Malnutrition in Hemodialysis

Malnutrition is a condition of reduced body nutrition, or a condition of limited functional capacity caused by an imbalance between intake and nutritional needs, which ultimately causes metabolic disorders, decreased tissue function, and loss of body mass.

Late stage of CKD patients who are hemodialysis are at risk of malnutrition due to several factors related to decreased kidney function. These include nausea, anorexia, changes in taste, weakness and dietary restrictions (Lavile and Fuoque, 2000). Nutritional status and functional ability can also be affected by anemia, metabolic acidosis and inadequate dialysis, this can be detected using measurements of hemoglobin, ferritin and urea reduction ratio (URR).

Research has shown the incidence of malnutrition by 20% to 80% in hemodialysis patients (Annes, 2004; Herselman et al., 2000). de Mutsert et al. (2009), who examined 1,601 hemodialysis patients found 28% of hemodialysis patients were malnourished using 7-point SGA, but it should be considered that research in developing countries showed a higher percentage. Patients undergoing hemodialysis have a high risk of malutrients, strict supervision of nutritional status is needed to facilitate nutritional therapy. The high incidence of malnutrition in hemodialysis has shown a strong correlation with morbidity and mortality (CANUSA, 1996; Herselman et al., 2000; Johansen et al., 2003).

Several studies (Asfar et al., 2006; Blondin and Ryan, 1999; Faintuch et al., 2006; Dwyer et al., 1998; Herselman et al., 2000) examined what methods best identify malnutrition in CKD undergoing hemodialysis. , these methods include SGA, anthropometry, laboratories, BIA, magnetic resonance imaging (MRI) and dual-energy X-ray absorptiometry (DEXA). Prospective data show that a high body mass index can predict a decrease in morbidity and mortality in a hemodialysis population (Zadeh et al., 2005), but recent evidence indicates that weight loss and decreased appetite are important precipitating factors for malnutrition and independent predictors. in the progression of CKD (Burrowes et al., 2005; de Mutsert et al., 2006). Therefore, despite an increase in overweight and obese populations, there is insufficient evidence to support the need for consistent nutritional

assessment methods to detect symptoms that lead to unintentional weight loss, decreased body mass, and a diagnosis of malnutrition.

MRI and DEXA have very good validity and can be applied, but daily use is limited due to costs, facilities and time. BIA is cheaper and more suitable for patients, but there are doubts in measuring patients with excess fluid and not all hemodialysis installations have BIA (Faintuch et al., 2006). On the other hand, SGA is faster and easier to do and not expensive, this is also recommended by the Kidney Disease Outcomes Quality Initiative (KDOQI) (2000), as a method for assessing nutrition in the CKD population at the final stage routinely.

2.3   Subjective Global Assessment (SGA)

Subjective Global Assessment was first described by Detsky et al, 1984. Used to assess malnutrition in patients, without requiring complete body composition analysis. The components of the physical examination evaluated were loss of subcutaneous and muscular fat, central and peripheral edema. Anamnesis components include changes in body weight in six months and the last two weeks, dietary intake, gastrointestinal symptoms in the past two weeks, as well as functional capacity (Detsky et al., 1984).

The original SGA was originally divided into 3 parts with scores A, B and C (A - good nutrition, B – malnutrition Light medium,C - severe malnutrition). However KDOQI recommends the use of 7-point SGA as a valid and useful clinical measurement in determining nutritional status in patients with regular dialysis. The 7-point SGA measurement is essentially the same as the original SGA but the measured component is reduced to 4 components, namely changes in body weight and gastrointestinal symptoms as a component of medical history with a value of 60%, then evaluation of subcutaneous fat and muscle evaluation as a component of physical examination with a value of 40 %, this is because the original SGA has a bias in food intake, functional capacity, fluid accumulation status when used in late stage CKD patients. The assessment is further deepened into 7 assessment sections where a score of 6/7 is said to be good nutrition, 3/4/5 is said to be mild to moderate malnutrition, and 1/2 is said to be severe malnutrition (CANUSA, 1996; Visser et al., 1999).

7-point SGA is associated with several other nutritional markers such as BMI, body fat percentage, and mid arm muscle circumference (MAMC) and is more sensitive in detecting small variations in nutritional status and more having a strong predictive factor for morbidity, mortality or various clinical results compared to original SGA in CKD patients with peritoneal dialysis and hemodialysis (CANUSA, 1996; Visser et al., 1999; Steiber et al., 2007). In a prospective, multicenter study conducted by de Mutsert et al (2009), a 7-point SGA score in moderate malnutrition had a Hazard Ratio (HR) 1.6 (CI: 1.3-1.9) and severe malnutrition score has HR 2.1 (CI: 1.7-2.5). The HR value is higher if it is connected dependent on time.

Table 2.3 The SGA assessment component, the SGA calculation recommended by KDOQI, consists of 4 components (attached to the table with italics)

SUBJECTIVE GLOBAL ASSESSMENT RATING FORM	
Patient Name: **ID #:** **Date:**	
HISTORY	

WEIGHT/WEIGHT CHANGE: *(Included in K/DOQI SGA)*
1.   **Baseline Wt:**   _____(Dry weight from 6 months ago)
     Current Wt: _____(Dry weight today)
     Actual Wt loss/past 6 mo: _____ **% loss:**_____(actual loss from baseline or last SGA)
2.   **Weight change over past two weeks:** _____No change _____Increase _____Decrease
	Rate 1-7

DIETARY INTAKE No Change_____(Adequate) No Change_____(Inadequate) 1. Change: Sub optimal Intake: _____ Protein _____ Kcal _____ Duration_____ Full Liquid: _____ Hypocaloric Liquid _____ Starvation _____	

GASTROINTESTINAL SYMPTOMS *(Included in K/DOQI SGA-anorexia or causes of anorexia)*
 	
  Symptom: **Frequency:**[*]   **Duration:**[+]
  _____ None   _____   _____
  _____ Anorexia   _____   _____
  _____ Nausea   _____   _____
  _____ Vomiting   _____   _____
  _____ Diarrhea   _____   _____
         Never, daily, 2-3 times/wk, 1-2 times/wk > 2 weeks, < 2 weeks	

FUNCTIONAL CAPACITY
  Description   **Duration:**
  _____ No Dysfunction   _____
  _____ Change in function   _____
  _____ Difficulty with ambulation   _____
  _____ Difficulty with activity (Patient specific "normal") _____
  _____ Light activity   _____
  _____ Bed/chair ridden with little or no activity _____
  _____ Improvement in function   _____
	b

DISEASE STATE/COMORBIDITIES AS RELATED TO NUTRITIONAL NEEDS Primary Diagnosis_____Comorbidities_____ Normal requirements ____Increased requirements____ Decreased requirements _____ Acute Metabolic Stress: _____None _____Low _____Moderate _____High	
PHYSICAL EXAM	

_____ Loss of subcutaneous fat (Below eye, triceps,   ____Some areas _____All areas
     biceps, chest) *(Included in K/DOQI SGA)*
_____ Muscle wasting (Temple, clavicle, scapula, ribs,   ____Some areas _____All areas
     quadriceps, calf, knee, interosseous *(Included in K/DOQI SGA)*
_____ Edema (Related to undernutrition/use to evaluate weight change)	

OVERALL SGA RATING	
Very mild risk to well-nourished=6 or 7 most categories or significant, continued improvement. **Mild-moderate** = 3, 4, or 5 ratings. No clear sign of normal status or severe malnutrition. **Severely Malnourished** = 1 or 2 ratings in most categories/significant physical signs of malnutrition.	

2.4   Quality of Life

SF-36 is a non-specific instrument that is usually used in almost all chronic disease studies and can also be used to assess the quality of life in a healthy population. SF-36 has been proven to be used to assess the quality of life of patients with chronic diseases including hemodialysis patients (Mingardi et al., 1999; Zadeh et al., 2001).

SF-36 contains 36 questions consisting of 8 scales, among others (John et al, 1998):

a.   Physical Functioning

It consists of 10 questions that assess the ability of activities such as walking, climbing stairs, bending, lifting, and exercise. Low values indicate the limitations of all these activities, while high scores indicate the ability to do all physical activities including heavy exercise.

b.   Limitations due to physical problems (Role of Physical)

It consists of 4 questions that evaluate how much physical health interferes with work and other daily activities. Low scores indicate that physical health causes problems with daily activities, including not being able to do it perfectly, limited in carrying out certain activities or difficulties in carrying out activities. High scores indicate physical health which does not cause problems with work or daily activities.

c.   Bodily Pain

It consists of 2 questions that evaluate the intensity of pain and the effect of pain on normal work both inside and outside the home. Low scores indicate very severe pain and severely restrict activities. High scores indicate no limitations caused by pain.

d.   Public health perception (General Health)

It consists of 5 questions that evaluate health including current health, predictions about health and resistance to disease. Low scores indicate feelings of deteriorating self-health. High scores indicate a very good perception of one's own health.

e.   Vitality

It consists of 4 questions that evaluate the level of fatigue and lethargic. Low scores indicate feeling tired,, and lethargic in all the time. High scores show a feeling of enthusiasm and energy.

f.   Social Functioning

It consists of 2 questions that evaluate the level of physical health or emotional problems that interfere with normal social activities. Low values indicate frequent disturbances. High values indicate no interference.

g.   Limitations due to emotional problems (Role Emotional)

It consists of 3 questions that evaluate the degree to which emotional problems interfere with work or other daily activities. Low scores indicate emotional problems interfering with activities including decreasing time spent on activities, work being less than perfect, and not even working as usual. High scores indicate no activity disruption due to emotional problems.

h.   Mental Health

It consists of 5 questions that evaluate general mental health including depression, anxiety, and emotional control habits. Low scores indicate feelings of tension and depression all the time. High grades indicate a feeling of calm, happiness, and peace.

The SF-36 scale is then divided into two dimensions, where the perception of general health, energy, social function, and limitations due to emotional problems is referred to as the "Mental Component Scale" dimension, while physical function, limitations due to physical problems, pain, perception of general health and energy is referred to as the "Physical Component Scale" dimension. Each scale is rated 0-100, where a higher score indicates a better quality of life.

2.5   Bioelectrical Impedance Analysis

That BIA was discovered in the early 1960s, is a portable tool that is easy to use, not invasive, not operator dependent with high accuracy.

There are several terms used in BIA namely impedance, resistance (R) and capacitance (Xc). Impedance is a term used to describe a combination of resistance and capacitance. Resistance is the resistance of the frequency of electric current produced by intracellular fluid and extracellular while capacitance is the resistance of the frequency of electric current produced by cell tissues and membranes. Resistance and capacitance are directly proportional to the length of the network and inversely proportional to the thickness of the body tissue (Kyle et al., 2004a; Liedtke, 1997; Saxena and Sharma, 2008).

The BIA principle is to measure changes in the electrical current of body tissues based on the assumption that body tissue is an ionic cylinder conductor where extracellular and intracellular free fat functions as resistors and capacitors. Electric current in the body is an ionic type and is related to the number of ions free of salt, base and acid and with medium concentration, mobility and temperature. The network consists of mostly water and electrolytes which are good electrical conductors, while fat and bone are poor electrical conductors (Kyle et al., 2004a; Liedtke, 1997).

RESEARCH METHODOLOGY

1.2.   Research design
Observational research with analytic cross-sectional types.
1.3.   Place and time
3.2.1   Place
The study was conducted in the hemodialysis unit of Haji Adam Malik Hospital in Medan.
3.2.2   Time
Sampling was conducted from the period of December 2013 until the number of samples met.
1.4.   Research subject
CKD sufferers with hemodialysis at the Haji Adam Malik Hospital Medan starting in December 2013 until the number of samples met.
1.5.   Research Criteria
3.4.1   Inclusion Criteria
CKD patients with hemodialysis, regularly undergo hemodialysis 2 times per week for ≥ 3 months, aged ≥ 18 years.
3.4.2   Exclusion Criteria
Patients who are unwilling to be examined, hemodialysis is irregular and there is an artificial venous artery fistula in both hands.

1.6.   Population and Sample
3.5.1   Population
CKD sufferers with hemodialysis at Haji Adam Malik Hospital Medan.

3.5.2   Sample
CKD sufferers with hemodialysis that fits the criteria of a large sample.

Sample size

$$n \geq \frac{\left(Z_{(1-\alpha/2)} \sqrt{P_o(1-P_o)} + Z_{(1-\beta)}\right)\sqrt{P_a(1-P_a)}\,\right)^2}{\left(P_o - P_a\right)^2}$$

Where:

$Z_{(1-\alpha/2)}$ = alpha standard deviates. for α = 0,05 then the normal default value is   1,96

$Z_{(1-\beta)}$ =   standard deviate beta. for β = 0,10 then the normal default value is   1,282

P_0 = estimated proportion of CKD with hemodialysis 0,029

P_a =   estimated proportion of CKD with hemodialis studied is = 0,129

$P_0 - P_0$ = the significant proportion difference set is 0,10

So the minimum sample for this study is 50 people.

3.6.   Research Materials and Procedures
a.   All research subjects were asked for approval to participate in the study.
b.   Recorded name, age, sex, body weight and height, length of hemodialysis, etiology of CKD and measurement of BMI. The data obtained is matched with the medical record.
c.   Nutritional status is checked with 7-point SGA.
d.   Quality of life was assessed using SF-36 form.
e.   BIA examination to get phase angle values and nutritional status parameters.
f.   Laboratory tests are hemoglobin, urea and creatinine.

3.7.   Sample Identification
3.7.1   Independent variables: *7-point* SGA
3.7.2   Dependent variables: quality of life is measured by SF-36 and phase angle and nutritional status parameters is measured by BIA.

3.8.   Research Ethics
Ethical Clearance (permission to conduct research) is obtained from the health research committee of the Faculty of Medicine, University of North Sumatra which was signed by Prof. Dr. Sutomo Kasiman, Sp. PP-KKV, Sp. JP (K) on December 9, 2013 with number 518 / KOMET / FK USU / 2013. Written informed consent from research subjects who are willing to participate.

3.9.   Operational definition
Chronic Kidney Disease (CKD) is end-stage chronic kidney disease based on data from medical records that have a glomerular filtration song <15ml / min / 1.73m2 for ≥ 3 months.
Regular hemodialysis is a kidney disease patient undergoing hemodialysis 2 times per week for ≥ 3 months.
Subjective Global Assessment (SGA) is a subjective assessment to assess nutritional status, a combination of subjective and objective data assessed by the CANUSA form, 1996.
Short Form-36 (SF-36)) is a non-specific instrument used to assess the quality of life of patients with chronic diseases including chronic kidney disease with hemodialysis.
Bioelectrical impedance analysis (BIA) is a tool for measuring body composition parameters with the principle of changing the electrical current of body tissue based on the assumption that body tissue is an ionic cylinder conductor where extracellular and intracellular free fat functions as resistors and capacitors.
Phase Angle **(PhA)** is a measurement method that is linearly related to resistance and reactants in series and parallel circuits.
Body Mass Index (BMI) is severebody mass in kg divided by height in meters.

Free Fat Mass (FFM) is all that is not body fat which is a combination of Body Cell Mass and Extracellular Mass.

Fat Mass (FM) is the actual severebody reduced by FFM.

Body Cell Mass (BCM) is defined as intracellular mass in the body, which mainly contains body potassium (98-99%).

RESEARCH RESULTS

4.1 Research results

4.1.1 Characteristics of Research Subjects

During the study period in the Hemodialysis Installation Room, H. Adam Malik General Hospital Medan obtained 52 research subjects with a diagnosis of end-stage kidney disease with regular hemodialysis who were willing to participate in the study and had an examination of BIA. Subjects were male sex as many as 37 patients (71.2%) and female sex as many as 15 patients (28.8%) and the age range between 21 - 66 years with a mean ± Primary School was 46.12 ± 10.62 years. The mean height was 163.49 ± 6.45 cm and the mean body weight was 57.26 ± 10.57 kg with a mean IMT of 21.33 ± 3.22 kg / m2. In laboratory parameters with mean Hb 8.92 ± 1.26 gr / dL, mean Ureum 136.21 ± 38.06 mg / dL and mean creatinine 13.42 ± 4.23 mg / dL. The mean duration of hemodialysis was 104.96 ± 90.86 weeks and the etiology of chronic kidney disease consisted of DM 12 patients (76.9%) and non DM 40 patients (23.1%) (Table 4.1).

For the nutritional score parameters with 7-Point SGA obtained mean 4.77 ± 1.41 with a classification of malnutrition weight as many as 6 people (11.5%), moderate malnutrition as many as 28 patients (53.8%) and good nutrition as many as 18 people (34.6%). In the quality of life parameters obtained SF-36 physical mean 51.99 ± 9.89% and mental SF-36 mean 58.46 ± 9.40%. The mean of PhA from BIA examination was 5.15 ± 1.29 0. (Table 4.1).

Among the parameters studied, it was found that 7-Point SGA,% FFM,% FM and the duration of hemodialysis were not normally distributed using the Kologorov-Smirnov normality test, other parameters were normally distributed.

4.1.2. Overview of nutritional status based on gender

In table 4.2 can be seen the picture of nutritional status in the research subject divided by gender. For the variables that are normally distributed, one way ANOVA test is used, while the variables that are not normally distributed are used by the Kruskal-Wallis test. There were significant differences in the parameters of IMT, creatinine, and BIA parameters except% FFM and% FM which were not significantly different between male and female.

Table 4.1 Basic characteristics of research subjects

VariablE	Total
Gender (n)	
– Male	37 (71,2%)
– Female	15 (28,8%)
Age (year)	46,12 ± 10,62
Height of body (cm)	163,49 ± 6,45
Severe of body (kg)	57,26 ± 10,57
Body mass index (kg/m²)	21,33 ± 3,22
Old of Hemodialysis (weeks)	104,96 ± 90,86
Etiology	
– DM	12 (23,1%)
– Non DM	40 (76,9%)
Laboratory	
– Hb (gr%)	8,92 ± 1,26
– Ureum (mg/dL)	136,21 ± 38,06
– Creatinine (mg/dL)	13,42 ± 4,23
Total of 7-Point SGA	4,77 ± 1,41
– Severe malnutrition	6 (11,5%)
– Moderate malnutrition	28 (53,9%)
– Good nutrition	18 (34,6%)
Life quality of SF-36	
– Physical (%)	51,99 ± 9,89
– Mental (%)	58,46 ± 9,40
BIA	

– RMR (Kkal)	1396,88 ± 171,448
– BCM (kg)	24,53 ± 4,45
– FFM (kg) / (%)	47,22 ± 7,47 / (81,64% ± 6,46)
– FM (kg) / (%)	10,87 ± 5,12 / (18,36% ± 6,46)
– Protein (kg)	9,21 ± 2,25
– Mineral (kg)	3,38 ± 0,69
– Glikogen	431,33 ± 66,04
– PhA (º)	5,15 ± 1,29

Table 4.2 Differences between IMT, 7-Point SGA, SF-36, Creatinine, RMR, BCM, FFM, FM, Protein, Minerals, Glycogen, PhA by gender

VariablE	Male (n=37)	Female (n=15)	P
IMT (kg/m²)	22,07 ± 3,02	19,96 ± 2,95	S
7-Point SGA	5,03 1,19	4,14 1,72	NS
SF-36			
– Physical (%)	53,85 ± 10,82	46,50 ± 10,67	S
– Mental (%)	58,70 ± 9,41	54,20 ± 10,28	NS
Creatinine (mg/dL)	14,5 ± 3,78	10,76 ± 1,23	S
BIA			
– RMR (Kkal)	1469,30 ± 142,40	1218,27 ± 83,02	S
– BCM (kg)	25,97 ± 3,78	21,00 ± 4,10	S
– FFM (%)	82,34 ± 5,92	79,92 ± 1,59	NS
– FM (%)	17,66 ± 5,92	20,08 ± 7,59	NS
– Protein (kg)	10,17 ± 1,65	6,83 ± 1,71	S
– Mineral (kg)	3,63 ± 0,54	2,76 ± 0,64	S
– Glikogen	455,95 ± 52,74	370,60 ± 56,42	S
– PhA (º)	5,47 ± 1,19	4,37 ± 1,23	S

NS= *Not Significant*, S= *Significant* p<0,05

4.1.3. Overview of nutritional status based on the etiology of end-stage kidney disease.

In table 4.3 can be seen the overview of nutritional status in the subject of regular hemodialysis research which is divided based on the etiology of end-stage kidney disease of DM and non-DM. There were statistically significant differences in 7-point SGA, creatinine, protein and PhA where non-DM had a higher value than DM, while other characteristics were not significant.

Table 4.3 Overview of nutritional status based on the etiology of end-stage kidney disease, namely DM and non-DM

Variable	Non DM (n=40)	DM (n=12)	P
IMT (kg/m²)	21,56 ± 3,33	21,15 ± 2,38	NS
7-Point SGA	4,95 ± 1,45	4,17 ± 1,11	S
Creatinine (mg/dL)	14,22 ± 4,11	10,77 ± 3,56	S
BIA			
– RMR (Kkal)	1421,63 ± 174,75	1314,42 ± 135,54	NS
– BCM (kg)	25,18 ± 4,53	22,39 ± 3,57	NS
– FFM (%)	81,66 ± 6,70	81,59 ± 5,87	NS
– FM (%)	18,34 ± 6,70	18,41 ± 5,87	NS
– Protein (kg)	9,62 ± 2,16	7,83 ± 2,04	S
– Mineral (kg)	3,47 ± 0,67	3,07 ± 0,67	NS
– Glikogen	438,58 ± 66,73	407,17 ± 60,03	NS
– PhA(º)	5,38 ± 1,28	4,39 ± 1,03	S

NS= *Not Significant*, S= *Significant* p<0,05

4.1.4. Relationship between 7-Point SGA and Phase Angle

Of the 52 study subjects, the mean of PhA was 5.15 ± 1.29 0 with a mean of 7-Point SGA score of 4.77 ± 1.41 0 and by using Spearman correlation, the value of r = 0.814 (p <0.001) was obtained with a strong correlation (figure 4.1). If the 7-Point SGA is grouped into 3 parts: severemalnutrition with 1/2 to 1, moderate malnutrition with 3/4/5 to 2 and good nutrition with 6/7 to 3, then the relationship remains significant with r = 0.717 (p <0.001). the lower score of PhA is associated with a lower nutritional score. To assess the difference in PhA based on 3 groups of nutritional status, LSD multiple comparison test was conducted based on the nutritional status group and obtained significant differences in severemalnutrition with moderate malnutrition and good nutrition and moderate malnutrition with good nutrition (p <0.001). Table 4.4 and Figure 4.1 show the PhA differences from the SGA 7-Point classification which statistically have a significant difference between each nutritional status variable (p <0.001).
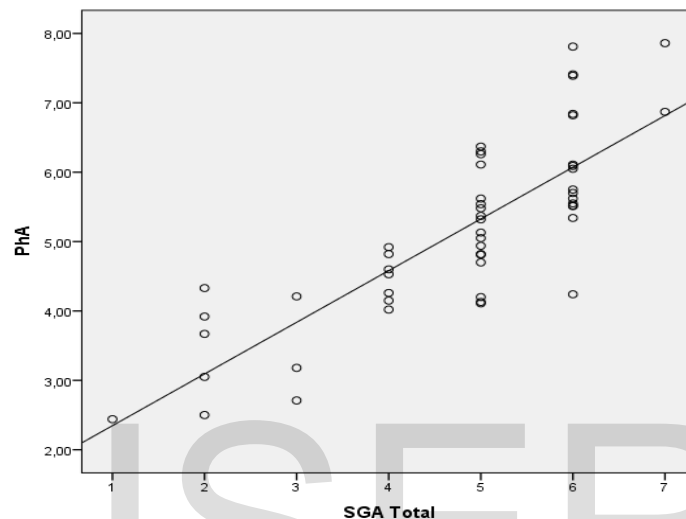

Figure 4.1. Relationship of PhA values based on SGA 7-Points

Table 4.4 Differences in PhA values based on SGA 7-Point categories

Variable	7-point SGA category		
	Severe malnutrition	**Moderate malnutrition**	**Good nutrition**
Phase Angle (^{0})	3,31 ± 0,78	4,84 ± 0,88	6,25 ± 1,29

p <0.001 for differences between the three nutritional categories.

Using the ROC curve to assess the cut-off in nutritional scores using 7-Point SGA in relation to PhA values found that severe malnutrition had a cut-off of 4,430 in PhA with a sensitivity of 100% and specificity of 78,3 %% (p <0,001) (Figure 4.2). Whereas moderate to severe malnutrition had a cut-off value of 5.540 in PhA with a sensitivity of 85.3% and specificity of 77.8% (p <0.001). (Figure 4.3).
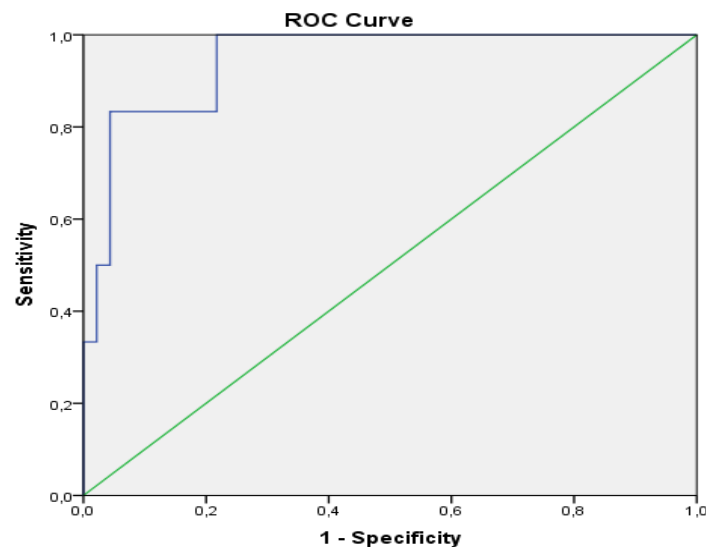
Figure 4.2 Relationship between PhA and severe Malnutrition Score. ROC curve value of PhA in severe malnutrition (AUC = 0.946; p <0.001), with a PHA cut-off value of 4.43° (sensitivity of 100%, specificity of 78.3%)
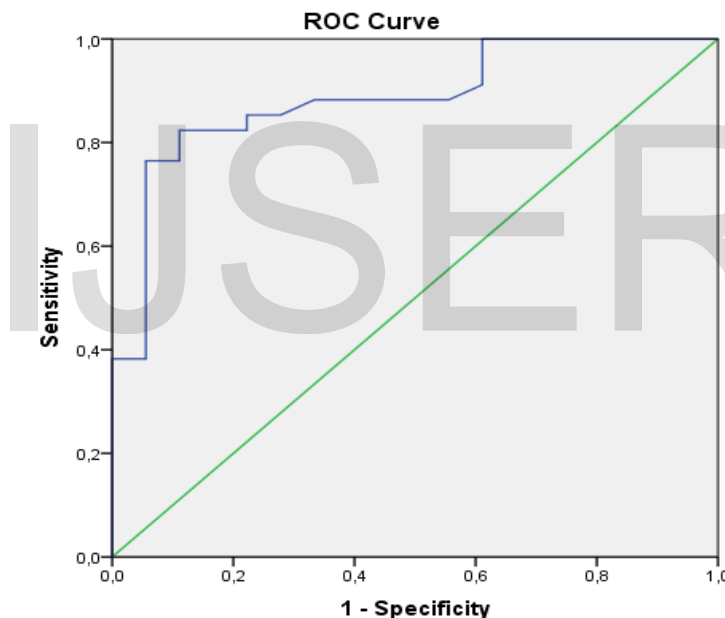

Figure 4.3 Relationship between PhA and Moderate - severe Malnutrition Score. ROC curve value of PhA in malnutrition (AUC = 0.886; p <0.001) with a cut-off of PhA 5.54° (sensitivity 85.3%, specificity 77.8%)

4.1.5. 7-Point SGA relationship with other nutritional status parameters.

In table 4.5, it can be seen the relationship between 7-Point SGA which is divided into 2 groups: malnutrition and good nutrition with other nutritional status parameters where IMT, creatinine, and BIA BCM parameters,% FFM and% FM have a significant relationship (p <0 , 05). This is not shown in RMR, protein, minerals and glycogen.

Table 4.5 Relationship of 7-Point SGA grouped into malnutrition and good nutrition with other nutritional parameters

Variable	7-Point SGA		P
	Malnutrition (n=34)	Good nutrition (n=18)	
IMT (kg/m²)	20,40 ± 2,84	23,47 ± 2,65	S
– ≤ 18,49	10 (29,41%)	0	
– 18,5 – 24,9	22 (64,70%)	12 (66,67%)	
– ≥ 25	2 (5,89%)	6 (33,33%)	
Creatinine (mg/dL)	12,35 ± 3,77	15,44 ± 4,41	S

BIA

–	RMR (Kkal)	1365,32 ± 168,14	1456,50 ± 165,98	NS
–	BCM (kg)	23,52 ± 4,30	26,45 ± 4,21	S
–	FFM (%)	83,47 ± 5,06	78,18 ± 7,50	S
–	FM (%)	16,52 ± 5,06	21,82 ± 7,50	S
–	Protein (kg)	8,99 ± 2,42	9,63 ± 1,89	NS
–	Mineral (kg)	3,32 ± 0,76	3,48 ± 0,53	NS
–	Glikogen	425,68 ± 67,16	442,00 ± 64,39	NS

NS= *Not Significant*, S= *Significant* p<0,05

4.1.6. Relationship between 7-Point SGA and Quality of life

Of the 52 study subjects obtained SF-36 mean physical health dimensions 51.99 ± 9.90% and mental health dimensions 58.46 ± 9.40%. Spearman correlation analysis obtained r = 0.480 (p <0.001) in physical health and r = 0.331 (p <0.05) in mental health, both showed a strong correlation. The lower SF-36 value, both physical and mental health, is associated with a lower nutritional score (figure 4.4).
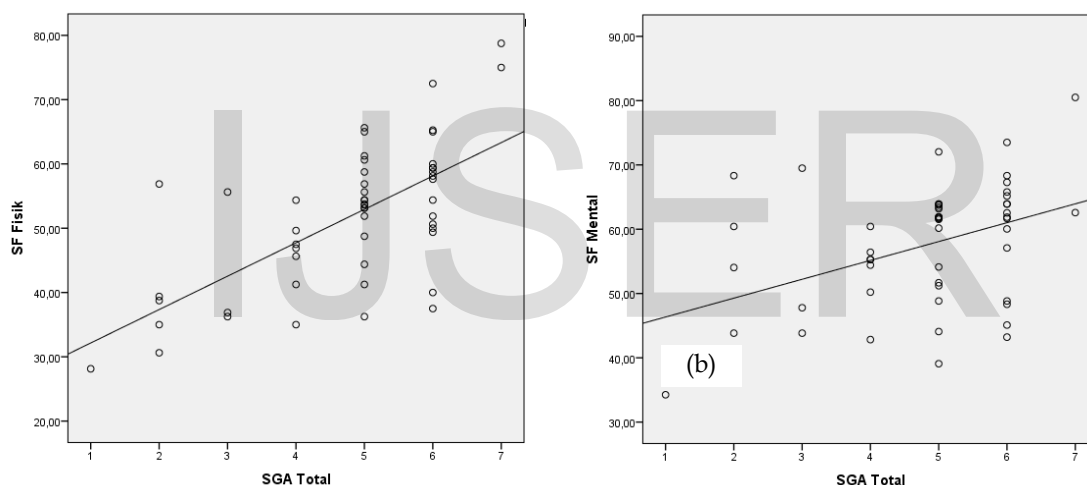

Figure 4.4 Relationship of quality of life of SF-36 based on nutritional status.
(a) Physical health. (b) Mental health

To assess differences in the quality of life of SF-36 physical health dimensions based on 3 groups of nutritional status, LSD multiple comparative tests were conducted based on these nutritional status groups and obtained significant differences in severe malnutrition with moderate malnutrition and good nutrition and moderate nutrition with good nutrition (P <0.001) On differences in the quality of life of SF-36 dimensions of mental health based on 3 groups of nutritional status with the same test obtained a significant relationship between severe malnutrition and good nutrition (p <0.05), but there was no relationship between moderate malnutrition and severe malnutrition (p = 0.136) and with good nutrition (p = 0.117) (table 4.6).

Table 4.6 Differences in the value of quality of life in physical and mental health dimensions based on nutritional status categories

		Category of 7-point SGA		
Variable	(a)	Severe malnutrition	Moderate malnutrition	Good nutrition
SF-36 physical (%)[1]		38,13 ± 10,19	50,58 ± 8,58	57,97 ± 10,92

SF-36 mental (%)[2]	50,18 ± 12,98	56,58 ± 8,33	61,09 ± 9,66

[1] p<0,001 for differences between the three nutritional categories.

[2] p<0,05 for the difference between severe malnutrition and good nutrition, p = 0.136 for severe malnutrition with moderate malnutrition, and p = 0.117 for moderate malnutrition with good nutrition.

4.2 Discussion

SGA is a semi-quantitative method for determining nutritional status, SGA is also often used in hemodialysis patients, both for research and clinical practice. 7-point SGA comes from SGA whose assessment is adjusted first for dialysis patients and is a recommendation from KDOQI to be used routinely as an assessment of nutritional status quickly and economically.

This study measures 7-point SGA values in regular hemodialysis patients and assesses their relationship with other nutritional status parameters such as through anthropometric, biochemical and BIA examination. One important component of BIA examination besides measuring nutritional status is PHA, which has a strong relationship to the prognosis of regular hemodialysis patients. Therefore, this study also assessed the relationship between PhA and 7-Point SGA and measured the strength of the relationship.

The prevalence of malnutrition in regular hemodialysis patients in H. Adam Malik General Hospital in 2010, in the same place as this study, using the original SGA measurement was 60.7% (Harmoko and Tala, 2010), and currently 65.3% with using 7-Point SGA. This figure indicates that there is still a high prevalence of malnutrition in Indonesia, especially in Medan.

In this study, the mean PhA value of regular hemodialysis patients was 5,150 ± 1,19, with a significantly different male and female sex ratio, the figure was not much different from the research conducted by Ramadani et al (2012), with a value of 5,320 ± 1,33 . However, this is not suitable for hemodialysis populations in Europe, which on average have higher PhA values, although there are indeed significant differences between men and women (Segall et al., 2009; Abad et al., 2011). This can be because the length of the body and body composition of each human being has no similarities, and this will affect the measurement of BIA. Body impedance differs between several ethnic groups and this will affect the accuracy of the BIA. PhA values that are indeed higher in healthy populations in other ethnic groups than in Asian ethnicities and greater BCM values. (Kyle et al., 2004a; Barbosa-Silva et al., 2005). The study by Maggiore et al (1996), shows the average PhA value that is not different from this study, but the average age of the population is 62 years, this confirms the statement that PhA is influenced by age and sex, not least in regular hemodialysis patients. Therefore it is important to know the normal value in the local healthy population, for reference material.

From the results of the study obtained 7-Point SGA which was categorized into 3 groups of nutritional status associated with PhA significantly (r = 0.717; p <0.001) in hemodialysis patients. This statement is in accordance with previous studies by Enia G et al (1993), Maggiore et al (1996), and Oliveria et al (2010), although these references use original SGA, but the grouping of nutritional status used is basically the same. The relationship was stronger because of the relationship between each group of nutritional status when compared with PhA (p <0.001).

Although SGA has been used as an indicator of patient prognosis, PhA is superior in predicting the risk of death in hemodialysis patients (Maggiore et al., 1996; Segall et al., 2009). Therefore, a cut-off is needed on PhA in determining its relationship with nutritional status. The study conducted by Maggiore et al (1996), which evaluated 131 hemodialysis patients received ≤4,5° for men and , ≤4,2° for women as a predictor of death risk of 2.6 times-fold. From this study, the ROC curve gets a cut-off of 4,43° with a sensitivity of 100% and a specificity of 78.3% for severe malnutrition status and it can be concluded that severe malnutrition as measured by 7-Point SGA indirectly has a strong risk of death through the PhA value. Determination of PhA cut-off was not carried out in men or women because in this study there were indeed no significant differences in male and female sex according to SGA 7-Point, and these results were not significant in this study due to the lack of severely malnourished subjects.

For malnutrition status with a value of 7-Point SGA 1-5 has a cut-off of 5.54° has a sensitivity of 85.3% and a specificity of 78.6%. Research conducted by Segall et al (2009), showed the value of PhA <6° had a risk of death of 4.12x compared to> 6° in both men and women. The cut-off value obtained from this study is included in the criteria of the reference value, therefore it can be a reference in daily clinical practice.

The relationship of nutritional status with PhA values is not surprising because PhA is directly related to cell membranes both in number and function, a person with better nutritional status has more cells in the body so that the value of PhA becomes higher. While the decrease in PhA value with increasing age indicates that PhA is not only an indicator of body composition and nutritional status, it is also an indicator of general health and function.

In addition, this study also assessed the relationship of other nutritional status parameters with 7-Point SGA and found that IMT, creatinine, BCM,% FFM and% FM had a significant relationship. IMT is easy to apply daily, but the malnutrition limit in the general population <18.5 kg / m[2] is not suitable for hemodialysis patients, Beddhu et al (2007), studied 50,732 hemodialysis patients and only 7.98% of those who were malnourished, Mancini et al (2003) also get numbers that are not much different. while the prevalence shows more than 20%. This study indicates that 7-Point SGA is associated with IMT, but this limit seems to be higher than the general population, due to fluid accumulation factors. Alharbi et al (2012), obtained a mean

IMT for Malnutrition of 21.3 kg / m² in hemodialysis patients. This is supported by Tokunaga et al (1991) who reported a IMT <22 kg / m² associated with increased morbidity and mortality.

Creatinine is known to have a relationship with SGA (Jones et al., 2004) and is an independent factor in influencing PhA values (Bebarasvili et al., 2009). Creatinine is produced from non-enzyme metabolism in the skeletal muscles of the body and is excreted in the urine, in individuals with end-stage renal disease who require hemodialysis, creatinine excretion is almost non-existent, especially in anuria patients. Therefore creatinine measurements have been used to assess muscle mass (Lowrie and Lew, 1990) and can assess lean body mass, which can reflect FFM values, the difference being that FFM has the addition of essential fat in the bones and internal organs. The results of this study indicate that good nutrition has higher creatinine and FFM levels, but FFM is also influenced by fluid accumulation that often occurs in hemodialysis populations. BCM is capacitant and affects the value of PhA, the measurements are obtained from a combination of intracellular fluid and visceral protein (Kyle et al., 2004a) but previous studies did not find a significant relationship between several types of SGA assessment with BCM in hemodialysis patients (Maggiore et al. , 1996; Oliveira et al., 2010), this can occur because SGA does not evaluate visceral proteins. A 2010 study by Dumler (2010), obtained higher PhA and BCM values in peritoneal dialysis than hemodialysis. This can occur due to the rapid transfer of fluid throughout the body and affect the cell membrane due to the hemodialysis process, while peritoneal dialysis focuses on the peritoneal cavity.

Quality of life is a multidimensional concept that describes the physical, emotional, cognitive and social functions, as well as symptoms associated with illness and treatment (Baizura et al., 2013). The quality of life of SF-36 according to previous studies conducted in the same place by Lina et al (2008), was 43.8% ± 14.7% for physical health dimensions and 51.9% ± 15.2% for Mental health dimensions. Zadeh et al (2001), also obtained SF-36 values with similar rates in hemodialysis patients. In this study, we got higher results, this can occur because the difference in the proportion of male sex is greater and higher in physical and mental quality of life although mental quality of life is not significant. Another factor that can give effect is the younger age difference in this study compared to previous studies.

Other studies have reported that there is a relationship between quality of life as measured by SF-36 both physical and mental health with SGA, although the relationship is better in physical health (Laws et al., 2000), these results were also obtained in this study. A study published recently in the United States involved 94 hemodialysis patients with a cross-sectional design getting 7-Point SGA related to SF-36 physical dimensions, but not SF-36 mental health (Vero et al., 2013). This indicates that the relationship between nutritional status and health is weak. The quality of life of hemodialysis patients is influenced by comorbid disease, adequate or not hemodialysis therapy and nutritional status. Poor nutritional status is influenced by anorexia and weight loss, then weight loss will result in worsening of muscle function and decreased physical function (Zadeh et al., 2001). Although a decrease in physical function can directly affect mental, psychosocial and cognitive factors also play a role in mental health (Baizura et al., 2013).

Thus 7-Point SGA is a cheap and easy and non-invasive method to routinely assess the nutritional status of hemodialysis patients and help predict mortality and assess quality of life, especially physical health, so that it can help further evaluation with other investigations because there is no gold standard set to determine malnutrition in hemodialysis patients. In addition, it can also establish therapeutic indications, both non-pharmacological and pharmacological. Seeing the prevalence of malnutrition in hemodialysis patients is still high, especially in developing countries such as Indonesia, it is expected that 7-Point SGA is one of the routine assessments carried out at hemodialysis facilities.

The weakness of this study is the number of samples that are not too large and no adjustments are made to the characteristics of the research subjects, so that further research is needed on a larger scale to validate 7-Point SGA, either singly or in combination with other SGA scores and more laboratory parameters. complete as albumin to assess diagnostic performance. In addition to the small number of samples, this research is cross-sectional, so the role of 7-Point SGA in prognostic factors cannot be done directly.

CONCLUSIONS AND RECOMMENDATIONS

1. Conclusions

From the results obtained in this study and the discussion, the following conclusions can be expressed:
1. 7-point SGA as a nutritional status parameter is significantly positively related to the phase angle as a prognosis where the lower the 7-point SGA value the lower the phase angle value.
2. 7-point SGA as a nutritional status parameter is positively related to physical and mental quality of life, but the relationship is more significant in physical than mental health
3. The prevalence of malnutrition in regular hemodialysis patients is still high based on the 7-point SGA value.

2. Recommendations
1. 7-point SGA is recommended in assessing the nutritional status of regular hemodialysis patients routinely for evaluation and subsequent therapeutic measures so as to control morbidity and mortality in a better result.

2. Mental health in regular hemodialysis patients is not necessarily affected by the physical limitations that occur, therefore it is important to take a holistic approach.
3. Further research is needed with a larger scale and is prospective to get a better relationship so that the 7-point SGA value can be more validated.

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