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Development, Validation and Reliability of the Simple Nutrition Screening Tool (SNST) for Adult Hospital Patient in Indonesia

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Abstract: Malnutrition is one common problem for hospitalized patient in all over the world. Thus, patients with at risk of malnutrition are recommended to receive a nutritional therapy which are identified by using nutritional screening tool. Some of the existing screening tools cannot be performed in Indonesia because most of Indonesian people rarely check their weight in regular basis. Therefore it's hard to know wether they lose or gain weight. The aim of this study was to develop a simple, valid and reliable screening tool that can be used to identify adult patients with risk of malnutrition. Four hundred and ninety five adult patients were screened by Simple Nutrition Screening Tool (SNST). This screening tool was developed in Sardjito General Hospital/Gadjah Mada University, Indonesia. The validity of SNST was tested by measuring the sensitivity and specificity value compared to Subjective Global Assessment (SGA), the interrater reliability value of the screening tool was also assessed by dietitian, nurse and food service officer in 73 patients. From the development process of SNST, 6 questions were obtained with sensitivity value 91.28 and specificity value 79.78. Subjects who were at risk of malnutrition, according to the SNST, had significantly lower mean values for the objective nutrition parameters ($p = 0.001$) and longer length of stays than subjects who were not at risk of malnutrition ($p = 0.001$). There was a good agreement in the assessment of at risk of malnutrition between dietitians (kappa = 0.803), dietitian and nurse (kappa=0.653) and between dietitian and food service officer (kappa=0.718). The SNST is a valid and reliable tool to identify patients with risk of malnutrition.

Key words: Malnutrition, nutrition screening, SNST-UGM, subjective global assessment

INTRODUCTION

The prevalence of malnutrition among hospitalized patients is high, reportedly ranging from 20-60% (Meyer, 2006; Norman *et al*., 2008; Kahokehr *et al*., 2009; Imoberdorf *et al*., 2010). *In Indonesia, the prevalence of malnutrition was 50% among 68 patients in surgery wards based on Nutrition Risk Index (NRI) and 56.6% among 76 cancer patients based on Patient Generated Subjective Global Assessment (PG-SGA). Research conducted at Dr. Sardjito Hospital Yogyakarta, Jamil Hospital in Padang and Sanglah Hospital in Denpasar involving 293 patients, found that based on a Subjective Global Assessment (SGA) 74 patients (28.2%) experienced a decline in nutritional status at the time of discharge compared to the time of admission to hospital (Budiningsari and Hadi, 2004). Studies related to the consequences of malnutrition in hospitalized patients and its relationship with the increased length of stay, costs, complications and mortality have been well documented. Meta-analysis of 27 Randomized Control Trial (RCT) studies involving 1.710 patients and 30 RCT studies involving 3.250 patients showed a significant correlation between malnutrition and complications, infections and mortality (Stratton, Green and Elia, 2003). Malnutrition goes largely undiagnosed and untreated particularly among hospital patients. This is mainly due to not only lack of nutritional training and awareness among staff, but also caused by lack of proper protocols for screening, assessment and action (Barendregt *et al*., 2008). Various studies have found that the main cause of the large number of malnourished patients in hospitals is due to lack of attention to nutrition and interdisciplinary cooperation in the management of nutritional care in the hospital setting (Mikkelsen, Beck and Balknas 2003; Kondrup, 2004).

Nutritional risk screening is an essential first step in the structured process of nutrition care to identify patients that will likely benefit from nutritional therapy (Sorensen *et al*., 2008). Recommendations of the European Society of Parenteral Enteral Nutrition (ESPEN) and the American Society of Parenteral Enteral Nutrition (ASPEN) established that nutritional screening should be done at the beginning of patients being hospitalized to identify those who are at risk of malnutrition (Kondrup *et al*., 2003; Mueller *et al*., 2011). Research over the past five years found that the prevalence of malnutrition in Hammersmith hospital can be reduced from 23.5 to 19.1% after the appropriate nutrition intervention through improved food quality, nutrition education and implementation of nutrition screening (O'flynn *et al*., 2005).

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Nutrition screening tools are used to identify individuals at nutritional risk. These tools must be easy to complete, cost-effective, quick and able to identify individuals at nutritional risk (American Dietetic Association, 1994). The result of a review of various nutrition screening and assessment tools showed that of the 44 tools identified, only four tools presented sufficient information to the reader on their development, including a justification of their content and an assessment of the tool within the target population (Jones, 2002).

There are many nutritional screening tools such as the Nutrition Risk Screening-2002 (NRS-2002), Malnutrition Universal Screening Tool (MUST) and Malnutrition Screening Tool (MST) which are proved to be valid and reliable. However, there is no screening tool most appropriate and acceptable in Indonesia. Some of the disadvantages of existing screening tools are the mathematical calculations and the requirement of data that can only be performed by skilled personnel. Meanwhile, not all hospitals have dietitians and adequate anthropometric equipment. Besides, Indonesians rarely weigh in regularly so that they do not know when they lose weight. Therefore, it is necessary to develop a nutrition screening tool that is simpler and in accordance with the conditions of the people in Indonesia.

MATERIALS AND METHODS

Study design: A set of parameters was chosen for the development of the nutrition screening tool, (1) It can be used in a heterogeneous population of adult patients, (2) It is simple and quick to administer; (3) Non-invasive; and (4) It can be used routinely on available data. Therefore, biochemical and anthropometric data were not considered. Questions on nutrition screening were selected or developed from the literature and clinical experience (Ferguson *et al*., 1999). In developing the nutritional screening tool, several steps were used to identify different variables associated with malnutrition in target population, assessment of content and validity, study protocol conduct and assessment of validity and reliability (Jones, 2004). Variables associated with at risk malnutrition use four main principles in nutritional screening: (1) How is the actual condition?; (2) Is the condition stable? (3) Will the condition worsen? and (4) Will the disease process accelerate nutritional deterioration? (Rasmussen *et al*., 2010).

Nutritional screening tool was developed by selecting questions based on the literature, clinical experience and discussion of experts. The questionnaires carried out by preparing 39 questions derived from the literature of nutritional screening tool development research done in various countries and is supported by numerous studies on risk factors that can lead to malnutrition and clinical experience. Based on the discussions of experts, total questions that can be used for preliminary study are 30 questions. Preliminary study conducted in 41 patients, with a data collector who are dietitians. Validity test used is the Pearson correlation test and reliability test used is the Cronbach alpha test. Based on the validity of test results, it is known that valid questions as many as 17 questions (the value of r count>r table (0.308)) with the reliability (Cronbach alpha value) was 0.869 (very reliable).

Study validity was conducted in Dr. Sardjito Hospital Yogyakarta from March to October 2011. All patients admitted to the hospital in this research were eligible for inclusion in the study, with the exception of the following: patients under 18 years old, psychiatric, pediatric and maternity patients and patients who were unable to communicate. Total sample needed in this research are 495 patients based on statistical power calculation. Subjective Global Assessment (SGA) was selected as the reference method for validation (Detsky *et al*., 1987). A dietitian assessed nutrition screening in the same patients using SGA within 48 hours of admission. This was then validated with objective nutrition parameters such as body mass index (BMI), upper arm circumference (UAC), albumin serum, hemoglobin and total lymphocyte count (TLC).

The Interrater reliability test determines an agreement between dietitians and dietitians, dietitians and nurse as well as dietitian of SNST. Interrater reliability was tested in patients was assessed during the first 24 h following admission in 3 different wards. Sample size was 73 patients in each ward which was calculated according to Jones formula (Jones, 2004a). The test was undertook in internal medicine wards for the test between the dietitian, in neurological ward for the test between dietitian and food officer and in surgical ward for the test between dietitian and nurse. The kappa statistic was used to determine interrater reliability.

Statistical analysis: Data was analyzed using univariate and bivariate analyses. Bivariate analysis used was t-test for normally distributed data and Mann-Whitney U test for data that are not normally distributed.

The nutrition screening questions were tested individually against Subjective Global Assessment (SGA) for significance using the chi-square test. Contingency tables were used to determine the sensitivity and specificity of both individual and combinations of nutrition screening questions at predicting SGA. The combination of questions and cut-off value that resulted in the highest sensitivity and specificity at predicting SGA was termed the Simple Nutrition Screening Tool (SNST) (Ferguson, 1999). The usefulness of diagnostic tests, that is their ability to detect a person with disease or exclude a person without disease, is usually described by terms such as sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) (Jones, 2004b).

The validity and reliability of nutritional screening tools (NST) must be tested before they are used for ethics and practical reasons (Jones, 2002; Keller *et al*., 2006). Validity shows the ability of NST to differentiate between individuals who are at risk of malnutrition and those who are not (Jones, 2004a; Jones, 2004c; Kondrup *et al*., 2003). Meanwhile, reliability shows how the NST results in consistency in several areas with different power (Jones, 2004c; Kondrup *et al*., 2003).

There are 3 validity tests: validity of content, validity of construction and validity of criteria. Validity of content shows the relevant component with risk of malnutrition variable in population. Validity of content in general is measured in the middle of the NST development process (Jones, 2004b, Kondrup *et al*., 2003). Validity of construct is a type of validity that determines how suitable the NST is with other variables which in theory are related to risk of malnutrition. Validity of construct hopes that patients who are determined at risk of malnutrition by the newly developed NST would have similar characteristics of malnutrition as determined by other variables that are not included in the NST (Jones, 2004b). Validity of criteria from the NST determines how far that NST is related to the risk of malnutrition. In other words it able to identify those patients with risk of malnutrition compared to other methods which are considered the gold standards (Jones, 2004b).

Cross-tabulation of the tool's assessments of nutrition status with the gold standard shows the level of agreement between the two procedures. The tool's performance is generally summarized by its sensitivity and specificity, with sensitivity being the percentage of malnourished subjects identified at risk by the tool at and specificity being the percentage of adequately nourished subjects identified as not at risk.

Receiver Operator Characteristic (ROC) curve analysis was performed to determine the sensitivity and specificity of the individual nutrition parameter. Youden's index (J) was used to determine these best cut-off scores. The optimal cut-off score is where Youden's index gives the maximum value. Study Reliability using Inter-observer reliability refers to the consistency between two different raters administering the same tool to the same individual (Jones, 2004). The reliability test was conducted between two dietitians in medical ward, dietitian and nurse in surgical and dietitian and food services officer in nerve ward with kappa analysis. Values above 0.4 are considered to reflect fair reliability, values above 0.6 are considered to have moderate reliability and values above 0.8 are considered to have excellent reliability (Jones, 2004).

Written informed consents were obtained from all participants and this study has received ethical clearance from the Ethics Committee of the Faculty of Medicine, University of Gadjah Mada.

RESULTS

Majority of the subjects were female (53.5%), age <60 years (71.9%) and hospitalized in internal medicine (55.4%). Subjects were admitted to the internal medicine ward, the majority of subjects were cancer patients (30.7%) and surgery (40.2%). Subjects' education levels were almost evenly in primary and secondary education and only a small proportion (8.1%) had advanced education (Table 1).

The present condition of the patients are illustrated in questions 1 and 2, the variables of weight loss was illustrated in questions 3 to 6. For variable reduction in food intake was shown in 7 to 12 questions and disease history variables was illustrated in questions 13 to 17. The result of an analysis of the 495 subjects was that each question tested with the gold standard (SGA) are presented in Table 2. From analytical results, we obtained 6 questions with high sensitivity and specificity values and have significant relationships with SGA.

Determination of cut-off for risk of malnutrition tested using contingency tables (2×2 Table), where the cut-off that has the highest area under the receiver operator characteristic curve. From the analysis result of gold standard (SGA), it was found that the cut-off of the Simple Nutrition Screening Tool (SNST) is 0-2 was in the category not risk of malnutrition and >2 with category risk of malnutrition (Table 3).

Validity of simple nutritional screening tool (SNST): The SNST was compared with objective nutritional parameters and outcome variables. There was a significant difference in mean values of anthropometric indicators such as body mass index (BMI) and Upper Arm Circumference (UAC) and biochemical markers such as: albumin, TLC and hemoglobin and length of stay (Table 4). Subjects at risk for malnutrition had

Table 1: Patients characteristics

Variable	N	%
Sex		
- Male	230	46.5
- Female	265	53.5
Age (years)		
- <60	356	71.9
- >60	139	28.1
Ward		
Internal medicine	274	55.4
Surgery	169	34.1
Other	52	10.5
Illness		
- Infectious	22	4.4
- Non-infectious	122	24.6
- Cancer	152	30.7
- Surgery	199	40.2
Education		
Primary	255	51.6
Secondary	200	40.4
Post-Secondary	40	8.1

Table 2: Sensitivity and specificity of nutrition screening questions at predicting SGA of nutritional status

Questions	P-value	Se	Sp	MSS
Does the patient look thin?	0.001	68.81	76.53	145.34
Are you experiencing a decline in the state of health than a year ago?	0.001	94.50	38.27	132.77
Does your clothes feel looser?	0.001	74.31	74.37	148.68
Have you recently lost weight unintentionally (6 months)?	0.001	73.85	75.81	149.66
Have you lost weight >3 kg in 1 month?	0.001	27.06	91.70	118.76
Have you lost weight >6 kg in 6 months?	0.001	33.03	96.03	129.06
Have you decreased food intake during the first weeks?	0.001	86.24	77.26	163.5
Have you recently felt pain/pain when eating (bloating, obstruction, pains in the stomach)?	0.001	29.36	86.28	115.64
Do you need help to eat and drink (cannot eat and drink yourself)?	0.001	30.73	90.25	120.98
Do you often put off eating?	0.001	48.16	67.15	115.31
Do you take supplements or tube feeding or porridge?	0.241	15.14	88.45	103.59
Do you often drink as a meal replacement?	0.001	27.06	84.84	111.9
Do you feel weak, sluggish and not lethargic?	0.001	65.14	72.20	137.34
Have you been admitted to hospital one night or more in the last year?	0.535	85.78	16.24	102.02
Have you ever been admitted to the hospital >3 times in the last year?	0.290	18.35	85.20	103.55
Have you ever suffered from a disease that makes you bed-rested in the last 1-3 months?	0.001	36.70	85.56	122.26
Do you suffer from a disease that results in a change in the amount or type of food you eat?	0.001	60.55	87.36	147.91

Se = sensitivity Sp = specificity MSS = maximum sum of sensitivity and specificity

Table 3: Sensitivity and specificity of SNST at different cut-off values to determine subjects at risk of malnutrition using Subjective Global Assessment as the reference tool

Not Risk of M	Risk of M	Sensitivity (%)	Specificity (%)	AUC
0	1-6	100	32.5	0.662
0-1	2-6	98.6	61	0.798
0-2	3-6	91.3	79.8	0.855
0-3	4-6	68.4	93.1	0.807
0-4	5-6	49.5	97.8	0.737
0-5	6	21.1	99.6	0.604

*AUC = Area Under the Curve M: Malnutrition

Table 4: Association SNST with objective nutrition parameters and length of stay

		Score of SNST		
Variable	Total	Not Risk of Malnutr. (0-2)	Risk of Malnutr. (3-6)	P-value
BMI (kg/m)***	411	22.65+4.50*	19.52+3.73*	<0.001***
UAC (cm)	458	26.00**	23.85**	<0.001****
Albumin (g/dl)	412	3.50**	2.92**	<0.001****
Hemoglobin (g/dl)***	458	12.41+2.31*	11.07+2.40*	<0.001***
TLC (cell/mm)	437	1561.60**	1325.33**	<0.001****
Length of stay (days)***	495	7.41*	9.78*	<0.001***

Malnutr.: Malnutrition

*Normally distributed data are presented as means ± standard deviations (SD)

**Normally distributed data are presented as median

***Data were tested using t-test

****Data were tested using mann-whitney u-test

significantly less value in objective nutrition assessment and longer length of stay than subjects who are not at risk of malnutrition. Analysis on validity of criteria is done by performing cross-tabulation between the new nutritional screening tool and the gold standard, which is SGA. The results of cross-tabulation will show the agreement between SNST and SGA. To determine the performance of the new nutritional screening tool, sensitivity and specificity were measured. From the analysis, it was found that the sensitivity value is 97%. This sensitivity value is based on those patients who were identified having risk of malnutrition using SGA, 97% of them were also identified being at risk of malnutrition by SNST. Meanwhile, the specificity value is 80%, which reflects the number of patients who are not at risk of malnutrition based on the SGA were also identified as not at risk of malnutrition based on the SNST. In addition, we also found 199 patients who were classified as malnourished (true positives) and 221 patients who were well-classified as not at risk of malnutrition (true negatives). There were 17,1% of patients who were misclassified, with 13,3% (66 patients) of them being classified as malnourished (false positives) and 3,8% (19 patients) of them being classified as not at risk of malnutrition (false negatives). Analysis of positive predictive value (PPV) showed that 78% of patients at risk of malnutrition will be malnourished and the negative predictive value (NPV) showed that 92% of patients not at risk of malnutrition will have good nutrition status. Predictive values are determined by sensitivity, specificity and prevalence of a disease in a population being tested, whereby when a test becomes more sensitive, the better the NPV will be. Meanwhile, when a test becomes more specific, the better the PPV will be (Fletcher *et al*., 1996).

Nutritional screening is conducted to determine patients who are at risk of malnutrition and should receive nutritional care. Based on the results of nutritional screening using SGA and SNST we can tell that the patients at risk of malnutrition were 44% and 51.5%.

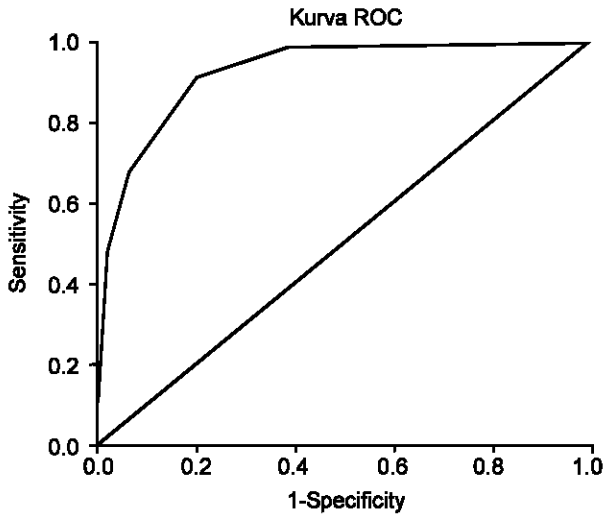

Fig. 1: Area Under Curve (AUC) of SNST to SGA

Table 5: Reliability interrater between dietitians, dietitians and nurses, dietitians and food service officers

	Dietitian					
	Not at risk		At risk		Total	
	N	%	N	%	N	P
Dietitian						<0.001
Not at risk	27	37	4	5.5	31	
At risk	3	4.1	39	53.4	42	
Total	30	41.1	43	58.9	73	
Nurse						<0.001
Not at risk	39	53.3	8	11.1	47	
At risk	4	5.6	22	30	26	
Total	43	58.9	30	41.1	73	
Food service officer						<0.001
Not at risk	45	26	4	5.5	31	
At risk	5	6.9	19	61.6	42	
Total	50	68.5	23	31.5	73	

To determine the accuracy of a new nutritional screening tool, which is being able to identify those at risk of malnutrition and those not at of malnutrition, is done by performing *receiver operating characteristic (ROC)* curve. Our analysis showed that the area under the ROC curve is 0,93. When the cut-off value of the area under the ROC curve is 0,8, it is considered good (Jones, 2004a).

The new nutrition screening methods significantly associated with SGA (p <0.001), with a sensitivity value 91.3%, specificity 79.8%, Negative Predictive Value (NPV) 92.1% and Positive Predictive Value (PPV) 78.%, Area Under the Curve (AUC) of 0.93 (p<0.001) (Fig. 1).

Reliability of Simple Nutritional Screening Tool (SNST): In Table 5, it is shown that the agreement on the SNST rating by the two dietitians occurred in 90% (66/73) of the cases. It means that there are 39 similarities in determining patients at risk of malnutrition and 27 similarities in determining the patient not at risk of malnutrition. Agreement on the SNST rating by a dietitian with a nurse occurred in 84% (61/73) of cases and agreement by a dietitian with a food service officer occurred in 88% (64/73) of cases.

There was excellent reliability in the assessment of risk of malnutrition between dietitians (kappa = 0.803, p<0.001) and moderate reliability between dietitian and nurse (kappa = 0.653, p<0.001) and between dietitian and food service officer (kappa = 718, p<0.001).

DISCUSSION

The results showed that six questions have high sensitivity and specificity values. These six questions were then used in the development of new Simple Nutritional Screening Tool (SNST). Questions in the SNST can represent the patient's condition now, weight loss, decreased food intake and history of the disease. This is in conformity with the four components of nutrition that is formulated by Rasmussen *et al*., (2010):

- Current conditions, described by height, weight and BMI. In some cases, where weight and height cannot be measured, arm circumference was then measured. In this regard the present state of the item is illustrated with the question "Does the patient look thin"
- A stable condition illustrated by weight loss was obtained from the patient's weight loss-related history. In this case the steady state is illustrated by the item question "Does your clothes feel looser?" And "Have you recently lost weight unintentionally (6 months)"
- Deteriorating condition was illustrated with questions related to decreased food intakes. Assessment of food intake can be done while in the hospital or from patient's nutritional history. In this case, the deteriorating condition is illustrated by the following question, “Have you decreased your food intake during the first weeks”
- The worsening of nutritional status influenced by the disease is described by the influence of a disease that leads to increasing energy/ nutrients demand and decreasing appetite. In this case the influence of the disease is illustrated by following the question "Do you feel weak, sluggish and lethargic?" And "Do you suffer from a disease that results in a change in the amount or type of food you eat"

Subjective Global Assessment (SGA) is a nutritional assessment tool that consists of patient's medical history and physical examination. Medical history consists of changes in body weight, food intake, gastrointestinal symptoms for 2 weeks and the body's ability to function. Physical examination includes an evaluation of fatty tissue, muscle loss, edema and

ascites. Subjective Global Assessment conducted for approximately 15 min (Abbot Laboratories, 2006). The American Society for Parenteral and Enteral Nutrition (ASPEN) recommends the use of SGA method to detect the prevalence of malnutrition in hospitalized patients (Alberda *et al*., 2006). SGA method is also a useful indicator in predicting complications of malnutrition and mortality among patients during hospitalization (Sacks, 2000). Similar to our study, other studies are using SGA as a gold standard. Limitations of the SGA are that it requires skilled workers, anthropometric measurements and a longer period to complete.

The analytical result of SNST has good validity (sensitivity 91.28%, specificity 79.78%, NPV 92.1% and PPV 78.%). SNST is a simple nutritional screening tool with 6 questions which does not perform anthropometric measurements. Therefore, it can be done by regular health care workers in a short period of time ranging from 3 to 5 minutes for each patient compared to the SGA, which takes 15 minutes. Simple Nutritional Screening Tool (SNST) results are valid and can be used to identify hospitalized patients who are at risk of malnutrition.

Patients with under nutrition based on SGA and at risk of malnutrition based on SNST at the time of admission are 44 and 51.5%, respectively. These results are higher than the results of a study based on nutrition screening among 5051 patients in 26 hospitals in Europe whereby it was obtained that 32.6% of patients were at risk of malnutrition based on NRS-2002 at hospital admission (Sorensen *et al*., 2008).

Body mass index is an anthropometric measurement that can be used as an indicator for monitoring nutritional status in adults of normal weight and are very sensitive to determine the status of underweight, normal and overweight or obese. Calculation of BMI is widely used in hospitals to measure the nutritional status of patients because BMI can estimate the size of body fat, although only estimates, but more accurate than measuring weight alone (Hartono, 2006). Upper Arm Circumference (UAC) is the measurement that is often used to detect protein energy malnutrition, where the amount of fatty tissue under the skin a little. UAC measurements tend to see the changes in muscle mass (Gibson, 2005). The analysis showed that patients at risk of malnutrition based on the SNST had an average BMI values lower than those not at risk of malnutrition, 19.5 and 22.6 respectively. Similarly, the same patients had an average of UAC at 23.8 and 26 cm. Tuck and Hennessy investigated the relationship UAC, BMI and weight loss as indicators of malnutrition in patients admitted the hospital emergency unit. Of the 1561 patients studied, 18.3% of patients are malnourished based on indicators of BMI <20, UAC <25 and weight loss = 10% (Tuck and Hennessy, 2003).

Biochemical indicator is a method to measure nutritional status. Measurement of inflammatory activity is done by measuring concentrations of albumin levels, hemoglobin, C reactive protein and cytokines in blood. In the past few decades, albumin is an good indicator of inflammatory activity and risk factors for the development of infectious complications after trauma (Soeters *et al*., 2008). Albumin is used to index both energy and protein malnutrition, in which normal serum albumin levels were 3.50 to 5.20 g/dL (Gibson, 2005). This study demonstrated that patients at risk of malnutrition based on the SNST has a low average albumin concentration at 2.92 g/dL compared to patients not at risk of malnutrition with normal albumin levels, which is 3.50 g/dL.

Low level of hemoglobin is an expression that is complex than the clinical symptoms of a disease that affects the pathogenesis mechanisms of impaired production of erythrocytes, bleeding and destruction of erythrocytes (Hill, 2000). Patients who suffered from lung problems, fever or poor physical condition will cause a reduction in oxygen transport capacity in moderation, so it will trigger the symptoms of fatigue, weakness and pale face. In chronic diseases with lack of hemoglobin, severity of anemia is directly proportional to disease (Hill, 2000). This study demonstrated that patients at risk of malnutrition based on the SNST have lower hemoglobin levels, which is 11.07 g/dl compared to patients not at risk of malnutrition, which is 12.41 g/dL.

Assessment of immune function can be done by calculating lymphocytes (Soeters *et al*., 2008) and malnutrition is indicated by lymphocyte counts of 900-1500 cells/mm, while the heavy malnutrition is indicated by the lymphocyte counts <900 cell/mm (Barendregt *et al*., 2008). In this study, we found that patients who are at risk and not at risk of malnutrition based on the SNST have normal total lymphocyte count (TLC). However, those with malnutrition risk have a lower value than those who are not at risk, 1325 cells/mm and 1561 cells/mm, respectively.

The kappa value between a dietitian and a nurse is lower than the value between dietitians or between a dietitian and a health care worker. This may be due to the fact that the nurses have other routines that they must perform other than providing nutritional service. Results from two hospital wards in Melbourne showed that compliance of a nurse in performing nutrition screening at admittance of patients using MUST (Malnutrition Universal Screening Tool) and MST (Malnutrition Screening Tool) was only 25 and 61%. Challenges in applying nutrition screening zrely on the fact that nurses have other routines they have to perform, as well as limited knowledge and skills to use and interpret the NST (Raja *et al*., 2008; Fletcher and Carey, 2011).

The newly developed Simple Nutrition Screening Tool (SNST) is a nutritional screening tool that is simple, quick and valid and can be used to detect patients at risk of malnutrition in hospital settings.

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