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Determining the Valid Tools to Screen Malnutrition in Cancer Patients: A Comparison to Patient Generated-Subjective Global Assessment (PG-SGA)

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ABSTRACT

Background: Nutrition screening tools are necessary to predict the risk of malnutrition for cancer patients.
Objectives: This study aimed to investigate the validity of nutrition screening tools in identifying malnutrition among cancer patients.
Materials and Methods: This cross-sectional study involved 175 oncology patients in Dr. Sardjito General Hospital. Malnutrition risk of participants was screened using Nutrition Risk Screening (NRS) 2002, Simple Nutrition Screening Tool (SNST), Malnutrition Screening Tool (MST), Nutriscore, and the Royal Marsden Nutrition Screening Tool (RMNST). Patient Generated-Subjective Global Assessment (PG-SGA) was used as a gold standard. Nutritional assessments, including Body Mass Index (BMI), Mid-Upper Arm Circumference (MUAC), albumin, hemoglobin, Total Leucocytes Count (TLC), and Hand Grip Strength (HGS), were used to evaluate nutritional status.
Results: The NRS 2002, SNST, MST, Nutriscore and RMNST identified nutritional risk in 64.6%; 58.9%; 49.1%; 30.3%; 84.6%, respectively. The SNST obtained the highest level of AUC discrimination (0.8) compared to NRS 2002 (0.7); MST (0.7); Nutriscore (0.7); and RMNST (0.7). There was a significant association between nutrition screening with nutritional parameters except for TLC (P>0.005). Patients who were at risk of malnutrition had a lower average of objective assessment tools.
Conclusion: All the nutritional screenings were valid to screen for malnutrition risk among cancer patients. Nutritional screening has a strong correlation with nutritional assessment. The lower risk detected by nutrition screening, the poorer the nutrition status measured by nutrition assessments.

Keywords: validity, nutrition screening tools, PG-SGA, cancer

BACKGROUND

Malnutrition is one of the problems faced by hospitalized patients.[1] The incidence of malnutrition among cancer patients was elevated.[2-5] Malnutrition in oncology patients is caused by disease-associated inflammation, effects of therapy, or other mechanisms. This condition, in the long term, leads to decreased body composition and diminished biological function.[5,6] Both of them contribute to anorexia, decreased food intake, as well as elevated metabolism, and increased protein catabolism.

Nutrition screening is an essential step before implementing the Nutrition Care Process on inpatients within 24 hours of admission to identify the risk of malnutrition. Academy of Nutrition and Dietetics (AND) stated that nutrition screening tools must be easy to complete, cost-effective, quick, and able to identify individuals at risk of malnutrition.[7,8] The ESPEN consensus recommends the Nutritional Risk Screening (NRS) 2002 as a good nutrition screening method as has been analyzed by several RCT studies.[9] Other literature reviews found that the Malnutrition Screening Tool (MST) was the nutrition screening tool with the highest ranking on the specific criteria. The Royal Marsden Nutrition Screening Tool (RMNST) was developed through professional consensus by the Department of Nutrition and Dietetics for inpatient use.[10] Nutriscore is a new screening tool recommended by Spanish Oncology Societies, which is the development from MST screening.[11]

In current clinical settings, nutrition screening tools required calculations and data that can only be revealed by skilled healthcare professionals. For these reasons, a new nutritional screening tool has been developed named the Simple Nutrition Screening Tool (SNST), which has been proven valid in detecting

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patients at risk of malnutrition compared with the gold standard, the SGA (sensitivity 91%; specificity 80%).[12] This study aimed to investigate the validity of nutrition screening tools for oncology patients.

MATERIALS AND METHODS

This study was a cross-sectional study conducted in Dr. Sardjito General Hospital, the central hospital in Yogyakarta Province, Indonesia. The study received ethical clearance from the Ethics Committee of the Faculty of Medicine, Universitas Gadjah Mada, Indonesia (KE/FK/0850/EC/201). Written informed consent was obtained from 175 participants, adult patients aged 18-60 years who were admitted to the oncology unit without pregnancy or postpartum conditions. Within 24 hours of hospital admission, the nutrition screening tools were carried out. The nutrition screening tools are Nutrition Risk Screening (NRS) 2002, Simple Nutrition Screening Tool (SNST), the Royal Marsden Nutrition Screening Tool (RMNST), Nutriscore and Malnutrition Screening Tool (MST). We assessed malnutrition status using Patient Generated-Subjective Global Assessment (PG-SGA) as a gold standard.

The new nutritional screening tools for oncology patients, Nutriscore and RMNST, were developed to predict the risk of malnutrition for oncology patients. Nutriscore is a new nutritional screening tool developed from MST screening. There are modifications to the nutrition screening form by adding two additional questions about the tumor site and the oncological treatment.[10] The Royal Marsden Nutrition Screening Tool (RMNST) incorporates parameter that is considered in nutrition screening, such as weight loss during the previous three months and food intake less than 50% in the previous five days. The symptoms that affect food intake, such as mucositis, dysphagia, and nausea, are also included as these have been shown to influence the risk of malnutrition[10]

The SNST, the novel nutrition screening tool developed in Indonesia, is a simple nutritional screening tool with six questions that do not include anthropometric and weight loss measurements. The SNST questions were 1) Does the patient look thin?, 2) Do your clothes feel loose?, 3) Have you recently lost weight unintentionally (6 months)?, 4) Have you decreased food intake during the past weeks? 5) Do you feel weak, sluggish, and not powerful?, and 6) Do you suffer from a disease that results in a change in the amount or type of food you eat?. [12]

Patients were screened upon admission and were identified using each nutrition screening tool's cut-off points, NRS-2002 ≥3; MST ≥2; SNST≥3, NUTRISCORE ≥5, and RMNST ≥4 and were categorized into two groups: not at risk and risk. The RMNST was designed to categorize the patients as well-nourished (cumulative score ≤4), moderately malnourished (score 5-9), and severely malnourished (score >10). The PG-SGA was adapted for the oncology population from the SGA tool. Due to its high sensitivity and specificity, it has been widely used in other oncology and patient settings and has performed well against other tools and is therefore used to cross-validate other screening tools. All the relevant sections of the PG-SGA were completed and summarized to classify the patients as well-nourished (PG-SGA–A), moderately or suspected of being malnourished (PG-SGA–B), or severely malnourished (PG-SGA–C).[10-12]

In order to compare the screening tools, outcome data for PG-SGA and RMNST was categorized into those at risk and not at risk of malnutrition. For PG-SGA data, number of patients falling into classification "B" and "C" of the PG-SGA tool were summed as those patients at risk of malnutrition. While for RMNST data, scores of more than five were classified as those at risk of malnutrition.[10]

Body weight was measured with electronic digital scales, and height was measured by microtoise to the nearest 0.5 kg and 0.5 cm, respectively. The Mid Upper Arm Circumference was measured by measuring the circumference of the upper arm at the middle point between the end of olecranon and the tip of acromion is measured using a standardized tape.[13] Albumin, hemoglobin, and TLC were also performed using secondary data from latest laboratory readings results. The value for TLC, which less than 1,500 cell/mm^3 was classified as malnutrition for both genders. [14] Normal hemoglobin level for males 13 g/dL and females 12 g/dL. [15] Serum albumin levels less than 3,5 g/dL are known as a parameter for malnutrition. [14] Handgrip strength was measured using hand grip strength dynamometer with position of the patient seated with their shoulders adducted, elbows flexed into 90° this measurement was repeated three times then mean was calculated.[16]

Characteristics of patients were presented by descriptive analysis. The sensitivity, specificity, maximum sum of sensitivity and specificity (MSS), positive predictive value (PPV), and negative predictive value (NPV) were determined to compare the accuracy of each screening tool in detecting malnutrition. Discrimination values of AUC determine the accuracy of a nutrition screening tool in detecting malnutrition. Values for each nutrition screening tool were interpreted as acceptable (0.70–0.80), excellent (0.80–0.90), or outstanding or the highest level (>0.90).[17] An independent sample t-test was performed to compare the nutrition screening tools and nutritional assessment. Significance was set by the P-value <0.05 with 95% CI.

RESULTS

In this study, we included 175 patients (42 males and 133 females), predominantly <60 years of age (80.6%). Most of the patients had gynecologic cancer (53,7%) (Table 1). The nutrition screening tools identified patients with risk of malnutrition differently. Figure 1, showed that nutritional screening by the NRS 2002, SNST, and RMNST identified patients who were at risk of malnutrition as 64.5%; 58.9%; 84.5%, respectively, while the MST and RMNST identified patients were only 49.1%; 30.3% respectively.

Table 1 Characteristics of Participants (n=175)

Characteristics	n	%
Sex		
Males	42	24.0
Females	133	76.0
Age (years)		
18-40 years old	22	12.6
41-60 years old	127	72.6
61-80 years old	26	14.9
Education degree		
Elementary	71	40.6
High school	86	49.1
University	18	10.3
Cancer Diagnose		
Head-neck	17	9.7
Breast	5	2.9
Liver	7	4.0
Gynecologic	94	53.7
Lung	15	8.6
Colon and Rectum	15	8.6
Leukemia	19	10.8
Others	3	1.7

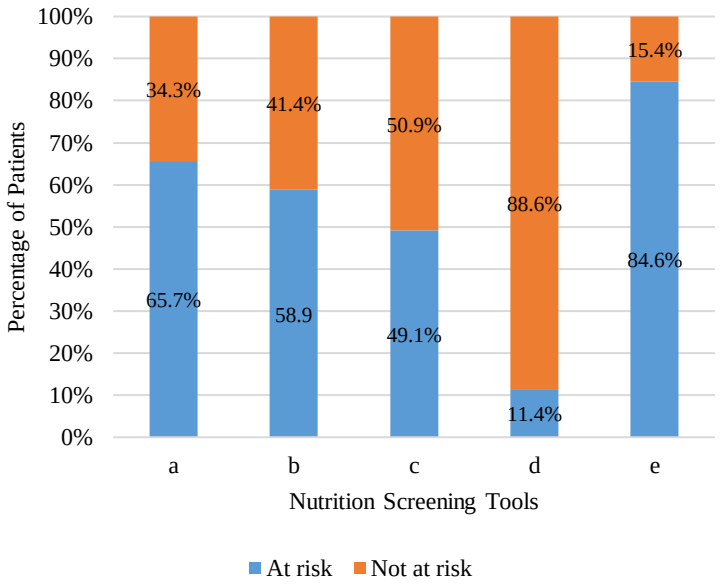

Figure 1. Prevalence Risk of Malnutrition based on Different Nutritional Screening Tool – a: Nutrition Risk Screening 2002; b: Simple Nutrition Screening Tool; c: Malnutrition Screening Tool; d: Nutriscore; e: Royal Marsden Nutrition Screening Tool.

The accuracy of each nutrition screening tool in identifying the risk of malnutrition against PG-SGA is shown in Table 2. The RMNST and SNST had the highest sensitivity, which means these nutrition screening tools are good for detecting malnutrition. Whereas the Nutriscore has high specificity but low sensitivity, The highest MSS (maximum sum of sensitivity and specificity) was achieved by SNST, which means that the higher the MSS value, the better the tool. Table 2 showed that the SNST was to be an excellent nutrition screening tool because it had the highest Area Under ROC Curve (AUC) discrimination.

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Table 2 Accuracy of Screening Tools to Identify malnutrition (as determined by Patient-Generated Subjective Global Assessment)

Nutrition Screening	Sensitivity	Specificity	MSSS	PPV	NPV	AUC (95% CI)
SNST	81.7	90.9	172.6	95.1	69.4	0.8 (0.8-0.9)
MST	64.2	83.6	147.8	89.5	51.7	0.7 (0.6-0.8)
Nutriscore	43.3	98.1	141.4	98.1	44.3	0.7 (0.6-0.7)
RMNST	97.5	43.7	141.2	79.1	88.9	0.7 (0.6-0.7)

SNST: Simple Nutrition Screening Tool, MST: Malnutrition Screening Tool, RMNST: Royal Marsden Nutrition Screening Tool, MSSS: maximum sum of sensitivity and specificity, PPV: positive predictive value, NPV: negative predictive value, AUC: area under the curve.

The association between the nutrition screening tool score with nutritional assessment is shown in Table 3**.** There are significant associations between NRS 2002, SNST, and RMNST with all the nutritional status parameters (p<0,05) except for the TLC. There were no significant associations (p>0,05) between MST and Nutriscore with all nutritional parameters except for the MST with handgrip strength. The analysis also showed that patients at risk of malnutrition had a lower average value for nutritional assessments such as BMI, MUAC, albumin, Hb, and TLC compared with patients who are not at risk of malnutrition.

Table 3 Association Between Nutrition Screening Parameter by NRS 2002, SNST, MST, Nutriscore, and RMNST with Anthropometric and Biochemical Assessment

Nutrition Tool	Screening	Nutritional Parameters					
		BMI (kg/m^2)	MUAC (cm)	HGS	Albumin (g/dl)	Hemoglobin (g/dl)	TLC (cell/mm^3)
NRS 2002	At-risk (n=113)	20.35±4.57*****	23.7±4.24*****	13.56±6.07*****	3.44±0.61*	10.74±1.99	1.810±2.10
	Not at risk (n=62)	23.20±3.27*****	26.46±3.97*****	16.99±7.74*****	3.64±0.74*	11.14±1.86	1.764±2.00
SNST	At-risk (n=103)	20.89±4.65*	24.06±4.39*****	13.65±6.75*****	3.35±0.61*	10.56±2.12	1.719±2.16
	Not at risk (n=72)	22.03±3.86*	25.56±4.12*****	16.38±6.80*****	3.74±0.68*	11.33±1.59	1.900±1.92
MST	At-risk (n=86)	21.68±4.78	24.96±4.25	13.40±6.49*	3.39±0.63	10.55±2.21	1.915±2.39
	Not at risk (n=89)	21.05±3.93	24.39±4.42	16.10±7.03*	3.62±0.69	11.19±1.63	1.677±1.69
Nutri-score	At-risk (n=53)	20.95±3.81	24.46±4.20	13.24±6.60	3.40±0.65	10.70±2.03	1.602±1.37
	Not at risk (n=122)	22.30±5.35	25.15±4.64	15.44±6.93	3.56±0.68	10.96±1.93	1.878±2.33
RM-NST	At-risk (n=53)	21.09±4.53*	24.38±4.45*	14.33±6.75*	3.44±0.67*	10.73±2.02*	1.811±2.22
	Not at risk (n=122)	22.81±3.03*	26.26±3.27*	17.22±7.23*	3.89±0.55*	11.68±1.29*	1.697±0.73

*Significant p<0.05. NRS 2002: Nutrition Risk Screening 2002, SNST: Simple Nutrition Screening Tool, MST: Malnutrition Screening Tool, RMNST: Royal Marsden Nutrition Screening Tool, BMI: body mass index, MUAC: mid-upper arm circumference, HGS: hand grip strength, TLC: total leukocyte count.

Malnutrition is one of the problems for oncology patients. More than 40% of female malignancies are gynecological cancers which is cancer cervix,[16] It appeared the most frequent cancer among females. [17] We found that almost half of the patients were gynecological cancer (53.7%). A previous study found that the peak age group in gynecological cancer was between 45-54 years old as shown in Table 1. Our study showed that the prevalence of malnutrition in oncology patients has ranged from 30%-83%. This discovery is quite high for the prevalence of cancer-related malnutrition.[2-5] As the first step of the nutrition care process, nutrition screening has an important role in detecting the risk of malnutrition before implementing nutritional support.

DISCUSSION

The performance of each screening tool in identifying the risk of malnutrition as determined by the PG-SGA is presented in Table 2. Due to detecting the risk of malnutrition, such a tool would identify all malnourished patients for assessment. The SNST and RMNST have a high sensitivity (81.7%; 97.5%). The MST and Nutriscore were showing high specificity but had low sensitivity (83.6%; 98.1%), indicating that malnourished patients could be overlooked using these nutrition screening tools. Our study found that

according to PG-SGA, the incidence rate of malnutrition in cancer patients was 68.6%. Martins reported that PG-SGA could be demonstrated as a significant association in predicting cancer cachexia and death in oncology patients.[20]

According to van Bokhorst-de van der Schueren et al. a good validity of the screening tools has both sensitivity (Se) and specificity (Sp) of >80%. [21] In this research, a screening tool that was considered into good validity was only the SNST (se 81.7% and sp 90.9%), while MST was fair due to the sensitivity or specificity <80% and both are >50% (se 64.2% and sp 83.6%). Lastly the RMNST and Nutriscore were considered poor due to the sensitivity or specificity <50% (se 97.5% and sp 43.7%; se 43.3% and up 98.1%, respectively). The sensitivity of SNST was higher than the specificity. This follows the theory that a nutrition

screening tool should have high sensitivity to predict more malnutrition risk in patients.[22] The RMNST has the highest sensitivity, but the specificity of the RMNST was poor compared to PG-SGA as a gold standard (43.6%). This would result in the classification of normally nourished patients into the category of malnourished or at risk of malnutrition. Likely, the inclusion of questions within the RMNST that are specifically related to symptoms affecting food intake could contribute to this misclassification. [11]

The MST and Nutriscore demonstrated a specificity of 83.6% and 98.1%, respectively, which was good but lower than previous studies undertaken in the outpatient setting.[11-12] This study showed it to be highly specific because of the high number of false-negative in this both screenings. The false-positive probably contributed to the early detection and diagnosis of cancer which many patients were not at risk of malnutrition but actually were diagnosed with cancer. This finding showed that both screenings are good for catching the actual cause of diseases rather than predicting the presence of malnutrition. Nutriscore focused on the tumor site and treatment for cancer patients, which can present different figures on malnutrition.[11]

The AUC evaluates the tool's ability to discriminate between malnourished and well-nourished participants correctly. It is also useful in determining the performance of the screening tools as compared to PG-SGA. As the new screening tool in Indonesia, SNST has the best performance, which achieved an AUC of 0.8. Based on the reported research by van Bokhorst-de van der Schueren et al, a good validity of the screening tools that have an AUC of >0.8. In our study, we found that a screening tool that was considered good was also only the SNST (0.9), while the others were considered fair due to their AUC ranging from 0.6 – 0.8 (MST 0.7; Nutriscore 0.7; RMNST 0.7). [21] This result is in accordance with the study of Nuraini, who stated that the SNST has a better validity than the NRS 2002 and RMNST.[20] Nutriscore and RMNST also show good performance with AUC >0.7, which would be interpreted as acceptable screening tools to identify malnutrition. A study by Sarasati showed that patients who were at risk of malnutrition based on NRS 2002, SNST, and Nutriscore had lower nutritional assessment compared with patients not at risk of malnutrition.[23]

All of the screening forms included questions about recent weight loss more than 10% in three months would be categorized as severely malnourished. Our study found that mean BMI from at-risk and not at-risk groups was ranged from 20-23 kg/m^2. Bodyweight may also have been influenced in extreme cases by tumor mass and response to treatment. Low initial BMI and more pronounced weight loss in cancer patients strongly correlate with lower survival and worse disease outcomes.[24] These factors make body weight to be a less reliable indicator of malnutrition.

The salient point is the negative energy balance and skeletal muscle loss observed, which is driven by a combination of reduced food intake and metabolic derangements.[26-27] Reduced skeletal muscle mass and function also occur in inpatients with cancer. Our study found that the malnourished group had a HGS range of 13.24-13.65 kgs, while well-malnourished subjects ranged from 15.44-16.99 kgs. According to the European Working Group on Sarcopenia, our subjects were had weak strength, which defined as dynapenia (HGS <30 kg for men and <20 kg for women).[28] Previous study in oesophago-gastric cancer showed that low muscle mass is strongly correlated with malnutrition, such as low anthropometric assessment. [29] Immune function is impaired in malnourished cancer patients and can be used to assess nutritional status. We did not find a significant correlation between nutrition screening tools with TLC. Despite the fact that lymphocyte counts can describe the severity of malnutrition, it depends on some hematological malignancies, immunosuppressive drugs, and infections.[25]

Serum albumin and hemoglobin provide a simple method of estimating visceral protein function and also being part of inflammation suppression. Almost half of our subjects were hypoalbuminemia (48.6%). Hypoalbuminemia in cancer patients supports the possibility of enhanced albumin catabolism in these metabolically affected patients.[30] Our study found that almost all of our cancer patients were anemia with hemoglobin levels ranging 10.55–11.14 g/dl in both malnourished and well-malnourished groups. Both low serum albumin and hemoglobin were also revealed in the previous study.[28-30] Anemia is a common condition in cancer patients associated with most chronic conditions and be a consequence of both myelosuppression of stem cells by tumor cell products and cytotoxic therapy. [24,31]

The search for indicators that reflect nutritional status changes in oncology patients is the most important because by identifying patients with risk of malnutrition before the evident signs such as body weight and weight loss are observed, early nutrition intervention can be established.[32] Our study found a significant association between nutritional screening with nutritional assessment, such as BMI, MUAC, hemoglobin, and albumin serum level, except for the TLC. This result is also in accordance with the previous study.[23] The cancer patient will be inserted with anti-cancer treatments such as chemotherapy, radiotherapy, and surgery. This treatment will make consequences of malnutrition which is characterized by weight loss, anorexia syndrome, and reducing food intake. Our study did not analyze the association between cancer treatment with nutritional status, which may become our limitations. Nevertheless, Nutriscore also included cancer treatment into screening questions to ensure that the severity of malnutrition may occur from the treatment.

A potential strength of our research is that we can present that various nutrition screening tools can be used in clinical settings. Besides, they are significantly associated with all objective assessments. Besides NRS 2002 and MST, which have been recommended for clinical settings, the SNST should be considered to be one of the valid and reliable screening tools to detect the risk of malnutrition for inpatient cancer. Our study revealed that new screening tools for oncology patients, Nutriscore and RMNST, showed good performance for detecting malnutrition and need to be developed more.

CONCLUSION

The prevalence of malnutrition in oncology patients was quite high based on nutritional screening and assessment. All the nutrition screening tools appropriately predict malnutrition in hospitalized cancer patients in Indonesia. Besides nutritional screening, nutritional assessment must be carried out since admission to ensure the severity of malnutrition so early detection can be prevented. Further research should explore the use of nutritional screening and intervention before, during, and after hospitalization to ensure the appropriate nutritional intervention.

ETHICAL STATEMENT

All procedures performed in studies involving human participants were under the ethical standard by the Ethics Committee, Faculty of Medicine, Nursing and Public Health Universitas Gadjah Mada and the approval number was KE/FK/0850/EC/2018. Informed consent was obtained from all participants included in this study.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest. This study was funded by a research grant from Universitas Gadjah Mada.

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