

Screening for nutritional risk in hospitalized children: comparison of two instruments

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Abstract

Background Malnutrition in hospitalized children has negative impact on morbidity, mortality, length of stay, and health-care cost. A simple screening tool is needed to detect hospital malnutrition risk in children.

Objective To compare the level of agreement of the *Screening Tool for Malnutrition in Pediatrics* (STAMP) and *Pediatric Nutritional Risk Score* (PNRS) with anthropometric measurements, as screening tools for hospital malnutrition in children.

Methods A cross-sectional study was conducted from February to July 2014 in the Pediatric and Surgery Wards at H. Adam Malik Hospital, Medan, North Sumatera. Inclusion criteria were children aged 2 to 18 years who were hospitalized for more than 72 hours. Subjects were screened using STAMP and PNRS, and underwent anthropometric measurement on admission. The weight measurements were repeated on the 3rd and 7th days, and just before discharge. The STAMP and PNRS results were compared in terms of level of agreement with anthropometric measurements. Data were analyzed by Kappa value and Spearman's correlation test.

Results A total of 127 children were screened with both instruments. The PNRS had slight agreement with hospital malnutrition prevalence ($K=0.175$; $P=0.028$), while STAMP had not ($K=0.080$; $P=0.193$). Both screening tools had weak positive correlations with length of stay, but the correlation was stronger for PNRS than for STAMP ($r=0.218$; $P=0.014$ vs. $r=0.188$; $P=0.034$, respectively). The prevalence of hospital malnutrition was 40.9%.

Conclusion The PNRS screening tool has slight agreement with anthropometric measurement for identifying hospital malnutrition risk in children. [Paediatr Indones. 2017;57:117-23; doi: <http://dx.doi.org/10.14238/pi57.3.2017.117-23>].

Keywords: hospital malnutrition; STAMP; PNRS; anthropometric

Hospital malnutrition (HM) is malnutrition that occurs in hospitalized patients.¹ Many factors contribute to the development of HM, such as decreased dietary intake caused by anorexia, feeding difficulties, side effects of medication, and other external factors such as invasive diagnostic or therapeutic procedures.² Poor nutritional status in hospitalized children has been associated with negative outcomes, including longer recovery time, greater requirement for intensive care, more complications, nosocomial infections, and even death.³ The prevalence of HM varies depending on the criteria and parameters used to define malnutrition. In European countries and the United States during a ten-year period, 6.1 to 14% of hospitalized children were malnourished.⁴ Two Indonesian studies reported higher prevalence of HM, from 24.3 to 24.8%.^{5,6}

In order to prevent HM, it is important to promptly identify the nutritional risk in hospitalized children, using nutritional screening tools. Several instruments have been developed, but there is a paucity of study on the application of these tools. The

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Pediatric Nutritional Risk Score (PNRS) and *Screening Tool for the Assessment of Malnutrition in Pediatrics (STAMP)* have been developed and validated by some institutions.^{7,8} We aimed to compare the level of agreement between PNRS and STAMP with anthropometric measurement, to identify hospital malnutrition risk in children.

Methods

A cross-sectional study was conducted from February to July 2014 in the Pediatric and Surgery Wards of Haji Adam Malik Hospital, Medan, North Sumatera. Both PNRS and STAMP scores were determined for all eligible pediatric patients. The inclusion criteria were children aged two to 18 years admitted to either the Pediatric or Surgery Ward, with length of stay at least 72 hours, who could undergo height measurement in a standing position, and whose parents gave informed consent. Children who were moved to the intensive care unit, had decreased consciousness or neurologic deficits such as spasticity, were diagnosed with congestive heart failure or nephrotic syndrome, were excluded. Further information was collected on age, sex, weight, height, length of stay, and reason for admission (disease category). We provided information about this study to the parents and subjects prior to data collection. This study was approved by the Health Research Ethics Committee of University Sumatera Utara.

Subjects' weights and heights were measured on the day of admission. Weight measurements were repeated on the 3rd and 7th days, and just before discharge, using a calibrated electronic scale (*Camry*®,

China; precision 0.1 kg). Heights were measured using a calibrated 2-meter microtoise (precision 0.5 cm). Nutritional status was determined according to the *World Health Organization (WHO)* growth chart for children ≤ 5 years old,⁹ and the *Centers for Disease Control (CDC)* growth chart for children aged > 5 years.¹⁰ Malnutrition was defined based on Waterlow criteria, which classified subjects into normal, mild-moderate malnutrition, severe malnutrition, overweight, and obese.¹¹ Hospital malnutrition was diagnosed if there was weight loss ≥ 2% for length of stay ≤ 7 days, 5% for length of stay 8 – 30 days, or 10% for length of stay > 30 days.⁷

Application of screening tools to assess nutritional risk was performed within the first 48 hours of admission. The PNRS score consisted of three parameters, namely, disease pathology, pain, and food intake. Disease pathology was classified as mild (grade 1) for conditions involving mild stress factors, e.g., admission for diagnostic procedures, minor infections not necessarily requiring hospitalization, other episodic illnesses, or minor surgery. Grade 2 conditions involved moderate stress factors, e.g., severe but not life-threatening infection, routine surgery, fracture, chronic illness without acute deterioration, or inflammatory bowel disease. Grade 3 conditions involved severe stress factors, e.g., AIDS, malignancy, severe sepsis, major surgery, multiple injuries, acute deterioration of chronic disease, and major depression.⁷ Pain was assessed using a visual analogue scale with rating from 0 (no pain) to 10 (worst pain imaginable). The cut-off point was a rating > 4.¹² Food intake was recorded by the investigator using 24-hour dietary recall. Score 0 was given for no pain, food intake > 50%, and grade 1 disease

Table 1. The pediatric nutritional risk score⁷

Risk factors [coefficients]		Score	Nutritional risk
Pathology of disease	Pain [1] and/or food intake < 50% [1]		
Mild (grade 1) [0]	Neither	0	Low
Mild (grade 1) [0]	One applies	1	Moderate
Mild (grade 1) [0]	Both apply	2	Moderate
Moderate (grade 2) [1]	Neither	1	Moderate
Moderate (grade 2) [1]	One applies	2	Moderate
Moderate (grade 2) [1]	Both apply	3	High
Severe (grade 3) [3]	Neither	3	High
Severe (grade 3) [3]	One applies	4	High
Severe (grade 3) [3]	Both apply	5	High

pathology. Score 1 was given for pain, food intake < 50%, and grade 2 disease pathology. Score 3 was given for grade 3 disease pathology. The total score of 3 parameters was recorded as the hospital malnutrition risk score, which ranged from 0-5. The PNRS score is described in **Table 1**.

The STAMP score assessed three elements: clinical diagnosis, nutritional intake, and anthropometric measures. Clinical diagnoses were divided into definite (score 3), possible (score 2), or no (score 0) nutritional implication. Nutritional intake was assessed by asking the parent/caregiver about the subject's recent food intake: no intake at all (score 3), recently decreased

or poor intake (score 2), or no change/good intake (score 0). Weights and heights were measured for the anthropometric component of the tool, then the score was determined using the appropriate growth chart (CDC or WHO, based on the child's age). The total score of all 3 elements determined the risk of malnutrition, and was classified into low, medium, and high risk. This tool is accompanied with a care plan based on overall malnutrition risk. If the result was low risk, the STAMP score was not repeated. But if the result was medium risk, the STAMP score was repeated after 3 days, and nutritional intake was monitored for 3 days. If the result was high risk, the

Table 2. The screening tool for the assessment of malnutrition in pediatrics (STAMP) form

Step 1 - Diagnosis				
Does the child have a diagnosis that has any nutritional implications?	Score	1 st screening	2 nd screening	3 rd screening
Definite nutritional implications	3			
Possible nutritional implications	2			
No nutritional implications	0			
Step 2 - Nutritional intake				
What is the child's nutritional intake?	Score	1 st screening	2 nd screening	3 rd screening
No nutritional intake	3			
Recently decreased or poor nutritional intake	2			
No change in eating pattern and good nutritional intake	0			
Step 3- Weight and height				
Use a growth chart or the centile quick reference tables to determine the child's measurement	Score	1 st screening wt: ht:	2 nd screening wt: ht:	3 rd screening wt: ht:
> 3 centile spaces/ ≥ 3 columns apart (or weight < 2 nd centile)	3			
> 2 centile spaces/= 2 columns apart	1			
0 to 1 centile spaces/columns apart	0			
Step 4 - Overall risk of malnutrition				
Add up the scores from the boxes in step 1 – 3 to calculate the overall risk of malnutrition	Score	1 st screening	2 nd screening	3 rd screening
High risk	≥ 4			
Medium risk	2-3			
Low risk	0-1			
Step 5 - Care plan				
What is the child's overall risk of malnutrition, as calculated in step 4?	Use management guidelines and/or local nutritional policies to developed a care plan for the child			
High risk	<ul style="list-style-type: none"> • Take action • Refer the child to a Dietitian, nutritional support team, or consultant • Monitor as per care plan • Monitor the child's nutritional intake for 3 day 			
Medium risk	<ul style="list-style-type: none"> • Repeat the STAMP screening after 3 days • Amend care plan as required • Continue routine clinical care 			
Low risk	<ul style="list-style-type: none"> • Repeat the STAMP screening weekly while the child is an in-patient • Amend care plan as required 			

subject was referred to a nutritional consultant for further action, and STAMP screening was repeated after 3 days.¹³ The STAMP form is shown in **Table 2**.

Data were processed and analyzed with SPSS version 20.0. The K statistical analysis (a chance-corrected index of agreement) was performed to determine the level of inter-tool agreement between both instruments and anthropometric measurement. Spearman's rank correlation test was used to analyze for a possible correlation between screening tool scores and length of stay. We also calculated the prevalence of HM. Results were considered to be statistically significant for P values < 0.05.

Results

A total of 127 children participated in the study, of whom 70 (55%) were male. Subjects' median age was 11.5 years (range 2.2 to 18.0 years). Their nutritional statuses on admission were mostly normal (55 subjects; 43.3%), while on discharge, most children had mild-moderate malnutrition (56 subjects; 44.1%). Mean length of stay was 8.6 days. According to PNRs, 81 children (63.8%) were at high risk, while 103 children (81.1%) had STAMP scores in the high risk category. The prevalence of HM in this study was 40.9%. The demographic data of subjects is shown in **Table 3**. The largest disease categories were oncology (36.2%) and hematology (23.6%). Only four patients (3.1%) had endocrinological conditions.

The results of the Kappa statistical test of PNRs and STAMP are explained in **Table 4**. The PNRs score had significant, slight agreement with hospital malnutrition, while the STAMP had not, for

Table 3. Subject's demographic data

Characteristics	N=127
Median (range) age, years	11.5 (2.2-18.0)
Gender, n (%)	
Male	70 (55.1)
Female	57 (44.9)
Mean length of stay (SD), day	8.6 (4.60)
Disease category, n (%)	
Oncology	46 (36.2)
Hematology	30 (23.6)
Infection	20 (15.7)
Gastrohepatology	8 (6.3)
Allergy-immunology	7 (5.5)
Surgery	6 (4.7)
Cardiology	6 (4.6)
Endocrinology	4 (3.1)
Nutritional status on admission, n(%)	
Normal	55 (43.3)
Mild-moderate malnutrition	54 (42.5)
Severe malnutrition	8 (6.3)
Overweight	3 (2.4)
Obesity	7 (5.5)
Nutritional status on discharge, n(%)	
Normal	50 (39.4)
Mild-moderate malnutrition	56 (44.1)
Severe malnutrition	11 (8.7)
Overweight	4 (3.1)
Obesity	6 (4.7)
Nutritional risk	
PNRS, n(%)	
Low	2 (1.6)
Moderate	44 (34.6)
High	81 (63.8)
STAMP, n(%)	
Low	1 (0.8)
Medium	23 (18.1)
High	103 (81.1)
Prevalence of HM, n(%)	52 (40.9)

identifying hospital malnutrition risk.

Correlations between PNRs and STAMP scores on day one and length of stay are described in **Table 5**.

Table 4. Cross-tabulation of agreement between PNRs, STAMP, and hospital malnutrition

Hospital malnutrition	PNRS		STAMP	
	Low risk*	High risk	Low risk*	High risk
Yes	13	39	7	45
No	33	42	17	58
Sensitivity (%)		92.8		86.5
Specificity (%)		44.0		22.7
PPV		0.48		0.43
NPV		0.71		0.71
K value		0.175		0.080
P value		0.028		0.193

PPV: positive predictive value; NPV: negative predictive value; *Low- and medium-risk categories grouped

Both instruments had positive, but weak correlations with length of stay, indicating that higher PNRS or STAMP scores on day 1 were predictive of longer length of stay.

The associations between disease category and nutritional risk or HM are described in **Table 6**. Disease category was associated with nutritional risk based on PNRS and STAMP scores ($P < 0.05$), but not with HM ($P > 0.05$). The prevalence of HM was highest in the surgery group (83.3%).

Table 5. Correlation between PNRS or STAMP scores on day 1 and length of stay

Score on day 1	Length of stay (r)*	P value
PNRS	0.218	0.014
STAMP	0.188	0.034

*Spearman's rangk correlation test

Table 6. Association between disease category with nutritional risk and HM

Disease category	n	PNRS		STAMP		HM n(%)	P value		
		Low-moderate	High	Low-medium	High		PNRS	STAMP	HM
Oncology	46	4	42	6	40	24 (52.2)			
Hematology	30	15	15	11	19	8 (26.7)			
Infection	20	9	11	2	18	9 (45.0)			
GH	8	5	3	1	7	2 (25.0)			
Allergy-immunology	7	0	7	0	7	1 (14.3)	0.0001*	0.043*	0.100*
Surgery	6	3	3	2	4	5 (83.3)			
Cardiology	6	6	0	0	6	2 (33.3)			
Endocrinology	4	4	0	2	2	1 (25.0)			

HG=gastro-hepatology, *Wilcoxon rank sum test

Discussion

Hospital malnutrition is a health problem of worldwide concern, even in developed countries. The prevalence of HM found in our study was 40.9%, which exceeded the prevalence in two previous Indonesian studies, 24.3% in Malang,⁵ and 24.8% in Bali.⁶ The difference may have been caused by different ages of subjects. In our study, subjects were children aged 2 to 18 years, while in the Bali study subjects were aged 2 months to 12 years. A French study also reported a 45% HM prevalence.⁷ The risk of malnutrition increases if nutritional status upon hospital admission is already compromised. Indeed this was the case in our study, as five out of eight children (62.5%) who came with severe malnutrition were classified to have HM on discharge. The largest proportions of disease in our subjects were oncology and hematology.

Nutritional risk can be identified on admission by applying instruments and scoring based on factors considered to contribute to hospital malnutrition. Five instruments have been developed and validated during the past ten years. The *Screening Tool for Assessment of Malnutrition in Pediatrics* (STAMP) and *Pediatric Nutritional Risk Score* (PNRS) were among

those instruments. Anthropometric measurements are used to assess nutritional status worldwide. In terms of agreement with anthropometric measurements, we found that PNRS scores had a significant, slight agreement ($K=0.175$; $P<0.05$) with anthropometric measurements, while STAMP had not ($K=0.080$; $P>0.05$). These results suggest that PNRS had better agreement with anthropometric measures, and can be used to promptly identify children with nutritional risk. A previous study in Bali also validated PNRS for accuracy against anthropometric measures, with sensitivity 79% and specificity 71%.⁶ To date, there is no accepted gold standard for screening malnutrition risk in hospitalized children, therefore, we sought to validate the tools by analyzing the inter-tool agreement with Kappa test. The numbers of children classified as high risk using both instruments were quite high, 81 children (63.8%) with PNRS and 103 (81.1%) with STAMP. As the nutritional screening tools were intended for early detection and to prevent HM, higher sensitivity is better even at the expense of low specificity. As such, the tools tend to classify children as high risk at the beginning, but not all "high

risk children” became HM on discharge, probably because nutritional intervention has been done.

In our study, both instruments showed only slight agreement with anthropometric measurements ($K < 0.2$) for determining nutritional risk. Similarly, a study which compared four screening tools (STAMP, PNRS, STRONGkids, and PYMS) with anthropometric measurements showed substantial inter-tool agreement between those four instruments ($K > 0.7$), but slight agreement with anthropometric measurements ($K < 0.1$).¹⁴ Another study in the United Kingdom (UK) compared three screening tools (PYMS, STAMP, and SGNA) with full dietitian assessment by an independent dietitian as the gold standard. They found that inter-rater agreement for PYMS, STAMP, and SGNA were 0.51, 0.34, and 0.24, respectively.¹⁵ The UK study found that STAMP had fair agreement with a full dietitian assessment. We found that STAMP had no agreement ($K = 0.080$; $P > 0.05$) with anthropometric measurement. In contrast to the UK study, we used anthropometric measurement as the reference standard to evaluate the screening tools, while the UK study used assessment by dietitian as the gold standard. This difference may have led to differing Kappa value results. In addition, we found that STAMP had sensitivity 86.5% and specificity 22.5%, In agreement with a study at Hasan Sadikin Hospital, Bandung, where STAMP and STRONGkids were compared to SGNA as the gold standard. Wonoputri et al. found STAMP to have a high sensitivity of 100% and specificity of 11.54%.¹⁶ They also evaluated Kappa value of the three instruments against anthropometric measures, and found that STAMP had slight agreement ($K = 0.018$; 95%CI 0 to 0.140) for acute malnutrition, and no agreement ($K = 0$; 95%CI 0 to 0.140) for chronic malnutrition.

We found a high rate of HM in surgery patients, where five out of six children in the Surgery Ward suffered from HM (83.3%). Those five children were admitted for digestive surgical procedures, such as colostomy closure, so they were required to fast before and after the procedure, leading to significant decrease of body weight. The patients were ordered to take nothing by mouth while parenteral nutrition management was inadequate, potentially leading to HM.² Children at high nutritional risk according to PNRS were in the oncology and allergy-immunology

groups, while STAMP identified children in the cardiology and allergy-immunology groups as high risk. Similarly, a UK study assessed two instruments (STAMP and STRONGkids) and described the distribution of nutritional risk by disease category. Cardiology and respiratory disease were in the high risk group.¹⁷ The explanation for these results is the classification of clinical diagnosis that has nutritional implications according to STAMP, and disease pathology according to PNRS, as both put cardiology in moderate risk, but in STAMP there is an anthropometric component where weight and height measurements are plotted to the growth chart. A previous study found that children with cardiology disease often had growth faltering and malnutrition.¹⁸ This component leads to subjects in the cardiology group scoring higher with STAMP, but not with PNRS.

Positive correlations between PNRS and STAMP scores on day one and length of stay were observed ($r = 0.218$ for PNRS and $r = 0.188$ for STAMP; $P < 0.05$), as described in **Table 5**. Higher PNRS or STAMP scores on the first day of admission are predictive of longer length of stay. Length of hospital stay has a significant impact on overall health-care costs.¹⁹ The cost to treat a nutritionally-at-risk patient is 20% higher than the average cost for a patient with a similar disease/condition, but without nutritional risk.²⁰

The strengths of this study are that it provides new information on the prevalence of HM and risk of under-nutrition in a prospectively recruited group of hospitalized children in Medan, North Sumatera. The study was well-accepted by children and their parents and there was consistent assessment of every subject recruited. The limitations of the study were, first, the heterogeneity of disease categories had an imbalanced proportion of subjects that may have affected the results. Other previous studies included subjects with one specific diagnosis, in order to validate the screening tools. Second, the implementation of the screening tools was done by a single physician investigator, and not compared to another observer. A good screening tool must be applicable for healthcare staff other than physicians, such as nurses or nutritionists. Further study is needed to evaluate the ease of use of these instruments by healthcare staff, and their effectiveness after being

performed routinely, with the hope of decreasing the prevalence of HM and overall health-care costs. In Haji Adam Malik Hospital, there are no guidelines for nutritional management between high risk and low-moderate risk patients, because neither tool is put into routine use.

In conclusion, PNRS score has slight agreement with anthropometric measurements, therefore PNRS can be used as routine screening tool to identify HM risk in children. However, many other aspects need to be considered before using such tools, including clinical performance, staff workload, and practicality. By knowing the HM risk, a *Nutritional Support Team* (NST) can design the appropriate interventions to prevent HM.

Conflict of Interest

None declared.

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