Assessment of Nutritional Status Based on $STRONG_{kids}$ Tool in Iranian Hospitalized Children

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Abstract: *Background & Objective*: Malnutrition is very common in hospitalized children and is associated with related clinical consequences such as increased risk of infections, increased muscle loss, impaired wound healing, longer hospital stay and higher morbidity and mortality. The estimated prevalence of acute malnutrition in hospitalized children varies from 6.1 to 40.9% in different countries. The current study was conducted with the aim of evaluating the efficiency of $STRONG_{kids}$ (Screening Tool for Risk On Nutritional Status and Growth) tool for assessing malnutrition in hospitalized children in Iran.

Methods: All children older than 28 days admitted to the pediatric hospital (Dr. Sheikh, Mashhad, Iran) were enrolled in this study and the screening tool named $STRONG_{kids}$ was applied for them. The anthropometric measurements were measured by a trained operator using standard methods and equipments. The children were classified in three groups of being at high risk, moderate risk and low risk of malnutrition.

Results: According to $STRONG_{kids}$ score; 17% of children were classified as low risk, 75% as moderate risk and 8% as high risk group. According to WFH, HFA and WFA z-scores31.4%, 19.2% and 28% of children were identified as moderately and severely malnourished respectively. According to MUAC cut-offs, 3.4% of children were classified as having moderate malnutrition and there was no child with severe malnutrition.

Conclusion: It is very important to recognize the nutritional status of the children as early as possible because of its effects on children's growth. Therefore, evaluating the nutritional status of the hospitalized children is an essential step in clinical assessment. We suggest to apply the $STRONG_{kids}$ score aside with other clinical and anthropometric data.

Keywords: Nutritional screening, Hospitalized children, Iran, $STRONG_{kids}$.

INTRODUCTION

Malnutrition is very common among hospitalized children. It has its related health consequences such as increased risk of infections, increased muscle loss, impaired wound healing, longer hospital stay and higher morbidity and mortality [1, 2]. The World Health Organization (WHO) describes malnutrition as "the imbalance between the supply of nutrients and energy, and the body's demand for them to ensure growth, maintenance, and specific functions [3]. Hospital malnutrition is often a compound of cachexia (linked-disease) and malnutrition (insufficient utilization of nutrients) as opposed to malnutritionalone [4].

The estimated prevalence of acute malnutrition in hospitalized children varies from 6.1 to 40.9% in different countries. In order to intercept malnutrition and specifically hospital-acquired malnutrition, the child nutritional status should be recognized early, at best at the admission, so the proper nutritional intervention could be done as soon as possible [1].

Several screening tools had been designed for evaluating nutritional status of hospitalized children, but none of them has been validated properly and are generally admitted for common usage [1].

In 2007, Hulst *et al*. created a simple tool for estimating nutritional risk. This nationwide survey was conducted in Netherlands, in 44 hospitals over three consecutive days. Four hundred and twenty-four patients with age of more than 30 days and hospitalization length of more than 1 day were included. The screening tool was called Screening Tool for Risk On Nutritional Status and Growth ($STRONG_{kids}$) and include four questions regarding nutritional status of patients at present, presence of an underlying diseases, nutritional intakes and losses, and history of recent weight loss [5, 6].

The current study was performed with the aim of evaluating the efficiency of $STRONG_{kids}$ (Screening Tool for Risk On Nutritional Status and Growth) in determining malnutrition in hospitalized children in Iran.

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METHOD & MATERIAL

All the children older than 28 days (n=100) who had been admitted at Dr. Sheikh Hospital, a tertiary pediatric teaching hospital in Mashhad, were enrolled in this cross-sectional study. The study was performed in 5 consecutive days from May20 to 25, 2014. Patients' demographic data such as age, sex, underlying diseases, diagnosis, and length of stay in hospital (LOS) were collected from their hospital records.

Participant's age ranged from one month to 18 years old. So we divided children into two age groups: (a) 1-72 months and (b) above 6 years.

The study was approved by the research committee of Dr. Sheikh Hospital by ethical committee number of 930452 at 2014 April. Since no intervention was performed on patients and only available patients` data were collected, the written consent was not obtained from parents. However, the researchers stated and clarified the process, nature and importance of study for parents and caregivers.

Anthropometric Measurements

All measurements were performed with a standard method by a single operator (a trained MSc of nutrition), using standard equipments. According to NHANES (national health and nutrition examination survey) height was measured in two forms; recumbent length for all children less than 4 years of age (1- 47 month) by using an infantometer (Seca417) with a fixed head piece and horizontal backboard and an adjustable foot piece, and standing height was measured using a stadiometer (Seca213) with a fixed vertical backboard and an adjustable head piece [7]. Mid-upper arm circumference (MUAC) was also measured by a color tape for all children above 2 years old. MUAC cut-off points were described as less than11.5 cm (Red area), 11.5-12.5 cm (Yellow area) and more than 12.5 cm (Green area) [8]. The registered weight in patient's medical record was considered as the current weight of child. The Seca725 mechanical baby scale for infants and Seca760 mechanical scale for older children weight measurement were applied formerly.

If patients were more than 4 years old, but incapable of standing, the length was measured and 0.7 cm was reduced in order to convert it to height. The patient's height was measured to the nearest 0.1 cm. Body Mass Index (BMI) was calculated for all the children above 2 years old and then the charts were interpreted according to CDC (centers for disease control and prevention) standards [9]. Z-scores were calculated by using a WHO software called "AnthroPlus 1.0.4" for children below 2 years old and with the CDC software called "EPi Info 3.2.2" for children above 2 years old.

Nutritional Status Assessment

According to WHO classification for malnutrition, children with z-scores of less than -3 for weight-for-height (WFH) and height-for-age (HFA) are classified as severely malnourished and stunted, respectively. Those with WFH or HFA z-scores between -3 and -2 are classified as moderately malnourished. Weight for height (WFH) was only calculated for those with a height <120 cm. Z-scores for WFH detects acute malnutrition and height for age (HFA) detects chronic malnutrition. Weight-for-age (WFA) z-scores were also calculated.

STRONG$_{kids}$ Tool

The STRONG$_{kids}$ tool was carried out for all the hospitalized children older than one month to evaluate nutritional status. The total score were calculated for each patient and children were classified into high, moderate or low-risk groups, according to their cut-offs. In addition, scores were re-arranged using adjusted cut-offs proposed by Moeeni *et al*. [10].

Statistical Analysis

Statistical analysis was performed using SPSS software 11.5 for Windows. In order to compare two independent groups, T-test or Mann-Whitney test was used (for data with normal and abnormal distribution, respectively). If the numbers of independent groups were more than two, we applied one-way ANOVA test. Pearson and Spearman's test were used to determine the relationship between two quantitative variables. The significance level was set at < 0.05.

RESULTS

Characteristics of Patients at Entry to Study

Table **1** shows the demographic characteristics of the study subjects. A total of 100 children (63 boys and 37 girls)with a mean age of27.49 months (range 1-72 months) in group 1 and mean age of 10.06 years (range 6-18 years) in group 2 were enrolled in the study. Overall 65 of 100 children(65%) had an underlying chronic disease. Figure **1** shows the common underlying chronic disease in studied patients. The length of hospital stay varied from 1 to 81 days. Thirty-three (33.9%) children were hospitalized for more than 4 days and the mean of LOS was 7.3 days.

Table 1: Characteristics of the 100 Patients

Patient's Characteristic	N = 100
Sex	
Male	63
Female	37
Mean age	
Month	27.4(1-72)
Year	10 (6-18)
Mean Los	7.3 (1-81)
Underlying Disease (%)	65(65%)

LOS=Length of Stay (calculated with range in days).

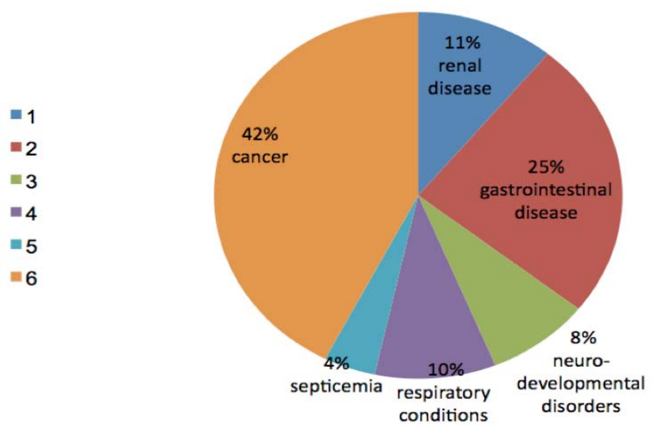

Figure 1: Distribution of children according to cause of admissions. The most common cause of admission was cancer.

STRONG$_{kids}$ Scores and Anthropometrics

According to the STRONG$_{kids}$ score, 17 (17%) of children were at low risk, 75 (75%) at moderate risk and 8 (8%) at high risk of malnutrition. Twenty two children (31.4%) were identified as moderately and severely malnourished according to their WFH z-scores. Nineteen children (19.2%) were identified as having moderate and severe malnutrition according to their HFA z-score. According to MUAC cut-offs, 3.4% of children were classified as being moderately malnourished and there was no child with severe malnutrition. According to WFA z-score28% of children were identified as moderately and severely malnourished. Based on BMI z-scores15.9%, 10.1% and 14.5% of children were identified as having severe, moderate and mild malnutrition, respectively. Table **2** shows the nutritional status of patients. In this study, 45.6 % of malnourished patients were hospitalized in PICU, 43.5% in Nephrology, 23.1%in Hematology, 35% in Emergency and 20.2% in Surgery ward (Table **3**). The mean of LOS was 14 days for malnourished children versus 5 days for non-malnourished children ($p<0.001$). 63% of severely malnourished children and 27% of moderately malnourished children were hospitalized for longer than 4 days ($p<0.001$).

Table 2: Classification of the Anthropometric Indices of the Patients

Anthropometric Index (Unit)	Mean ± SD
Weight (kg)	18.13±12.94
Height (cm)	99.64±29.77
BMI (kg/m^2)	16.32±4.03
IBW (kg)	20.15±13.15
WFA Z-score	-1.14±1.80
HFA Z-score	-1.00±1.68
WFH Z-score	-.96±2.39
BMI Z-score	-.88±2.51
MUAC (cm)	17.43±4.22

BMI: Body Mass Index; IBW: Ideal Body Weight; MUAC: Mid Upper Arm Circumference; WFA: Weight-for-Age; HFA: Height-for-Age; WFH: Weight for Height.

Table 3: Prevalence of Moderate and Severe Malnutrition According to Hospital Ward

Ward	No. (%)	Moderate and Severe Malnutrition (WFH)
Surgery	25 (25%)	20.2%
Nephrology	9 (9%)	43.5%
Hematology	31 (31%)	23.1%
PICU	10 (10%)	45.6%
Emergency	25 (25%)	35%

The Relationship between STRONG$_{kids}$ and Anthropometric Data

The risk stratification of STRONG$_{kids}$ didn't correlate with MUAC ($p=0.886$), LOS ($p=0.111$) HFA ($p=0.384$), WFH ($p=0.314$), WFA ($p=0.979$) and BMI z-scores ($p=0.569$). STRONG$_{kids}$ classified 83% of malnourished children in the moderate and high risk groups. After applying the adjusted cut-offs proposed by Moeeni *et al.* [10], the total number of moderately and severely malnourished patients detected by STRONG$_{kids}$ decreased from 83% to 71%.

DISCUSSION

The aim of this study was to evaluate the efficiency of $\text{STRONG}_{\text{kids}}$ tool in assessing the malnutrition in Iranian hospitalized children. Acute (WFH) and chronic (HFA) malnutrition were detected in about 30.6% and 22.8% of our patients, respectively. In 2008 a survey was performed in Tabriz, one of the cities of Iran. In this study 140 children with the age of 2 to12 years old were recruited from Tabriz pediatrics hospital. They reported the prevalence of acute and chronic malnutrition as 32.2% and 30.7% respectfully [11].

Two studies in the developing country of Thailand was performed in 1985 and with a 10 years interval in 1995.In both of these surveys, the prevalence of malnutrition in children 1-15 years old was similar and between 50%-60% [12].

Nevertheless in the developed countries such as UK, Netherlands, France and Germany, malnutrition is less prevalent with a prevalence of 6% to19% [2].

These reports indicated that the developed and the developing countries are very different in regard to malnutrition prevalence.

According to a Turkish study, prevalence of malnutrition was 55.1% [13]. In a survey in Germany malnutrition has been reported in 24.1% of children admitted to a tertiary care centre [14]. A study from Netherlands reported that 15% and 20% of hospitalized children had acute and chronic malnutrition [15]. The differences in the prevalence of malnutrition in different countries may be related to the differences in their population and different criteria for evaluating malnutrition.

Underlying disease in hospitalized children may be responsible for malnutrition. At least65 of total 100 children who were admitted to the pediatric hospital in the current study had an underlying disease, most of all cancer. Like our study other research also demonstrated similar outcomes? In 2013 ASPEN published a review article and declared that underlying disease affects malnutrition’s prevalence and its range differs between different diseases as follow 40% in patients with neurologic diseases, 34.5% in those with infectious disease, 33.3% in patients with cystic fibrosis, 28.6% in those with cardiovascular disease, 27.3% in oncology patients, and 23.6% in those with GI diseases [3]. In two separate studies by Moeeni *et al*. in 2013 and 2012 in New Zealand and Iran, respectively, about one third to half of malnourished studied children had an underlying disease [10, 16].

In our study, we evaluated the $\text{STRONG}_{\text{kids}}$ tool that was created in a developed country hospital setting, because its applicability could be different in a developing country setting substantially. The $\text{STRONG}_{\text{kids}}$ tool does not include the patient’s weight and height; accordingly make it faster and easier to apply. This tool requires physician assessment which is listed as a useful and reliable screening tool for pediatric patients [5].

The current study considered 83% of children as being at moderate or high nutritional risk according to $\text{STRONG}_{\text{kids}}$ but only 31.4% were actually malnourished according to anthropometric measurements (WFH), which this discrepancy is considerable. Our findings are similar to the results of a prospective observational multi-centre study that was performed in 12 Italian hospitals and showed that70% of patients were at moderate or high nutritional risk according to $\text{STRONG}_{\text{kids}}$, but only approximately 20% were actually malnourished according to anthropometric measurements [2].

Our study demonstrated that the risk stratification of $\text{STRONG}_{\text{kids}}$ didn't correlate with WFH, WFA, BMI z-scores and MUAC. In a study that was comprised 12 Italian hospitals covering 144 Children of 1–18 years old, a significant but weak correlation between the $\text{STRONG}_{\text{kids}}$ score and the parameters of acute and chronic malnutrition was found, which is different from our findings [2]. Also our findings are in contrast with another study by Ling *et al*. that stated $\text{STRONG}_{\text{kids}}$ is significantly related with both BMI and HFA [17]. A study in Mashhad by Moeeni *et al*. declared that $\text{STRONG}_{\text{kids}}$, but not STAMP, correlated with HFA z-score which is dissimilar from our findings [7].

Another survey by Ling *et al*. [17] indicated that both STAMP and $\text{STRONG}_{\text{kids}}$ were able to detect all malnourished patients. Also a survey in New Zealand by Moeeni *et al*. demonstrated that $\text{STRONG}_{\text{kids}}$ can detect all the children with severe and moderate malnutrition (16/16) compared with PYMS (13/16) and STAMP (15/16) [16]. The outcomes of above mentioned studies are in contrast with our study findings, which expresses that $\text{STRONG}_{\text{kids}}$ can detect only 17 ⁄ 21 malnourished hospitalized children, but cannot detect all malnourished patients. Findings from another study which applied current NRS tools, considering their benefits and shortcomings and evaluating the potential roles of these tools, had indicated that STRONG$_{kids}$ was able to detect more than half (53%) of malnourished patients (16/30,) in its moderate to high risk groups, which is similar to our findings [5].

Also Spagnuolo *et al*. showed that prevalence of malnutrition is associated with cause of admission and patients with Gastro-intestinal diseases were more likely to be at high risk group [2]. Their finding is similar to ours which demonstrated high prevalence of malnutrition in children in ICU (80% of children in ICU were admitted for gastrointestinal disease).

Also Moeini *et al*. demonstrated that more undernourished inpatients were male (81.2%) rather than female which is similar to our findings [16].

Mahdavi *et al*. stated that there are no significant differences regarding to sex for prevalence of malnutrition according to WFH which is dissimilar from our findings [11].

In our study the highest prevalence of malnutrition (50%) was observed in ICU ward, and the prevalence of malnutrition in surgical ward was 22%. Tienboon *et al*. showed that about 30% of patients in surgical ward were malnourished at the time of admission [12].

In several studies a relation between LOS and malnutrition according to anthropometric data was detected and malnourished children had a longer LOS compared with normal-nourished ones [5, 7]. Also, in our study the mean LOS was 14 days for malnourished children versus 5 days for non-malnourished children, similar to the previous studies.

Our study didn't find a correlation between STRONG$_{kids}$ risk status and LOS which is in contrast with two studies performed by Moeini *et al*. [5, 10] that found a relationship between the risk stratification of STRONG$_{kids}$ and patient's length of stay.

CONCLUSION

All patients are at risk of malnutrition specially children because of their rapid growth and development. Our study showed high prevalence of malnutrition among hospitalized children. It is very important to recognize then utritional status of child as early as possible because of its effect on his growth, wound recovery, infection, length of stay, rate of survival and mortality. Therefore evaluation of the nutritional status of hospitalized children is an essential step in clinical assessments. The screening tool that is used should be easy and quick to administer, reliable and consistent, with low false positive or false negative findings. We suggest the STRONG$_{kids}$ score to be considered aside with other clinical and anthropometric data because of the mismatch between prevalence of malnutrition according to anthropometrics data and the categorization deriving from the STRONG$_{kids}$ assessment. This fact that a large number of children with severe malnutrition according to anthropometry were classified by STRONG$_{kids}$ as being at low and medium risk, decrease this tool validity.

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