Prevalence of Malnutrition risk Based on Three Nutritional Risk Scores in Hospitalized Iranian children

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ABSTRACT: Objective: It is essential for patients who are malnourished to be identified as soon as admitting to the hospital. Nutrition risk screening (NRS) has been validated to predict the risk of malnutrition. The aim of this study was to assess the nutritional status of hospitalized children and compare the prevalence of malnutrition based on three nutritional risk scores.

Material and Methods: This study applied three NRS tools (STRONGkids, STAMP and PYMS) for children admitted to a pediatric hospital in Mashhad, Iran. These tools, classified as low, medium and high-risk groups. The anthropometric indices of hospitalized children were determined and classified via using standard criteria. Result: The study group was comprised of 115 children. 30.6% were found to have acute malnutrition based on their weight for height (WFH) Z-score and the prevalence of chronic malnutrition was 22.8% according to height for age (HFA) Z-score. PYMS identified 23.5% in the medium-risk group and 52.2% in the high-risk group. STAMP identified 20.9% in medium-risk group and 69.6% in high-risk group. STRONGkids classified 71.3% of children at medium and just 7.8% at high-risk. Only the risk stratification of PYMS was correlated with WFH Z-scores (p<0.001). Weight for age (WFA) Z-scores correlated with the risk stratification of STAMP and PYMS (p<0.001 for both). Conclusion: High prevalence of malnutrition risk was seen among hospitalized children. Also NRS tools were able to detect children at a higher risk of nutritional deterioration; however, variable utility was observed.

Keywords: Malnutrition, Pediatric, Nutrition Screening Tool

INTRODUCTION

Malnutrition is a major health problem in hospitalized Pediatric patients. It is reported that the number of malnourished Pediatric patients varies between 21% and 80%, according to the level of the country's development (1,2,3). Low rates of under-nutrition are reported in developed countries. In contrast, much higher rates of under-nutrition are observed in developing countries. For example, 31.8% of 170 Turkish children and 60% of a group of Thai children were malnourished at admission (2). Malnutrition rates of 6% to 19% have been reported in European countries such as the UK, France, Germany and the Netherlands, reaching 40% in Turkey (3). Since malnutrition affects the quality of one's life, it is essential that patients who are malnourished or at risk of malnutrition are identified as soon as they are admitted to the hospital (1). Indeed, Malnutrition is the result of an imbalance between nutritional requirement and intake. It is associated with poor outcomes, fluid and electrolyte imbalance, depressed ventilator response, decreased response to certain kinds of chemotherapy and other treatment regimens, depressed immune mechanisms, reduced functional status and increased risk of infections such as wound infection and septicemia and catheter related sepsis. Also, increased muscle loss, impaired wound healing, longer hospital stay, increased morbidity and mortality, postoperative complications and slowing of growth have been observed (2), (4), (5).

Nutrition Risk Screening (NRS) refers to a rapid and simple set (easy for routine use to identify patients at risk of malnutrition during hospitalization) of usually two or three questions and include measurements that have been validated to predict the risk of malnutrition. Nutrition screening can be performed by any trained health professional, but is usually completed by nursing or nutrition staff assistants (6).
Several Pediatric NRS tools have been developed in recent years. These include the PYMS, STAMP and STRONGkids. The PYMS tool was introduced in the UK in 2008 in Pediatric patients aged 1-16 years. This tool was developed with three components: patient's current nutritional state (by measuring patient's BMI), the recent changes in nutritional status and the possibility of deterioration of the patient's status as a result of their current disease (2). Screening Tool for the Assessment of Malnutrition in Pediatrics (STAMP) was undertaken by McCarthy et al. to assess British children aged 2-17 years, who were admitted to medical and surgical wards during a four-week period. The STAMP tool considered three elements: clinical diagnosis of the patient and its nutritional implication (if any), nutritional intake and anthropometric measurements. The other tool, STRONGkids, consisted of a questionnaire about the current nutritional status of the patients, existence of underlying diseases, nutritional intakes and losses and history of recent weight loss. STRONGkids was performed in 2007 in a nationwide study in the Netherlands and patients aged 1 month to 16 years were assessed (2).

Three nutrition-risk screening tools are designed to facilitate the early identification of children with an increased risk of nutritional impairment. However, they were all developed in European countries and have not yet been fully evaluated in settings of higher malnutrition rates or in developing countries (7).

**MATERIALS AND METHODS**

**Subjects**

The first aim of our study was to evaluate the nutritional status of hospitalized children in a tertiary Pediatric Hospital in Mashhad (one of the capital cities of Iran), and secondly to compare the different prevalence of malnutrition risk according to these three nutritional risk screening tools.

All children (n=115) admitted to the emergency department of the Dr. Sheikh Hospital, a tertiary pediatric-teaching hospital in Mashhad in May 2014, were enrolled in this cross-sectional study. The Patients' demographic data such as age, sex, underlying disease, diagnosis, and length of hospital stay (LOS) were collected from their hospital records.

The Inclusion criteria were age between 1 month to 18 years, and admitted to a pediatric emergency ward for more than 24 hours.

The age of participants in this study was from 30 days to 18 years old. We divided the children into two age groups: (a) 1-72 months and (b) above 6 years. The study was approved by the institute board of the Dr. Sheikh Hospital. Because of the standard and routine measurements and non-interference in this study, the need for a written consent from each parent was not required. However, the researchers stated and clarified the process, the nature and importance of the study for both parents and caregivers.

**Anthropometric measurements**

All measurements were taken in a standard way by a single operator (a trained MSc. of nutrition), using standard equipment. 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 (birth to 47 months) was measured using an infantometer (Seca 417) with a fixed head piece, horizontal backboard, and an adjustable foot piece; and standing height was measured using a stadiometer (Seca 213) 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 cutoff points were described as 0-11.5 cm (Red area), 11.5-12.5 cm (Yellow area) and more than 12.5 cm (Green area) (8).

The weight in patients was measured by Seca. The Seca 725 mechanical baby scale for infants and Seca 760 mechanical scale for older child's 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 reduced in order to convert it to the 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). Finally, Z-scores were calculated by using a WHO software called "AnthroPlus 1.0.4" for children below 2 years old and the with CDC software called "EPI Info 3.2.2" for children above 2 years old.

**Nutritional status assessment**

The WHO Global Database on Child Growth and Malnutrition uses a Z-score cutoff point of <-2 SD to classify low weight-for-age, low height-for-age and low weight-for-height as moderate and severe undernutrition, and <-3 SD to define severe undernutrition.

According to the WHO classification for malnutrition, children with weight-for-height (WFH) and height-for-age (HFA) Z-scores of less than -3 were classified as severely wasted and severely stunted, respectively. Those with WFH or HFA Z-scores between -3 and -2 were classified as moderately malnourished. Z-scores for WFH detects acute malnutrition and HFA detects chronic malnutrition.
STAMP, PYMS and STRONGkids NRS tools

STAMP, PYMS and STRONGkids tools were used for all hospitalized children older than one month to estimate malnutrition. The total scores were calculated for each child and children were classified into high, moderate or low-risk groups, according to their cutoffs. In addition, scores were re-arranged using adjusted cutoffs proposed by Moeeni et al. (10).

Statistical Analysis

Statistical analysis was done 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 the one-way ANOVA test. Pearson and Spearman’s test were used to determine relationships between two quantitative variables. The significance level was set at < 0.05.

RESULTS

Background characteristics of the patients

The study group was comprised of 115 children (72 boys and 43 girls). The mean age was 27.4±2.87 months (range 1-72 months) and 10±2.07 years (range 6-18 years) in the first and second age group, respectively (Table 1).

Overall 73/115 (63.4%) children suffered from an underlying disease at the time of admission to the hospital. These included renal diseases (n = 8), gastrointestinal diseases (n = 18), neuro-developmental disorders (n = 6), respiratory disorders (n = 7), sepsis (n = 3) and cancer (n = 31).

Thirty nine (33.9%) children were hospitalized for more than 4 days, the median LOS was 1, and the mean LOS was 7.6 ± 12.14 days (range, 1–81 days).

Patients were mainly hospitalized in the Pediatric surgery ward (Table 2).

Nutritional status of children

The prevalence of moderate and severe malnutrition (acute malnutrition) was found in 22(30.6%) patients, according to their WFH Z-scores. Twenty six (22.8%) patients were classified as chronic malnutrition based on their HFA Z-scores. Table 3 showed classification of the anthropometric indices of the patients.

Results of the three NRS tools

PYMS identified 28 (24.3%), 27 (23.5%) and 60 (52.2%) patients as low, medium and high-risk, respectively. STAMP identified 11 (9.6%) children to be at low risk of under-nutrition, 24 (20.9%) at medium risk and 80 (69.6%) at high risk. The STRONGkids tool classified 24 (20.9%), 82 (71.3%) and 9 (7.8%) children as low, medium and high risk, respectively (Table 4).

The relationship between NRS tools and anthropometric data

The evaluated risk by these three tools was compared to the current nutritional status of patients derived from their anthropometric data. The risk stratification of PYMS (but not the other two tools) correlated with WFH Z-scores (p<0.001). WFA Z-scores correlated with the risk stratification of STAMP and PYMS (p<0.001 for both tools). In addition, the risk stratification of STAMP (but not the other two tools) correlated with HFA Z-scores (p<0.001). BMI Z-scores correlated with the risk stratification of STAMP and PYMS tools (p<0.001 for PYMS and p<0.04 for STAMP). STAMP classified more children in the high-risk group compared to PYMS and STRONGkids. STRONGkids classified more children in the moderate-risk group compared to PYMS and STAMP. STAMP detected more malnourished children (21/21) compared to PYMS (20 / 21) and STRONGkids (17/21).

Outcome of NRS tools after using adjusted cutoffs

After applying the adjusted cutoffs proposed by Moeeni et al. (10), the total number of moderate and severe malnourished patients detected by PYMS decreased from 76% to 51%. Also, the total number of moderate and severe malnourished patients detected by STRONGkids decreased from 79% to 67%. However, the number of STAMP risk groups did not change after using the adjusted cutoffs. (table5)

The number of malnourished children detected by PYMS changed from 20/21 to 18/21, and the total number of malnourished patients detected by STRONGkids decreased from 17/12 to 14/21. There was no change in the number of malnourished children detected by STAMP. We observed higher prevalence of malnutrition risk was detected in males according to WFH (p<0.001). The mean range of LOS was 14 days for malnourished children versus 5 days for non-malnourished children (p<0.001). 63% of severe malnourished children and 27% of moderate malnourished children were hospitalized for longer than 4 days (p<0.001).

Table 3 showed the prevalence of moderate and severe malnutrition according to underlying disease.
DISCUSSION

This study was done to evaluate the nutritional status of hospitalized pediatrics in one of the capital cities of Iran. We aimed to develop simple pediatric nutritional risk scores that could be used at hospital admission to identify patients at risk of malnutrition during hospitalization in Iran. The other aim of this survey was to compare the three NRS tools in developing countries.

About 30.6% of the patients in our study had acute (WFH) malnutrition, while 22.8% had chronic (HFA) malnutrition. In a survey done in 2008 in Tabriz, one of the other capital cities in Iran, a total number of 140 children, aged 2-12 years, were admitted into Tabriz Pediatric Hospital and the prevalence of acute (WFH) and chronic (HFA) malnutrition was estimated to be about 32.2% and 30.7% respectively (1).

In two other studies in Thailand (one in 1985 and the other 10 years later), the prevalence of malnutrition risk in children, aged 1-15 years, in the Pediatric ward was between 50%-60% (4). However, based on studies done in developed countries such as the UK, France, Germany and the Netherlands, the malnutrition prevalence was estimated between 6%-19% (3). According to another study from Turkey, the malnutrition prevalence was 55.1% (11). In a survey in Germany, malnutrition has been reported 24.1% in children admitted to a tertiary care center (12). In a study from the Netherlands, 15% and 20% of all hospitalized children was reported to have acute and chronic malnourishment, respectively (13). The differences in the prevalence of malnutrition risk in different countries may be related to the differences in population and different criteria for evaluating malnutrition.

In our study, STAMP, PYMS and STRONGkids classified 69.6%, 52.2% and 7.8% of patients as high-risk, respectively. Therefore, STAMP detected a larger number of children at a higher risk of nutritional deterioration and STRONGkids classified more children in the moderate-risk group. This finding contrast with those of a previous similar study done by Moeeni et al. in 2012 (10) in which PYMS detected more children in the high-risk group. Also STAMP could detect more malnourished patients compared with PYMS and STRONGkids in the mentioned study.

A survey by Ling et al. indicated that both STAMP and STRONGkids were able to detect all malnourished patients (14). Also a survey in New Zealand by Moeeni et al. demonstrated that STRONGkids can detect all of the children with severe and moderate under-nutrition (16/16) compared with PYMS (13/16) and STAMP (15/16) (15). The outcomes of the above mentioned studies are in contrast to our findings, which expresses that STRONGkids can detect only 17 / 21 (80%) of malnourished hospitalized children but cannot detect all malnourished patients. Findings of another study applying current NRS tools, considering their benefits and shortcomings, and evaluating the potential roles of these tools, had indicated that STRONGkids was able to detect more than half (53%) of under-nourished patients (16/30) in its moderate to high risk groups, which is similar to our findings (2).

Our study demonstrated that the risk stratification of STRONGkids didn’t correlate to WFH, WFA and BMI Z-scores. This was in contrast to Spagnuolo et al. which stated STRONGkids’ correlation with HFA Z-scores (3) and another study by Ling et al. that stated STRONGkids is significantly related with both BMI and HFA (16). PYMS and STAMP had a relationship with WFA Z-scores and BMI z-scores. The only screening tool that was correlated with HFA Z-scores in our study was STAMP. A study in Mashhad by Moeeni et al. declared that STRONGkids, but not STAMP, correlated with HFA Z-score, which is different from our findings (2). On the other hand, in our study, PYMS had a deep correlation with WFH Z-scores while the other two tools did not.

In the current study, 73 of 115 children admitted to the hospital had an underlying disease, most common cancer. Spagnuolo et al. showed that prevalence of malnutrition risk is associated with cause of admission and patients with gastro-intestinal diseases were more likely to be at high risk group (3). In a review article published by ASPEN in 2013, the prevalence of malnutrition risk varied depending on the underlying medical condition and ranged from 40% in patients with neurologic diseases, 34.5% in those with infectious diseases, 33.3% in those with cystic fibrosis, 28.6% in those with cardiovascular diseases, and 27.3% in oncology patients, to 23.6% in those with GI diseases (17). In a study that was done by Moeeni et al. in 2013 in New Zealand, 162 children were assessed and about one-third of undernourished children had an underlying disease (15). In another study by Moeeni et al. in 2012 in Iran, almost half of the undernourished children had an underlying disease (10).

In the current study, higher prevalence of malnutrition risk was detected in males according to WFH. Also Moeini et al. demonstrated more male undernourished patients (81.2%) rather than the female which is similar to our findings (15). Mahdavi et al. stated that there are no significant differences regarding to sex for prevalence of malnutrition risk according to WFH (1).

A relation between length of stay (LOS) and malnutrition, according to anthropometric data was detected and showed that malnourished children had a longer LOS than normal-nourished ones (2). 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 STRONGkids risk status and LOS.
which is in contrast with Moeini et al. (2,10) that displayed a relationship between the risk stratification of STRONGkids and patient’s length of stay.

In a recent study done by ASPEN, WFA Z-score was considered as an effective means for malnutrition-assessment in Pediatric patients. The fact that children in early stages of under-nutrition are at an increased risk of deterioration during acute illnesses suggests that preexisting malnutrition has to be taken into account in malnutrition-risk assessment. It also justifies the use of WFA Z-score as an element of the screening tool (18).

**Limitations**

In children older than two years of age, who can’t stand, it is recommended to obtain an alternative proxy measure of height such as arm span, knee height, or tibia length. But in this study, we measured the stature, length and subtracted 0.7 cm to convert it to the height. Also, our study didn’t consider the objective measurements such as biochemical factors and body composition.

**Table 1. Background Characteristics of the study**

<table>
<thead>
<tr>
<th>Patient’s Characteristic</th>
<th>N = 115</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Male, n</td>
<td>72</td>
</tr>
<tr>
<td>Female, n</td>
<td>43</td>
</tr>
<tr>
<td>Mean age</td>
<td></td>
</tr>
<tr>
<td>Months (range)</td>
<td>27.4 (1-72)</td>
</tr>
<tr>
<td>Years (range)</td>
<td>10 (6-18)</td>
</tr>
<tr>
<td>Mean LOS* in days (range)</td>
<td>7.6 (1-81)</td>
</tr>
<tr>
<td>Underlying disease, n(%)</td>
<td>73 (63.4%)</td>
</tr>
</tbody>
</table>

*LOS = length of stay (calculated with range in days)

**Table 2. Classification of the children based on underlying disease**

<table>
<thead>
<tr>
<th>Ward</th>
<th>No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastrointestinal anomalies</td>
<td>18(15.6%)</td>
</tr>
<tr>
<td>Nephrology</td>
<td>8(6.9%)</td>
</tr>
<tr>
<td>Hematology/cancer</td>
<td>31(27%)</td>
</tr>
<tr>
<td>Respiratory disorders</td>
<td>7(6.08)</td>
</tr>
<tr>
<td>Neurodevelopmental disorders</td>
<td>6(5.2%)</td>
</tr>
<tr>
<td>Sepsis</td>
<td>3(2.6%)</td>
</tr>
<tr>
<td>Total</td>
<td>115 (100%)</td>
</tr>
</tbody>
</table>

**Table 3. Classification of the anthropometric indices of the patients**

<table>
<thead>
<tr>
<th>Anthropometric index (Unit)</th>
<th>Mean (Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (kg)</td>
<td>16.18 (2.2,59)</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>93.13 (44,167)</td>
</tr>
<tr>
<td>*BMI (kg/m²)</td>
<td>15.86 (9.10,29.74)</td>
</tr>
<tr>
<td>**IBW (kg)</td>
<td>35.7 (4.50,67)</td>
</tr>
<tr>
<td>***WFA Z-score</td>
<td>-1.15 (-7.44,3.10)</td>
</tr>
<tr>
<td>****HFA Z-score</td>
<td>-1.03 (-6.68,1.8)</td>
</tr>
<tr>
<td>*****WFH Z-score</td>
<td>-0.95 (-11.08,4.17)</td>
</tr>
</tbody>
</table>

*BMI= Body Mass Index; **IBW= Ideal Body Weight; ***WFA= Weight-for-Age; ****HFA= Height-for-Age; *****WFH= Weight for Height

**Table 4. Results of the three NRS tools**

<table>
<thead>
<tr>
<th>Risk of undernutrition</th>
<th>PYMS (%)</th>
<th>STAMP (%)</th>
<th>STRONGkids (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low risk</td>
<td>28 (24.3%)</td>
<td>11 (9.6%)</td>
<td>24 (20.9%)</td>
</tr>
<tr>
<td>Medium risk</td>
<td>27 (23.5%)</td>
<td>24 (20.9%)</td>
<td>82 (71.3%)</td>
</tr>
<tr>
<td>High risk</td>
<td>60 (52.2%)</td>
<td>80 (69.6%)</td>
<td>9 (7.8%)</td>
</tr>
</tbody>
</table>

**Table 5. Results of the three NRS tools after adjustment**

<table>
<thead>
<tr>
<th>Risk of undernutrition</th>
<th>PYMS (%)</th>
<th>STAMP (%)</th>
<th>STRONGkids (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low risk</td>
<td>55 (47.8%)</td>
<td>15 (13%)</td>
<td>37 (32.2%)</td>
</tr>
<tr>
<td>Medium risk</td>
<td>24 (20.9%)</td>
<td>22 (19%)</td>
<td>69 (60%)</td>
</tr>
<tr>
<td>High risk</td>
<td>36 (31.3%)</td>
<td>78 (67%)</td>
<td>9 (7.8%)</td>
</tr>
</tbody>
</table>

**CONCLUSION**

This study was designed to evaluate the efficacy and usefulness of the previously validated screening tools.

Our findings showed high prevalence of malnutrition risk among hospitalized Iranian children. The treatment of malnutrition first requires a malnourished patient to be identified via either screening or
assessment. We can conclude all of these three NRS tools were able to identify children at nutritional risks, but each of them has different efficiencies and advantages.

To confirm these results, further studies of a valid NRS tool are needed for Iran. The ideal screening tool should be quick and easy to apply, and identify most high-risk children while not misclassifying those who are low-risk. We suggested that none of these forms alone are ideal tools in developing countries. Further assessment of NST, in a larger sample size in the developing countries, is also required.

REFERENCES

http://www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/about_childrens_bmi.html (access date: May 2014)
http://www.cdc.gov/nchs/data/nhanes/nhanes_09_10/bodymeasures_09.pdf (access date: August 2014)
http://www.unicef.org/supply/files/Mid_Upper_Arm_Circumference_Measuring_Tapes.pdf (access date: July 2014)