Abstract

Background: Identification of children at risk of malnutrition is not easily achieved in hospital settings.

Aims: This study was designed to assess the merits of using the Screening Tool for Risk on Nutritional status and Growth (STRONGkids) as a nutrition screening tool in hospitalized children aged under three years and correlate it with the severity of their nutritional derangements.

Methods: This cross-sectional study was conducted on 500 children aged under three years admitted to the Children’s Hospital Ain Shams University wards. STRONGkids score was used to assess the risk for nutritional derangements and WHO growth charts were used to define underweight, wasted and stunted patients on admission and upon discharge.

Results: According to STRONGkids score 19.6% of patients were low risk, 42.6% were moderate risk and 37.8% were high risk. Out of the enrolled patients 62.4% were underweight, 58.4% were stunted and 57.8% were wasted. Among the 66 patients with severe malnutrition, nutritional status improved in 6.06% while deterioration was observed in 13.00% of the moderately wasted. STRONGkids score was worse among those who deteriorated which together with its significant positive correlation with the duration of hospital stay emphasize that STRONGkids score can be a predictive tool.

Conclusions: The use of STRONGkids screening tool can ensure early identification of these vulnerable children ensuring prompt nutritional interventions that may contribute to overall improvements in our patients’ care as well as shortening hospitalization period.
Keywords: malnutrition, screening; underweight, paediatrics, hospital.

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Introduction

Malnutrition in hospitalized children is a highly relevant pathologic condition and a risk factor for unfavourable outcomes, prolonged hospital stay, delayed recovery and increased care costs. The reduction of dietary intake, together with the increase of energy requirements are the main causes of hospital undernutrition (1). The reported prevalence of acute malnutrition in infants and children admitted to hospitals from different countries ranges from 6.1 to 40.9% (2). In children with an underlying disease, higher prevalence of chronic malnutrition (44–64%) was reported in several studies (3).

To prevent hospital-acquired malnutrition, the risk of nutritional depletion needs to be identified as soon as possible, best at admission, so that appropriate nutritional intervention can be initiated at an early stage (4). Routine nutritional screening is rarely carried out in paediatric patients because of the lack of a simple and properly validated nutritional screening tool. The current practice of identifying children at risk of malnutrition is heavily reliant on the interpretation of anthropometric data and clinical judgment, the reliability of which is dependent on pediatric nutrition knowledge of pediatricians (5). Severe cases of malnutrition are relatively easily recognized; however, the identification of children with lesser degrees of malnutrition or at risk of malnutrition, which is also very important, is not as easily achieved. Reports of malnutrition prevalence among hospitalized Egyptian infants and children are lacking. This study was thus designed to assess the merits of using the Screening Tool for Risk on Nutritional status and Growth (STRONGkids) as a nutrition screening tool in hospitalized Egyptian children aged under three years and correlate it with the severity of their nutritional derangements.

Methods
This cross-sectional study was conducted on 500 newly hospitalized children aged under three years recruited from the Children’s hospital, Ain Shams University, Cairo, Egypt, during the period from 1 January 2015 to 31 July 2015. Patients more than one month of age and expected hospital stay of at least one day were included. They were classified as surgical or non-surgical and underlying diseases were explored clinically and by using laboratory and imaging assessment methods.

For all enrolled children under three years of age, the age, sex, diagnosis and length of hospital stay were recorded. Nutritional status was assessed using the STRONGkids and complete anthropometric evaluation of weight, length/height, weight for length/height, skinfold thickness and mid arm circumference was done on admission and upon discharge. STRONGkids is an easy to apply nutritional risk screening tool developed according to the latest European Society for Parenteral and Enteral Nutrition (ESPEN) guidelines (6). It consists of four elements: subjective clinical assessment, high-risk disease, nutritional intake and weight loss or poor weight gain. It is a comprehensive summary of commonly asked questions concerning nutritional issues, combined with a clinical view of the child’s status. Each of the four items of this nutritional risk screening questionnaire was allocated a score of 1–2 points with a maximum total score of 5 points. Patients obtaining 0 points are considered low risk; moderate risk is considered when the patient gets 1–3 points and high risk if the score is 4–5 points.

Anthropometric measurements were estimated by two trained investigators. Height was measured to the nearest 0.1 cm with a portable stadiometer (Marsden, UK) with children standing bare footed and recumbent length was measured by an infantometer. Weight was recorded to the nearest 0.1 kg using a calibrated baby scale (Seca, Model 834, Japan) with only the patients’ underpants or clean diaper on. Triceps skinfold thickness was measured vertically over the left triceps muscle midway between the acromion and olecranon process using the triceps skinfold caliper (Beta Technology Inc. USA). Mid arm circumference was measured to the nearest cm using a non-stretchable tape (Butterfly, China) with the left arm hanging and relaxed in sitting or in lying positions, midway between the tip of the acromion and the olecranon process.

Children with malnutrition were divided according to the WHO Global Database on Child Growth and Malnutrition, which uses a Z-score cut-off point of <-2 SD to classify low weight-for-age, low height-for-age and low weight-for-height as moderate undernutrition, and <-3 SD to define severe undernutrition (7).
IBM SPSS Statistical package for social science, version 20, was used for data analysis. Descriptive statistics were generated and number and percentages were used. Multivariate logistic regression analysis was performed for predictors of higher STRONGkids score. Correlation studies were demonstrated in figures and r values provided (P < 0.05 is considered significant).

**Results**

This cross-sectional study was conducted on 500 children aged under three years admitted to hospital wards with different diagnoses; 297 were males (59.4%) and 203 were females (40.6%). The mean age of patients was 13.73 ± 10.68 months with an age range of 1–36 months; 315 of whom were ≤12 months old (63%) and 185 were >12 months old (37%). The mean hospital stay of patients was 6.62 ± 3.85 days with a range of 2 to 14 days. According to disease type 86 (17.2%) patients had chronic illnesses and 414 (82.8%) had acute conditions; the most common causes of which were chest infection in 190 (38%) and gastroenteritis in 176 (35.2%). According to STRONGkids score 98 patients were classified as low risk (19.6%), 213 as moderate risk (42.6%) and 189 as high risk (37.8%). Table 1 shows the details of the points given to the screened patients.

Among the studied patients 289 (57.8%) were underweight (weight for age ≤ - 2 Z score), 292 (58.4%) were stunted (height for age ≤ - 2 Z score) and 312 (62.4%) were wasted (weight for height ≤ - 2 Z score). Among the wasted cases 66 were severe and the rest were moderate. Table 2 shows that among the 66 patients with severe malnutrition, nutritional state was not altered in 62 (93.93%) while it improved in 4 (6.06%) patients who became moderately malnourished. Nutritional deterioration was observed in 32 (13.00%) children, who had been moderately malnourished at admission and progressed to severe malnutrition; while 214 (86.99%) remained moderately malnourished. Also nutritional deterioration was observed in 6 (3.19%) children who had been normal at admission and progressed to moderate malnutrition while 182 (96.8%) remained normal.

The results of the current study also showed that five out of the six patients who deteriorated from the group of normal weight for height z score and 28 out of the 32 patients who deteriorated from the moderate wasting group scored as high risk by the STRONGkids score. However, three of the four severely wasted patients who improved had a moderate risk score by the STRONGkids and the fourth one had a high risk compared to 51 high risk and 11 moderate risk from the 62 severely patients who did not improve.

Figure 1 demonstrates a significant positive correlation between STRONGkids score and
duration of hospital stay ($r = 0.114$, $P = 0.01$). However, there is a significant negative correlation between STRONGkids score and maternal education ($r = -0.633$, $P = 0.005$). The logistic regression showed that after elimination of all other factors, there was significant association between higher STRONGkids score and each of the following: low maternal education, high duration of hospital stay and low admission weight for age (Table 3).

**Discussion**

The results of the current study showed that 17.2% of the studied patients had chronic illnesses and 82.8% had acute ones. The most common acute causes were chest infection in 38% and gastroenteritis in 35.2%. This patients’ profile is similar to Silveira et al. (8) and Saccardo Sarni et al. (9) who reported that respiratory diseases are the main reason for hospitalization. Additionally, Rocha et al. (5) found that the most frequent disease responsible for hospital admission was pneumonia (33%) followed by diarrhoea (6.4%). The noticeable difference in the current study figures is the percentage of hospitalization from gastroenteritis, which still poses a load despite the various preventive efforts of both Egyptian governmental and non-governmental agents.

According to WHO cutoff values, 62.4% of the studied patients were underweight, 58.4% were stunted and 57.8% were wasted, which are far above the Egyptian figures for children aged under five years (6%, 21% and 8% respectively) reported in the 2014 Egyptian DHS (10). Although Rocha et al. (5) reported lower figures for underweight, stunting and wasting in Brazil (18.7, 18.2 and 6.9% respectively), they mentioned that hospital malnutrition in Latin America can reach up to 70–80%, which would agree with our results. Ozturk et al. (11) found that 31.8% of their hospitalized Turkish children were malnourished and added that well-nourished children do not carry nutritional risk due to hospitalization for other medical reasons. Another Turkish study by Dogan et al. (12) reported that 27% of the hospitalized patients were stunted, 52.4% were underweight and 40.9% were wasted, which are closer to the numbers reported in the current study. Malnutrition rates of 32% among hospitalized Turkish children (13) and 60% among a group of hospitalized Thai children (14) further demonstrate the diversity of the published figures.

Nutritional deterioration was observed in 13% of the moderately malnourished children and 3.19% of the studied patients who had been normal on admission. Ferreira and França (15) observed that 20% of the children who had been well-nourished on admission became malnourished. On the other hand, Rocha et al. (5) reported that 51.6% of their 186 hospitalized children lost weight and 9.17% of their well-nourished children developed mild malnutrition while hospitalized. The incidence of nutrition deterioration in inpatient children with non-serious disease was also found to be higher than that reported in the literature by Pacheco-Acosta et al. (16) who advised early detection of children at risk for early interventions. Special consideration should be payed to children who are already malnourished on admission as they were found to
be at risk for further nutritional deterioration during their hospital stay (17).

In the current study 42.6% of the patients were at moderate risk and 37.8% at high risk of developing malnutrition according to STRONGkids. These results are collectively higher than the risk score recorded in a multi-centre Dutch study by Hulst et al. (18). The latter authors reported that 62% of their hospitalized children were classified “at risk” by the STRONGkids tool. In Romania 58% of the children were found at risk of malnutrition (24% were at high risk) by STRONGkids tool (19). The higher figures in the present study can be attributed to the increased incidence of underweight, stunting and wasting to begin with as well as the persistence of high hospitalization rate for gastroenteritis which, if prolonged, can affect weight tremendously (20).

The current study showed significant associations between STRONGkids score and both prolonged hospital stay and low admission weight for age. These findings are consistent with the Dutch study (18), which predicted a significant relationship between “high risk” score, a negative standard deviation score of weight for height and a prolonged hospital stay. Several other studies also document that malnourished patients stay longer in hospital than well-nourished patients (21,22) further proving the need for the early detection of such vulnerable patients.

The Pediatric Nutritional Risk Score is the screening tool that has been reported to predict weight loss during hospitalization (23). In accordance, the results of the current study showed that patients whose nutritional status deteriorated scored as high risk by the STRONGkids compared to moderate risk score by those who improved. Although in retrospective, this point further emphasizes that the STRONGkids score can be a predictive prognostic tool. Interestingly, Huysentruyt and associates (24) did not find a significant correlation between STRONGkids risk categories and weight loss during hospitalization, but they mentioned that these categories correlated with the length of hospital stay and the set-up of a nutritional intervention during hospitalization.

Limitations

To our knowledge this is a unique work that explores the STRONGkids as screening and prognostic tool in an Egyptian hospital setting, yet this study has its own limitations, mainly in the small sample size and lack of long-term follow up. Additionally, there should be a larger multi-centre study including other age groups from all over Egypt to allow drawing conclusions on a nationwide basis.

Conclusion
Using STRONGkids for screening hospitalized children aged under three years revealed that nearly 80% are at risk of nutritional derangements and its value correlated positively with the length of hospital stay and negatively with the admission weight. Moreover, the overall malnutrition among these children is a significant problem and patients whose nutritional status deteriorated scored higher by STRONGkids. We thus recommend the implementation of STRONGkids nutritional risk assessment tool for early screening of hospitalized Egyptian children to avoid prolonged hospitalization and further compromise of their nutritional status.

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