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Application of STRONGkids method on assessing the risk of malnutrition among hospitalised children in Universitas Sebelas Maret Hospital

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ABSTRACT

Introduction: Hospital malnutrition (HM) in children augments morbidity and mortality, thus early detection is a preventive measure that may improve a patient's condition. This study identified the risk factors of HM among children hospitalised in Universitas Sebelas Maret (UNS) Hospital using the STRONGkids method. **Methods**: This observational analytical cross-sectional study was performed in children hospitalised at the paediatric ward of UNS Hospital between February and August 2021. The samples were taken by consecutive sampling technique. Subjects meeting the inclusion criteria were assessed for their underlying disease, nutritional status based on World Health Organization Anthro software, and STRONGkids score. Chi-square test and logistic regression analysis were used, with a *p*-value of <0.05 considered as statistical significance. **Results**: A total of 173 children were included in the study, 56% were males, mean age was 62.5 months, 45% had an underlying chronic disease, and 17.9% experienced moderate malnutrition. Based on the STRONGkids score, 39.3% children were at high risk of malnutrition and 60.7% were at moderate risk of malnutrition. Logistic regression analysis showed that high risk of HM was significantly associated with age (OR 2.58, 95% CI 1.38-4.84, *p*=0.003), chronic disease (OR 7.23, 95% CI 3.3-15.86, *p*=0.018), and moderate malnutrition (OR 13.5, 95% CI 3.96-45.98, *p*<0.001). **Conclusion**: Children hospitalised in UNS Hospital were at risk of malnutrition. Toddlerhood, chronic disease, and moderate malnutrition significantly increased the risk of HM. Thus, these children need optimal nutritional support to improve their clinical condition. STRONGkids is a convenient and easy method to identify malnutrition risk during hospitalisation.

Keywords: children, hospital malnutrition, nutritional status, STRONGkids

INTRODUCTION

Malnutrition in children remains a serious problem globally, both in developed and developing countries. The World Health Organization (WHO) reports that children under five years of age face nutritional problems, in which 150.8 million are stunted and 50.5 million are underweight (WHO, 2018). Malnutrition can occur either prior to a hospitalisation

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or during hospitalisation. Hospital malnutrition (HM) is malnutrition seen in hospitalised patients, which are characterised by weight loss >2% in <7 days of treatment or 5% in 8-30 days of treatment or 10% in >30 days of treatment (Sidiartha, 2008; Gouveia & Silva, 2017). The prevalence of HM in paediatric patients is relatively high. It varies considerably, ranging from 2.5 to 51% based on the population and the operational definition used (McCarthy *et al.*, 2019; Nasar *et al.*, 2014).

HM increases morbidity, mortality, disease complications, length of stay (LOS), and treatment costs (Freijer *et al.*, 2018). The course of the disease, hospital environment, and various medical procedures performed on paediatric patients cause stress to the patients and their parents. This results in reduced or loss of appetite leading to decreased nutritional intake (Maryani *et al.* 2016). Meanwhile, ill children experience hypermetabolism, malabsorption, and even loss of nutrients, which impact the increased nutritional requirement. Therefore, inadequate nutrition during hospitalisation will cause HM. Early detection of HM is crucial and beneficial for patients, doctors, and hospital management as it may prevent complications and reduce hospital costs (McCarthy *et al.* 2019).

One of the methods to detect early HM is the Screening Tool for Risk of Impaired Nutritional Status and Growth (STRONGkids) (Gouveia, Tassitano & Silva, 2018). This method is straightforward and practical, and can be carried out by nutritionists, nurses, medical students, and general practitioners. It has been developed in Europe and is the most often validated nutritional screening tool to identify the risk of HM (Pérez-Solís *et al.*, 2020). Therefore, we performed this study to define the risk factors influencing HM using the STRONGkids method and evaluate its correlation with nutritional status, underlying disease, sex, and age of children hospitalised in the paediatric ward of UNS Hospital, Sukoharjo, Indonesia.

MATERIALS AND METHODS

An observational analytical cross-sectional study was conducted in children hospitalised at the paediatric ward of UNS Hospital from February to August 2021. This study was approved by the Public Health Research Ethics Commission of Dr Moewardi Hospital, Surakarta, Indonesia, with the approval number of 1.219/X/HREC/2020. A consecutive sampling technique was applied for sample collection. Patients aged 1 month to 18 years old were included in this study. Sample size was calculated using OpenEpi software to obtain a representative sample, with a minimum sample size of 158–173 children. Sample size calculation took into account the average of hospitalised children, the prevalence of high/moderate nutrition score based on previous reports, and possibility of loss to follow-up (Maharani *et al.*, 2020; Tuokkola *et al.*, 2019; Dean, Sullivan & Soe 2013). We excluded those discharged before 24 hours, dead within 24 hours of arrival, on ventilator assistance during hospitalisation, or in which the nutrition screening tool could not be applied within the first 72 hours of admission. Parents or guardians who agreed to participate in this study signed an informed consent during the hospital stay. We interviewed the parents or guardians regarding the history of patients' underlying disease.

The collected data were age, sex, underlying disease, nutritional status, and STRONGkids score. These data were taken at admission. Acute or chronic diseases were diagnosed by paediatricians blinded to the study based on each disease's guidelines. In this

study, acute diseases were defined as diseases currently affecting the patients leading to hospitalisation, for example Dengue Haemorrhagic Fever (DHF), typhoid fever, diarrhoea, pneumonia, and febrile seizure. Chronic diseases were described as prolonged underlying diseases suffered by subjects, like autoimmune, malignant, and congenital diseases. Nutritional status of patients was determined based on weight-for-height *z*-score for subjects <60 months old using the WHO Anthro software and body mass index-for-age *z*-score for the older ones. STRONGkids is a nutrition risk screening tool, comprising four items i.e. (i) subjective clinical assessment of children's nutritional status, (ii) history of nutritional status based on weight gain, (iii) acute condition affecting nutritional status such as excessive diarrhoea or vomiting in the last three days, reduced food intake, as well as inability to have adequate food intake due to pain, and (iv) weight loss resulting from underlying chronic conditions. Based on STRONGkids, study subjects were categorised as high risk of HM if the score was 4-5 points, moderate risk if the score was 1-3 points, and low risk if the score was 0 point.

All demographic data were presented in percentages. Chi-square test was used for categorical variable analysis. Risk factors were presented as odds ratio (OR) with a 95% confidence interval (CI). Logistic regression analysis was performed to obtain significant risk factors for HM with a significance level of $p<0.05$. All data were statistically analysed using SPSS Statistics for Windows version 25.0 (IBM Corp, Armonk, New York, USA).

RESULTS

The demographic characteristics of subjects were a general description of the entire sample obtained in this study. All children hospitalised in UNS hospital were at risk of malnutrition. Among these study subjects, moderate risk of HM was more common than high risk (Table 1). Most children hospitalised at UNS hospital were well-nourished. However, based on STRONGkids classification, they had a moderate risk for HM. In our study, paediatric patients with either acute or chronic disease had a risk of HM based on STRONGkids classification. Subjects with chronic disease had a higher risk of HM than those with acute disease (Table 2).

Table 1. The demographic characteristics of study subjects

Characteristics	*n (%)*
Sex	
Male	97 (56.1)
Female	76 (43.9)
Age (months), mean (*SD*)	79.8 (62.5)
Toddler (< 60 months)	88 (50.9)
≥ 60 months	85 (49.1)
STRONGkids	
High risk	68 (39.3)
Moderate risk	105 (60.7)
Underlying disease	
Chronic	78 (45.1)
Acute	95 (54.9)
Nutritional status	
Severe malnutrition	6 (3.5)
Moderate malnutrition	31 (17.9)
Well-nourished	136 (78.6)

Nutritional status and underlying disease significantly affected STRONGkids score ($p=0.018$ and $p<0.001$, respectively). Surprisingly, well-nourished paediatric patients also had a high risk of HM (52.90%). Nutritional status played a significant role in HM based on STRONGkids score (OR 13.89; 95% CI 1.57-122.90). Study subjects with acute underlying disease were at moderate risk of HM (74.3%). Both subjects with chronic and acute diseases were at risk of HM, either high

Table 2. STRONGkids score on nutritional status and underlying disease of study subjects

Variable	*STRONGkids*		*OR*	*95% CI*	*p*
	High risk	*Moderate risk*			
Nutritional status			13.89	1.6-122.9	0.018
Severe malnutrition	5 (7.4)	1 (1.0)			
Moderate malnutrition	27 (39.7)	4 (3.8)			
Well-nourished	36 (52.9)	100 (95.2)			
Underlying disease			8.67	4.3-17.5	<0.001
Chronic	51 (75.0)	27 (25.7)			
Acute	17 (25.0)	78 (74.3)			

or moderate risk (OR 8.67; 95% CI 4.30-17.50) (Table 2). Logistic regression analysis revealed that age, sex, underlying disease, and nutritional status were risk factors of HM based on STRONGkids score classification. Children at toddler age were at significant risk of HM, and so were those with chronic disease and moderate malnutrition. Toddlers were at 2.58 folds risk of suffering from HM than older aged children. Meanwhile, children with chronic disease had 7.23 times higher risk of experiencing HM than those with acute disease. In addition, children with moderate malnutrition had 13.50 folds risk of having HM (Table 3).

DISCUSSION

In this study, we found high proportions of HM, with 39.3% of children at high risk and 60.7% at moderate risk of malnutrition. HM was associated with younger age, chronic disease, and moderate malnutrition. Several studies have reported that boys have a higher risk of HM than girls. However, another study reported that girls dominated HM (80%) (Juliaty, 2013). To date, there has not been any study explaining the factors that cause gender dominance (Hafsah, Prawitasari & Djais 2019).

Age is an essential risk factor for malnutrition. Malnutrition in children under five years is caused by a complex combination of food and healthcare service availability, accessibility, and utilisation (Govender *et al.*, 2021). This current study revealed that HM was more common in toddlers (50.9%). A previous study reported that age <5 years old was a risk factor of HM in children hospitalised in a rural hospital (Prasetya, Haryanti & Nurani, 2021). Similarly, another study found that children under 60 months old were more likely to suffer from hospital-acquired malnutrition (Spagnuolo *et al.*, 2013). Age is also a risk factor for weight loss during hospitalisation in children and adolescents. Many factors can influence this, including changes in the underlying condition, management, diet, and mental stress. A study by Rocha, Rocha & Martins (2006) in Brazil reported that 51.60% of children aged <5 years old

Table 3. Logistic regression analysis on STRONGkids for all variables

Variable	*Exp(B)*	*95% CI for Exp(B)*	*p*
Age: toddler	2.58	1.38 – 4.84	0.003
Sex: male	1.11	0.51 – 2.47	0.368
Underlying disease: chronic	7.23	3.3 – 15.86	0.018
Nutritional status: moderate	13.5	3.96 – 45.98	<0.001

lost weight on discharge. Protein-energy malnutrition (PEM) in children <5 years old remains one of the most serious public health problems in developing countries. It has been estimated that 80% of these malnourished children live in Asia, 15% in Africa, and 5% in Latin America. In addition, 43% of these children (230 million) are chronically malnourished (Rocha *et al.*, 2006). Children under five tend to develop HM since weight loss is the only factor taken into account in assessing nutritional status of hospitalised children (Teixeira & Viana, 2016). Children under the age of five require more calories per kilogram of body weight than older children and adolescents, which puts them at risk for HM. Patient's condition, research context, type of hospital, country status, and age group determine the prevalence of HM in each study (Gouveia & Silva, 2017; McCarthy *et al.*, 2019).

Underlying disease and nutritional status were significant risk factors for the occurrence of HM in our study subjects. These findings support a previous study conducted in several hospitals in Bali and West Borneo, which reported that a high risk of HM was significantly associated with chronic, moderate-to-severe disease and nutritional status (Sidiartha, 2018; Prasetya, Haryanti & Nurani, 2021). Malnutrition is a pathological condition affecting most children. Children are more likely to become malnourished because they demand more energy for growth and have fewer energy reserves. Based on our data, malnutrition and chronic illnesses in children caused the most significant weight loss. Campanozzi *et al.* (2009) revealed that malnourished children had a lower BMI at discharge than those who were not malnourished at admission. Weight loss during hospitalisation relates to the primary ailment and reason for admission as fast catabolism of lean body mass occurs due to inflammatory response. Inflammation increases nitrogen excretion and basal energy consumption, leading to weight loss. Malnutrition can be aggravated by a chronic condition resulting in protein catabolism, lower energy intake, and increased energy expenditure (Gouveia & Silva, 2017). Fever, anorexia, vomiting, and diarrhoea further exacerbate the imbalance in intake and nutritional needs (Campanozzi *et al.*, 2009). Malnutrition affects the immune system, increasing the risk of surgical complications, infection, and poor wound healing. Hence, malnutrition impairs recovery, prolongs hospital stays, and increases costs and other healthcare-related factors (Mehta & Duggan, 2009). Most studies confirm that every hospitalised child is at risk of malnutrition. As a result, professionals should be aware of the risk of malnutrition in hospitals (Quadros *et al.*, 2018).

Based on the obtained STRONGkids scores, all subjects in this study were classified as having high risk (39.3%) or moderate risk (60.7%) of HM. Other studies in Romania and Brazil demonstrated that the risk for malnutrition in children admitted to hospitals assessed with STRONGkids score was lower than our study (Mărginean *et al.*, 2014). The differences are perhaps due to the interpretation of each element of the question in the STRONGkids method. Screening for malnutrition during hospitalisation is intended to identify the risk of HM. A high STRONGkids score reliably predicts the risk of malnutrition (Borda, Espitia & Otalvaro, 2018). In our hospital, we use STRONGkids for malnutrition screening because it is an easy to apply, simple, and accurate instrument. In paediatric in-patients, routine screening for the risk of malnutrition is critical in recognising at-risk children who need dietary intervention (Maharani *et al.*, 2020). All children at risk of HM require comprehensive nutritional intervention, extended

hospital stays, and high hospital costs. They also have an increased risk of mortality (Sidiartha 2008; McCarthy *et al.*, 2019). Therefore, we must be more aware of nutritional care.

The most outstanding independent risk factor for HM in our hospital was patients with moderate malnutrition. McCarthy *et al.* demonstrated that at the time of discharge, patients who were malnourished at the time of admission lost more BMI than those with better nutritional status at admission (McCarthy *et al.*, 2019). Our study found that subjects with moderate malnutrition had a 13.50 folds risk of suffering from HM. These findings suggest that STRONGkids can be used to detect malnutrition risk in the hospital before it progresses to more severe malnutrition, which will be increasingly challenging to seek a cure for the underlying disease (Beser *et al.*, 2018; Pérez-Solís *et al.*, 2020). Another study also reported that the STRONGkids screening method was associated with malnutrition at the time of hospital admission (Moeeni, Walls & Day, 2014). A study in China reported that hospitalised paediatric patients evaluated using STRONGkids were at high risk of malnutrition, especially those with heart disease, respiratory disease, oncological disease, and underlying gastrointestinal disease (Cao *et al.*, 2014). Paediatric patients who have moderate or high risk of malnutrition should be monitored closely during hospitalisation so that early intervention can be carried out to improve their prognosis.

We found a correlation between STRONGkids scores with chronic disease, as well as nutritional status. Children with chronic diseases tended to have higher STRONGkids scores than those with acute illnesses. Children with chronic disease have a 7.23 times risk of experiencing malnutrition. Other studies also suggested that children with chronic diseases have a higher risk of malnourishment during hospitalisation (Sidiartha, 2018). A study in China reported that the STRONGkids score was closely related to patient's clinical symptoms. Children at high risk of malnutrition have more complications, longer treatment duration, more significant weight loss and nutritional support, and higher hospital cost (Cao *et al.,* 2014). Children at risk of malnutrition need adequate and optimal nutritional intake during hospitalisation to support the healing process of their underlying disease (Beser *et al.,* 2018). Another study stated that nutritional support in children under three years of age with congenital heart disease reduced LOS and mortality after surgery. Although nutritional support during hospitalisation has been shown to reduce disease complications, the nutritional aspect is still underestimated (Bauer, Jürgens & Frühwald, 2011). During hospitalisation, the concern is mostly on the primary medical problem, so often times, the importance of nutritional management is neglected. According to Kazem & Hassan (2008), the nutritional condition of children had a significant impact on those who were either well-nourished or mildly malnourished at the time of admission. Therefore, increasing paediatric nutritional care according to underlying disease is an effort to reduce the incidence of malnutrition in hospitals.

Our study had several limitations. The assessment of nutritional status was primarily based on basic anthropometric measurements (weight and height), with no consideration given to other indicators such as skinfolds or body composition, which may have resulted in subjects being miscategorised as malnourished, especially in the case of chronic malnutrition. In addition, many other risk factors such as

parental characteristics, socioeconomic conditions, the type and volume of nutritional intake during hospitalisation were not studied, which may affect the prevalence of HM. Therefore, future studies must consider all the aforementioned factors and involve multiple centres so that the findings can be generalised.

CONCLUSION

All children hospitalised in UNS Hospital were at risk of malnutrition. Toddlerhood, chronic disease and moderate malnutrition significantly increased the risk of HM. Hence, optimal nutritional support is necessary for these children to improve their clinical condition. The STRONGkids method is convenient and easy for screening the risk of malnutrition during hospitalisation, which health workers can apply.

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Authors' contributions

MGKS, principal investigator, conceptualised and designed the study, conducted the study, performed data analysis and interpretation, prepared the draft of the manuscript, and reviewed the manuscript; VW, reviewed the manuscript and advised on the data analysis, as well as interpretation; ASP, led the data collection, analysed the nutritional status, and reviewed the manuscript; SW, assisted in drafting of the manuscript and reviewed the manuscript; AML, led the data collection and analysed the nutritional status.

Conflict of interest

The authors have no conflict of interest in the research, authorship, and publication of this work. None of the authors received funding from the government, business sector, or non-profit organisation.

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