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The Prevalence of Malnutrition and Effectiveness of STRONGkids Tool in the Identification of Malnutrition Risks among Pediatric Surgical Patients

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Background: High prevalence of malnutrition along with the risk for the development of malnutrition in hospitalised children has been reported. However, this problem remains largely unrecognised by healthcare workers.
Aims: To determine the prevalence of malnutrition and effectiveness of STRONGkids nutritional risk screening (NRS) tool in the identification of malnutrition risk among pediatric surgical patients.
Study Design: Cross-sectional study.
Methods: A total of 494 pediatric surgical patients (median age 59 months, 75.8% males) were included in this prospective study conducted over 3 months. SD-scores <-2 for Body Mass Index (BMI) for age or weight-for-height (WFH) and height-for-age (HFA) were considered to indicate acute and chronic malnutrition, respectively. The STRONGkids NRS tool was used to determine risk for malnutrition.
Results: Malnutrition was detected in 13.4% in this group of pediatric surgical patients. Acute malnutrition was identified in 10.1% of patients and more commonly in patients aged ≤60 months than aged >60 months (13.4 vs. 6.6%, p=0.012). Chronic malnutrition was identified in 23 (4.6%) of patients with no significant difference between age groups. There were 7 (1.4%) children with coexistent acute and chronic malnutrition. The STRONGkids tool revealed that 35.7% of patients were either in the moderate or high risk group for malnutrition. Malnutrition, as revealed by anthropometric measurements, was more likely in the presence of gastrointestinal (26.9%, p=0.004) and inguinoscrotal/penile surgery (4.0%, p=0.031), co-morbidities affecting nutritional status (p<0.001) and inpatient admissions (p=0.014). Among patients categorized as low risk for malnutrition, there were more outpatients than inpatients (89.3 vs. 10.7%, p<0.001) and more elective surgery cases than emergency surgery cases (93.4 vs. 6.6%, p<0.001).
Conclusion: Providing data on the prevalence of malnutrition and risk of malnutrition in a prospectively recruited group of hospitalised pediatric surgical patients, the data acquired in the present study emphasise the need to raise clinician's awareness about the importance of nutritional status assessment among hospitalised pediatric patients and the benefits of identifying patients at the risk of nutritional depletion before malnutrition occurs. Our findings support the use of the STRONGkids tool among pediatric surgical patients to identify patients at risk for malnutrition and to increase the physician's awareness of nutritional assessment among hospitalised patients upon admission.
Key Words: Hospitalisation, malnutrition, nutritional status, outpatients, pediatric surgery, risk assessment, STRONGkids

Nutritional status in children has been considered an indicator of health and well-being at the individual and population levels (1). Both the malnutrition prevalence and the risk for development of malnutrition have been consistently reported as high in hospitalised children (2, 3). However, this problem remains largely unrecognised by healthcare workers. Due to the likelihood of the prevention of nutrition-associated complications, such as the slowing of growth and increased susceptibility to various infections, as well as prolonged hospitalisation, early detection of the risk for malnutrition among hospitalised children has been considered essential (3, 4).

The importance of identifying those children at increased nutritional risk has led to the development of a number of nutritional risk screening (NRS) tools. However, there is a paucity of data on their application in clinical practice and the degree of inter-tool agreement and a consensus regarding which screening tool to use has not yet been reached (3, 5). The most recent instrument, STRONGkids, has been developed accord-

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ing to the newest European Society for Parenteral and Enteral Nutrition (ESPEN) guidelines in an effort to introduce an easy to apply NRS tool to overcome some of the issues reported for previous tools, such as the fact that they were too complicated and time-consuming to use in daily clinical practice (2, 6, 7). The STRONGkids tool is a comprehensive summary of commonly asked questions concerning nutritional issues, combined with a clinical view of the child's status; as this is performed upon admission to the hospital, it helps to raise the clinician's awareness of nutritional risks (7).

The present study was designed to determine the prevalence of malnutrition and the effectiveness of STRONGkids NRS tool in the identification of malnutrition risk among pediatric surgical patients.

MATERIALS AND METHODS

Study population

This prospective study was conducted in a single pediatric surgery unit of a tertiary referral hospital over three consecutive months between April and July 2012. Patients who were younger than 30 days of age, admitted to the clinics other than "pediatric surgery" ward or had had another operation in the preceding 30 days were excluded. All of the remaining patients who were operated on during the given time interval were included. By definition, outpatients were those children who were admitted to the hospital for surgery but stayed for less than 24 hours.

Written informed consent was obtained from each subject or relative following a detailed explanation of the objectives and protocol of the study which was conducted in accordance with the ethical principles stated in the "Declaration of Helsinki" and approved by the institutional ethics committee.

Definition of malnutrition

Malnutrition was evaluated based on anthropometric measurements that were performed by the same ward nursing staff. WHO Anthro and AnthroPlus Programs were used for the evaluation of results (8, 9). For acute malnutrition (AM), Weight-for-Height (WFH) Z score or Body Mass Index (BMI) for age Z, scores of ≥-3 to <-2 were considered moderate malnutrition and scores of <-3 as severe malnutrition, while scores of ≥-2 denoted a lack of AM (10). For chronic malnutrition (CM), Height-for-Age (HFA) Z scores of ≥-3 to <-2 were deemed moderate malnutrition and scores of <-3 as severe malnutrition, while scores of ≥-2 denoted a lack of CM in accordance with WHO classification (10). Mid-upper arm circumference (MUAC) Z scores were calculated for patients aged ≤60 months only, in compliance with WHO standards.

STRONGkids nutritional risk screening tool

Risk for malnutrition was evaluated via the STRONGkids questionnaire (7), which was completed by physicians via the face to face method. STRONGkids is a malnutrition "*risk assessment tool*" that consists of 4 items, including subjective clinical assessment (1 point), high risk disease (2 points), nutritional intake and losses (1 point) and weight loss or poor weight gain (1 point).

Patients with STRONGkids score 0 were classified as "low risk", whereas those with a score of 1-3 were classified as "medium risk" and those with a score of 4-5 were classified as "high risk".

Statistical analysis

Statistical analysis was performed using computer software (IBM SPSS Statistics version 20.0, SPSS Inc. Chicago, IL, USA). Categorical variables were compared with the Chi-square, Fisher's exact or Mantel Haenszel tests. Continuous variables were compared with the Kruskal Wallis and Mann Whitney U tests. Data were expressed as "mean (standard deviation; SD)", minimum-maximum and percent (%) where appropriate. A $p<0.05$ was considered statistically significant.

RESULTS

Patient demographics and basic clinical features

A total of 494 pediatric surgical patients were included in this study. The study population was composed primarily of male patients (75.8%) with a mean age of 70.1 (SD 56.1, range 1-220) months. The percentage of patients aged ≤60 months was 51.1% while 48.9% were aged >60 months. Elective surgery was performed in 76.0% and outpatient admission was evident in 67.0% of patients. Among the inpatients, 63.8% were admitted for ≤3 days and the remaining 36.2% were admitted for over 3 days. The admission rate for those remaining in hospital for over 3 days was 11.7% when all patients were considered. Inguinoscrotal and penile diseases (50.3%) were the most common primary operative indication. Co-morbidities affecting nutritional status like chronic renal failure, swallowing dysfunction and the presence of malignancy were present in 16.4% (Table 1). In contrast, co-morbidities not affecting nutritional status like unilateral renal agenesis, minor cardiac malformations or Familial Mediterranean Fever under medical therapy were present in 4% of cases.

Anthropometrics and Z scores

Mean BMI was 16.8 (SD 3.2, ranged 9.5-33.6) kg/m^2 and MUAC was 18.5 (SD 4.3, range 9.0-36.0) cm. in the overall

TABLE 1. Patient demographics and basic clinical features (n=494)

Age	n (%)	Mean (SD)	Median (min-max)
Overall (months)	494 (100.0)	70.1 (56.1)	59.0 (1.0-220.0)
≤60 months	253 (51.1)	25.1 (17.4)	22.0 (1-60)
>60 months	241 (48.9)	116.6 (42.7)	106.5 (61.0-220.0)
Gender		n (%)	
Male		374 (75.8)	
Female		120 (24.2)	
Type of surgery			
Emergency		119 (24)	
Elective		375 (76)	
Admitted clinic setting			
Outpatient		334 (67.0)	
Inpatient		160 (33.0)	
For 1-3 days		102 (63.8)	
For >3 days		58 (36.2)	
Primary operative indication			
Inguinoscrotal and penile surgery		248 (50.3)	
Acute abdominal surgery		94 (19.0)	
Urological surgery		34 (6.9)	
Gastrointestinal surgery		26 (5.3)	
Foreign body ingestion/aspiration		23 (4.6)	
Other		69 (13.9)	
Other minor		63 (12.7)	
Oncologic surgery		3 (0.6)	
Thoracic surgery		3 (0.6)	
Co-morbidities			
Affecting nutritional status			
Positive		81 (16.4)	
Negative		413 (83.6)	
Not affecting nutritional status			
Positive		20 (4.0)	
Negative		474 (96.0)	
History of prematurity			
Yes		15 (3.0)	
No		479 (97.0)	

population. Mean z scores for weight for age, height for age, BMI for age and weight for height were 0.3 (SD 1.6, range -5.1-9.4), 0.5 (SD 1.9, range -10.9-11.6), -0.1 (SD 1.6, range -6.7-5.9), and -0.2 (SD 1.5, ranged -6.3-4.0), respectively. The mean MUAC Z score was 0.7 (SD 1.3, range -4.9-4.6) (Table 2). Anthropometrics and Z scores as well as respective distribution with regard to age groups (≤60 months and >60 months) are summarised in Table 2.

Malnutrition prevalence

Overall, malnutrition was present in 66 (13.4%) patients (Table 3). The percentage of children with malnutrition was higher in patients aged ≤60 months than in those aged >60 months (16.6% vs. 10%, p=0.015). Among the patients with malnutrition, 7 (1.4%) had coexistent AM and CM.

AM was significantly more common in patients aged ≤60 months compared with patients aged >60 months (13.4 vs. 6.6%, p=0.012), but there was no significant difference between age groups in terms of prevalence of CM (Table 3).

STRONGkids risk groups

The STRONGkids NRS tool revealed that most patients (64.2%) were in the low risk category, while 34.5% were medium risk and only 1.2% were considered high risk for malnutrition (Table 3).

The relation between malnutrition type and STRONGkids risk groups

The rate of AM was determined to increase from 8.2% in patients at low risk to 33.3% in patients at high risk for malnutrition (p=0.026). CM was noted in 3.5% of patients at low risk, while it was reported in 16.7% of those at high risk (p=0.057). There was a statistically significant relationship (p=0.026) and a borderline significant trend (p=0.057) between overall future risk for malnutrition and the presence of AM and CM, respectively. There was no significant difference between risk groups in terms of the presence of malnutrition (Table 4).

Moderate to severe acute/chronic malnutrition in relation to study parameters

Moderate to severe AM and CM were determined to be more likely in the presence of gastrointestinal (26.9%, p=0.004) and inguinoscrotal/penile surgery (4.0%, p=0.031), co-morbidities affecting nutritional status (p<0.001), and in inpatient than outpatient admission (p=0.014). CM was more common in patients with a history of prematurity (corrected gestational age ≤6 months) (p=0.003) (Table 5).

Having MUAC Z scores of <-2 was also more likely in the presence of gastrointestinal (p=0.025) and inguinoscrotal/penile surgery (p=0.031), co-morbidities affecting nutritional status (p=0.018) and history of prematurity (p=0.014) (Table 5).

STRONGkids risk groups with respect to study parameters

Patients determined to be in the medium risk category for malnutrition according to the STRONGkids risk assessment tool were significantly older (100.0 months) than patients in the low (53.6 months) and high (52.7 months) risk categories (p<0.001). Mean (SD) HAZ scores were

TABLE 2. Anthropometrics and Z scores with respect to age groups

	Age ≤60 months (n=253)			Age >60 months (n=241)			Total (n=494)		
Anthropometrics	n	Mean (SD)	Median (min-max)	n	Mean (SD)	Median (min-max)	n	Mean (SD)	Median (min-max)
Weight (kg)	253	12.3 (4.5)	12.0 (3.3-25.0)	241	34.9 (15.9)	30.1 (12.0-91.7)	494	23.3 (16.2)	18.5 (3.3-91.7)
Height (cm)	253	86.4 (16.3)	88.0 (47.0-118.0)	241	136.8 (19.2)	134.0 (99.0-176.0)	494	111.0 (30.9)	110.0 (47.0-176.0)
Body mass index (kg/m^2)	253	15.9 (2.0)	15.8 (9.5-23.1)	241	17.7 (3.9)	16.6 (10.2-33.6)	494	16.8 (3.2)	16.1 (9.5-33.6)
Mid-upper arm circumference (cm)	253	15.9 (2.1)	16.0 (9.0-23.0)	239	21.2 (4.4)	20.0 (13.0-36.0)	492	18.5 (4.3)	17.0 (9.0-36.0)
Z scores									
Weight for age	253	0.3 (1.6)	0.3 (-5.1-9.4)	147	0.3 (1.6)	0.3 (-4.4-5.2)	400	0.3 (1.6)	0.3 (-5.1-9.4)
Height for age	253	0.8 (2.1)	0.6 (-6.5-11.6)	241	0.1 (1.3)	0.3 (-4.2-3.2)	494	0.5 (1.9)	0.5 (-10.9-11.6)
Body mass index for age	253	-0.3 (1.5)	-0.2 (-6.7-253)	241	0.1 (1.6)	0.1 (-5.3-241)	494	-0.1 (1.6)	-0.1 (-6.7-5.9)
Weight for height	253	-0.2 (1.5)	-0.1 (-6.3-4.0)	-	-	-	253	-0.2 (1.5)	-0.1 (-6.3-4.0)
Mid-upper arm circumference for age	231	0.7 (1.3)	0.6 (-4.9-4.6)	-	-	-	231	0.7 (1.3)	0.6 (-4.9-4.6)

TABLE 3. Malnutrition prevalence with respect to age groups

	Age ≤60 months (n=253)	Age >60 months (n=241)	Total (n=494)	p value
Malnutrition type		n (%)		
Negative	211 (83.4)	217 (90)	428 (86.6)	0.015
Acute	34 (13.4)	16 (6.6)	50 (10.1)	0.012
Chronic	11 (4.3)	12 (5.0)	23 (4.7)	0.739
Only acute or chronic	39 (15.4)	20 (8.3)	59 (11.9)	0.015
Acute and chronic	3 (1.2)	4 (1.7)	7 (1.4)	0.656

TABLE 4. The relation between malnutrition type and STRONGkids risk groups

Strongkids risk group	Low risk	Medium risk	High risk	Total	Comparison	Test	p value
Acute malnutrition		n (%)			All group	Mantel Haenszel	0.026
Negative	292 (91.8)	148 (87.1)	4 (66.7)	444 (89.9)	Low vs. medium	Chi square	0.092*
Positive	26 (8.2)	22 (12.9)	2 (33.3)	50 (10.1)	Low vs. high	Fisher's exact	0.087*
Total	318 (100.0)	170 (100.0)	6 (100.0)	494 (100.0)	Medium vs. high	Chi square	0.190*
Chronic malnutrition		n (%)			All group	Mantel Haenszel	0.057
Negative	307 (96.5)	159 (93.5)	5 (83.3)	471 (95.3)	Low vs. medium	Chi square	0.127*
Positive	11 (3.5)	11 (6.5)	1 (16.7)	23 (4.7)	Low vs. high	Fisher's exact	0.204*
Total	318 (100.0)	170 (100.0)	6 (100.0)	494 (100.0)	Medium vs. high	Chi square	0.350*

*Significance level (type 1 error) of sub-group comparisons was set to <0.167 by using Bonferroni adjustment

significantly lower in the high risk (-1.62 (2.15)) and moderate risk (0.07(1.70)) groups when compared to the low risk group (0.73 (1.80)) (p<0.001) (Table 6). With regard to patients categorised as low risk for malnutrition, outpatients were significantly more common than inpatients (89.3 vs. 10.7%, p<0.001) and elective surgery was significantly more common than emergency surgery (93.4 vs. 6.6%, p<0.001) in this group (Table 6).

DISCUSSION

Malnutrition prevalence in pediatric surgical patients has not been sufficiently studied. The present study is unique, as it was performed in a group of Turkish pediatric surgical patients. It revealed he presence of malnutrition in 13.4% of the overall study population. AM was more common in patients aged ≤60 months. Moderate to severe AM and CM were more likely in

TABLE 5. Malnutrition/anthropometrics with respect to study parameters

	Moderate to severe malnutrition				
	Acute			Chronic	
	BAZ <-2	WHZ <-2	BAZ or WHZ <-2	HAZ <-2	MUACZ <-2
	n (%)				
Total (n=494)	47 (9.5)	23 (4.7)	50 (10.1)	23 (4.7)	4 (0.8)
Gender					
Male (n=374)	36 (9.6)	18 (4.8)	39 (10.4)	18 (4.8)	2 (0.5)
Female (n=120)	11 (9.2)	5 (4.2)	11 (9.2)	5 (4.2)	2 (1.7)
p	0.881	0.603	0.690	0.770	0.140
Primary operative indication					
Acute abdominal surgery (n=94)	7 (7.4)	0 (0.0)	7 (7.4)	2 (2.1)	0 (0.0)
p (vs. patients without this surgery)	0.448	1.000	0.339	0.196	1.000
Foreign body ingestion/aspiration (n=23)	2 (8.7)	0 (0)	2 (8.7)	1 (4.3)	0 (0.0)
p (vs. patients without this surgery)	0.891	0.232	0.816	1.000	1.000
Gastrointestinal surgery (n=26)	7 (26.9)	4 (15.4)	7 (26.9)	2 (7.7)	2 (7.7)
p (vs. patients without this surgery)	0.002	0.056	0.004	0.345	0.025
Inguinoscrotal and penile surgery (n=248)	20 (8.1)	10 (4.0)	21 (8.5)	13 (5.2)	1 (0.4)
p (vs. patients without this surgery)	0.270	0.031	0.221	0.535	0.031
Urological surgery (n=34)	4 (11.8)	4 (11.8)	5 (14.7)	4 (11.8)	0 (0)
p (vs. patients without this surgery)	0.643	0.080	0.358	0.065	1.000
Other (n=69)	7 (10.1)	5 (7.2)	8 (11.6)	1 (1.4)	1 (1.4)
Co-morbidities affecting nutritional status					
No (n=413)	31 (7.5)	12 (2.9)	32 (7.7)	13 (3.1)	1 (0.2)
Yes (n=81)	16 (19.8)	11 (13.6)	18 (22.2)	10 (12.3)	3 (3.7)
p	0.001	<0.001	<0.001	<0.001	0.018
Co-morbidities not affecting nutritional status					
No (n=474)	46 (9.7)	23 (4.9)	49 (10.3)	22 (4.6)	23 (4.9)
Yes (n=20)	1 (5)	0 (0)	1 (5)	1 (5)	0 (0)
p	0.709	0.606	0.438	1.000	0.606
Type of surgery					
Elective (n=375)	37 (9.9)	22 (5.9)	40 (10.7)	20 (5.3)	4 (1.1)
Emergency (n=119)	10 (8.4)	1 (0.8)	10 (8.4)	3 (2.5)	0 (0.0)
p	0.635	0.378	0.476	0.205	1.000
Admitted clinical setting					
Inpatients (n=160)	20 (12.5)	9 (5.6)	22 (13.8)	8 (5)	2 (1.3)
Outpatients (n=334)	27 (8.1)	14 (4.2)	28 (8.4)	15 (4.5)	2 (0.6)
p	0.117	0.014	0.064	0.802	0.198
Prematurity history					
No (n=479)	44 (9.2)	22 (4.6)	47 (9.8)	19 (4.0)	2 (0.4)
Yes (n=15)	3 (20.0)	1 (6.7)	3 (20.0)	4 (26.7)	2 (13.3)
p	0.163	1.000	0.186	0.003	0.014

BAZ: body mass index for age z score; WHZ: weight-for height z score; HAZ: height-for-age z score; MUACZ: mid-upper arm circumference z score

TABLE 6. STRONGkids risk groups with respect to study parameters

	STRONGkids risk group				
	Low risk (n=318)	Medium risk (n=170)	High risk (n=6)	Total (n=494)	
	Mean (SD)				p value
Age (month)	53.6 (44.3)	100.6 (62.5)	52.7 (58.4)	69.7 (56.0)	<0.001
WHZ	-0.08 (1.38)	-0.42 (1.75)	-1.38 (2.52)	-0.16 (1.48)	0.381
BAZ	0.02 (1.49)	-0.16 (1.66)	-1.62 (1.79)	-0.06 (1.56)	0.085
HAZ	0.73 (1.80)	0.07 (1.70)	-1.06 (2.15)	0.48 (1.8)	<0.001
MUACZ	0.82 (1.16)	0.37 (1.52)	-0.92 (2.15)	0.71 (1.27)	0.083
Admitted clinical setting	n (%)				
Inpatients - n (%)*	34 (10.7)	122 (71.8)	4 (66.7)	160 (32.4)	<0.001
Outpatient - n (%)*	284 (89.3)	48 (28.2)	2 (33.3)	334 (67.6)	
Type of surgery	n (%)				
Elective- n (%)*	297 (93.4)	73 (42.9)	5 (83.3)	375 (75.9)	<0.001
Emergency- n (%)*	21 (6.6)	97 (57.1)	1 (16.7)	119 (24.1)	
History of prematurity	n (%)				
No- n (%)*	315 (99.1)	159 (93.5)	5 (83.3)	479 (97.0)	<0.001
Yes- n (%)*	3 (0.9)	11 (6.5)	1 (16.7)	15 (3.0)	

*percentage in STRONGkids risk groups

BMI: body mass index Z score; WHZ: weight-for-height Z score; HAZ: height-for-age Z score; MUACZ: mid-upper arm circumference Z score

the presence of gastrointestinal and inguinoscrotal/penile surgery, co-morbidities affecting nutritional status and inpatient admissions. Higher prevalence of AM in children aged <5 years has been indicated in some other past studies (11).

Data from the Turkey Demographic and Health Survey in 2008 (12) revealed the prevalence of AM (WFA <-2SD) in 1.5% and CM (HFA <-2SD) in 7.5% of children aged ≤5 years (n=396) in the general population. In another previous study performed among Turkish school children, AM and CM rates were reported to be 5.7% and 1%, respectively, in children aged 6-16 years (n=1576) (13). Comparatively, we identified AM in 10.1% of pediatric surgical patients (13.4% in patients aged ≤5 years and 6.6% in patients aged >5 years) and CM in 4.7% (4.3% in patients aged ≤5 years and 5.0% in patients aged >5years). Identification of the higher prevalence of malnutrition among pediatric surgical patients than in the Turkish general pediatric population correlates with the statement that children who are admitted to hospital are at a higher risk of malnutrition than healthy children from the same community (2, 4, 11, 14).

Malnutrition rates of 31.8 to 56.6% in hospitalised pediatric patients have been previously reported in our country; these rates were much higher than the prevalence of AM reported in hospitalised children in Germany, France, UK, and the USA, with results varying from 6% to 14% (10, 15-17) Accordingly, the prevalence of malnutrition in pediatric surgical patients on admission in the present study seems to be in agreement with data from developed countries, but poorer than rates reported in the Turkish general pediatric population and apparently lower than rates reported in pediatric hospitalised patients in Turkey (10, 14-17).

Malnutrition in hospitalised children has been very prevalent, especially in children with underlying disease and clinical conditions (2). Because AM and CM were significantly more likely in the presence of co-morbidities affecting nutritional status, our findings support previous studies indicating a higher prevalence of malnutrition in children with an underlying disease (14). In our study population, in addition to having co-morbidities affecting nutritional status, both AM and CM were determined to be more likely in the case of gastrointestinal and inguinoscrotal/penile surgery and a concomitant history of prematurity. In accordance with that, being a good indicator of the body's somatic muscle mass size, MUAC Z scores were lower in exactly the same patient groups. Given the presence of nutritional problems such as swallowing dysfunction due to esophageal stricture and achalasia as well as intestinal motility disorders, the higher likelihood of malnutrition in patients undergoing gastrointestinal surgery seems to be associated with the ongoing nutritional problems related to their primary diagnoses. In line with the consideration of preterm infants to be sensitive to changes in nutritional status with the frequent likelihood of growth failure during a hospital stay (2), malnutrition was noted to be more likely in the presence of prematurity history. On the other hand, the relationship between malnutrition and inguinoscrotal/penile surgery in our patient population seems to be secondary to age rather than the underlying diagnosis. Indeed, AM as well as inguinoscrotal and penile pathologies were all more common in patients aged ≤60 months.

Nutritional risk screening differs from global nutritional assessment in terms of identifying those individuals at risk of deterioration rather than those who are already malnourished. The NRS is a quick and simple process combining personal nutritional status with clinical disease information (18, 19). To date, four non-disease-specific nutrition screening tools designed for pediatrics have been developed for use. These are the Simple Pediatric Nutrition Risk Score (PNRS), Screening Tool for the Assessment of Malnutrition in Pediatrics (STAMP), Pediatric Yorkhill Malnutrition Score (PYMS) and STRONGkids (7, 20-22). The STRONGkids tool has been considered to be quicker to apply than PYMS and STAMP owing to the exclusion of weight and height measurements. It considers the impact of underlying diseases unlike PYMS and requires physician assessment, unlike both PYMS and STAMP which were designed for completion by nursing staff (11). The inter-tool agreement was found to be good between STAMP, STRONGkids and PNRS in one study conducted using 46 children with inflammatory bowel disease (23). None of these tools has been previously used in a population composed purely of pediatric surgical patients.

Although STRONGkids was developed to estimate the future risk of malnutrition in hospitalised patients, recent studies have used the tool in the outpatient setting as well (24). The initial study was conducted nationwide in Dutch pediatric wards in 2010 (7). It revealed that in a population with a malnutrition prevalence of 19%, STRONGkids predicted that 54% of the children were at moderate risk and 8% were at high risk of developing malnutrition. Similarly, in our pediatric surgical patients, STRONGkids predicted that 34.5% were at moderate risk and 1.2% were at high risk of developing malnutrition. The increased risk for malnutrition determined via the STRONGkids risk assessment tool was significantly associated with a higher prevalence of both AM and CM. On the other hand, no statistical difference was noted in malnutrition prevalence with respect to individual risk groups.

Our findings support data from past studies reporting a correlation between STRONGkids risk categories and HFA Z scores (3, 7, 11). However in contrast to past studies indicating a significant correlation of STRONGkids risk scores to WFH, HFA and BMI, no correlation was noted between anthropometric measures other than HZA and risk categories in our study population (6, 25, 26).

Indeed, the lack of a relation between STRONGkids scores and anthropometric measurements apart from HZA in our study population also seems to be consistent with the fact that the STRONGkids NRS tool provides data on the future risk of malnutrition rather than the current nutritional status (7).

It was also reported that shorter stays at hospital were associated with the lack of a relationship between STRONGkids risk score and weight loss during hospital admission in pediatric ward patients (7). While the STRONGkids NRS tool revealed a high risk for malnutrition in only 1.2% of pediatric surgical patients in the present study, it should be noted that the majority of our inpatients were hospitalised for 1-3 days and the length of hospital stay was >3 days only in 11.7%. Furthermore, inpatient admissions were associated with the increased likelihood of moderate to severe AM and CM compared with outpatient admissions. In accordance with that, STRONGkids assessment classified a significantly higher number of outpatients under the low risk category for future malnutrition than inpatients.

Malnutrition determined within the first 72 h of admission is most likely attributable to conditions prior to hospitalisation (27). The majority of our patients were hospitalised for less than 3 days. Therefore, hospital-acquired malnutrition does not seem to be an essential cause of the malnutrition observed in pediatric surgical patients. Although hospital-acquired malnutrition is important and should not be neglected in hospitalised pediatric patients, pediatric surgery wards seem to refer a specific group of patients in relation to the shorter length of hospital stay and higher likelihood of outpatient follow up.

A past study conducted with hospitalised pediatric patients emphasised that undernutrition on admission in children remains unrecognised by our healthcare workers, malnourished children are still not recognised sufficiently by pediatricians and that specific nutritional support is not used systematically (28). Especially, pediatric patients with mild malnutrition on admission were considered to be at the highest risk of adverse effect of hospitalisation and thus, this population of patients was recommended to be given special attention (28). Therefore, future efforts in pediatric nutrition should include identifying those patients who require nutritional support, ensuring the provision of appropriate nutritional management and educating hospital staff about the identification and management of malnutrition (16).

The use of any screening tool to identify children at risk of malnutrition can only be considered effective and reasonable if it results in early intervention and improved clinical outcomes. Much larger scale and longitudinal studies in hospitalised pediatric patients seem to be necessary to investigate whether or not malnutrition will develop in patients categorised to be at high risk for malnutrition via STRONGkids.

The principal strength of the present study is that it provides new information on the prevalence of malnutrition and risk of malnutrition in a prospectively recruited group of hospitalised Turkish pediatric surgical patients. The major limitation of this study is the representation of the cohort since it is a single-centre survey. However, it should be noted that by means of a single centre design, anthropometric measurements could be performed by the same nurse eliminating the influence of results by inter-observer variability. The second limitation seems to be the fact that the STRONGkids score does not include any objective assessment, whereas we also assessed the global nutritional statuses of the children by anthropometric examination. The third limitation of our study is the cross-sectional design with no data on the longitudinal analysis of nutritional changes over time which could limit the ability to identify whether those well-nourished patients who were classified as high risk by STRONGkids tool would have subsequently developed malnutrition.

In conclusion, the prevalence of malnutrition (13.4%) and medium or high risk for malnutrition in 35.7% as determined by the NRS tool in the present study emphasises the need to raise clinician's awareness about the importance of nutritional status assessment among pediatric surgical patients and the benefits of identifying patients at risk of nutritional depletion before malnutrition occurs. Given the shorter length of hospital stay and the likelihood of hospital admission on an outpatient basis; factors other than hospital-acquired malnutrition, such as age ≤60 months, type of surgery, co-morbidities effecting nutritional status and admitted clinical setting seem to be more effective in the prevalence and future risk of malnutrition among pediatric surgical patients. These findings support the use of an NRS tool among pediatric surgical patients to identify patients at risk for malnutrition and to increase physician's awareness about nutritional assessment among hospitalised patients on admission.

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