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Factors influencing malnutrition risk in hospitalized pediatric patients and the application of STRONGkids scoring

Hastanede yatan pediatrik hastalarda yetersiz beslenme riskini etkileyen faktörler ve STRONGkids skorlaması uygulaması

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Abstract

Aim: A significant factor affecting the response to treatment in children is malnutrition. To reduce its risk and morbidity, necessary precautions should be taken on the first day of hospitalization. It is highly essential to obtain clues that assist with the early detection of malnutrition at the time of hospitalization. In this study, we aimed to show the risk factors, body measurements and the importance of a scoring system in its early detection and evaluation. To this end, we examined the accuracy of the STRONGkids score, which is a simple, useful, and practical scoring system, in detecting the risk of malnutrition.

Methods: Children between 0-18 years of age without any chronic diseases who were hospitalized due to acute infection were included in this retrospective cohort study. Those with chronic illnesses were left out of scope of our research. The duration and frequency of hospitalization, maternal age, number of births, birth weight, duration of breastfeeding and its continuation, transition period of supplemental nutrition intake, respective weights measured at the time of hospitalization and discharge were evaluated. By using Gomez and Waterlow, malnutrition degree and STRONGkids score were calculated and the risk of malnutrition was determined.

Results: Among all, 61% of the children included in the study were males. While the mean age was 34.67 (39.95) months, 84.62% of the children's age was less than or equal to 60 months and 15.38% were aged over 60 months. Based on the STRONGkids scores, 55.77%, 31.41% and 12.82% of the included cases were low, moderate, and high-risk in terms of malnutrition, respectively. The length of hospitalization, breastfeeding duration and maternal age were related with middle arm circumference.

Conclusion: Malnutrition risk should be evaluated together with various risk factors rather than one. The definition and classification of malnutrition vary based on the method used. Middle arm circumference can be used together with STRONGKIDS score in estimating the duration of hospitalization and the level of malnutrition.

Keywords: Child, Malnutrition, STRONGkids, Gomez, Waterlow

Öz

Amaç: Çocuklarda tedaviye yanıtı etkileyen önemli bir faktör malnutrisyondur. Hastaneye yatışın ilk gününde malnutrisyon açısından gerekli önlemlerin alınması malnutrisyonu önleyecek ve morbiditeyi azaltacaktır. Bu amaçla hastane yatışında malnutrisyonun erken saptanmasını sağlayacak ip uçlarına ihtiyaç vardır. Bu çalışmada malnutrisyonu erken tesbit etmede ve değerlendirmede göz önünde bulundurulması gereken risk faktörlerini, vücut ölçümlerini ve skorlama sisteminin önemini göstermeyi amaçladık. Bu amaçla da basit, kullanışlı ve pratik bir skorlama olan STRONGkids skoru tercih edilerek malnutrisyonu gösterme başarısı araştırılmıştır.

Yöntemler: Bu çalışma retrospektif bir kohort çalışmasıdır. Bu çalışmanın denekleri 0-18 yaşları arasında herhangi bir kronik hastalığı olmayan çocuklar iken, altta yatan kronik hastalıkları olan hastalar araştırmamızın dışında bırakılmıştır. Akut enfeksiyon nedeniyle hastaneye yatırılan pediyatrik hastalar çalışmaya alındı. Hastanede yatış süresi ve sıklığı, anne yaşı, doğum sayısı, doğum kilosu, emzirme süresi ve emzirmenin devamı, ek besin alımının geçiş süresi, hastaneye yatış ve taburculuk sırasında ölçülen ilgili ağırlıklar değerlendirildi. Gomez ve Waterlow kullanılarak yetersiz beslenme derecesi ve STRONGkids skoru kullanılarak yetersiz beslenme riski belirlenmiştir.

Bulgular: Çalışmaya dahil edilen çocukların %61'i erkek, %39'u kadındı. Yaş ortalaması 34,67 (39,95) aydı. Çocukların %84,62'si 60 aydan küçük ve %15,38'i 60 ayın üzerindedir. Hastaların STRONGkids değerlendirmesi olguların %55,77'si için düşük, %31,41'i için ılımlı ve %12,82 yüksek risk grubu olarak değerlendirildi. Orta kol çevresi ile hastanede yatış süresi, emzirme süresi ve anne yaşı ilişkili bulunmuştur.

Sonuç: Malnutrisyon riski, tek bir risk yerine çok yönlü risk faktörleri ile birlikte değerlendirilmelidir. Malnutrisyon tanımı ve sınıflandırılması kullanılan yönteme göre değişmektedir. Orta kol çevresi, hastaneye yatış süresini ve yetersiz beslenme düzeyini tahmin etmede STRONGkids skoru ile birlikte kullanılabilir.

Anahtar kelimeler: Çocuk, Malnutrisyon, STRONGkids, Gomez, Waterlow

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Introduction

Malnutrition is a change in the balanced body composition due to a lack of nutrition [1]. Protein-energy malnutrition (PEM) remains a major health problem in less developed countries. Nearly, 60% of pediatric mortality under the age of five is due to malnutrition [2]. Deaths due to diarrhea and lower respiratory tract infections, which are responsible for pediatric deaths in developing and underdeveloped countries, may occur twice as more frequent in case of malnutrition. Clinical findings vary depending on the duration and severity of the nutritional deficiency, quality of nutrition as well as factors unique to the patient (i.e., age, underlying chronic disease, acute infections, etc.). Heavily malnourished patients can be easily noticed during hospitalization and clinical examinations. On the other hand, it may take a longer time to diagnose moderately or mildly malnourished patients. In this case, the nutrition plan of each patient should be adjusted by the doctor, energy needs should be determined, anthropometric measurements and biochemical parameters should be analyzed [3,4]. The degree of malnutrition is determined by Gomez and Waterlow's classifications in children with protein-energy malnutrition [5,6]. In developed countries, PEM emerges due to hospital stay and insufficient nourishment following underlying chronic diseases and surgical procedures [7,8]. In underdeveloped countries, on the other hand, PEM develops due to errors in nutritional content or inadequate and low-quality malnutrition as well as frequently recurring infections [9]. Although the rate of malnutrition is lower in studies conducted at separate times and in different regions of Turkey, malnutrition remains significant for both healthy and hospitalized children.

The European Society of Clinical Nutrition and Metabolism recommends a nutritional screening guide for adult patients; however, this guideline is not intended for pediatric patients [10]. Clinical scales that determine the nutritional risk of adult patients have been available for many years [11]. Similar clinical scales have been developed for hospitalized children and tested in small cohort groups [12,13]. One of these scales in determining the risk of malnutrition is STRONGkids [5,15]. The STRONGkids score includes 4 parameters: Subjective clinical evaluation, nutritional status, presence of underlying high-risk diseases, nutritional intake, and loss assessment (diarrhea, vomiting, inadequate weight gain or loss). Therefore, we aimed to determine the rate and degree of malnutrition among patients aged between 0-18 years at the pediatric clinic of our hospital via Gomez and Waterlow classifications and evaluate the use and importance of the STRONGkids score in determining the risk of malnutrition.

Materials and methods

Study population

This study was approved by the Ethical Committee of Taksim Education and Research Hospital on 22.05.2019 (no: 73). Pediatric patients aged between 0-18 years who were admitted to the hospital due to acute infections such as pneumonia were included in the study. Patients with underlying chronic diseases, oncological patients, patients with immunodeficiency, congenital heart disease or chronic diarrhea were excluded. Patients who underwent surgery within a month, as well as those with frequent hospitalizations were also left out of the study population.

Definition of malnutrition

Height, weight and other measurements of the patients during hospitalization were measured and recorded by a physician from the pediatric clinic. Anthro and anthroplus programs were deployed for evaluating the results [16,17]. For acute malnutrition (AM), Weight-for-Height –(WFH) score or Body Mass Index (BMI) for age Z scores were analyzed. For Z scores ≥-3 and <-2, moderate malnutrition was considered and for Z scores below -3, severe malnutrition was denoted. For Z scores ≥-2, malnutrition was ruled out [10]. For chronic malnutrition (CM), height-for-age (HFA) Z scores of ≥-3 and <-2 were deemed moderate malnutrition and scores <-3 as severe malnutrition while scores ≥ 2 showed lack of CM per WHO classification [18]. Middle arm circumference, subscapular and triceps skinfold thickness were also measured with a caliper instrument in pediatric patients under 60 months. The duration and number of hospitalizations, maternal age, number of births, birth weight, breastfeeding status, breastfeeding duration, transition period of supplemental nutrition intake, admission weight and discharge weight were also assessed. The degree of malnutrition was determined with Gomez and Waterlow, and the risk of malnutrition was determined by STRONGkids scoring.

STRONGkids nutritional risk screening tool

Physicians assessed the risk of malnutrition with the STRONGkids survey conducted after direct examination of the patients [14]. STRONGkids is a malnutrition risk assessment tool comprising 4 distinct parameters: A subjective clinical evaluation (1 pt), a high-risk disease (2 pts), nutritional intake (1 pt) and weight loss or poor weight gain (1 pt). Patients who scored 0 in STRONGkids survey were categorized as “low-risk” as opposed to those considered “medium-risk” with a score ranging between 1 and 3 and “high-risk” with a score between 4-5.

Statistical analysis

Categorical variables were summarized in numbers and percentages. The normality assumption of the numerical variables was checked with the Kolmogorov Smirnov test. Mann Whitney U test was used in the comparison of two independent groups characterized by non-normally distributed numerical variables. Kruskall Wallis H test was used in comparisons of more than two independent groups of non-normally distributed numerical variables. Differences between the groups were evaluated by the Dwass-Steel-Critchlow-Fligner test. Pearson Chi-Square was used in 2x2 tables whereas Fisher's Exact Test was used in RxC tables. Z scores were calculated with the help of WHO Child Growth Standards SPSS Syntax File (https://www.who.int/childgrowth/software/en). Statistical analyses were carried out with the Jamovi project (2019, Jamovi (Version 0.9.5.12) [Computer Software] (Retrieved from https://www.jamovi.org) and statistical significance was set at *P*-value <0.05.

Results

Patient demographics and basic clinical features

One hundred fifty-six children were included in the study, for which the minimum number of patients was determined as 140 for statistical significance purposes. While 61% of these children were male and 39% were female, their mean age was 34.67 (39.95) months. 84.62% of the children were aged 60 months or younger and 15.38% were older than 60 months. The mean ages of the children who were younger and older than 60 months was 20.51(16.94) months and 112.58 (40.44) months, respectively. The STRONGkids evaluation of the children suggested that 55.77%, 31.41% and 12.82% were in the low, medium, and high-risk categories, respectively, in terms of malnutrition (Table 1).

The mean duration and number of hospitalizations, age of mothers, number of births, birth weights of patients, duration of breastfeeding, time until switching to supplementary nutrition, weight at time of hospitalization and hospital discharge weights of patients, height, arm circumference, skin thickness of triceps, subscapular skin thickness and BMI values are all presented in Table 2.

The relationship between STRONGkids score and malnutrition parameters

No significant differences were detected between the nutritional status, malnutrition status by height, BMI by age, nutritional status by arm circumference, arm circumference SDS by age, triceps skin thickness SDS by age and BMI SDS by age with regards to STRONGkids evaluations (P>0.05 for each) (Table 3).

Acute-chronic malnutrition and chronic malnutrition were observed in 24.6% and 21.9% of patients with low STRONGkids score according to Waterlow classification, respectively. In patients with high STRONGkids scores, the prevalence of acute-chronic malnutrition and chronic malnutrition were 37.5% and 18.75%, respectively.

Table 1: Distribution of gender, age and STRONGkids analyses of the children

		n (%)	Mean (SD)	Median [Min-Max]
Age (month)		156 (100)	34.67 (39.95)	18 [1-192]
	≤60	132 (84.62)	20.51 (16.94)	14 [1-60]
	>60	24 (15.38)	112.58 (40.44)	96 [66-192]
		n (%)		
STRONGkids	Low risk	87 (55.77)		
	Medium risk	49 (31.41)		
	High risk	20 (12.82)		
Gender	Boys	95 (61)		
	Girls	61 (39)		

SD: Standard deviation

Table 2: Demographic and anthropometric characteristics of the children

		Mean (SD)	Median [Min-Max]
Length of Hospitalization (month)		5.61 (3.12)	5 [1-19]
Frequency of Hospitalization		1.62 (1.18)	1 [1-11]
Mother's Age (years)		29.67 (6.42)	30 [17-47]
Number of Births		2.61 (1.42)	2 [1-8]
Birth Weight (gram)		2956 (656)	3007.5 [260-4460]
Breastfeeding Status n (%)	Yes n (%)	59 (37.82)	
	No n (%)	97 (62.18)	
Duration of Breastfeeding (month)		14.73 (9.07)	17 [0.25-36]
Weaning time (month)		5.68 (2.24)	6 [0-12]
Admission Weight (kg)		13.49 (9.53)	11 [2.75-68]
Discharge Weight (kg)		13.73 (9.59)	11.28 [3-68]
Height (cm)		88.66 (24.47)	84.5 [47-166]
Arm Circumference (cm)		15.14 (2.82)	15 [6-30]
Skin Thickness of Triceps (cm)		11.9 (4.64)	10.75 [4-35]
Subscapular Skin Thickness (cm)		7.73 (2.47)	7 [3-19]
BMI (kg/m²)		15.64 (2.4)	15.33 [9.98-24.7]

BMI: body mass index, SD: standard deviation, Descriptive statistics provided as count (%)

Table 3: Comparison of nutritional status, according to STRONGkids evaluations

		STRONGkids			P-value
		Low	Medium	High	
Weight by height %	Acute-chronic malnutrition n (%)	18 (24.6)	7 (17.07)	6(37.5)	0.831
Weight by age %	Chronic malnutrition n (%)	16 (21.9)	9 (21.95)	3(18.75)	
	Normal n (%)	34 (46.6)	22(53.6)	6 (37.5)	
Waterlow classification	Acute malnutrition n (%)	5 (6.85)	3 (7.32)	1(6.25)	
Weight by height	Stunted n (%)	5 (7.25)	5 (14.71)	0 (0)	0.601
	Stunted and Obese n (%)	0 (0)	1 (2.94)	0 (0)	
Height by age	Normal (n (%))	50 (72.46)	24 (70.6)	12 (85.7)	
Waterlow classification	Obese n (%)	1 (1.45)	1 (2.9)	0 (0)	
	Weak n (%)	12 (17.4)	3 (8.8)	2 (14.3)	
	Weak and Short	1 (1.45)	0 (0)	0 (0)	
BMI by age	Overweight n (%)	10 (13.7)	2 (4.9)	1 (6.25)	0.581
	Very weak n (%)	5 (6.85)	2 (4.9)	1 (6.25)	
	Morbid obese n (%)	1 (1.37)	1 (2.4)	0 (0)	
	Normal n (%)	46 (63.01)	30(73.2)	13 (81.25)	
	Obese n (%)	0 (0)	2 (4.9)	0 (0)	
	Weak n (%)	11 (15.1)	4 (9.76)	1 (6.25)	
Arm circumference nutrition status by age	Heavy malnutrition n (%)	3 (3.45)	2 (4.08)	0 (0)	0.926
	Normal n (%)	77 (88.5)	45 (91.8)	19 (95)	
	Malnourishment n (%)	7 (8.05)	2 (4.08)	1 (5)	
Arm circumference SDS by age (SDS)	<(-1) - ≥ (-2) n (%)	8 (12.5)	7 (18.42)	2 (15.38)	0.882
	≤ (-2) n (%)	6 (9.38)	2 (5.26)	1 (7.69)	
	≥ (-1) n (%)	50 (78.13)	29(76.3)	10 (76.9)	
Triceps skin thickness by age (SDS)	< (-1) - ≥ (-2) n (%)	2 (3.45)	1 (2.7)	3 (23.08)	0.061
	≤ (-2) n (%)	1 (1.72)	0 (0)	0 (0)	
	≥ (-1) SDs n (%)	55 (94.83)	36 (97.3)	10 (76.92)	
BMI SDS by age	< (-1) - ≥ (-2) n (%)	14 (19.18)	9 (21.95)	5 (31.25)	0.712
	≤ (-2) n (%)	16 (21.92)	6 (14.63)	2 (12.5)	
	≥ (-1) n (%)	43 (58.9)	26(63.4)	9 (56.25)	

BMI: body mass index, SDS: standard deviation score

A significant relationship was detected between the mean length of hospital stay and middle arm circumference (P=0.015). Accordingly, the median length of stay in children with normal nutritional status was substantially shorter than those with severe malnutrition and malnutrition (Table 4). There were no significant differences between nutritional status, malnutrition status by height, BMI by age, arm circumference by age, triceps skin thickness by age, and median length of stay according to BMI assessments (P>0.05 for each).

The mean maternal age of the children and arm circumference by age differed significantly with regards to nutritional status (P=0.026, P=0.041, respectively). Accordingly, the mean age of the mothers of the children with normal arm circumferences by age was significantly higher than that of the malnourished children by age. The median duration of breastfeeding was significantly higher in children with normal nutritional status by arm circumference (P=0.003). The median duration of breastfeeding was similar with respect to nutritional status, malnutrition status by height, BMI by age, arm circumference by age, triceps skin thickness by age, and BMI by age (P>0.05 for each) (Table 4).

Table 4 shows no significant differences between the median values of the nutritional status, malnutrition status by height, BMI by age, nutritional status by arm circumference for age, arm circumference by age, triceps skin thickness by age, and transition to supplemental food by BMI assessments by age (P>0.05 for each) of the children included in the study.

No significant differences were found between the gender and age ratios of children in this study Likewise, in terms of STRONGkids evaluations, the medians of body weight, admission body weight, height, BMI, weight difference from admission-hospital discharge, duration and number of hospitalizations, maternal age, number of births, birth weight, duration of breastfeeding and duration of transition to supplementary nutrition were similar (P>0.05 for each) (Table 5).

Table 4: Comparison of hospitalization length based on nutritional status of the children

		Hospitalization Length (days)	*P*-value	Mother Age (years)	*P*-value	Breastfeeding Duration (month)	*P*-value	Weaning Time (month)	*P*-value
Weight by height %	Acute-chronic Malnutrition	6 [4-8]	0.147	27.29 (6.56)	0.282	10.5 [4.5–20]	0.915	6 [4.5-6]	0.309
Weight by age %	Chronic malnutrition	5 [4-8.5]		30.04 (6.03)		18 [3–24]		6 [4-6]	
Waterlow classification	Normal	4 [3-6]		28.73(5.3)		16 [8–18]		6 [6-6]	
	Acute malnutrition	5.5 [4-7.5]		28 (6.89)		10.5 [5.17–21]		6 [5-7.5]	
Weight by height	Stunted	7.5 [5-14]	0.055	30.5 (6.96)	0.297	18 [3–24]	0.334	6 [5-6]	0.083
Height by age z score	Stunted and Obese	3 [3-3]		36		[-]		0 [0-0]	
Waterlow Classification	Normal	5 [4-6]		28.73 (5.35)		17.5 [9–18]		6 [5-6]	
	Obese	5 [4-6]		29 (1.41)		8 [7–9]		7.5 [6-9]	
	Weak	6 [5-8]		27.41 (7.76)		5 [5–6]		6 [5-6]	
	Weak and Stunted	7 [7-7]		23		2 [2h2]		0 [0-0]	
BMI by age	Overweight	4 [3-5]	0.063	28.54 (4.12)	0.770	17 [10-18]	0.564	6 [5-6]	0.319
	Very weak	5.5 [3-9]		29.38 (9.87)		6 [6-6]		6 [1-6]	
	Morbid obese	3.5 [3-4]		33(4.24)		7 [7-7]		3 [0-6]	
	Normal	5 [4-7]		28.62 (5.67)		18 [8-20]		6 [5-6]	
	Obese	9 [6-12]		25 (4.24)		9 [9-9]		7.2 [5.5-9]	
	Weak	6 [5-8]		28.44 (6.88)		5 [2-24]		6 [5-6]	
Nutritional status by arm circumference	Heavy malnutrition	8 [6-13]	0.015*	30.2 (6.57)	0.026	2 [2-2]	0.003	6 [5-6]	0.095
	Normal	5 [3-7]		30.03 (6.39)		18 [9-24]		6 [5-6]	
	Malnourishment	7.5 [4-11]		24.4 (4.9)		3 [1-5]		5 [4-5]	
Arm circumference	< (-1) - ≥ (-2)	5 [4-7]	0.157	25.59 (5.27)	0.041	9 [2-16]	0.153	6 [4-6]	0.165
SDS by age	≤ (-2)	8 [5-8]		28.78 (5.97)		5 [3-22]		6 [5-6]	
	≥ (-1)	5 [3-7]		29.61 (5.88)		18 [9-19]		6 [5-6]	
Triceps skin thickness	< (-1) - ≥ (-2)	4 [3-8]	0.219	28 (3.03)	0.332	13.5 [5-22]	0.368	6 [5-6]	0.889
SDS by age	≤ (-2)	13 [13-13]		22		2 [2-2]		6 [6-6]	
	≥ (-1)	5 [4-7]		29.08 (6.03)		16.5 [8-19]		6 [5-6]	
BMI	< (-1) - ≥ (-2)	5.5 [4-8.5]	0.103	26.43 (4.89)	0.073	18 [6.5-23]	0.269	6 [5-6]	0.128
SDS by age	≤ (-2)	6 [5-8]		28.75 (7.79)		5 [2.5-15]		6 [4-6]	
	≥ (-1)	5 [4-7]		29.41 (5.47)		16 [8-18]		6 [5-6]	

* *P*<0.05, Kruskal-Wallis H test applied, Descriptive statistics provided in medians (inter-percentile ranges). BMI: Body mass index, SDS: Standard deviation score

Table 5: STRONGkids analysis of the children

	STRONGkids			*P*-value
	Low	Medium	High	
Gender, count (%)				
Male	50 (57.47)	35 (71.43)	10 (50)	0.157
Female	37 (42.53)	14 (28.57)	10 (50)	
Age (month), mean. (SD)	33.25 (39.92)	37.1 (43.17)	34.9(32.78)	0.652
Age, count (%)				
00-05 months	16 (18.39)	3 (6.12)	2 (10)	0.831
06-11 months	16 (18.39)	11 (22.45)	4 (20)	
12-23 months	17 (19.54)	11 (22.45)	3 (15)	
24-35 months	10 (11.49)	7 (14.29)	2 (10)	
36-47 months	5 (5.75)	4 (8.16)	3 (15)	
48-59 months	5 (5.75)	5 (10.2)	1 (5)	
60 months	5 (5.75)	1 (2.04)	1 (5)	
≥60 months	13 (14.94)	7 (14.29)	4 (20)	
Age (month), mean. (SD)				
>60 months	13 (14.94)	7 (14.29)	4 (20)	0.825
≤60 months	74 (85.06)	42 (85.71)	16 (80)	
Admission weight (kg)	10.6 [7-15.7]	12 [9.4-14.5]	11.58 [7.6-16.83]	0.449
Discharge weight (kg)	10.8 [7.23-15.7]	12 [9.6-14.2]	11.9 [7.65-16.93]	0.488
Height (cm)	82 [68.5-101]	87 [75-99]	85.5 [74.5-106]	0.361
Body mass index	15.56 [14.05-17.28]	15.59 [14.42-16.53]	14.94 [14.1-15.84]	0.571
Admission-Discharge weight difference (kg)	0.2 [0-0.4]	0.01 [-0.05-0.4]	0.16 [0-0.45]	0.181
Hospitalization duration (days)	5 [3-7]	5 [3-6]	5.5 [4-8]	0.624
Number of hospitalizations	1 [1-2]	1 [1-2]	1 [1-1]	0.364
Mother age (years)	30 [24-33]	29 [25-34]	31.5 [27.5-35.5]	0.571
Birth number	2 [1-4]	2 [2-3]	3 [2-4]	0.241
Birth weight (gram)	3070 [2750-3400]	3000 [2750-3250]	3000 [2850-3300]	0.907
Breast feeding duration	12 [6-18]	18 [9-24]	13 [6-22]	0.379
Weaning time	6 [5-6]	6 [5-6]	6 [6-6]	0.474

SD: Standard deviation, In descriptive statistics, categorical variables denoted with counts (%) and numerical variables with mean (standard deviation) and medians [inter-percentile range]

Discussion

Malnutrition remains an important health problem in hospitalized children in developing countries. Studies have been carried out for many years to determine the risk factors. PYMS and STAMP scores include anthropometric measurements, while STRONGkids classification also includes subjective criteria. Although there are similar steps in the scoring of these three methods in children, there are significant differences in the assessment [19]. While PYMS and STAMP include anthropometric measurements and may seem more successful in detecting malnutrition patients, STRONGkids is a more practical and useful method for determining malnutrition risk. Malnutrition rates ranging from 31.8% to 56.6% among hospitalized pediatric patients have been previously reported in Turkey [20]. These rates turn out to be much higher than reports from Germany, France, UK, and the US with results varying from 6% to14% [21]. In a similar study conducted in Turkey, 1513 hospitalized pediatric patients were screened with regard to malnutrition. 11.2% of the subjects had acute and 16.6% of the children had chronic malnutrition [22]. In our study, the chronic malnutrition rate was approximately 21% while the acute malnutrition rate was detected around 6.5%. A demographics and health survey conducted in 2018 on 2568 children below 5 years of age assessed the height and weight measurements of 1951 subjects and determined that less than 2% of them were malnourished whereas severely malnourished subjects accounted for less than 1% of the survey population [23].

In our study, the malnutrition rate was 21.9% in low-risk patients and 37.5% in high-risk patients according to STRONGkids, and these findings are consistent with studies and data from across the country. In the study by Joosten and Hulst, eight pediatric malnutrition screening tools were identified, and eight validation studies were incorporated. The authors defined only two tools (STRONGkids and PYMS) as the most practical and reliable [24]. In this meta-analysis, the most reliable scoring in terms of assessing children's nutritional risk and condition was noted as PYMS. Another study confirming malnutrition

screening tools for inpatients containing a meta-analysis was carried out by Huysentruyt et al [25]. In this study, four malnutrition screening tools (PYMS, STRONGkids, STAMP and PNRS) and 15 validation studies were reviewed. Authors of the study had difficulty in comparing the results while evaluating them since these studies were heterogeneous in nature. Therefore, they were not able to state the superiority of a single screening tool over other malnutrition screening methods. In another meta-analysis conducted by Teixeira and Viana, 5 malnutrition screening methods (PYMS, STRONGkids, STAMP, PNST and SGNA) were compared. In that study, authors displayed that STRONGkids and STAMP methods had the best clinical performance. On the other hand, STRONGkids scoring alone was not statistically sufficient to highlight the risk of malnutrition in our study. However, middle arm circumference as a simple additional measurement method was beneficial in assessing the malnutrition risk.

In studies conducted by Moeeni et al. [26] STRONGkids is described as a reliable and effective scoring method for showing the malnutrition risk. In our study, there was no significant relationship between malnutrition status of the three risk groups that were determined according to the STRONGkids score. However, the difference in acute-chronic malnutrition rates is remarkable in patients with low and high-risk scores.

The duration of hospitalization correlates with the middle arm circumference in indicating the malnutrition status of hospitalized children. In other words, the middle arm circumference of the hospitalized patients was lower as expected. The undisputed benefit of breastfeeding also draws attention to our study. As breastfeeding duration increased, malnutrition was observed less frequently. Middle arm circumference was higher in children who were breastfed. Similarly, the risk and rate of malnutrition were also lower. In another study conducted in Turkey, no significant relationship was found between malnutrition rate and age, sex, maternal age, number of maternal births and duration of breast milk intake [27]. In our study, the maternal age of the severely malnourished patients based on middle arm circumference was found to be high. Furthermore, patients with severe malnutrition based on BMI had longer periods of hospital stay. Similarly, in a study conducted with 157 children in Australia, it was observed that the length of hospital stay was longer in patients with malnutrition [28].

Limitations

To prevent any effect on malnutrition measurements and risk factors, patients with chronic diseases were not included in this study. However, a comparison group consisting of patients with chronic diseases could be drawn. Thus, the number of patients with high STRONGkids score could possibly be higher. The sociocultural level of families is also effective in the development of malnutrition. This variable is estimated by looking at factors such as the number of maternal births, breastfeeding duration, and birth weight. However, families could then be grouped as low, medium, and high groups based on the sociocultural level and subsequently, an intergroup comparison of STRONGkids score could also be made.

Conclusion

We believe that the use of more than one method rather than a single method or tool in determining malnutrition and malnutrition risk will provide more accurate and predictable results. STRONGkids scoring is a practical and useful method, and when evaluated together with malnutrition measurements, it provides promising concrete data for early detection of malnutrition and necessary precautions. Middle arm circumference is also a supplementary and practical measurement method for estimating malnutrition and length of hospital stay.

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