



# Does Preoperative Nutritional Assessment Affect Clinical Outcomes in Children with Acute Appendicitis?

## Pediatric Akut Apendisitlerde Preoperatif Beslenme Değerlendirilmesi Klinik Sonuçları Etkiler Mi?

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### Abstract

**Background:** Malnutrition increases postoperative complications in pediatric surgery patients.

**Objective:** The present study aims to examine whether the preoperative nutritional status has any effects on postoperative outcomes in patients with pediatric acute appendicitis who require urgent surgery.

**Material and Method:** This retrospective clinical study was conducted in the Department of Pediatric Surgery. Seventy-four patients were included in this study, and the data were analyzed retrospectively. After preoperative determination of malnutrition status by the Gomez classification system, BMI calculation results were compared with clinical outcomes.

**Results:** Seventy-four children who underwent appendectomy procedures were included in this study. The mean age was  $11.5 \pm 3.7$  years. Of the included patients in this study, 64.9% were male, while 35.1% were female. The length of hospital stay was  $1.77 \pm 1.34$  days. A BMI cut-off value of fewer than 16.74 was statistically significant ( $p < 0.001$ ), with 100.0% percent sensitivity and 68.66% specificity. Wound infection was more common in patients whose BMI value was lower than 16.74 ( $p = 0.010$ ). The findings showed that the mean age ( $p < 0.001$ ) of the patients with a BMI value below 16.74 was lower, and their hospital stay was longer ( $p = 0.011$ ).

**Conclusion:** Nutritional status assessment is an essential part to care children undergoing surgery. In the present study, we discovered that mild-to-moderate malnutrition and low BMI before surgery increase the postoperative morbidity, hospital stay, and wound infection frequency in children. Our findings suggest that this evaluation system can lead to positive changes in postoperative management.

**Keywords:** Nutritional status assessment, acute appendicitis, postoperative complications

### Öz

**Arka plan:** Malnutrisyon, pediatrik cerrahi hastalarda postoperatif komplikasyonların artmasına sebep olur.

**Amaç:** Bu çalışma, acil cerrahi gerektiren akut apandisitli çocuk hastaların preoperatif beslenme durumunun postoperatif sonuçlara etkisini belirlemeyi amaçladı.

**Gereç ve Yöntem:** Bu retrospektif kesitsel çalışma, Çocuk Cerrahisi Kliniğinde yürütülmüştür. Toplam 74 hasta çalışmaya alınmış ve verileri geriye dönük olarak incelenmiştir. Hastaların preoperatif Gomez malnutrisyon sınıflandırmaları, beden kitle indeksleri (BMI) belirlenerek klinik sonuçlarla karşılaştırılmıştır.

**Sonuçlar:** Apendisit nedeni ile ameliyatları yapılan 74 çocuk hasta bu çalışmaya dahil edildi. Yaş ortalaması  $11,5 \pm 3,7$  yıldır. Çalışmaya alınan hastaların %64,9'u erkek, %35,1'i kadındır. Hastanede yatış süresi  $2,96 \pm 2,1$  gündür. Hastaneye başvuru süresi  $1,77 \pm 1,34$  gündür. BMI cut-off değerinin 16,74'ün altında olması, %100,0 sensitivite, %68,66 spesifite ile istatistiksel olarak anlamlı bulunmuştur. BMI değeri 16,74'ün altında olan hastalarda yara yeri enfeksiyonu görülme sıklığı daha yüksek idi ( $p = 0,010$ ). BMI değeri 16,74'ün altında olan hastaların yaş ( $p < 0,001$ ) ortalamalarının daha düşük olduğu ve hastanede kalış sürelerinin daha uzun olduğu saptandı ( $p = 0,011$ ).

**Sonuç:** Beslenme değerlendirmesi, akut apandisit nedeni ile ameliyat edilen hastalarda hastaların yönetiminin çok önemli bir parçasıdır. Bu çalışmada, preoperatif hafif-orta malnutrisyonun ve zayıf BKİ çocuklarda postoperatif morbiditeyi, hastanede kalış süresini, yara yeri enfeksiyon sıklığını artırdığını gördük. Bu değerlendirme sistemlerinin postoperatif yönetiminde olumlu değişikliklere zemin hazırlayacağını düşünmekteyiz.

**Anahtar Kelimeler:** Beslenme değerlendirmesi, akut apandisit, ameliyat sonrası komplikasyonlar



## INTRODUCTION

The patient's nutritional status before the operation influences the complications after the operation. Pre-operative nutritional status assessment in pediatric patients undergoing surgery may be useful in preventing post-operative wound infections, delays in wound healing, and prolonged hospital stay.

Many studies have shown the importance of proper nutrition in the post-surgery recovery of pediatric patients. In the absence of adequate nutrition, the surgical stress on the child can place significant demands on the metabolism, potentially leading to organ and system dysfunction.<sup>[1,2]</sup>

Malnutrition is a risk factor for postoperative complications in patients undergoing abdominal surgery, according to many studies published in recent years.<sup>[3,4]</sup> The link between poor preoperative nutrition and poor surgical outcomes, on the other hand, is unclear. The scarcity of high-quality, randomized and controlled studies that found a statistically significant association makes evaluating the effects of malnutrition on surgical outcomes in pediatric patients challenging.

Despite the well-known negative effects of poor nutritional status, to our knowledge, the effects of preoperative nutritional status on postoperative outcomes in pediatric patients undergoing surgery have not been thoroughly investigated. Drawing on this, we sought to investigate the effects of preoperative nutritional status on wound healing in 74 patients aged 0 to 18 years who underwent appendectomy for acute appendicitis in our hospital in 2020.

## MATERIAL AND METHOD

The study was carried out with the permission of Adana City Training and Research Hospital Clinical Researches Ethics Committee (Date: 02.12.2021, Decision No: 1660). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

The present retrospective study included 74 patients with acute appendicitis who underwent an appendectomy in the Department of Pediatric Surgery, City Training and Research Hospital, Health Sciences University, between January 1, 2020, and December 31, 2020. After the determination of the patient's nutritional status and body mass index using the Gomez classification, the relationship between preoperative nutritional status and clinical outcome was evaluated (**Table 1**). Patients between 0-18 years who were operated on due to acute appendicitis were included in this study. The patients' demographic data, Gomez malnutrition classification, body mass index (BMI), hospital stay, wound infections, and laboratory data were all examined. It was assessed as prolonged hospitalization 48 hours following the surgery. Patients who were discharged by oral feeding within 48 hours of appendectomy were classified as non-complicated, while those who were discharged after 48 hours were classified as complicated.

**Table 1.** Gomez Classification-Body Mass Index (BMI)

Gomez Classification	
The Gomez classification is determined by comparing the child's body weight to the body weight of a healthy, normally growing child of the same age group.	
Weight for age (%)=(Child weight/Height of healthy child at the same age) x100	
Percentage of Weight by Age	Comment
90-110%	Healthy Child
75-89%	1: Mild Malnutrition
60-74%	2: Moderate Malnutrition
<60%	3: Severe Malnutrition
Body Mass Index (BMI)	
BMI = weight (kg) divided by height (in meters squared).	
<ul style="list-style-type: none"> <li>• Less than 18.5 kg/m: Weak.</li> <li>• Between 18.5 and 24.9 kg/m: Normal weight.</li> <li>• Between 25 and 29.9 kg/m: Overweight.</li> <li>• Between 30 and 39.9 kg/m: Obese.</li> <li>• Over 40 kg/m: Severely obese (morbidly obese)</li> </ul>	

## Statistical Analysis

The data were statistically analyzed using the SPSS 23.0 package program. Continuous measurements were summarized as mean, deviation, and minimum-maximum values, while categorical measurements were summarized as numbers and percentages. The Shapiro-Wilk test was used to assess conformity to the normal distribution. To compare categorical variables, the chi-square and Fischer tests were used. In groups with a normal distribution, the independent Student's t-test was used, while in groups that did not fit normally, the Mann-Whitney U test was used. The sensitivity and specificity values to the BMI value were calculated based on the Gomez score variable of the patients included in the present study. The cut-off value was determined by examining the area under the ROC curve. In all tests, the statistical significance level was set to 0.05.

## RESULTS

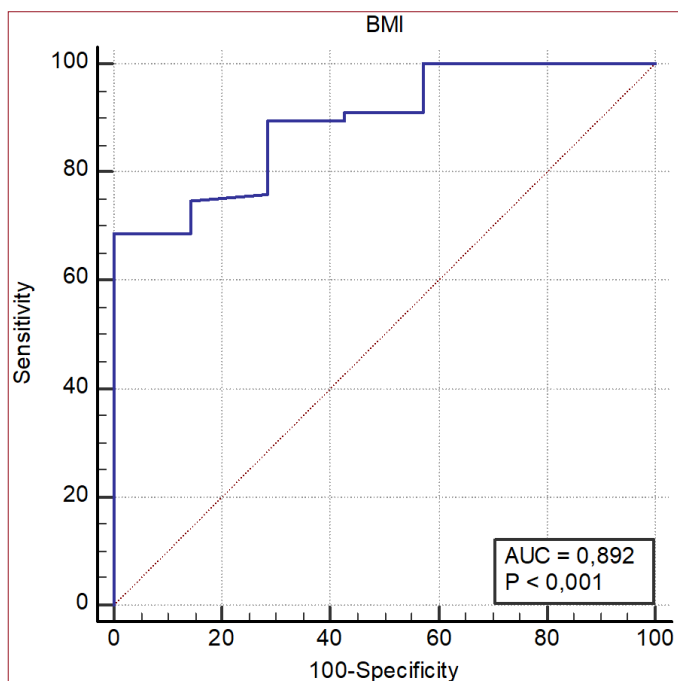
The present study included 74 children who had appendectomy surgery. The mean age was 11.5±3.7 years. Appendectomy was performed on 50% of patients aged seven to 13. 64.9% of the patients in this study were male, while 35.1% were female. According to the preoperative Gomez malnutrition classification, 58.1 percent of the patients were healthy, 32.4 percent had mild malnutrition, and 9.5 percent had moderate malnutrition. There was no evidence of severe malnutrition in any of the patients. The total length of stay in the hospital was 2.96±2.1 days. The duration of admission to the hospital was 1.77±1.34 days. The diameter of the appendix was measured to be 10.1±3.33 mm. The average C-reactive protein in laboratory parameters was 41.4±72.1 mg (Normal value 0-5 mg) (**Table 2**).

**Table 2.** Examination of demographic data

	Frequency (n)	Percentage (%)
Gomez		
Normal	43	58.1
Mild	24	32.4
Middle	7	9.5
Wound infection		
with wound infection	11	14.9
without wound infection	63	85.1
Sex		
Male	48	64.9
Female	26	35.1
Distribution of Age		
0-6 years	8	10.8
7-13 years	37	50.0
14-18 years	29	39.2
	<b>Mean±SS</b>	<b>Med (min-max)</b>
Weight	44.2±17.6	46.3 (9-80)
BMI	19.5±4.8	18.74 (10.74-34.24)
Age (year)	11.5±3.7	12 (0-16)
Length of hospitalization	2.96±2.1	2 (1-15)
The duration of admission to the hospital	1.77±1.34	1 (1-10)
Appendix diameter (mm)	10.1±3.3	10 (4-20)
WBC	15.5±4.9	15.9 (4.5-26.6)
NE%	75.3±14.7	79.9 (9.8-91.5)
LY%	15.2±10.8	10.6 (4-45.5)
PLT	307.9±82.6	295 (168-650)
CRP	41.4±72.1	8.65 (0.1-303)

WBC: White blood cell (5.14-13.3 10<sup>9</sup>), NE: neutrophil percentage (22.4-69%), LY: Lymphocyte percentage (18.4-66.6%), PLT: Platelet count (150-400 10<sup>9</sup>)

The mean preoperative BMI of the patients was 19.5±4.8. The BMI value of the patients was subjected to ROC analysis based on their Gomez score (Figure 1, Table 3). The values for sensitivity and specificity were calculated. As a result of the examination, the calculated cut-off value for the BMI value was fewer than 16.74, with 100.0 percent sensitivity and 68.66 percent specificity, which was statistically significant (p<0.001). The patients were divided into two groups based on their BMI (below and above 16.74). The differences between the parameters were statistically determined. Wound infection was more common in patients with a BMI greater than 16.74 (p=0.010). Low BMI patients were more common in the 0-6 age group and the 7-13 age group (p<0.001). While the mean age of patients with low BMI was lower (p<0.001), the length of hospital stay (p=0.011), appendix diameter (p=0.026), NE percent (p=0.041) and PLT (p=0.002) values were all higher (p<0.05) (see Table 4).

**Figure 1.****Table 3.** Examination of the value between Gomez score and BMI through the ROC curve

	BMI
Threshold (cut-off)	<16.74
AUC (95% CI)	0.892 (0.799-0.952)
Sensitivity (95% CI)	100 (59-100)
Specificity (95% CI)	68.66 (56.2-79.4)
PPV (95% CI)	100 (100-100)
NPV (95% CI)	25 (19-32.2)
P	<0.001**

\* p<0,05, ROC curve test

**Table 4.** Differences in relevant parameters between groups with BMIs fewer than and greater than 16.74

	BMI Low (n=28) n(%)	BMI High (n=46) n(%)	
Wound infection			
with wound infection	8 (28.6)	3 (6.5)	0.010** <sup>c</sup>
without wound infection	20 (71.4)	43 (93.5)	
Sex			
Male	21 (75)	27 (58.7)	0.154 <sup>c</sup>
Female	1(25)	19 (41.3)	
Distribution of Age			
0-6 years	5 (17.9)	3 (6.5)	<0.001** <sup>c</sup>
7-13 years	20 (71.4)	17 (37)	
14-18 years	3 (10.7)	26 (56.5)	
	<b>Low (n=28)</b>	<b>High (n=46)</b>	
Age (year) <sup>b</sup>	9 (2-15)	14 (0-16)	<0.001**
Length of stay in hospital <sup>b</sup>	3 (1-15)	2 (1-7)	0.011*
The duration of admission to the hospital <sup>b</sup>	1.5 (1-5)	1 (1-10)	0.500
Appendix diameter (mm) <sup>b</sup>	10 (5-19)	10 (4-20)	0.026*
WBC <sup>a</sup>	16.3±4.7	15.0±5.0	0.287
NE% <sup>b</sup>	83.8 (54.5-91.5)	78 (9.8-91.3)	0.041*
LY% <sup>b</sup>	8.9 (4.7-37.4)	11.8 (4-45.5)	0.075
PLT <sup>a</sup>	346.0±84.6	284.7±72.9	0.002**
CRP <sup>b</sup>	16.2 (0.2-297.3)	6.77 (0.1-303)	0.099

\*p<0.05, \*\*p<0.001, a: Independent Student t-test, b: Mann-Whitney U test, c: Chi-square and Fisher's exact test

## DISCUSSION

Nutritional assessment is essential in the care of surgical patients. The Gomez malnutrition classification is a screening tool used in pediatric patients to detect preoperative malnutrition. We employed the Gomez score and BMI preoperatively to assess preoperative malnutrition in patients in this study, and we discovered that more than half of our patients were not malnourished. However, we discovered that 14.9 percent of patients with mild to moderate Gomez and BMI fewer than 16.74 had infectious processes after surgery, and their hospital stay was significantly prolonged ( $p < 0.05$ ). In the present study, we discovered that the risk of wound infection was statistically significantly higher in patients whose BMI was fewer than the cut-off value we established. As a result, identifying patients with nutritional deficiencies before surgery is critical for avoiding sub-optimal outcomes. Many parameters, such as weight, length, mid-arm circumference, and triceps skinfold thickness, have been used in the literature to assess nutritional status. Some methods were used to try to determine nutritional status.

[5-8]

We aimed to investigate if there was a postoperative correlation between Gomez classification and BMI. We discovered a statistically significant association between preoperative weight and postoperative wound infection. 9 Koofy et al. discovered the highest prevalence of malnutrition in patients undergoing gastrointestinal surgery in the screening developed according to STRONGKIDS newly published ESPEN (European Society for Clinical Nutrition and Metabolism) guidelines used in his study and discovered a significant correlation between preoperative age and postoperative complications.

The findings obtained in the study conducted by Roberson et al. suggest that preoperative malnutrition may be a modifiable risk factor for preventing surgical complications and is associated with increased morbidity in surgery.

Previous research identified malnutrition predictors, such as hypoalbuminemia, weakness, and the need for nutritional support, as potential indicators of poor postoperative outcomes.

Secker et al. observed and evaluated patients for nutrition-related complications for 30 days after surgery. These complications were divided into four categories: length of hospital stay, emergency reoperations, hospital readmission, infection complications, and non-infectious complications.

According to Wessner, consensus would be ideal for evaluating standard nutrition in pediatric surgery patients and would guide further studies. Toole et al. revealed that children with mild malnutrition required a longer hospital stay in a retrospective study to determine the preoperative nutritional status in children with congenital heart disease. Based on anthropometric data, a cross-

sectional cohort study of 125 patients found that 12% of the patients were malnourished and 40% had a high BMI, with no relationship found between complications.

Because of age differences, it has been challenging to develop a standard malnutrition analysis in children. As a result, many studies have a direct impact on postoperative outcomes, which is especially important in pediatric surgery patients to best predict nutritional status with various combinations and due to the high metabolic rates and energy requirements after surgery.

## CONCLUSION

Nutritional assessment is a critical component of the care of children undergoing surgery. In the present study, we revealed that mild-to-moderate malnutrition before surgery increased postoperative morbidity, hospital stay, and wound infection frequency in children with low BMI. The findings suggest that routinely implementing these evaluation systems into clinical practice can pave the way for positive changes in postoperative management strategies.

## ETHICAL DECLARATIONS

**Ethics Committee Approval:** The study was carried out with the permission of Adana City Training and Research Hospital Clinical Researches Ethics Committee (Date: 02.12.2021, Decision No: 1660).

**Informed Consent:** Because the study was designed retrospectively, no written informed consent form was obtained from patients.

**Referee Evaluation Process:** Externally peer-reviewed.

**Conflict of Interest Statement:** The authors have no conflicts of interest to declare.

**Financial Disclosure:** The authors declared that this study has received no financial support.

**Author Contributions:** All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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