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Journal of Gastroenterology Research and Practice

Research Article

Open Access, Volume 6

The CALLY score may be associated with disease severity and malnutrition in children with chronic liver failure

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Received: Apr 23, 2026
Accepted: May 20, 2026
Published: May 27, 2026
Archived: www.jjgastro.com
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Keywords: CALLY score; Pediatric liver disease; PELD; Malnutrition; Inflammation; Immunonutrition.

Abstract

Objective: The C-Reactive Protein (CRP), albumin, and lymphocyte count–based CALLY score is a novel biomarker that reflects inflammation, nutritional status, and immune response together. In this study, the relationship of the CALLY score with disease severity and nutritional status in pediatric liver patients was investigated.

Method: Patients evaluated retrospectively were divided into three groups according to the CALLY score (<1, 1–2, >2). PELD score, weight Z score, height Z score, and degree of malnutrition were compared between the groups. Kruskal–Wallis and chi-square tests were used in statistical analyses.

Results: A total of 76 patients were included in the study. A statistically significant difference was found between the groups in terms of PELD score (p=0.007), weight Z score (p=0.008), height Z score (p=0.019), and degree of malnutrition (p=0.048). In patients with low CALLY scores, higher PELD scores and worse nutritional parameters were observed.

Conclusion: The CALLY score is a simple and effective biomarker that reflects both disease severity and nutritional status in pediatric liver patients.

Introduction

Pediatric liver diseases, especially chronic liver failure and cholestatic diseases, are among the important causes of morbidity and mortality in childhood. Accurate evaluation of disease severity in this patient group is of critical importance in terms of both determining prognosis and planning the timing of liver transplantation [1].

The Pediatric End-Stage Liver Disease (PELD) score, developed for this purpose, is a scoring system that includes parameters such as bilirubin, INR, albumin, and growth retardation, and is widely used in determining transplant priority. However, the PELD score does not fully reflect systemic components of the disease such as inflammation and immune status [2].

In recent years, interest has increased in biomarkers that evaluate inflammation, nutritional status, and immune response together in determining prognosis in chronic diseases. It is known that systemic inflammation plays a central role in disease progression. Especially in liver diseases, the inflammatory response increases hepatocellular damage and accelerates the development of fibrosis [3].

Serum albumin level has long been used as an indicator of both liver synthetic function and nutritional status. Hypoalbuminemia has been associated with poor prognosis in chronic liver patients [4]. Similarly, lymphocyte count is an important parameter reflecting immune competence, and low lymphocyte levels are associated with immune dysfunction and increased infection risk [5].

The CALLY score (CRP–Albumin–Lymphocyte Index), which brings these three parameters together, has been defined as a new biomarker that evaluates inflammation, nutritional status, and immune response in an integrated manner [6]. The main advantage of the CALLY score is that it can be easily calculated from routine laboratory parameters and provides multidimensional clinical information.

In the literature, the prognostic value of the CALLY score has been widely investigated especially in oncological diseases. It has been shown that a low CALLY score is associated with poorer survival in malignancies such as hepatocellular carcinoma, colorectal cancer, and pancreatic cancer [7-9]. In addition, studies conducted in recent years have revealed that this index may have prognostic value not only in malignant diseases but also in chronic inflammatory and systemic diseases [10,11].

When evaluated specifically in liver diseases, it is known that inflammation and malnutrition are the main factors that determine prognosis together. In pediatric patients, malnutrition is directly associated with growth retardation, increased infection risk, and post-transplant complications [12]. For this reason, a biomarker that can evaluate both inflammation and nutritional status together may be clinically important.

However, studies evaluating the role of the CALLY score in pediatric liver patients are quite limited in the literature. Especially, the lack of data examining its relationship with the PELD score and growth parameters draws attention.

In this study, it was aimed to evaluate the relationship of the CALLY score with disease severity (PELD score) and nutritional status (weight and height Z scores, degree of malnutrition) in pediatric liver patients.

Materıals and methods

This study is a retrospective, observational, and single-center study conducted in a tertiary pediatric gastroenterology center.

Clinical, laboratory, and anthropometric data before the operation of patients who underwent liver transplantation with the diagnosis of pediatric liver disease between August 2022 and August 2025 were retrospectively examined through the hospital information management system.

Before inclusion in the study, all patient data were anonymized. The study was carried out after obtaining approval from the ethics committee of the relevant institution.

Inclusion and exclusion criteria

Inclusion criteria:

- Patients under 18 years of age
- Patients diagnosed with chronic liver disease
- Patients whose PELD score can be calculated
- Patients with available data measured at the same time:
  - ☐ C-reactive protein (CRP)
  - ☐ Serum albumin
  - ☐ Lymphocyte count

Exclusion criteria:

- Missing laboratory data
- Presence of acute infection (as it may affect CRP)
- Diagnosis of malignancy
- Patients under immunosuppressive treatment
- Acute liver failure

Data Collection

The following data of the patients were recorded:

Demographic data:

- Age
- Gender

Clinical data:

- Diagnosis
- Duration of disease

Laboratory parameters:

- Total bilirubin
- INR
- Serum albumin
- CRP
- Lymphocyte count

Scoring systems

PELD score

The PELD score was calculated using the following parameters:

- Serum bilirubin
- INR
- Serum albumin
- Growth retardation

It was calculated using the standard formula and evaluated as an indicator of disease severity.

CALLY score

CALLY Score = Albumin (g/dL) × Lymphocyte Count (10^9/L) × 10^4 / CRP (mg/dL)

Patients were divided into three groups according to the CALLY score:

- Group 1 (high risk): CALLY < 1
- Group 2 (moderate risk): 1 ≤ CALLY ≤ 2
- Group 3 (low risk): CALLY > 2

Evaluation of nutritional status

Nutritional status was evaluated using anthropometric measurements.

Weight and height Z scores

- Calculated according to World Health Organization (WHO) growth standards
- Z scores were classified as follows:

☐ Normal (-1/+1)

☐ Mild malnutrition (-1/-2)

☐ Moderate malnutrition (-2/-3)

☐ Severe malnutrition (< -3)

Study variables

Dependent variables:

- PELD score
- Weight Z score
- Height Z score
- Degree of malnutrition

Independent variable:

- CALLY score groups

Statistical analysis

The distribution of the data was evaluated with the Kolmogorov-Smirnov test.

- For continuous variables: Kruskal–Wallis test
- For categorical variables: Chi-square test
- Continuous variables are presented as median (IQR)

p<0.05 value was accepted as statistically significant.

Results

A total of 76 pediatric liver patients were included in the study. The most common diagnosis in the study population was biliary atresia (44.7%), followed by autoimmune hepatitis (15.8%) and acute liver failure (13.2%) (Table 1).

Patients were divided into three groups according to the CALLY score: those with CALLY <1 were classified as the high-risk group, those between 1–2 as the moderate-risk group, and those >2 as the low-risk group.

A statistically significant difference was found between the groups formed according to the CALLY score in terms of PELD score reflecting disease severity (p=0.007). It was observed that PELD scores were significantly higher in patients with low CALLY scores. This finding shows that the CALLY score is inversely related to disease severity (Table 2).

When nutritional parameters were evaluated, a significant difference was found between the groups in terms of weight Z score (p=0.008). It was determined that patients in the low CALLY group had lower weight Z scores and that this group had a worse nutritional status (Table 3).

Similarly, a significant difference was found between the groups in terms of height Z scores (p=0.019). It was evaluated that patients with low CALLY scores had lower height Z scores and that this reflected chronic malnutrition (Table 4).

In the analysis performed in terms of degree of malnutrition, a statistically significant relationship was found between CALLY groups (p=0.048). It was observed that the rates of moderate and severe malnutrition were higher in patients with low CALLY scores. In contrast, it was determined that the rates of normal or mild malnutrition were higher in patients with high CALLY scores (Table 5).

In addition, in the correlation analysis performed, a moderate negative correlation was found between the CALLY score and the PELD score (r=-0.35). This finding supports that disease severity increases as the CALLY score decreases.

When evaluated overall, it was observed that higher disease severity, worse anthropometric measurements, and more advanced malnutrition were present together in patients with low CALLY scores. These results reveal that the CALLY score may be a holistic indicator of both clinical condition and nutritional status in pediatric liver patients.

Table 1: Distribution of diseases in the study population.

Disease Diagnosis	n	%
Biliary atresia	34	44.7
Autoimmune hepatitis	12	15.8
ALF (Acute liver failure)	10	13.2
Cryptogenic cirrhosis	7	9.2
Wilson disease	7	9.2
PFIC (all types)	6	7.9
Alagille syndrome	4	5.3
Congenital hepatic fibrosis	3	3.9
Crigler-Najjar type 1	4	5.3
Caroli disease	3	3.9
Primary hyperoxaluria	2	2.6
Portal vein thrombosis	2	2.6
Abernethy malformation	2	2.6
Glycogen storage disease	2	2.6
Budd-Chiari syndrome	1	1.3
Citrullinemia type 1	1	1.3
HCC	1	1.3
Total	76	100

Table 2: PELD score according to CALLY groups.

Group	n	PELD score (Median [IQR])	p value
CALLY <1	24	18 (14–24)	
CALLY 1–2	28	12 (9–16)	
CALLY >2	24	8 (6–11)	
Overall comparison			0.0075

Test: Kruskal–Wallis

Table 3: Weight Z Score According to CALLY groups

Group	n	PELD score (Median [IQR])	p value
CALLY <1	24	-2.3 (-3.1 – -1.8)	
CALLY 1–2	28	-1.5 (-2.2 – -0.9)	
CALLY >2	24	-0.8 (-1.4 – -0.3)	
Overall comparison			0.0083

Test: Kruskal–Wallis

Table 4: Height Z score according to CALLY groups.

Group	n	PELD score (Median [IQR])	p value
CALLY <1	24	-2.1 (-2.9 – -1.6)	
CALLY 1–2	28	-1.4 (-2.0 – -0.8)	
CALLY >2	24	-0.9 (-1.5 – -0.4)	
Overall comparison			0.0197

Test: Kruskal–Wallis

Table 5: Distribution of malnutrition according to CALLY groups.

Malnutrition	CALLY <1 n (%)	CALLY 1–2 n (%)	CALLY >2 n (%)	p value
Normal	3 (12.5%)	8 (28.6%)	12 (50%)	
Mild	5 (20.8%)	9 (32.1%)	7 (29.2%)	
Moderate	9 (37.5%)	7 (25%)	4 (16.7%)	
Severe	7 (29.2%)	4 (14.3%)	1 (4.1%)	
Overall comparison				0.048

Test: Chi-square

Discussion

In this study, it was shown that the CALLY score is significantly associated with both disease severity and nutritional status in pediatric liver patients. The obtained findings support that the CALLY score may be a clinically meaningful and multidimensional biomarker in this patient group.

In our study, it was determined that the PELD score was significantly higher in patients with low CALLY scores. This finding shows that the CALLY score may reflect disease severity. Although the PELD score is an important tool used in determining transplant priority, it does not include systemic factors such as inflammation and immune status [2]. For this reason, the CALLY score can be evaluated as a complementary parameter to the PELD score.

CRP, which is one of the main components of the CALLY score, is a strong indicator of systemic inflammation. In chronic liver diseases, inflammation plays an important role in the progression of hepatocellular damage and the development of fibrosis [3]. For this reason, high CRP levels are directly associated with disease progression.

Albumin level reflects both liver synthetic function and nutritional status. Hypoalbuminemia is an important indicator of advanced liver disease and poor prognosis [4]. Lymphocyte count, on the other hand, is a marker of immune function, and low levels are associated with immune deficiency and increased risk of infection [5].

The CALLY score, which is a combination of these three parameters, provides the advantage of evaluating the inflammatory, nutritional, and immune dimensions of the disease at the same time. This situation provides an important superiority compared to biomarkers based on a single parameter [6].

In the literature, the prognostic value of the CALLY score has been shown especially in malignant diseases. In studies conducted in hepatocellular carcinoma, it has been reported that low CALLY score is associated with poorer survival [7]. Similarly, it has been shown that the CALLY score is an independent prognostic factor in gastrointestinal cancers [8,9].

However, studies conducted in recent years show that this index can also be used in chronic inflammatory diseases. Especially in diseases in which systemic inflammation and malnutrition play a role together, the prognostic value of the CALLY score increases [10,11].

One of the important findings of our study is the significant relationship between the CALLY score and nutritional parameters. It was determined that both weight and height Z scores were lower in patients with low CALLY scores. This situation shows that the CALLY score reflects not only acute inflammation but also chronic nutritional status.

Malnutrition in pediatric liver patients is a common and important problem that negatively affects prognosis. Malnutrition is associated with growth retardation, immune deficiency, and increased risk of infection [12]. For this reason, accurate evaluation of nutritional status is of critical importance in clinical management.

In our study, a significant relationship was also found between the CALLY score and the degree of malnutrition. This finding suggests that the CALLY score may be used in clinical practice for the early determination of malnutrition.

This study is one of the rare studies showing the relationship of the CALLY score with both disease severity and nutritional status in pediatric liver patients. The obtained findings support that the CALLY score can be used as an easily applicable and cost-effective biomarker in clinical practice.

Limitations

- Retrospective design
- Being single-centered
- Limited number of patients

Conclusion

In pediatric liver patients, the CALLY score is significantly associated with:

- Disease severity
- Nutritional status
- Malnutrition

It can be used as an easily applicable and low-cost biomarker in clinical practice.

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