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The Role of C-Reactive Protein as an Inflammatory Marker in Pediatric Acute Diarrhea

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دور البروتين التفاعلي C كمؤشر التهابي في الإسهال الحاد لدى الأطفال

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ABSTRACT

Background: In children, particularly those living in low-resource settings, acute diarrhea is still a leading contributor to illness and death. We examined how serum C-reactive protein (CRP) relates to clinical findings, including fever and the passage of bloody stools, among children admitted to hospital. **Methods:** We retrospectively reviewed the case files of 66 children between 1 month and 5 years of age who were hospitalized at the Pediatric Department of Tobruk Medical Center, Libya, between June 2024 and June 2025 because of acute diarrhea accompanied by dehydration, fever, or blood in the stool. History and examination findings, blood tests (CRP and complete blood count), and stool analysis results (fecal red cells, occult blood, and microscopy) were extracted. **Results:** The children were aged 4 months to 5 years, and 65.2% were girls. Diarrhea was watery in 78.8% and bloody in 21.2%. The most common presentation was fever together with vomiting (42.4%), and symptoms lasted from under 1 day up to 10 days. Fecal red cells of ≥10/HPF and a positive occult blood test were each detected in 7.6% of children, while microscopy showed yeast in 18.2% and ova in 6.1%. Forty-two children (63.6%) had an elevated CRP. CRP was not significantly related to bloody diarrhea (p = 0.955) or to any stool finding, but it rose with body temperature (r = 0.369, p = 0.004). **Conclusion:** In hospitalized children with diarrhea, CRP on its own is not sufficient to identify the underlying cause, although its level tracks body temperature.

الملخص

الخلفية: لا يزال الإسهال الحاد سببًا رئيسيًا للمراضة والوفيات لدى الأطفال، ولا سيما في البلدان النامية. هدفت هذه الدراسة إلى تقييم العلاقة بين المؤشر الحيوي الالتهابي البروتين التفاعلي (CRP) C والسمات السريرية مثل الحمى والإسهال الدموي لدى الأطفال المنوَّمين.
طرق البحث: أُجريت دراسة رصدية استعادية على السجلات الطبية لـ 66 طفلًا تتراوح أعمارهم بين شهر واحد وخمس سنوات، أُدخلوا إلى قسم الأطفال بمركز طبرق الطبي، ليبيا، بسبب إسهال حاد مصحوب بالجفاف أو الحمى أو الإسهال الدموي، خلال الفترة من يونيو 2024 إلى يونيو 2025. وجُمعت بيانات التاريخ المرضي والفحص السريري والفحوصات الدموية (CRP وتعداد الدم الكامل) وتحليل البراز (كريات الدم الحمراء البرازية، والدم الخفي، والفحص المجهري). النتائج: تراوحت أعمار المرضى بين 4 أشهر و5 سنوات، وشكّلت الإناث 65.2%. ووُجد الإسهال المائي لدى 78.8% والإسهال الدموي لدى 21.2%، وكانت الحمى المصحوبة بالقيء أكثر الأعراض شيوعًا (42.4%)، وتراوحت مدة الشكوى بين أقل من يوم و10 أيام. ووُجدت كريات الدم الحمراء في البراز بعدد ≥10 في الحقل عالي التكبير، والدم الخفي، لدى 7.6% من المرضى لكلٍّ منهما، والخمائر لدى 18.2%، والبيوض لدى 6.1%. وكان مستوى CRP مرتفعًا بصورة غير طبيعية لدى 42 مريضًا (63.6%). ولم يُظهر مستوى CRP ارتباطًا ذا دلالة إحصائية بالإسهال الدموي ($p = 0.955$) أو بنتائج تحليل البراز، في حين ارتبط ارتباطًا طرديًا ذا دلالة إحصائية بدرجة حرارة الجسم ($r = 0.369$، $p = 0.004$). الخلاصة: لا يمكن الاعتماد على CRP وحده للتمييز بين المسببات المرضية للإسهال لدى الأطفال المنوَّمين، إلا أنه يرتبط بدرجة حرارة الجسم.

الكلمات المفتاحية: طب الأطفال، الإسهال الحاد، الجفاف، البروتين التفاعلي C، المؤشر الحيوي الالتهابي

1. INTRODUCTION

Acute diarrheal illness continues to weigh heavily on child health, with the greatest toll in low-resource countries, and worldwide it is the second most common cause of death before the fifth birthday. Most episodes are caused by viruses and resolve spontaneously; however, a considerable share results from bacteria that need targeted treatment. Distinguishing viral from bacterial disease early and reliably therefore helps clinicians avoid needless antibiotic prescribing, limit the spread of antimicrobial resistance, and choose the right management (Mahajan et al., 2023). In a Libyan series of hospitalized children, viruses were identified in 93% of cases; rotavirus was detected in 93%, norovirus in 29%, and adenovirus in 14% (Gammodi, Ahmed, Abufayed, Ben Saleh, & Othman, 2025). Children younger than five years carry a disproportionate share of the worldwide burden of acute diarrhea. Even with better sanitation and the rollout of rotavirus vaccination, diarrheal illness still accounts for many deaths and hospital admissions across low- and middle-income settings (Troeger et al., 2018). Bacterial agents, notably *Shigella*, *Salmonella*, and *Campylobacter*, tend to make diarrheal episodes more severe and prolonged. Yet, because bacterial and viral illnesses present in similar ways, telling them apart from symptoms alone is difficult (Chhabra et al., 2022). In resource-limited countries, a child may experience as many as 10 bouts of diarrhea during the first 2 years of life, and these bouts remain a leading reason for hospital admission, with considerable associated illness and death (Walker et al., 2013). Stool culture is slow and insensitive, particularly for organisms that are difficult to grow or less frequently encountered. Newer tools, such as multiplex polymerase chain reaction (PCR) panels and measurement of inflammatory biomarkers, may overcome these shortcomings (Petersen et al., 2020). Blood markers of systemic inflammation, including CRP and the erythrocyte sedimentation rate (ESR), have proved useful for separating bacteria from viral gastroenteritis, particularly when interpreted together with the white blood cell (WBC) count (Takemura et al., 2021). Stool-based markers, among them calprotectin and lactoferrin, are being adopted more widely to assess intestinal inflammation without invasive testing. Because these proteins originate from neutrophils, their concentrations rise in bacterial infection, which may spare children from invasive investigations (Mahajan et al., 2023). Compared with viral illness, bacterial diarrhea more often produces marked fever, blood in the stool, and dehydration. Stool culture has long been the reference test, but it is slow and lacks sensitivity. Biomarkers measured in blood and stool are now being explored as faster ways of recognizing a bacterial cause. In blood, CRP, ESR, and the leukocyte count are the most commonly used, whereas in stool, neutrophil products calprotectin, lactoferrin, myeloperoxidase (MPO), and polymorphonuclear elastase (PMN-e) indicate intestinal inflammation and show promise as diagnostic aids (Chhabra et al., 2022). The present work therefore set out to examine how serum CRP relates to fever, bloody stools, and other clinical findings in children admitted with acute diarrhea.

2. METHOD

Research questions and hypothesis.
Two questions were addressed: (1) whether serum CRP can separate bacterial from viral causes of acute diarrhea in children, and (2) whether inflammatory markers are related to clinical findings such as fever and bloody stools. We hypothesized that higher CRP values would accompany a bacterial cause and more severe disease.

Aim and objectives.
The study aimed to determine the clinical value of CRP for recognizing a bacterial cause of acute diarrhea in children. Specifically, we sought (1) to measure CRP in children with acute diarrhea and (2) to relate it to fever and bloody diarrhea.

Study design and setting.
We carried out a retrospective, record-based observational study in the Pediatric Department of Tobruk Medical Center, Libya, covering admissions from June 2024 through June 2025.
Sample size. Of the 450 children admitted over this period, the records of 66 were included, this being the minimum number required according to earlier studies.

Eligibility criteria.
We included children 1 month to 5 years old who had been hospitalized for acute diarrhea associated with dehydration, a temperature of ≥38 °C, or blood in the stool. We excluded those with an underlying chronic gastrointestinal or systemic disease, diarrhea acquired in hospital or following antibiotic use, and immunodeficiency.

Data collection.
From each file, we extracted (1) the history and clinical examination findings and (2) laboratory results, comprising blood tests (CRP and complete blood count [CBC]) and stool analysis (macroscopic appearance, fecal red blood cells [RBCs], occult blood, and microscopy).

Statistical analysis.
Analysis was performed with SPSS version 27. Categorical data are presented as counts and percentages, and groups were compared with the chi-square test, or with the chi-square test for trend in the case of ordinal variables. Normality of continuous data was checked with the Kolmogorov–Smirnov test. Continuous data are summarized as mean ± SD or as median (IQR), as appropriate to their distribution. Associations between pairs of non-normally distributed continuous variables were assessed with Spearman's rank correlation. A *p-value* below 0.05 was taken to indicate statistical significance.

3. ETHICS APPROVAL

Approval for the study protocol was granted by the Institutional Review Board of the University of Tobruk (reference no. 009.H.25.41; 16 October 2025).

4. RESULT

This study included 66 patients aged 4 months to 5 years; females represented 65.2% (Table 1). About 79% of patients had watery diarrhea, and 21.2% had bloody diarrhea (Fig. 1). Twenty-eight patients (42.4%) presented with fever and vomiting, and 20 patients (30.3%) had fever alone. The duration of complaints ranged from less than 1 day to 10 days.

Table 1 Baseline data of the studied patients

Variable	N = 66	%
Gender		
Female	43	65.2
Male	23	34.8
Complaint		
Bloody diarrhea (presumed bacterial)	14	21.2
Watery diarrhea (presumed viral)	52	78.8
Symptoms of other systems affected		
Fever	20	30.3
Fever and cough	1	1.5
Fever and vomiting	28	42.4
Fever, vomiting, and ear itching	1	1.5
Fever, cough	1	1.5
Fever and ear itching	1	1.5
URTI	1	1.5
Vomiting	4	6.1
Vomiting and cough	3	4.5
Vomiting and ear itching	1	1.5
NAD	6	9.1
Age (months)		
Median (IQR)	7 (3–19)	
Range	4 months–5 years	
Duration of complaint (days)		
Median (IQR)	3 (1–4)	
Range	0–10	

IQR: interquartile range; URTI: upper respiratory tract infection; NAD: no abnormality detected.

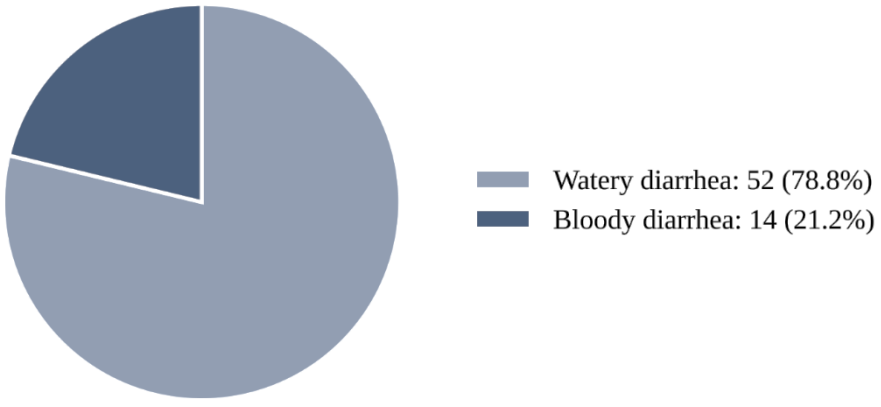


Fig. 1 Distribution of patients according to complaint

Regarding stool color, 57.6% of patients had yellow stool and 24.2% had green stool. About 39% had mucoid stool, 24.2% had soft stool, and 21.2% had liquid stool. Forty-four patients (66.7%) had a bad odor of stool. Five patients (7.6%) had fecal RBCs ≥10/HPF, and five (7.6%) had occult blood in the stool (Fig. 2). Microscopic examination revealed yeast in 18.2% and ova in 6.1% of patients (Table 2; Fig. 3).

Table 2. Stool analysis of the patients studied

Variable	N = 66	%
Color		
Yellow	38	57.6
Green	16	24.2
Brown	5	7.6
Bloody	2	3.0
Glow greenish	2	3.0
Red	2	3.0
Yellow with fatty globules	1	1.5
Form		
Mucoid	26	39.4
Soft	16	24.2
Liquid	14	21.2
Watery	5	7.6
Semi-formed	4	6.1
Fat globules	1	1.5
Odor		
No smell	22	33.3
Bad odor	44	66.7
RBCs (/HPF)		
0	12	18.2
<5	46	69.7
5–<10	3	4.5
≥10	5	7.6
Occult blood		
Absent	61	92.4
Present	5	7.6
Microscopic examination		
Yeast	12	18.2
Ova	4	6.1
Free	50	75.8

RBCs: red blood cells; HPF: high-power field.

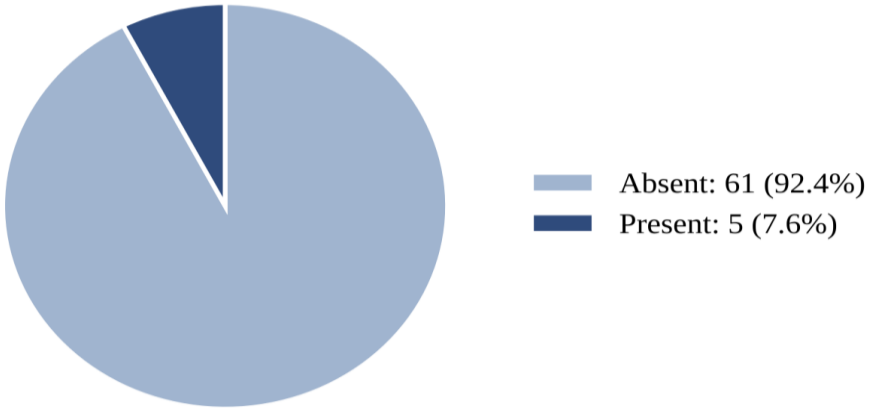


Fig. 2 Occult blood in the stool of the study children

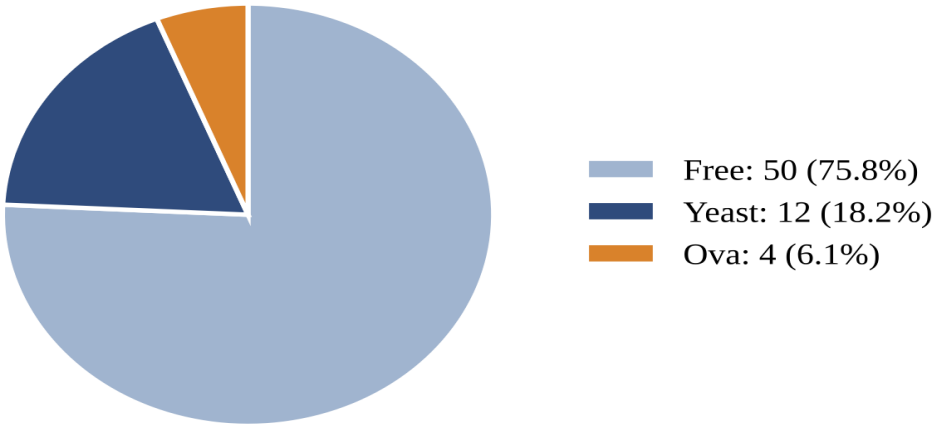


Fig. 3 Distribution of patients according to microscopic examination of stool

Forty-two patients (63.6%) had abnormally high CRP, and 16 patients (24.2%) had abnormally high WBC counts (Table 3; Fig. 4).

Table 3 Clinical and laboratory characteristics of the study population

Variable	Mean ± SD	Range
Temperature (°C)	38.63 ± 0.54	38–40
Respiratory rate (breaths/min)	38.06 ± 11.3	22–67
Heart rate (beats/min)	124.24 ± 20.82	80–180
WBCs (10^3/mm^3)	15.25 ± 5.35	5.61–26.2
Normal, n (%)	50 (75.8)	
Abnormally high, n (%)	16 (24.2)	
Platelet count (10^3/mm^3)	396.8 ± 132.38	16.1–669
Hemoglobin (g/dL)	10.48 ± 1.35	5.4–14.8
	Median (IQR)	**Range**
CRP (mg/L)	17 (6.8–90.9)	0.5–192
Normal, n (%)	24 (36.4)	
Abnormally high, n (%)	42 (63.6)	

SD: standard deviation; IQR: interquartile range; WBCs: white blood cells; CRP: C-reactive protein.

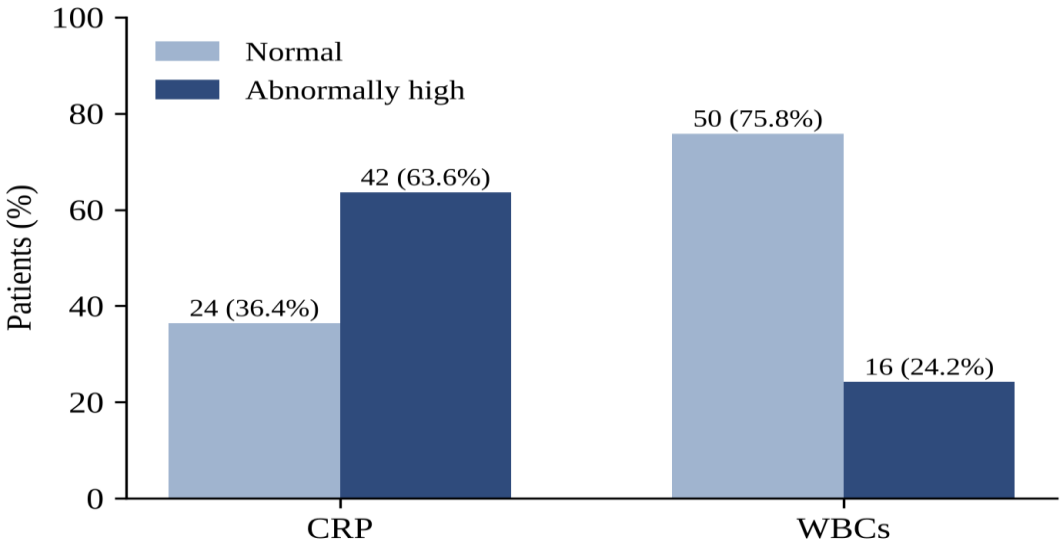


Fig. 4 Distribution of patients according to CRP and WBC levels

CRP category was not significantly related to the type of diarrhea ($\chi^2 = 0.003$, $p = 0.955$); bloody stools were reported in 20.8% of children with a normal CRP and in 21.4% of those with an elevated CRP (Table 4).

Table 4 Relation between CRP level and complaint

Complaint	Normal CRP N = 24, n (%)	Abnormally high CRP N = 42, n (%)	χ^2	*p*
Bloody diarrhea	5 (20.8)	9 (21.4)	0.003	0.955
Watery diarrhea	19 (79.2)	33 (78.6)		

χ^2: chi-square test.

Likewise, none of the stool characteristics—color, consistency, odor, RBC count, occult blood, or microscopic findings—differed significantly between the two CRP categories (Table 5).

Table 5 Relation between CRP level and stool analysis

Variable	Normal CRP N = 24, n (%)	Abnormally high CRP N = 42, n (%)	χ^2	*p*
Color			8.909	0.179
Yellow	18 (75.0)	20 (47.6)		
Green	3 (12.5)	13 (31.0)		
Brown	1 (4.2)	4 (9.5)		
Bloody	0 (0.0)	2 (4.8)		
Glow greenish	0 (0.0)	2 (4.8)		
Red	1 (4.2)	1 (2.4)		
Yellow with fatty globules	1 (4.2)	0 (0.0)		
Form			6.723	0.242
Mucoid	8 (33.3)	18 (42.9)		
Soft	8 (33.3)	8 (19.0)		
Liquid	6 (25.0)	8 (19.0)		
Watery	0 (0.0)	5 (11.9)		
Semi-formed	1 (4.2)	3 (7.1)		
Fat globules	1 (4.2)	0 (0.0)		
Odor			–	–
No smell	8 (33.3)	14 (33.3)		
Bad odor	16 (66.7)	28 (66.7)		
RBCs (/HPF)			0.479[a]	0.489
0	4 (16.7)	8 (19.0)		
<5	18 (75.0)	27 (64.3)		
5–<10	1 (4.2)	2 (4.8)		
≥10	1 (4.2)	5 (11.9)		
Occult blood			3.091	0.078
Absent	24 (100.0)	37 (88.1)		
Present	0 (0.0)	5 (11.9)		
Microscopic examination			0.842	0.358
Yeast	6 (25.0)	6 (14.3)		
Ova	1 (4.2)	3 (7.1)		
Free	17 (70.8)	33 (78.6)		

χ^2: chi-square test; [a]chi-square test for trend; RBCs: red blood cells; HPF: high-power field.

Serum CRP rose significantly with body temperature (r = 0.369, $p = 0.004$) (Table 6), whereas it showed no significant relationship with age, duration of illness, respiratory rate, heart rate, WBC count, platelet count, hemoglobin, or fecal RBCs. The total leukocyte count correlated positively and significantly with both temperature (r = 0.251, $p = 0.042$) and respiratory rate (r = 0.246, $p = 0.047$).

Table 6 Spearman correlations of CRP and total leukocyte count with clinical and laboratory variables

Parameter	CRP		TLC	
	r	*p*	r	*p*
Age (years)	0.139	0.290	−0.114	0.362
Duration of complaint (days)	−0.159	0.229	−0.074	0.558
Temperature (°C)	**0.369**	**0.004***	**0.251**	**0.042***
Respiratory rate (breaths/min)	−0.229	0.079	**0.246**	**0.047***
Heart rate (beats/min)	−0.055	0.675	0.172	0.168
WBCs (10^3/mm^3)	0.214	0.101	−0.114	0.362
Platelet count (10^3/mm^3)	−0.014	0.918	0.157	0.209
Hemoglobin (g/dL)	−0.078	0.553	−0.194	0.119
RBCs in stool (/HPF)	0.058	0.662	0.194	0.119

r: Spearman rank correlation coefficient; *$p < 0.05$ is statistically significant; TLC: total leukocyte count.

5. DISCUSSION

Gastroenteritis of bacterial and viral origin share many clinical features, including vomiting, diarrhea, and abdominal pain (Al-Asy, Gamal, Abd Albaset, Elsanosy, & Mabrouk, 2017), yet the two are managed quite differently: bacterial disease usually calls for antibiotic therapy, whereas viral disease is treated mainly with supportive measures (Çetin et al., 2024). Separating them quickly and reliably therefore matters both for the individual child and for public health.

Our objectives were to measure CRP in children hospitalized with acute diarrhea and to examine its relationship with fever and bloody stools.

In a recent Saudi series, girls made up a slightly larger share of children with diarrhea (51.2%); the mean age was 47.05 months, 11% had bloody stools, and illness lasted on average 2.94 days (Alhazmi et al., 2025). By contrast, boys predominated (61%) in an earlier Libyan report (Gammodi et al., 2025). Gupta, Sarker, Rout, Mondal, and Pal (2015) likewise found acute diarrhea to be more frequent in girls, with an overall incidence of 22.4% among preschool-aged children.

Based on clinical features only, roughly 79% of our patients were judged to have a viral illness. Park et al. (2019) identified a viral cause in 64.5% of their patients, while bloody diarrhea was recorded in 11% of the children studied by Alhazmi et al. (2025).

CRP is an acute-phase protein produced by hepatocytes under cytokine stimulation. Its concentration starts to rise 4–6 h after inflammation or tissue injury begins and roughly doubles every 8 h thereafter. Cho et al. (2025) found that CRP outperformed other markers in both sensitivity and specificity for detecting bacterial gastroenteritis.

In our cohort, CRP was elevated in 42 children (63.6%) and the WBC count in 24.2%. The proportion with bloody stools was almost identical in children with normal and elevated CRP (20.8% vs 21.4%), and no stool characteristic—color, consistency, odor, RBC count, or microscopy differed between the two CRP groups. CRP rose significantly with body temperature, consistent with Park et al. (2019), but was unrelated to age, illness duration, respiratory rate, heart rate, WBC count, platelet count, or hemoglobin.

Alhazmi et al. (2025), working in Saudi Arabia, found that CRP increased with symptom duration in children with no or mild dehydration but not in those with moderate or severe dehydration; our results partly match theirs.

When etiology was inferred from the clinical picture, CRP did not separate bacterial from non-bacterial cases in our series. This contrasts with earlier reports in which CRP helped flag children likely to have a bacterial infection (Alhazmi et al., 2025; Borgnolo, Barbone, Guidobaldi, & Olivo, 1996; Sanders, Barnett, Correa-Velez, Coulthard, & Doust, 2008).

Our findings are partly in line with those of Zhang, Tan, Fu, and Deng (2022), who reported that WBC count, CRP, and procalcitonin (PCT) did not differ significantly between children with enterovirus infection alone and those with an additional bacterial infection. In that study, children with concurrent acute gastroenteritis (AGE) likewise showed no meaningful differences in any inflammatory marker.

6. CONCLUSION

Among Libyan children hospitalized for acute diarrhea, bloody stools were relatively common. In this setting, CRP alone cannot identify the cause of diarrhea; of the clinical variables examined, it was significantly associated only with body temperature, with which it correlated positively.

Limitations. The main weaknesses of this work are the modest number of patients and the lack of microbiological confirmation of the cause of gastroenteritis. Moreover, because data were drawn retrospectively from hospital files, incomplete documentation may have introduced recording bias, and missing data restricted the conclusions that could be drawn about inflammatory biomarkers.

Recommendations. Larger prospective studies in which the pathogen is confirmed microbiologically are needed to clarify how CRP relates to the cause of childhood diarrhea. In addition, mothers should be reached through mass media and educational sessions with messages on preventing diarrheal disease in children.

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