C-Reactive Protein and Biochemical Parameters as Early Indicators in Newborns and Children

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Abstract

Background: *Neonatal infections remain a major cause of illness and death worldwide, and early detection is often challenging due to nonspecific clinical signs. The purpose of the study was to assess C-Reactive Protein and key biochemical parameters as early diagnostic indicators in newborns and young children.*

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Methods: *This cross-sectional study was conducted in the Department of Biochemistry and Molecular Biology, Bangladesh Shishu Hospital & Institute, Dhaka, from January to March 2024. Two hundred newborns (0–28 days) and children (1 month–5 years) were enrolled. Demographics and blood samples were collected to measure CRP, Serum AST, ALT, albumin, bilirubin, and creatinine. Data were analyzed with SPSS 25.0, using descriptive and inferential statistics, with p < 0.05 as significant.*

Results: *Among 200 paediatric participants (80 newborns, 120 aged 1 month–5 years; 55% male), 32% had CRP >10 mg/L. High CRP was associated with higher AST (229.8 vs. 87.1 U/L, p = 0.034) and trends toward elevated ALT, creatinine, albumin, and bilirubin. Newborns had higher CRP (18.5 vs. 4.8 mg/L, p = 0.012), higher serum bilirubin (9.17 vs. 5.10 mg/dL, p = 0.018), and lower albumin (28.9 vs. 33.1 g/L, p = 0.045). Overall, 49% exceeded AST, 44.5% ALT, 22.5% albumin, 17.5% bilirubin, and 14% creatinine thresholds, supporting their role as early biochemical indicators.*

Conclusion: *Elevated CRP and associated biochemical changes, particularly in newborns, serve as early indicators of systemic inflammation and hepatic involvement in newborns and young children.*

Keywords: *C-Reactive Protein, Biochemical Parameters, Early Indicators.*

1. INTRODUCTION

Neonatal infections remain a significant cause of illness and death worldwide, with high incidence rates despite improvements in intensive care. Globally, among the 130 million annual births, approximately 4 million infants die within the first month of life, and a substantial proportion of these deaths are associated with serious infections [1, 2].

In neonates, infections can rapidly progress to multiorgan dysfunction due to an exaggerated or dysregulated immune response, yet early clinical signs are often nonspecific, making timely diagnosis challenging [3-5]. To minimize undue stress on vulnerable organs and reduce unnecessary antimicrobial use, several biomarkers have been explored as supportive tools for early detection of infection in newborns [6, 7]. Among these, C-reactive protein (CRP) is widely recognized for its sensitivity and reliability in identifying systemic inflammation. Other biochemical parameters, including serum albumin, liver enzymes, serum bilirubin, and

serum creatinine, provide complementary information about organ function and inflammatory status, with hypoalbuminemia commonly observed in inflammatory conditions [8,9].

Evidence suggests that serum CRP can be a useful indicator for infection in neonates, particularly when assessed serially rather than as a single measurement [10, 11]. However, CRP levels rise detectably only a few days after birth and are naturally lower in premature infants, which can limit the usefulness of a single threshold [12]. Similarly, decreased serum albumin is frequently reported in children with inflammatory conditions, though its diagnostic utility in neonates is less established [13]. These findings underscore the importance of evaluating CRP in combination with other key biochemical markers as early indicators of illness in newborns and young children (1 month to 5 years).

Despite the recognized potential of CRP and other biochemical parameters, there remains limited data on their combined utility as early diagnostic indicators in newborns and young children, particularly in the context of age-dependent physiological variations. Most studies have focused either on CRP alone or on individual organ function markers, and few have systematically evaluated these parameters together in a representative pediatric population. Moreover, the optimal thresholds and timing for early detection in asymptomatic or high-risk infants are not well established. The purpose of the study was to assess C-Reactive Protein and key biochemical parameters as early diagnostic indicators in newborns and young children.

2. OBJECTIVE

- To evaluate C-Reactive Protein and key biochemical parameters as early diagnostic indicators in newborns and young children.

3. METHODOLOGY & MATERIALS

This cross-sectional observational study was conducted at the Department of Biochemistry and Molecular Biology, Bangladesh Shishu Hospital & Institute, from January 2024 to March 2024.

A total of 200 children were enrolled based on specific inclusion criteria. Data were collected to evaluate C-Reactive Protein and key biochemical

parameters as early diagnostic indicators in newborns and young children.

3.1. Inclusion Criteria

- Newborns (0–28 days) and children aged 1 month to 5 years admitted to Bangladesh Shishu Hospital & Institute during the study period.
- Children for whom blood samples were available for CRP and biochemical parameter analysis.
- Patients whose guardians provided informed consent for participation.

3.2. Exclusion Criteria

- Children with known chronic liver, kidney, or metabolic disorders.
- Patients receiving medications that could alter CRP or biochemical markers (e.g., steroids, immunosuppressants).
- Incomplete clinical or laboratory data.
- Children with congenital anomalies affecting biochemical parameters.

Venous blood samples were collected from all participants following standard aseptic procedures, and demographic data including age and gender were recorded. Biochemical tests were performed to measure C-Reactive Protein (CRP), liver enzymes (AST/SGOT and ALT/SGPT), serum albumin, total bilirubin, and serum creatinine using standard automated laboratory methods. Participants were stratified into high (>10 mg/L) and low (≤10 mg/L) CRP groups for comparison. Primary outcomes included CRP and other biochemical parameter levels, while secondary outcomes assessed the frequency of elevated markers above established cut-offs (CRP >10 mg/L, AST >40 U/L, ALT >45 U/L, albumin <3.5 g/dL, total bilirubin >1.2 mg/dL, serum creatinine >1.0 mg/dL). Data were analyzed using SPSS version 25.0, with continuous variables expressed as mean ± SD or median (IQR) and categorical variables as frequencies and percentages. Group comparisons were performed using Mann–Whitney U test for continuous variables and Chi-square test for categorical variables, with $p < 0.05$ considered statistically significant.

4. RESULTS

Table 1. *Baseline Characteristics of the Study Population (n =200)*

Characteristic		Frequency (n)	Percentage (%)
Age Group	Newborns (0–28 days)	80	40.0
	Children (1 month–5 years)	120	60.0
Gender	Male	110	55.0
	Female	90	45.0

Table 1 presents the demographic distribution of the study participants. Among the 200 children enrolled, 40% were newborns (0–28 days) and 60% were aged 1 month to 5 years. The gender distribution was nearly balanced, with a slight male predominance (55% male vs. 45% female), reflecting common pediatric population trends and providing a representative sample for evaluating early biochemical indicators.

Table 2. *Comparison of Biochemical Parameters between High and Low CRP Groups*

Parameter	CRP >10 mg/L Group (Mean ± SD [Median, IQR])	CRP ≤10 mg/L Group (Mean ± SD [Median, IQR])	p-value
C-Reactive Protein (mg/L)	76.06 ± 70.30 [51.40, 23.28–84.80]	3.41 ± 2.78 [2.90, 1.40–4.80]	<0.001
Serum Creatinine (mg/dL)	69.15 ± 47.86 [55.00, 42.75–79.25]	58.16 ± 61.15 [50.00, 42.00–63.00]	0.230
Serum Albumin (g/L)	28.93 ± 15.07 [26.85, 18.20–35.80]	33.92 ± 33.81 [34.40, 27.85–40.20]	0.270
Serum Total Bilirubin (mg/dL)	9.81 ± 5.68 [9.17, 5.10–13.17]	7.15 ± 8.88 [5.10, 0.50–9.78]	0.200
AST (SGOT) (U/L)	229.82 ± 262.63 [146.00, 74.00–280.00]	87.10 ± 173.43 [48.00, 40.00–72.00]	0.034
ALT (SGPT) (U/L)	157.45 ± 244.93 [82.50, 55.00–172.00]	70.48 ± 111.27 [55.00, 44.00–64.00]	0.140

Table 2 compares biochemical markers between children with elevated CRP (>10 mg/L) and those with normal CRP (≤10 mg/L). As expected, CRP was markedly higher in the elevated group.

AST levels were significantly higher in the CRP >10 mg/L group (p = 0.034), indicating hepatic involvement during systemic inflammation, while ALT, although elevated, did not reach statistical significance.

Serum creatinine, albumin, and bilirubin values were also higher in the high-CRP group, supporting the trend toward multi-organ biochemical changes with systemic inflammation.

Table 3. *Comparison of Biochemical Parameters between Newborns and Children*

Parameter	Newborns (0–28 days) (n = 80)	Children (1 m–5 y) (n = 120)	p-value
C-Reactive Protein (mg/L)	18.50 [1.20, 51.40]	4.80 [1.30, 29.00]	0.012
Serum Creatinine (mg/dL)	55.50 [43.00, 71.00]	50.00 [42.00, 63.00]	0.210
Serum Albumin (g/L)	28.90 [18.20, 37.80]	33.10 [27.85, 38.20]	0.045
Total Bilirubin (mg/dL)	9.17 [5.10, 13.17]	5.10 [0.50, 9.78]	0.018
AST (SGOT) (U/L)	72.00 [40.00, 188.00]	67.00 [40.60, 146.00]	0.590
ALT (SGPT) (U/L)	58.00 [44.00, 97.00]	55.00 [44.00, 83.00]	0.670

Table 3 illustrates age-related differences in biochemical parameters. Newborns demonstrated significantly higher median CRP and total bilirubin levels and lower albumin compared to older children, reflecting normal physiological and age-dependent biochemical variations.

AST and ALT showed slight non-significant elevations, and serum creatinine did not differ significantly by age, indicating that liver function and inflammatory markers are more variable in early life.

Table 4. *Frequency of Elevated Biochemical Parameters in the Study Population*

Parameter	Cut-off for Abnormality	Number Elevated (n)	Percentage (%)
C-Reactive Protein (CRP)	>10 mg/L	64	32.0
AST (SGOT)	>40 U/L	98	49.0
ALT (SGPT)	>45 U/L	89	44.5
Serum Albumin	<3.5 g/dL	45	22.5
Total Bilirubin	>1.2 mg/dL	35	17.5
Serum Creatinine	>1.0 mg/dL	28	14.0

Table 4 summarizes the proportion of children exceeding established biochemical thresholds. Elevated CRP (>10 mg/L) was observed in 32% of participants, suggesting systemic

inflammation. Liver enzyme elevations were common, with 49% exceeding AST and 44.5% exceeding ALT cut-offs. Hypoalbuminemia (<3.5 g/dL) occurred in 22.5%, while total bilirubin and serum creatinine were elevated in 17.5% and 14%, respectively. These data highlight the clinical utility of these markers as early indicators of systemic or hepatic involvement in newborns and children.

5. DISCUSSION

C-Reactive Protein and key biochemical parameters as early indicators in newborns and children. Elevated CRP and altered biochemical markers reflect underlying systemic inflammation and organ involvement, presenting significant challenges to pediatric health that often require prompt recognition and intervention. The findings highlight age-dependent variations and the multifactorial nature of these markers, with CRP, liver enzymes, albumin, bilirubin, and creatinine all contributing to early detection. The high prevalence of elevated CRP and associated biochemical changes underscores the importance of monitoring these parameters to guide timely clinical decision-making and improve outcomes in newborns and young children.

In this study of 200 paediatric participants, newborns (0–28 days) accounted for 40% of the cohort, while children aged 1 month to 5 years made up 60%, with a slight male predominance (55% vs. 45%). This demographic distribution is consistent with previous pediatric studies, such as Pulliam et al. [14], who evaluated CRP and biochemical markers in children aged 1 to 36 months, and Kamruzzaman et al.[15], who reported higher male representation in pediatric populations. While Perrone et al.[16] focused on CRP measurements at 12, 24, and 48 hours of life in neonates, our study extended the scope to include older children, providing a broader perspective on early inflammatory and biochemical indicators across pediatric age groups.

Comparison of biochemical parameters between CRP >10 mg/L and CRP ≤10 mg/L groups demonstrated that children with elevated CRP exhibited higher mean values of AST, ALT, and serum creatinine, suggesting a trend toward multi-organ biochemical changes associated with systemic inflammation. Although ALT elevation did not reach statistical significance (157.45 vs. 70.48, p = 0.140), the direction of change is consistent with Kim et al.[17], who reported that elevated ALT, CRP, and creatinine are significantly associated with sepsis severity in

children, highlighting ALT as a marker of disease progression. In contrast, AST was significantly elevated in the CRP >10 mg/L group (p = 0.034), supporting the relationship between systemic inflammation and hepatic enzyme derangements. Serum albumin and bilirubin also showed trends toward abnormal values in the high-CRP group, although these differences were not statistically significant.

Age-stratified analysis revealed that newborns had significantly higher median CRP (18.50 vs. 4.80 mg/L, p = 0.012) and total bilirubin (9.17 vs. 5.10 mg/dL, p = 0.018) and slightly lower albumin (28.90 vs. 33.10 g/L, p = 0.045) compared to older children, while AST and ALT exhibited non-significant trends toward higher values in the younger age group. These findings are in agreement with studies by Badakhshan et al. [18], who reported that serum bilirubin levels are markedly elevated in early life and liver enzymes such as ALT are higher in infants under 5 months, reflecting physiological variation and age-dependent reference intervals. Similarly, Rödöö et al. [19] demonstrated that several biochemical analytes, including albumin, CRP, bilirubin, AST, and ALT, vary with age, providing benchmarks for interpreting pediatric laboratory results.

The distribution of elevated biochemical parameters in our cohort further supports these observations. In line with Yin et al. [20], 32% of children had elevated CRP (>10 mg/L), while 22.5% exhibited hypoalbuminemia, underscoring the diagnostic relevance of these markers in detecting early systemic inflammation or sepsis. Liver enzymes were frequently elevated, with 49% and 44.5% of participants exceeding reference thresholds for AST and ALT, respectively, corroborating Kolho et al.'s[21] findings that infants, particularly those under 28 days, tend to have higher baseline hepatic enzyme activity compared to older children. Elevated total bilirubin in 17.5% and increased serum creatinine in 14% of participants reinforce age-dependent variations in biochemical markers. Collectively, these results emphasize that CRP, liver enzymes, albumin, bilirubin, and creatinine serve as early biochemical indicators of systemic inflammation, with age-specific considerations being critical for accurate interpretation in pediatric populations.

6. LIMITATIONS OF THE STUDY

This study had several limitations:

- Findings may not be generalizable due to the specific population studied.

- The study's limited geographic scope may introduce sample bias, potentially affecting the broader applicability of the findings.

7. CONCLUSION

This study demonstrates that C-Reactive Protein and key biochemical parameters serve as valuable early indicators of systemic inflammation and hepatic involvement in newborns and young children. Among 200 participants (40% newborns, 60% aged 1 month–5 years; 55% male), elevated CRP (>10 mg/L) was observed in 32%, with concurrent elevations in AST (49%) and ALT (44.5%), and hypoalbuminemia in 22.5%. Newborns exhibited significantly higher CRP and total bilirubin and lower albumin compared to older children, reflecting age-dependent physiological variations, while AST, ALT, and creatinine showed non-significant trends toward elevation. These findings underscore the importance of integrating CRP and biochemical markers in the early assessment of pediatric patients, particularly in the neonatal period, to identify those at risk of systemic or hepatic dysfunction.

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