Alqalam Journal of Medical and Applied Sciences. 2026;9(9):2796-2801
https://doi.org/10.54361/ajmas.269922

Original article

Correlation Between C-Reactive Protein and Procalcitonin in the First Hour of Life: A Newborn Observational Study

Abdulmajid Alshaykh[1]*, Azab Azab[2]

[1]Department of Pediatrics, Faculty of Medicine, Sabratha University, Libya
[2]Department of Physiology, Faculty of Medicine, Sabratha University, Libya
Email: Abdulmajid.alshaykh@sabu.edu.ly

Abstract
Early recognition of neonatal infection remains challenging because clinical manifestations may be nonspecific and inflammatory biomarkers undergo dynamic changes during the immediate postnatal period. Procalcitonin (PCT) and C-reactive protein (CRP) are widely investigated as complementary biomarkers of neonatal inflammation; however, their relationship when measured immediately after delivery remains insufficiently characterized. This study aimed to determine the correlation between serum PCT and CRP measured during the first hour of life and to explore differences in these biomarkers according to recorded maternal history of infection and clinical signs of sepsis. A secondary observational study was performed on a cohort of 30 newborns from Al-Noor Private Clinic in Sabratha City. Available variables included sex, maternal history of infection, clinical signs of sepsis, CRP, and PCT concentrations. Because biomarker distributions were right-skewed, Spearman's rank correlation was used as the primary measure of association, with Pearson correlation and Mann–Whitney U tests performed as complementary analyses. The median CRP concentration was 3.25 mg/L (interquartile range [IQR], 0.63–15.75; range, 0.12–94.0 mg/L), while the median PCT concentration was 0.70 ng/mL (IQR, 0.26–1.35; range, 0.12–18.0 ng/mL). A statistically significant moderate positive correlation was observed between CRP and PCT (Spearman's ρ = 0.414, P = 0.023; 95% bootstrap confidence interval, 0.037–0.728), with a comparable Pearson correlation (r = 0.410, P = 0.024). Newborns with recorded clinical signs of sepsis had higher median CRP and PCT concentrations than those without clinical signs, although the differences were not statistically significant (CRP, P = 0.143; PCT, P = 0.061). Maternal history of infection was associated with significantly higher CRP concentrations (P = 0.029), whereas the difference in PCT concentrations was not statistically significant (P = 0.290). The CRP and PCT measured during the first hour of life demonstrated a moderate positive correlation, suggesting that these biomarkers may reflect partially overlapping inflammatory responses during the immediate postnatal period. However, correlation alone does not establish neonatal infection or diagnostic accuracy. Given the small sample size and absence of definitive infection outcomes in the available dataset, these findings should be considered exploratory and require confirmation in larger prospective studies incorporating gestational age, birth weight, standardized sampling time, blood-culture results, antibiotic exposure, delivery characteristics, and longitudinal clinical outcomes.
Keywords. C-Reactive Protein, Procalcitonin, First Hour of Life, Newborn, Observational Study.

Introduction

Neonatal sepsis remains a major diagnostic challenge because the clinical presentation of early-onset infection may overlap with normal transitional physiology and with noninfectious conditions. Respiratory distress, abnormal temperature, tachycardia, lethargy, poor perfusion and feeding difficulty are not specific for bacterial infection. Consequently, clinicians frequently combine clinical assessment with laboratory investigations rather than relying on a single biomarker [1–4].

Early-onset neonatal sepsis is generally considered infection presenting during the first 72 hours of life. The timing of biomarker sampling is particularly important because inflammatory mediators and acute-phase proteins have different kinetics. Procalcitonin, a precursor of calcitonin, can increase relatively early following systemic inflammatory stimulation. In newborns, however, PCT also undergoes a physiological postnatal rise, making interpretation during the first 48 hours dependent on postnatal age and clinical context [5,6].

CRP is an acute-phase protein synthesized predominantly by the liver in response to inflammatory signaling. Compared with some early cytokine responses, CRP generally rises later and may therefore be less sensitive at the very beginning of an infectious process. Serial measurement can be more informative than a single early result, particularly when infection remains clinically plausible [3,7].

The example study supplied for this project evaluated simultaneous inflammatory markers in newborns with suspected early-onset infection and used correlation analysis, group comparisons and receiver-operating-characteristic analysis to investigate diagnostic performance. Its results demonstrated that inflammatory markers could be elevated in neonatal infection, while also emphasizing that no single marker should be interpreted in isolation [8].

The present study addresses a narrower and distinct question: whether CRP and PCT are correlated when measured very early, during the first hour after delivery. This distinction is important because an association at this time point may reflect shared inflammatory physiology, maternal influences, birth-related stress, or early infection. A correlation should therefore not be interpreted as proof that one marker diagnoses sepsis.

Received: *03-07-2026 - **Accepted:** 02-09-2026 - **Published:** 10-09-2026*

Methods

Study design and data source

This study was designed as a retrospective observational secondary analysis of a 30-newborn dataset provided by the investigator. According to the investigator's description, the measurements were obtained from newborns during the first hour after delivery inside the Al-Noor private clinic. The source Word document contained five analytical variables: sex, maternal history of infection, clinical signs of sepsis, CRP concentration, and PCT concentration. The file also contained infant names; those identifiers were excluded from the analytical dataset and are not reproduced in this manuscript.

Because the supplied dataset does not contain dates, gestational age, birth weight, delivery mode, Apgar score, antibiotic exposure, blood-culture results, maternal fever, rupture-of-membranes duration, or assay/platform details, these variables could not be incorporated into the analysis. They must be added from the original clinical records before a final journal submission.

Participants

Thirty newborn records were available. The dataset included 16 girls (53.3%) and 14 boys (46.7%). Maternal history of infection was recorded as positive in 15 infants (50.0%) and negative in 15 (50.0%). Clinical signs of sepsis were recorded as positive in 11 infants (36.7%) and negative in 19 (63.3%). The manuscript treats the supplied binary entries as recorded variables; it does not independently redefine them as culture-proven sepsis.

Laboratory variables

CRP concentrations were recorded in mg/L and PCT concentrations in ng/mL. The analytical values were transcribed from the supplied dataset without imputation. The observed CRP range was 0.12–94.0 mg/L and the PCT range was 0.12–18.0 ng/mL.

Statistical analysis

Continuous variables were summarized using mean, standard deviation, median, interquartile range (IQR), minimum and maximum. The primary analysis was Spearman rank correlation because the distributions were markedly right-skewed and included extreme values. Pearson correlation was reported as a sensitivity analysis. A 10,000-resample nonparametric bootstrap was used to estimate a 95% confidence interval for Spearman's rho.

For exploratory comparisons, CRP and PCT were compared between infants with and without recorded clinical signs and between infants with positive and negative maternal infection history using the Mann–Whitney U test. Two-sided $P<0.05$ was considered statistically significant. These comparisons are exploratory and were not adjusted for multiple testing because of the small sample size and the limited variables available.

Ethical considerations

The supplied dataset originated from real newborns and therefore represents human-subject research. The present manuscript cannot truthfully state that institutional ethical approval or parental consent was obtained because that information was not included in the supplied files. Before submission, the investigators must insert the name of the approving ethics committee, approval/reference number, consent procedure or documented waiver, and the data-protection/de-identification procedure. No infant names are included in the manuscript or figures.

Results

Participant and biomarker characteristics

CRP showed substantial dispersion, with a mean of 17.40 mg/L compared with a median of 3.25 mg/L. PCT was similarly right-skewed, with a mean of 1.59 ng/mL and a median of 0.70 ng/mL (Table. 1). The difference between means and medians indicates that a small number of high measurements exerted substantial influence on the arithmetic means.

Table 1. Overall distribution of CRP and PCT in the 30 newborn records.

Variables	n	Mean ± SD	Median (IQR)	Range
CRP	30	17.40 ± 27.32	3.25 (0.63–15.75)	0.12–94.00
PCT	30	1.59 ± 3.31	0.70 (0.26–1.35)	0.12–18.00

CRP: C-reactive protein; PCT: Procalcitonin; IQR: Interquartile range.

Correlation between CRP and PCT

The primary analysis identified a statistically significant moderate positive monotonic relationship between CRP and PCT (Spearman $\rho=0.414$, $P=0.023$; 95% bootstrap CI 0.039–0.722). The Pearson correlation was similar ($r=0.410$, $P=0.024$), suggesting that the observed association was not entirely dependent on rank transformation.

Simple linear regression produced a slope of 0.0497 ng/mL PCT per mg/L CRP, with $R^2=0.168$ (Figure 1). Because of the small sample, skewed distributions and absence of clinical outcome validation, this regression should not be interpreted as a clinical conversion equation. The fitted least-squares line is shown for descriptive purposes. The analysis supports association, not causation or diagnostic equivalence.

Received: *03-07-2026 -* ***Accepted:*** *02-09-2026 -* ***Published:*** *10-09-2026*

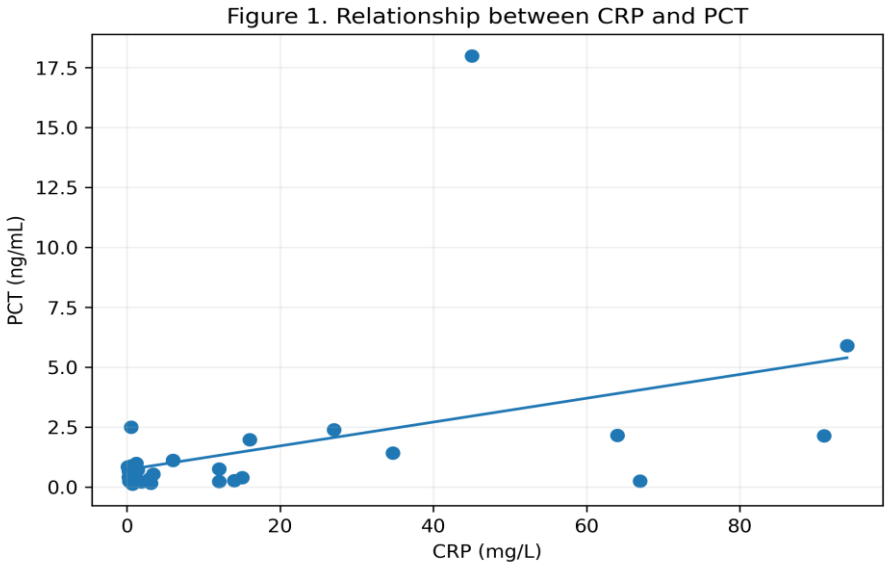

Figure 1. Scatter plot showing the relationship between CRP and PCT.

Clinical signs of sepsis

Infants with recorded clinical signs had higher median CRP (15.00 mg/L) than those without signs (1.90 mg/L), and higher median PCT (1.98 ng/mL versus 0.55 ng/mL). Nevertheless, the small sample and wide within-group variability meant that neither comparison reached P<0.05 (Table 2, Figure. 2)

Table 2. Exploratory comparison by recorded clinical signs. P values are from two-sided Mann–Whitney U tests comparing positive versus negative groups.

Group	n	CRP median (IQR)	PCT median (IQR)	CRP P	PCT P
Clinical signs absent	19	1.90 (0.66–12)	0.55 (0.26–0.87)	0.143	0.061
Clinical signs present	11	15.00 (1.85–54.50)	1.98 (0.41–2.33)	—	—

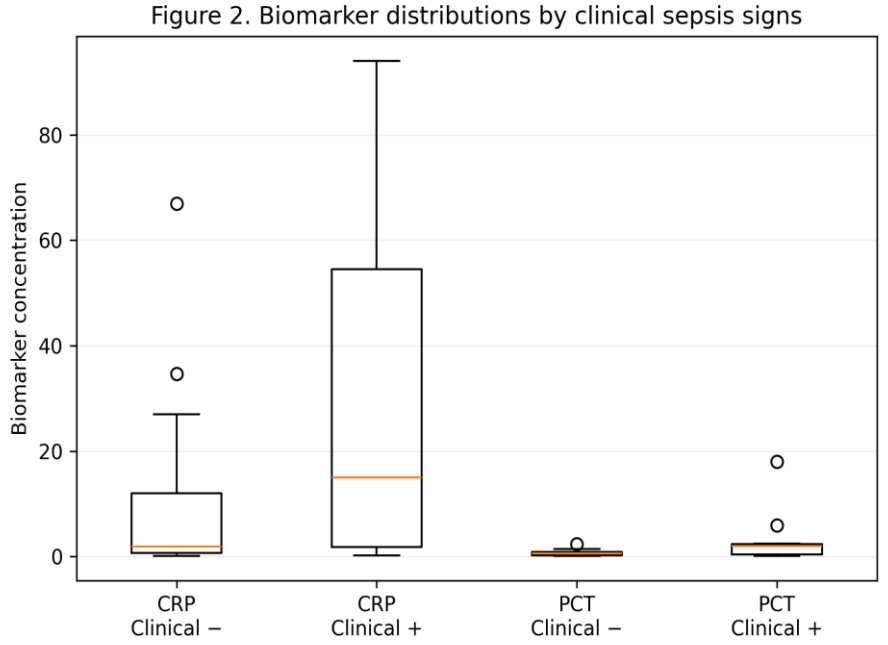

Figure 2. Distribution of CRP and PCT according to recorded clinical signs. The figure is exploratory and does not establish clinical diagnostic thresholds.

Maternal history of infection

CRP was significantly higher in the positive-history group, whereas PCT was not significantly different (Table 3).

Received: *03-07-2026 -* ***Accepted:*** *02-09-2026 -* ***Published:*** *10-09-2026*

Table 3. Exploratory comparison by maternal history of infection.

Group	n	CRP median (IQR)	PCT median (IQR)	CRP P	PCT P
Maternal history negative	15	1.40 (0.53–4.70)	0.55 (0.30–1.01)	0.029	0.290
Maternal history positive	15	14.00 (2.15–54.50)	0.85 (0.27–2.16)	—	—

Discussion

This study examined the relationship between two commonly investigated inflammatory biomarkers at an unusually early point in neonatal life. The principal finding was a moderate positive correlation between CRP and PCT during the first hour after delivery. The consistency of the Spearman and Pearson coefficients suggests that the relationship was not merely an artifact of the extreme values. However, the magnitude of the association was moderate rather than strong, indicating that the biomarkers share some variation but also capture distinct biological and clinical influences.

The observed association is biologically plausible. PCT responds relatively rapidly to systemic inflammatory stimuli, whereas CRP is an acute-phase reactant whose production is downstream of inflammatory signaling and generally changes more slowly [5–7]. Because both markers participate in the systemic inflammatory response, some degree of concordance is expected. Nevertheless, their different kinetics mean that a high PCT with a low CRP, or vice versa, is not inherently contradictory during the earliest hours of life.

The first-hour timing is especially important. Published neonatal studies emphasize that PCT has a physiological postnatal increase during the first 48 hours, which complicates the use of fixed adult thresholds in newborns [5,8]. Similarly, a very early CRP measurement can be normal even when an inflammatory process is developing because hepatic acute-phase synthesis requires time. Thus, the present correlation should not be used to infer that simultaneous first-hour measurements have adequate sensitivity for early-onset sepsis.

The original example article used a broader clinical design involving newborns with clinical signs or maternal risk factors and evaluated biomarkers at more than one time point. It found higher PCT and hs-CRP concentrations among neonates with sepsis and reported a correlation between PCT and hs-CRP in blood-culture-positive sepsis at a later interval [8]. The present dataset differs substantially: all 30 records are restricted to the first hour, and culture results, gestational age and longitudinal measurements are unavailable. Therefore, the present findings complement rather than reproduce the diagnostic conclusions of that study.

The exploratory subgroup analysis provides two clinically interesting observations. First, infants with recorded clinical signs had higher median CRP and PCT concentrations. Although the differences did not reach statistical significance, the direction was consistent with the hypothesis and may be clinically relevant in a larger cohort. Second, maternal history of infection was associated with higher CRP but not PCT. This may reflect maternal inflammatory exposure, perinatal inflammatory signaling, or differences in the definition and timing of the recorded maternal risk factor. Because the variable is only a binary history field, causal interpretation is inappropriate.

Clinical interpretation

The current evidence does not support using either CRP or PCT as a stand-alone rule-in or rule-out test for neonatal sepsis. The American Academy of Pediatrics emphasizes clinical assessment and appropriate risk stratification and notes limitations of routine inflammatory markers, including CRP alone, for predicting early-onset infection in well-appearing infants [2,3]. Meta-analytic evidence nevertheless suggests that PCT can provide useful adjunctive diagnostic information, although accuracy varies with postnatal age, population and diagnostic definition [9,10].

Why correlation matters—but is not enough

A statistically significant correlation answers an association question, not a diagnostic question. For a biomarker to be clinically useful for sepsis, the study must establish a reference standard and estimate sensitivity, specificity, predictive values and likelihood ratios at prespecified or internally validated thresholds. Receiver-operating-characteristic analysis is appropriate only when a defensible outcome classification is available. The supplied dataset does not contain a culture-proven sepsis outcome, so diagnostic accuracy analysis would be methodologically unsupported.

Comparison with previous literature

The diagnostic literature generally supports a complementary rather than substitutive role for PCT and CRP. A systematic review and meta-analysis of neonatal sepsis studies reported pooled PCT sensitivity and specificity of approximately 81% and 79%, respectively, with substantial heterogeneity and lower accuracy in early-onset than late-onset disease [9]. Another meta-analysis reported that PCT generally demonstrated moderate accuracy across several early postnatal sampling windows and could be more informative than CRP in some settings [10]. More directly relevant to combined testing, a systematic review and meta-analysis found higher pooled sensitivity for PCT plus CRP than for CRP alone, while emphasizing that further studies were required [11]. The supplied example paper similarly concluded that simultaneous inflammatory markers could improve diagnostic assessment but cautioned against reliance on a single marker [8]. These findings support the rationale for measuring PCT and CRP together while also highlighting the need for careful interpretation of their temporal kinetics.

Received: *03-07-2026 -* ***Accepted:*** *02-09-2026 -* ***Published:*** *10-09-2026*

The present correlation coefficient (ρ=0.414) is compatible with partial biological overlap but is lower than would be expected if the two biomarkers were interchangeable. Approximately 17% of the variance in a simple linear sense is explained by the Pearson correlation (R^2≈0.168), leaving most variability unexplained. This is an important result: CRP and PCT should be regarded as complementary biomarkers rather than surrogate measurements of one another.

Strengths

The main strengths are the direct use of real newborn measurements, a clearly defined very-early sampling window according to the investigator, complete paired CRP/PCT observations for all 30 records, preservation of the raw numerical values, and use of a rank-based primary correlation appropriate for skewed biomarker distributions. Removal of names from the analytical dataset also reduces unnecessary exposure of personal identifiers.

Limitations

Several limitations substantially restrict the conclusions. First, the sample size is small (n=30), which makes estimates imprecise and limits subgroup analyses. Second, the dataset does not provide a gold-standard infection outcome such as blood culture, cerebrospinal fluid culture, or a prespecified clinical sepsis definition. Third, gestational age and birth weight are absent, although neonatal biomarker concentrations vary with maturity and clinical condition. Fourth, assay manufacturer, analytical method, detection limit, and specimen type are not provided. Fifth, the exact timing within the first hour is unavailable, even though minutes may matter for rapidly changing biomarkers. Sixth, delivery mode, maternal fever, duration of membrane rupture, intrapartum antibiotics, Apgar score, hypoxia/asphyxia and other potential confounders are missing.

Seventh, the clinical-signs variable is binary and lacks the individual signs, severity and timing. Eighth, the maternal infection variable is not defined sufficiently to determine whether it represented confirmed infection, suspected infection, colonization, fever, chorioamnionitis or another risk factor. Ninth, the analysis is cross-sectional and cannot establish whether elevated biomarkers preceded or followed clinical deterioration. Finally, because the dataset was supplied without a study protocol, the possibility of selection bias cannot be assessed.

Implications for future research

A definitive prospective study should enroll consecutive newborns at delivery, record gestational age, birth weight, sex, mode of delivery, Apgar scores, maternal temperature, membrane status and duration, intrapartum antibiotics, suspected or confirmed intra-amniotic infection, and neonatal clinical status. Blood should be collected at predefined windows (for example, within 1 hour, 12 hours, 24 hours and 36–48 hours) using the same validated assays. Blood culture and a prespecified adjudication algorithm should provide the reference outcome. This design would permit time-specific ROC curves, multivariable models and assessment of whether combined PCT/CRP measurements improve classification beyond clinical risk factors alone.

Conclusion

In this exploratory analysis of 30 newborn records with CRP and PCT measured during the first hour after delivery, the biomarkers showed a statistically significant moderate positive correlation (Spearman ρ=0.414, P=0.023). Newborns with recorded clinical signs had higher median CRP and PCT values, although subgroup differences were not statistically significant, while maternal infection history was associated with higher CRP but not PCT. The findings support a biological relationship between CRP and PCT but do not establish diagnostic accuracy for neonatal sepsis. Given the physiological postnatal behavior of PCT, the delayed acute-phase response of CRP, and the absence of culture outcomes and important clinical covariates, these biomarkers should be interpreted as components of a broader neonatal assessment rather than as stand-alone diagnostic tests.

Acknowledgments

The authors acknowledge the clinical and laboratory personnel who collected the newborn measurements. Specific names and institutional acknowledgments should be inserted after confirmation by the investigators.

Conflict of Interest

The authors declare that they have no competing interests.

References

1. Puopolo KM, Benitz WE, Zaoutis TE; Committee on Fetus and Newborn; Committee on Infectious Diseases. Management of neonates born at ≥35 0/7 weeks' gestation with suspected or proven early-onset bacterial sepsis. Pediatrics. 2018;142(6):e20182894. doi:10.1542/peds.2018-2894.
2. Puopolo KM, Lynfield R, Cummings JJ; American Academy of Pediatrics Committee on Fetus and Newborn; Committee on Infectious Diseases. Management of infants at risk for group B streptococcal disease. Pediatrics. 2019;144(2):e20191881. doi:10.1542/peds.2019-1881.

Received: *03-07-2026 -* ***Accepted:*** *02-09-2026 -* ***Published:*** *10-09-2026*

3. Ng PC. Diagnostic markers of infection in neonates. Arch Dis Child Fetal Neonatal Ed. 2004;89(3):F229-F235. doi:10.1136/adc.2002.023838.
4. Chiesa C, Panero A, Osborn JF, Simonetti AF, Pacifico L. Diagnosis of neonatal sepsis: a clinical and laboratory challenge. Clin Chem. 2004;50(2):279-287. doi:10.1373/clinchem.2003.025171.
5. van Rossum AMC, Wulkan RW, Oudesluys-Murphy AM. Procalcitonin as an early marker of infection in neonates and children. Lancet Infect Dis. 2004;4(10):620-630. doi:10.1016/S1473-3099(04)01146-6.
6. Athhan F, Akagunduz B, Genel F, Bak M, Can D. Procalcitonin: a marker of neonatal sepsis. J Trop Pediatr. 2002;48(1):10-14. doi:10.1093/tropej/48.1.10.
7. Mathers NJ, Pohlandt F. Diagnostic audit of C-reactive protein in neonatal infection. Eur J Pediatr. 1987;146(2):147-151. doi:10.1007/BF02343221.
8. Abdollahi A, Shoar S, Nayyeri F, Shariat M. Diagnostic value of simultaneous measurement of procalcitonin, interleukin-6 and high-sensitive C-reactive protein in prediction of early-onset neonatal sepsis. Mediterr J Hematol Infect Dis. 2012;4(1):e2012028. doi:10.4084/MJHID.2012.028.
9. Vouloumanou EK, Plessa E, Karageorgopoulos DE, Mantadakis E, Falagas ME. Serum procalcitonin as a diagnostic marker for neonatal sepsis: a systematic review and meta-analysis. Intensive Care Med. 2011;37(5):747-762. doi:10.1007/s00134-011-2174-8.
10. Bellos I, Fitrou G, Daskalakis G, Thomakos N, Papantoniou N, Pergialiotis V. The diagnostic accuracy of procalcitonin in neonatal sepsis: a meta-analysis. Eur J Pediatr. 2018;177:1051-1061.
11. Ruan L, Chen GY, Liu Z, Zhao Y, Xu GY, Li SF, et al. The combination of procalcitonin and C-reactive protein or presepsin alone improves the accuracy of diagnosis of neonatal sepsis: a meta-analysis and systematic review. Crit Care. 2018;22:316. doi:10.1186/s13054-018-2236-1.

Received: *03-07-2026 -* ***Accepted:*** *02-09-2026 -* ***Published:*** *10-09-2026*