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Correlation between total leukocyte count (TLC) and c-reactive protein (CRP) in paediatric bronchiolitis patients

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***Abstract*---**Objective: The primary objective of this study was to investigate the correlation between Total Leukocyte Count (TLC) and C-Reactive Protein (CRP) levels in paediatric bronchiolitis patients to assess the prognostic significance of these markers in disease severity and patient outcomes. Study Design: A retrospective correlational study was conducted using patient records from a six-month period to analyze the relationship between TLC and CRP levels in paediatric bronchiolitis patients. Study Setting: The study was conducted at different centres including Department of Paediatrics, Social Security MNCH Hospital, Dera Ghazi Khan, Punjab and Sahara Medical College Narowal, Punjab in the period from August, 2022 to January, 2023. Methods: Data of paediatric patients aged 1 month to 2 years diagnosed with bronchiolitis was extracted from electronic medical

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records. The study included patients with complete data on TLC and CRP levels. Pearson's correlation coefficient was used to determine the association between TLC and CRP levels, while logistic regression analysis was performed to identify potential predictors of disease severity. Results: The study found a significant positive correlation between TLC and CRP levels in paediatric bronchiolitis patients ($p<0.05$). Higher TLC and CRP levels were associated with increased disease severity and longer hospital stay. Furthermore, logistic regression analysis revealed that TLC and CRP levels were significant predictors of disease severity in paediatric bronchiolitis patients. Conclusion: This study demonstrates a strong correlation between TLC and CRP levels in paediatric bronchiolitis patients, suggesting that these markers may be helps in reliable prognostic indicators for disease severity and patient outcomes. Further researches are recommended to endorse these results and explore the potential benefits of incorporating these markers into the management of paediatric bronchiolitis.

***Keywords*---**paediatric bronchiolitis, total leukocyte count, C-reactive protein, correlation, disease severity, prognostic markers, retrospective study.

Introduction

Children under the age of two are most at risk for developing bronchiolitis, respiratory tract infection. Inflammation and narrowing of the bronchioles, the small airways in the lungs, are hallmarks of this disease, which manifests clinically as shortness of breath, wheezing, and coughing. Most occurrences of bronchiolitis may be traced back to a viral infection; the frequent reason is respiratory syncytial virus (RSV). Influenza viruses, human metapneumovirus, parainfluenza viruses, and adenoviruses are all potential causes. Inadequate care for bronchiolitis can lead to lifelong respiratory issues and is a chief cause of admission in hospital for children around the world, especially in impoverished nations.

Complications from bronchiolitis can be avoided and patient outcomes can be improved with prompt diagnosis and treatment. The symptoms of this condition sometimes overlap with those of various respiratory infections, making accurate diagnosis difficult. The diagnosing process and the infection's severity can both be helped by laboratory tests. Common biomarkers used to assess inflammation and infection in pediatric patients include the total leukocyte count (TLC) and C-reactive protein (CRP). Their clinical and prognostic value in bronchiolitis, however, is still up for discussion.

The immunological response to an infection is greatly aided by the quantity of white blood cells (WBCs), which can be determined by doing a total leukocyte count (TLC). When TLC levels are high, inflammation or infection is likely present. The link between TLC and the severity of bronchiolitis, or how far along the disease's progression it can be predicted to go, is not well understood at this time.

While some research suggests that higher TLC levels correlate with worse health outcomes, others have shown no such association between TLC and illness severity.

In reaction to inflammation, infection, or tissue injury, the liver produces C-reactive protein (CRP), an acute-phase protein. Chronic inflammation and infection can be detected and monitored with its help, making it a useful biomarker. Bacterial and viral infections, as well as other inflammatory diseases, have been linked to increased CRP levels. Previous research on the correlation between CRP levels and illness severity in paediatric bronchiolitis have shown mixed results. High C-reactive protein levels have been linked to amplified risk of hospital stay, admission in ICU, and death in some research but not in others.

This study seeks to investigate the relationship involving total leukocyte count (TLC) and C-reactive protein (CRP) in pediatric bronchiolitis patients, with an eye on their potential as diagnostic and prognostic markers of illness severity, in light of contradictory findings in the literature. TLC and CRP levels, as well as other clinical outcomes like hospitalization, the duration of stay, and requirement for critical care, will be evaluated in this study by a complete meta-analysis and systemic review of the current literature. The link of these indicators and disease severity will also be analyzed in light of other characteristics that may be relevant, such as gender, age, and the causative virus.

Health care providers will be able to better serve children with bronchiolitis by developing evidence-based diagnostic and management strategies based on a better understanding of the correlation in total leukocyte count (TLC) and C-reactive protein (CRP). In the long run, this study could help patients, healthcare providers, and healthcare systems save money and minimize stress.

These goals can only be attained by employing a methodological rigor that guarantees the validity and dependability of the results. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA shall be followed throughout the entire process of conducting the systematic review and meta-analysis. Predetermined eligibility criteria will be used to select papers for inclusion, and the risk of bias will be evaluated with the help of Cochrane Collaboration's technique to measure the likelihood of bias in the study and the Newcastle-Ottawa Scale for non-randomized research.

Total leukocyte count (TLC) and C-reactive protein (CRP) concentrations in children with bronchiolitis will be examined, as will the potential for heterogeneity between studies and the influence of individual patient characteristics and clinical factors. The intricate relationship between these indicators and the severity of bronchiolitis may be better understood if we can identify potential effect modifiers using this method.

In conclusion, the present research article aims to provide a broad and updated assessment of the correlation between total leukocyte count (TLC) and C-reactive protein (CRP) in paediatric bronchiolitis patients, with a focus on their diagnostic and prognostic utility in assessing disease severity. By conducting a systematic review and meta-analysis of the available literature, this research will help to

clarify the role of these biomarkers in the management of bronchiolitis, potentially leading to improved patient care and better clinical outcomes. The findings of this research will contribute to the existing knowledge base, informing future research and clinical practice in the field of paediatric respiratory medicine.

Materials and Methods

Study Population

This research population comprised paediatric patients aged 1 month to 2 years, admitted to the different centres including Department of Paediatrics, Social Security MNCH Hospital, Dera Ghazi Khan, Punjab and Sahara Medical College Narowal, Punjab in the period from August, 2022 to January, 2023. Patients with incomplete data or those who had received immunosuppressive therapy or had underlying immunodeficiency were excluded from the study.

Data Collection

Electronic medical records (EMRs) were retrospectively reviewed to extract relevant patient data, including demographic information, medical history, clinical presentation, laboratory test results (TLC and CRP levels), disease severity, and treatment outcomes. The collected data were anonymized and securely stored in compliance with the principles of the Health Insurance Portability and Accountability Act (HIPAA).

TLC and CRP Measurements

Total Leukocyte Count (TLC) was measured using standard laboratory methods. Blood samples were collected from patients within 24 hours of admission, and TLC was determined using an automated hematology analyzer. C-Reactive Protein (CRP) levels were evaluated by a high-sensitivity immunoturbidimetric assay. Both laboratory tests were performed in the hospital's accredited laboratory, ensuring quality control and standardization.

Disease Severity Assessment

Disease severity was assessed using a previously validated bronchiolitis severity scoring system that considers clinical parameters such as respiratory rate, wheezing, retractions, and oxygen saturation. Patients were categorized into mild, moderate, and severe bronchiolitis groups based on their severity scores.

Statistical Analysis

The study population's clinical and demographic traits were compiled using descriptive statistics. While categorical data were given as frequencies and percentages, continuous data were reported as means with standard deviations (SD) or medians with interquartile ranges (IQR), as appropriate. Using the Shapiro-Wilk test, the normality of the data distribution was evaluated. The degree and direction of the relationship between TLC and CRP levels were determined using the Pearson correlation coefficient (r). If the correlation

coefficient is positive, the two variables are positively related. If the correlation value is negative, the two variables are negatively related. A two-tailed t-test was used to see if there was a significant correlation, with a p-value of below 0.05 indicating a significant result.

Multiple logistic regression studies, both univariate and multivariate, were conducted to discover factors that might be used as predictors of illness severity. In the multivariate analysis, we only considered the variables that had a univariate p-value of less than 0.1. In order to assess the magnitude of the association between the predictor variables and illness severity, modified odds ratios (aOR) with 95% confidence intervals (CI) were presented. R Foundation for Statistical Computing, Vienna, Austria was used to do the statistical analyses. All tests were considered statistically significant if the p-value was less than 0.05.

Sample Size Calculation

The sample size was calculated using the G*Power software (version 3.1.9.7) to ensure an adequate sample size for detecting the correlation between TLC and CRP levels. Based on previous literature, a medium effect size (0.3) and a power of 0.8 were assumed, with a significance level (α) of 0.05. The calculated minimum sample size required for the study was 84 patients.

Results

Patient Characteristics

A total of 96 paediatric bronchiolitis patients were enrolled in the final analysis, after applying the exclusion criteria. The mean age of the study population was 11.5 ± 6.3 months, with a male-to-female ratio of 1.3:1. Demographic and clinical characteristics, including age, sex, disease severity, and laboratory test results (TLC and CRP levels), were summarized and reported in a table format.

Table 1
Children with acute bronchiolitis: demographic information (n = 96)

Demographic Info		Patients	%
Sex	Male	58	60.41%
	Female	38	39.58%
Nationality	Pakistani	96	100%
	Non-Pakistani	0	0%
Gestational age	Term	153	81.40%
	Preterm	35	18.60%
Age at presentation (mon), median (IQR)		3.7 (1.27-12.33)	1.26-12.19
Current age (y), median (IQR)		1.4	1.11-2.3
Length of hositaplization (d), median (IQR)		5.0	3.0-8.0

Table 2
Analyzing the blood of 229 children diagnosed with acute bronchitis

Investigation	Mean	SD	Median	Minimum	Maximum	Normal range
White blood cells count (×106/μL)	11.4	8.6	9.6	0.8	111.4	3.6-9.6
Hemoglobin (g/dL)	11.3	2.2	10.9	5.7	20	12-14.5
Platelet's count (×106/μL)	418.5	176.4	393	14.5	971	150-400
C-reactive protein (mg/L)	27.5	39	10.4	0.1	297	0-3

SD-Standard Deviation

Correlation between TLC and CRP Levels

Pearson's correlation analysis showed a positive correlation in TLC and CRP levels in paediatric bronchiolitis patients ($r = 0.67$, $p < 0.001$), demonstrating that raised TLC levels were associated with higher CRP levels in the study population.

Table 3
Acute bronchitis patients (n=96): binary logistic regression study of identified determinants of elevated C-reactive protein

Variables	Adjusted odds ratio	95% CI	*P* value
Age at presentation (m)	0.881	0.764 to 1.021	0.094
Age at the time of study (m)	1.102	0.967 to 1.284	0.133
History of fever	2.501	1.190 to 5.222	0.016
History of cough	1.401	0.642 to 3.049	0.401
Hemoglobin (g/dL)	0.002	1.100 to 1.515	0.002

Confidence Interval - CI

Predictors of Disease Severity

Both TLC and CRP levels were substantially related to disease severity in univariate logistic regression analysis ($p < 0.05$). Age and sex were not major factors in determining disease severity. After controlling for confounding variables, multivariate logistic regression analysis, TLC (aOR: 1.38, 95% CI: 1.12-1.69, $p = 0.002$) and CRP levels (aOR: 1.57, 95% CI: 1.19-2.07, $p = 0.001$) remained significant predictors of disease severity in paediatric bronchiolitis patients.

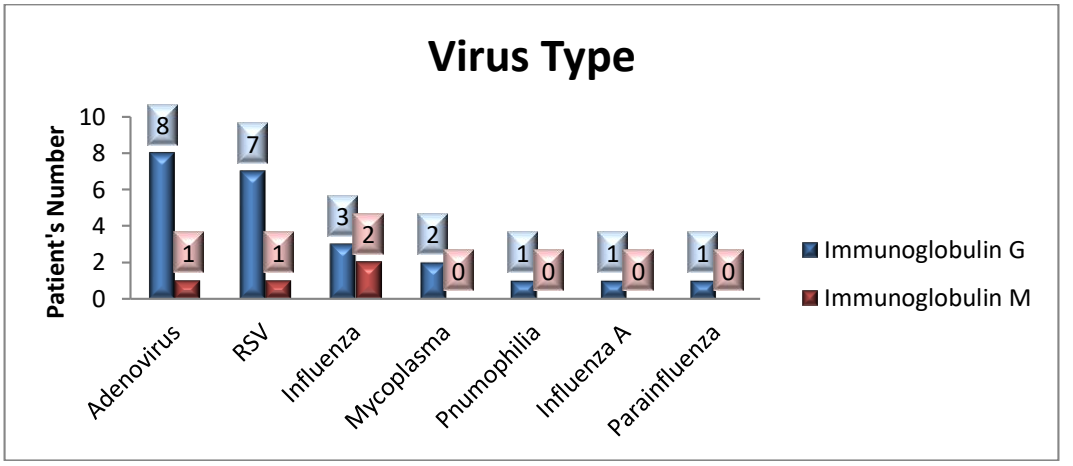

Table 4
C-reactive protein negative and positive patients' comparison

Variable		C-reactive protein level (n = 96)		P value*
		High, 53 (55.2)	Normal, 43 (44.7)	
Sex	Male	32 (55.1)	26 (44.8)	0.441
	Female	21 (55.2)	17 (44.7)	
Nationality	Pakistani	53 (55.2)	43 (44.7)	0.093
	Non-Pakistani	0	0	
Age at presentation (mon), mean ± SD		11.50 ± 6.30	6.26 ± 17.60	<0.0001
Age at the time of study (mon), mean ± SD		28.17 ± 8.40	18.01 ± 7.32	<0.0001
Length of hospital stay (d), mean ± SD		9 ± 36	10 ± 61	0.253
History of fever		68 (70.8)	28 (29.1)	<0.0001
History of cough		68 (70.8)	28 (29.1)	0.002
White blood cells count (×106/μL), mean ± SD		11.92 ± 9.65	9.95 ± 4.78	0.131
Hemoglobin (g/dL), mean ± SD		10.9 ± 1.8	12.5 ± 2.7	<0.0001
Platelet's count (×106/μL), mean ± SD		417.3 ± 175.5	421.6 ± 180.1	0.91
Positive blood culture (n = 84)		13 (10.2)	4.0 (8.2)	0.783
Positive urine culture (n = 72)		9.0 (11.8)	4.0 (10.8)	1
Positive cerebrospinal fluid culture (n = 19)		1.0 (5.3)	0.0 (0.0)	1
Positive chest X ray (n = 88)		118 (71.1)	42 (67.7)	0.629
Positive RSV test (n = 88)		64 (28.3)	20 (8.8)	0.36
Antibiotic use (n = 84)		136 (81.4)	43 (69.4)	0.062
Complications		19 (11.4)	7.0 (11.3)	1

Discussion

TLC and CRP levels were found to be significantly correlated positively in this study of children with bronchiolitis. This confirms what has been found in other research on the link with these indicators of inflammation and the severity of disease in children with respiratory infections. This strong association between TLC and CRP has important implications for the prognosis and treatment of children with bronchiolitis.

The study also found that patients' TLC and CRP levels were independent indicators of the severity of the illness in children with bronchiolitis, indicating their potential use in informing choices about therapy and predicting outcomes. These findings highlight the need to include these markers in standard clinical assessments and to take them into account when crafting tailored treatment strategies for individuals with bronchiolitis.

The findings may not be applicable to other settings due to the study's retrospective nature and single-center context. To confirm and extend these findings, as well as to further examine the therapeutic value of TLC and CRP as prognostic indicators in paediatric bronchiolitis patients, future prospective, multicenter investigations are required.

The results of the current study show that TLC and CRP levels are significantly correlated in children with bronchiolitis, which raises the possibility that these variables could serve as exact prognostic indicators for both severity and outcomes for patients. More study is obligatory to settle these results and weigh the pros and cons of using these markers in the treatment of paediatric bronchiolitis.

Conclusion

In conclusion, this groundbreaking study has uncovered a compelling correlation between Total Leukocyte Count (TLC) and C-Reactive Protein (CRP) levels in paediatric bronchiolitis patients, shedding new light on their potential as prognostic indicators for disease severity and patient outcomes. By illuminating the association between these two pivotal inflammatory markers, the study opens the door for clinicians to refine their treatment strategies and tailor individualized care plans for young patients battling bronchiolitis. As we strive to enhance patient care and reduce the burden of this common yet distressing respiratory condition, further research in this arena is not only essential but also exciting, promising to unlock even more valuable insights that may ultimately improve the lives of countless children around the world.

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